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The Great Contractions in Russia, the Baltics and the Other Countries of the Former Soviet Union: A View from the Supply Side

Mark De Broeck and Vincent Koen

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Prepared by Mark De Broeck and Vincent Koen[1]

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Abstract

The output contractions during the initial transition stages in the Baltics and in Russia and the other CIS countries are examined across several dimensions, and the reliability of the available official statistics evaluated. The depth, length and breadth of the contractions are studied and set against a longer-run historical perspective. The relationship between inputs and outputs as described in a standard accounting framework shows that there is more to the contractions than collapsing investment and shrinking employment. Sharp declines in productivity, reflecting in part transition-related factors, also played a major role.

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Author's E-Mail Address: MDeBroeck@imf.org; Vincent.Koen@oecd.org

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[1]Mark De Broeck is a staff member in the IMF's Research Department, and Vincent Koen was a visiting scholar to the same department from the OECD. The authors are grateful to Andrew Berg, Dominique Guillaume, Oleh Havrylyshyn, Thomas Wolf, and Jeromin Zettelmeyer for comments and suggestions, and to Timothy Heleniak for sharing data.

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I. Introduction

The early years of transition from a command to a market-based economy in central and eastern Europe have typically witnessed considerable output drops, at least according to official national statistics. Output contractions were even more pronounced in the Baltics, Russia and the other countries of the former Soviet Union. By 1997, growth had resumed in the vast majority of transition countries. Even though a number of them faced renewed output declines in 1998, mainly associated with the financial crisis in Russia, it appears that the bulk of the transitional recession is now over in most cases. With the benefit of hindsight, this paper attempts to put the contractions endured in the Baltics as well as in Russia and the other countries of the Commonwealth of Independent States (CIS) in perspective, examining them from several angles.

A first and obvious question arises as to their magnitude. On many scales, it seems to be very large. While this impression can be corroborated in a number of ways, quantification has been, and remains, a major challenge because of the poor quality of available statistics. In fact, because of these uncertainties, any point estimate is likely to be misleading. Bearing this caveat in mind, a second issue is how to evaluate the welfare consequences of these contractions. All too often, the magnitude of the output decline is equated, at least implicitly, with that of the welfare loss. On reflection, however, it turns out that there is no straightforward, one-to-one, relationship between the former and the latter, as welfare measures reflect the type of social welfare function used.

Next, the stylized features of the contractions in the Baltics and the CIS countries are described, and contrasted with the experience of selected central European transition economies. While many studies tend to focus on the depth of the contractions, their length and breadth are also highlighted here, and performance is set against countries' longer-run growth record.

The contractions have been ascribed a variety of causes in the literature, including the dislocation of traditional domestic and international links, fiscal retrenchment, and credit crunches, with the relative importance of these factors differing across countries.[2] This paper does not consider such a broad range of factors, but instead focuses on changes in inputs and the evolution of productivity to interpret the observed decline in output, in line with earlier work by Easterly and Fischer (1994). It also sheds light on the reallocation of inputs across sectors.

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[2]For an empirical cross-country study, see for instance Berg et al. (1999) and Havrylyshyn et al. (2000), and the references therein. For an in-depth country specific analysis, see for instance the analysis by De Broeck and Kostial (1998) on Kazakhstan and by Zettelmeyer (1998) on Uzbekistan. Analytical reviews of the causes of the output decline are presented in Conway (forthcoming) and Mundell (1997).

II. BACKGROUND CONSIDERATIONS

Starting in the late 1980s or early 1990s, official measures of output and value-added declined precipitously in the Baltics, Russia and the other countries of the CIS. The size of the actual contractions, however, is hard to gauge.

On the one hand, part of the falling activity reflected the replacement of the previous incentive to report the (over-)fulfillment of plan targets by the incentive to avoid the scrutiny of the tax and other authorities (Koen, 1994). Anecdotal evidence of the dynamism of underground businesses abounds, at least in some sectors. In the early years of transition, statistical offices generally did not have at their disposal the tools required to track the volume of economic activity under the new conditions. Erring on the conservative side, they typically preferred to base their published estimates on what was still reported to them rather than on their best estimate of aggregate output. Some alternative indicators of overall economic activity, most notably electricity consumption, suggested that the official real GDP estimates were substantially downward biased (Gavrilenkov and Koen, 1995; and Dobozi and Pohl, 1995).

Later on, several of the statistical offices, recognizing those problems, started to incorporate survey-based evidence and even guesstimates of hidden activity into their GDP series.[3] They also revisited the series they had published thus far and implemented some substantial upward revisions, in particular in Russia, Kazakhstan and Lithuania (Appendix I).[4] The GDP series as revised for the initial transition years are indeed more in line with what is suggested by independent estimates carried out from the demand side of the national accounts (in the case of Russia) or based on physical output statistics (in the case of Kazakhstan), and they continue to show a massive output decline. In addition, alternative indicators are not necessarily good proxies for actual GDP (Appendix II), and not all biases need go in the same direction.[5] Finally, the authorities sometimes face political incentives to publish higher rather than lower GDP figures.[6]

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[3]Methodological guidelines are spelled out in Goskomstat of the Russian Federation (1996) and OECD (1997). In practice, however, non-reported or under-reported activities seem to have been taken into account, if at all, on a rather ad hoc basis.

[4]Substantial upward revisions were also carried out in Poland and in Bulgaria.

[5]For example, the fall in gross output in industry is understated to the extent that it does not control for the splitting of large state enterprises, which turns intra-firm transactions into inter-enterprise sales (Kolodko and Nuti, 1997). This phenomenon should have no direct impact on value-added in industry, however.

[6]Gavrilenkov (1996) conjectured that the official real GDP series for Russia understated the actual 1995 decline. In the case of such countries as Belarus or Uzbekistan, published changes in real GDP are widely perceived as suffering from a potential upward bias (on Uzbekistan, see Zettelmeyer (1998)).

On balance, it is hard to believe that output did not contract massively in the early years of transition, even if the magnitude of the actual decline may be somewhat overstated by the official statistics, especially where no efforts were deployed to take into account new and underground economic sectors. Further output declines beyond the initial transition years are generally measured more accurately in the official numbers as statistical agencies made progress in implementing market-based methodologies and the overall economic environment became more stable.

In addition to the practical obstacles standing in the way of a comprehensive and precise measurement of activity, a serious theoretical conundrum deserves to be highlighted. The quantification of changes in real GDP relies on the prices used to aggregate developments in enterprises and branches. The choice of prices matters a lot for the end result in a period of highly unstable relative prices. Depending on the issue under consideration, it may be more sensible to use actual or notional market prices, current or base-period prices. No weighing scheme is intrinsically superior to all others when aggregating observations. Moreover, when notional prices are used (e.g., "world" prices instead of distorted, actual prices), it must be recognized that quantities would have been different had that set of prices prevailed. Thus, even if information on quantities and prices were perfect, it can be argued that there would still be no single, "true" real GDP series.

The scope for divergence across estimates can be significant, as illustrated by the example of the Russian economy, which experienced a 7-year contraction over the period 1989-96. The cumulative drop in real GDP in Russia during the period amounts to 45 percent if volumes are aggregated at 1989 prices. If prices of the previous year are used instead, it amounts to 42 per cent. If 1996 prices are used, possibly on the grounds that those are more relevant because closer to market levels, the cumulative drop is yet smaller, at 41 per cent.[7]

Assumptions regarding the size and dynamism of activities in the shadow economy that are not captured in the official statistics also affect the size of the decline.[8] A conservative assumption could be that it represented 10 per cent of official GDP in 1989 and expanded at 2 per cent per annum. This would be in line with a perception that official numbers capture much of the unrecorded activity, or that there are limits to the speed at which it can develop. An alternative assumption would be that the shadow economy represented 20 per cent of official GDP in 1989 and expanded at 5 per cent per annum. In the context of the Russian example, the first assumption implies that the

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[7]Other weighing schemes could have been used, producing different results. The cumulative decline according to the official numbers, which are broadly based on an aggregation scheme using prices of the previous year, is 41½ percent.

[8]Even in cases where adjustments to GDP to account for hidden activities have been introduced, these tend to be limited in scope. In Russia, for instance, the official upward revisions for 1991-94 incorporate estimates of hidden activities in trade and other services but not for underreporting of the gross value of output in other major sectors (World Bank and Goskomstat of the Russian Federation, 1995).

shadow economy represented 18 per cent of official GDP by 1996 (using a weighing scheme based upon the 1989 shares) and the second that it represented 38 per cent of official GDP by that date (a range well within the range of estimates that are commonly cited for the Baltic and the CIS countries).[9] The conservative view then implies that actual GDP declined by 35 per cent between 1989 and 1996, while the alternative view implies a smaller cumulative drop of 23 per cent. Relying on electricity consumption as a proxy for actual GDP would lead to yet another range of estimates (Appendix II).

Not only is the magnitude of the contraction difficult to pin down, but its implications for welfare are also complex, even abstracting from distributional considerations.[10] Part of the output decline may have been welfare-enhancing. This could apply to the termination or downsizing of some types of military or prestige investment, for instance. It could also apply to some heavy, energy-intensive and polluting industries producing unsophisticated intermediate outputs for which value-added measured at market prices would be negative. Assigning a social value to such (dis)investments or recompiling value-added at undistorted prices involves a fair degree of discretion, however, over and beyond access to data that may not be available.[11] Another set of welfare effects disregarded by conventional output measures but important in transition economies are those associated with enhanced access to markets by consumers. The disappearance, or at least lessening, of rationing and queuing, as well as the increased variety on offer are tangible benefits that are not directly reflected in real GDP measures. Again, the size of such offsetting welfare gains depends on the type of social welfare function used, but it can be consequential (Roberts, 1997). In the subsequent sections, only output movements as captured by the official data are considered, and the distributional consequences and welfare implications of the output decline are left aside.

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[9]For instance, the share of the shadow economy was estimated at 14 per cent of GDP in 1996 for Estonia by the Institute for Socio-Economic Analysis (Baltics News Service, April 13, 1997), at 30 per cent in 1997 for Kazakhstan (Kulekeev, 1997), at 33 per cent of GDP in 1995 for Moldova (in a study sponsored by the Ministry of Economy and the Markets Problems Research Center of the Moldovan Academy of sciences, cited in the IMF (1998), at 43 per cent in 1997 for Ukraine by the Economics Minister (Itar-Tass, January 3, 1998) and at 50 per cent for Russia by a U.S. Treasury sponsored report (*Financial Times*, January 16, 1998). Johnson et al. (1997) estimate that in 1995 the shadow economy ranged from as little as 7 per cent of official GDP in Uzbekistan to as much as 167 per cent in Georgia.

[10]Gavrilenkov and Koen (1995) quantify the effect of the changes in income distribution in Russia.

[11]On remaining price distortions, see Koen and De Masi (1997), and on data existence and accessibility, Koen (1996).

III. SELECTED STYLIZED FEATURES

Notwithstanding the numerous caveats outlined in the previous section, official national accounts appear to broadly reflect the main characteristics of the underlying output movements during the transition. In view of the poor quality of the data, the analysis in the remainder of the paper is, however, limited to an overview of the main features of the contraction and to a study of the relationship between outputs and inputs at both the aggregate and sectoral levels, data on which are generally of comparable quality.[12]

The length of the contraction varied considerably across countries, but on the whole was much longer in the Baltics and CIS countries than in central Europe. Looking at the transition through 1997, the duration of contractions ranged from 4 to 9 years or more, with a median of 6 years (Table 1). In contrast, the contractions in the 6 comparator countries of central Europe lasted between 2 and 5 years, with a median of 4 years.

Likewise, the depth of the contractions varied tremendously across countries, and was in general distinctly larger than in central Europe (Table 2). In Uzbekistan, where the contraction was the shallowest, measured real GDP shrank by 19 percent, compared with a 77 percent fall in Georgia at the other end of the spectrum. On an unweighted basis, the contraction averaged some 51 percent,[13] two-and-a-half times the 21 percent in central Europe on a comparable basis.

An alternative way to gauge the depth of the contractions which is fairly popular in some transition countries is to compute how far back the contraction threw the level of economic activity. On official measures, GDP typically reverted to levels witnessed two decades or more earlier,[14] again over twice as deep in the Baltics and CIS countries as in central Europe, which "regressed" by only about one decade.

The depth of the contractions also varied substantially across sectors. For the fifteen successor countries as a group, overall (unweighted) output dropped by 46 percent between 1990 and 1997. The decline was more pronounced in industry and transport and communication, where production fell by over half, and most spectacular in the construction sector, where it shrank to around one third of the level observed in 1990, mirroring the collapse in investment spending. In contrast, production in agriculture and

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[12]The extent of hidden economic activities differs across sectors, and is higher in the trade and services sectors in particular. Since the national statistical agencies take these sectoral differences into account when adjusting initially reported data for hidden activities, they should not affect the published output data.

[13]This average reflects outcomes through 1997. Given that real GDP fell further in several countries, this average is an understatement of the eventual contraction depth.

[14]The dates shown in Table 1 are deliberately less precise for the distant than for the more recent past, owing to the larger margins of uncertainty surrounding them.

Table 1. Contraction length
In years, based on observations through 1997

	Duration of contraction[1]	Reversion to measured output level of[2]
Armenia	4	early 1970s
Azerbaijan	9	1960s
Belarus	6	late 1970s
Estonia	5	early 1970s
Georgia	6	late 1950s
Kazakhstan	7	late 1960s
Kyrgyz Republic	5	early 1970s
Latvia[3]	4	late 1960s
Lithuania	5	1970s
Moldova	7	1950s / 1960s
Russia[1]	7	early 1970s
Tajikistan	8	1950s / 1960s
Turkmenistan[4]	at least 9	1960s or earlier
Ukraine	at least 8	1960s or earlier
Uzbekistan	5	early 1980s
Comparator countries in central Europe		
Bulgaria[1,5]	5	early 1980s
Czech Republic	4	late 1970s
Hungary	4	late 1970s
Poland[1]	2	mid-1980s
Romania[1]	5	mid-1970s
Slovakia	4	late 1970s

Sources: Yearbooks of national statistical offices; Statistical Committee of the CIS; CMEA Yearbooks.

[1/]Contraction from peak year, as given in Table 2.
[2/]Based on the revised series.
[3/]Indicative only, since pre-transition real output series are generally for net material product.
[4/]Output declined anew following the first recovery.
[5/]Activity rebounded modestly in 1990, following a sharp drop in 1989.
[6/]GDP contracted again in 1996.

trade fell by around one third. Much sharper variations across sectors have been reported in a number of individual countries.

In most of the countries under consideration, industry has been the largest sector of the economy, prompting the question of the extent to which the contraction in GDP tracks the collapse of industrial output. On an unweighted basis, the peak-to-trough decline in gross industrial output on average exceeds the fall in measured GDP only marginally, while the length of the industrial contractions is broadly comparable, also

Table 2. Contraction depth
Real GDP level in percent of historical peak

	Peak year	1990	1991	1992	1993	1994	1995	1996	1997
Armenia	1989	95	83	49	44				
Azerbaijan	1988	80	80	62	48	38	34		
Belarus	1989	98	97	88	81	71	63		
Estonia	1989	94	83	65	60	58			
Georgia	1988	83	65	36	25	23			
Kazakhstan	1988	95	85	80	72	63	58		
Kyrgyz Republic	1990	100	92	79	67	54	51		
Latvia[2]	1989	95	85	55	47				
Lithuania	1989	95	90	71	59	53			
Moldova	1989	98	81	57	56	39	38	35	
Russia[1]	1989	97	92	79	72	63	60	58	
Tajikistan	1988	94	86	60	50	44	38	32	
Turkmenistan	1988	95	88	84	85	62	59	57	49
Ukraine	1989	96	88	79	68	52	46	41	40
Uzbekistan	1990	100	100	88	86	82	81		
Comparator countries in central Europe									
Bulgaria[1,2]	1988	90	80	74	73				
Czech Republic	1989	99	85	79	79				
Hungary	1989	97	85	82	82				
Poland[1]	1989	92	86						
Romania[1,2]	1987	88	77	70					
Slovakia	1989	100	85	85	85				

Sources: National statistical offices; Statistical Committee of the CIS.

NB: Through the late 1980s or the early 1990s, real net material product series are typically used as a proxy for real GDP for Russia, the Baltics and the other countries of the Former Soviet Union.
The data are shown through the end of the contraction, or if it had not ended through 1997.

[1/]Higher, revised, series.

[2/]Output declined anew following the first recovery.

ranging from 4 to at least 9 years with a median of 6 years (Tables 3 and 4). In contrast, the depth of the industrial contractions in the comparator central European countries is almost twice that of the decline in measured GDP, although similar in length. Two non-mutually exclusive conjectures offer themselves. Since output in industry is probably less difficult to monitor than in other sectors, this evidence might be taken to suggest that the GDP contractions are overstated in the Baltics and CIS countries to the extent industry might be expected to show larger declines than other sectors.[15] It may also be that the environment in these countries was less conducive to the development of sectors other than industry than in central Europe, thus limiting their cushioning potential.

[15]This interpretation is reinforced by the fact that industry has a higher weight in aggregate value added in the central European countries.

Table 3. Depth of the contractions in industrial output
Gross industrial output level in percent of historical peak

	Peak year	1990	1991	1992	1993	1994	1995	1996	1997
Armenia	1987	84	77	40	36				
Azerbaijan	1989	94	98	75	69	53	44	41	
Belarus	1990	100	99	89	80	66	58		
Estonia	1989	100	91	58	47	46			
Georgia	1989	94	73	39	29	17	16		
Kazakhstan	1989	99	100	83	71	51	47		
Kyrgyz Republic	1989	99	100	74	55	40	33		
Latvia	1990	100	99	65	45	40	38		
Lithuania	1989	97	92	66	43	31			
Moldova	1990	100	93	68	68	49	47	43	
Russia	1989	100	92	75	65	51	50	48	
Tajikistan	1990	100	96	73	67	51	43	35	34
Turkmenistan[1]	1991	95	100	85	89	66	62	74	52
Ukraine	1989	100	95	89	82	60	53	50	49
Uzbekistan	1991	98	100	93					
Comparator countries in central Europe									
Bulgaria	1988	82	64	54	48				
Czech Republic	1989	97	76	70	66				
Hungary[2]	1988	96	83	75					
Poland[2]	1988	75	69						
Romania	1988	79	61	48					
Slovakia	1988	95	77	70	67				

Sources: National authorities; Statistical Committee of the CIS

[1/]Temporary rebounds were officially recorded in 1993 and 1996.
[2/]Revised, higher series.

Most studies of output developments have focused on countrywide indicators. At a more disaggregated level, the evolution of output has varied as much from one region to another as from one country to another. In fact, some regions experienced a relatively shallow and brief recession, while in others output continued to contract well after the start of the national recovery, falling much deeper than the average trough.[16] Such

[16]This holds even given the uncertainty associated with the unreliability of regional statistics, which are often even less trustworthy than at the national level.

regional disparities are particularly striking in vast countries such as Russia, Ukraine and Kazakhstan (Table 5).[17] To some extent, and like at the nationwide level, the differences

Table 4. Length of the contractions in industrial output
In years, based on observations through 1997

	Duration of contraction	Reversion to measured output level of
Armenia	6	Early 1970s
Azerbaijan	5/7	1960s
Belarus	5	late 1970s/early 1980s
Estonia	4	1960s
Georgia	6	1960s or earlier
Kazakhstan	6	1960s or earlier
Kyrgyz Republic	6	mid-1970s
Latvia	5	1960s
Lithuania	5	Early 1970s
Moldova[1]	6	late 1960s
Russia	7	Early 1970s
Tajikistan	at least 7	1960s
Turkmenistan[1]	at least 6	1970s or earlier
Ukraine	at least 8	1960s or earlier
Uzbekistan	1	1988
Comparator countries in central Europe		
Bulgaria[2]	5	mid-1970s
Czech Republic	4	mid-1970s
Hungary	4	mid-1970s
Poland	3	mid-1970s
Romania	4	mid-1970s
Slovakia	5	late 1970s

Sources: Yearbooks of national statistical offices; Statistical Committee of the CIS.

[1/]Temporary rebounds were officially recorded in 1993 and 1996.

[2/]Output declined anew following the first recovery.

across regions reflect, among other factors, the diversity in the stance of local policies, as documented by Berkowitz and DeJong (1997) in the case of Russia.

IV. Inputs and Outputs: Contraction Accounting

The remainder of the paper explores the sharp output decline in the Baltics and

[17]Although the contraction had not ended by 1997 in Ukraine, the bulk of the decline is captured.

Table 5. Fall in industrial output across regions during the first half of the 1990s[1] [2]

	Countrywide drop	Dispersion[3]	Maximum	Minimum	Number of regions
Russia	52	25	87	23	87[4]
Ukraine	50	22	74	29	26
Kazakhstan	52	32	73	6	20

Sources: Regional statistical yearbooks of the national statistical offices and authors' computations.

[1/]Between 1990 and 1995 (Kazakhstan), 1996 (Russia) or 1997 (Ukraine). Peak to trough for each region.

[2/]All columns in percent except for the last one.

[3/]Coefficient of variation.

[4/]Two regions, Chechnya and Ingushetia, are not included.

CIS countries from the angle of the relationship between inputs and outputs. A commonly used approach to link output to inputs and to measure economic performance over time is to set up a growth accounting framework to assess the efficiency with which the factors of production labor and physical capital are employed. To illustrate how the transition process has affected the economic performance of the fifteen transition countries of the former Soviet Union, a growth-accounting exercise is performed for each country individually and for all fifteen as a group. Furthermore, to put the output decline during the transition in perspective and relate it to distortions and misallocations inherited from central planning, the sample period is extended to include the last two decades prior to the Soviet breakdown. The exercise covers the overall economy and the aforementioned six main sectors of the central planning recording system.

The exercise is based upon the assumption that output is produced according to a neoclassical production function of the following form,

$$Y(t) = A(t)F\left[K(t), L(t)\right] \qquad (1)$$

where A is an index of total factor productivity (TFP), K is the capital stock, and L measures the inputs of labor. Differentiation of equation (1) with respect to time yields, after division by Y,

$$g_Y = g_A + \eta_K g_K + \eta_L g_L \qquad (2)$$

where g_Y, g_A, g_K and g_L are the rates of growth of Y, A, K, and L, respectively, and where $\eta_K = (K/Y).(\partial F/\partial K)$ and $\eta_L = (L/Y).(\partial F/\partial L)$ denote the elasticities of output with respect to capital and labor, respectively. Further differentiation of equation (2) with respect to time gives

$$\partial g_Y/\partial t = \partial g_A/\partial t + (\partial \eta_K/\partial t).g_K + \eta_K.(\partial g_K/\partial t) + (\partial \eta_L/\partial t).g_L + \eta_L.(\partial g_L/\partial t) \quad (3)$$

which allows to decompose changes in the growth rate of output period by period.

This type of accounting relies on underlying assumptions about the nature of the

production function that is specified in equation (1).[18] In the absence of information on factor prices that would allow to approximate the elasticities of output with respect to capital and labor, the computations below assume that these elasticities are constant over time and add up to 1.[19] The computed changes in TFP should be interpreted as residuals that reflect, in addition to biases due to methodological assumptions and measurement errors, a wide range of factors affecting the efficiency with which inputs are used.[20] The remainder of the paper focuses on analysing the fall in growth during the transition period relative to pre-transition growth, in line with equation (3). This is a valid approach as long as the biases and errors in the computations are not subject to a regime shift following the transition. Furthermore, since no corrections are made for variations in hours worked and capacity utilization, or, more generally, for quality changes and factor obsolescence, this approach also implies that, except for reductions in reported employment and investment, the impact of the transition will be reflected entirely in changes in estimated TFP.

The computational results are summarized in Table 6, which reports average annual output and input growth rates, factor contribution rates, and TFP growth rates by country and by sector for the periods 1971-90, and 1991-97. TFP growth turned sharply negative during the transition in all countries and sectors, after having fallen to close to zero in the last two decades of central planning.[21] The drop was especially pronounced in conflict-torn countries (Armenia, Azerbaijan, Georgia, Moldova, Tajikistan) and in Ukraine, where the output fall continued throughout the sample period. Negative values for TFP growth during the transition are also observed on a sectoral basis, mostly so in construction, industry, and transport and communication.

To test the robustness of these computations, alternative calculations are presented based on labor productivity growth rates, which do not depend on assumptions about the nature of the production function and about output elasticities with respect to inputs of factors nor on particular data construction procedures for the capital stock variable. The results, presented in the last column of Table 6, show a broadly comparable pattern for productivity measures based upon either TFP or labor productivity. According to both measures, in all countries and sectors, productivity fell during 1991-97, by on average more than 6 percent a year. Labor productivity growth rates were slightly less negative

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[18]For a detailed discussion of these assumptions, see Barro (1998).

[19]The values chosen are 0.3 for capital and 0.7 for labor. These additional assumptions imply that the production function underlying the computations is of the constant returns-to-scale Cobb-Douglas variety. The elasticity of substitution between capital and labor accordingly is constant and equal to 1.

[20]The computed value of the rate of change of TFP should therefore not be interpreted as simply an estimate of the rate of exogenous technological progress.

[21]The computations for the rate of change of TFP during 1971-90 confirm the low productivity gains in the Soviet economy during the last two decades of central planning that are found in studies of the Soviet economic slowdown, as surveyed in Easterly and Fischer (1994).

than TFP growth rates in all countries reflecting the more rapid expansion of capital inputs over the period. At the sectoral level, however, this was not the case in agriculture, trade, and services. In these three sectors, labor productivity fell by more than TFP, reflecting increases in sectoral employment.

The implications of the productivity decline in the early transition years can be put in perspective by comparing its contribution to the overall output fall to that from reductions in inputs of capital and labor. In most countries and sectors, factor contribution was negative during the transition, reflecting reductions in employment and investment. Total employment in the fifteen successor states as a group fell by more than 12 percent in 1991-97, with sharper reductions in the Baltic countries (by around 20 percent) and in Russia (by 15 percent),while it actually expanded in Turkmenistan and Uzbekistan. On a sectoral basis, employment in the trade and services sectors rose significantly, was broadly stable in agriculture, but shrank by over 35 percent in industry and by over 40 percent in construction. The contribution of capital accumulation also was reduced sharply, reflecting the investment collapse during the transition. By 1997, real investment fell short of its 1990 level in fourteen of the fifteen countries and in all six sectors,[22] with the average shortfall amounting to around 70 percent. In most countries and sectors, investment fell to well below replacement rates and the growth rate of the capital stock turned negative.

The investment collapse had additional negative repercussions, as it accelerated the aging of the capital stock. Reflecting the slowdown of investment spending in the second half of the 1980s and its reduced effectiveness,[23] capital stock obsolescence had already begun to set in before the transition (Akopian, 1992). In Russia, for instance, the average age of plant and equipment had increased to 10.8 years in 1990 from 8.4 years in 1970. With investment collapsing in most countries, the capital obsolescence problem became more severe in the course of transition.[24] In Russia, the average age of plant and equipment increased further to 14.9 years in 1996, by which time the volume of investment had fallen to less than one-fourth of its 1990 level. Since the production function in equation (1) does not incorporate vintage effects, efficiency losses associated with increasing capital obsolescence are reflected in the TFP growth estimates in Table 6.

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[22]The exception was Azerbaijan, where investment boomed in 1996-97 owing to large-scale oil projects.

[23]The ratio of the annual value of uncompleted construction projects and uninstalled equipment to new investment rose significantly during this period.

[24]In the countries where investment has picked up in recent years as robust growth resumed, Azerbaijan and the Baltics in particular, large scale capital renewal has begun in earnest.

Table 6. Output and TFP growth, period averages

		Output growth	Capital growth	Labor growth	Factor contribution	TFP growth	Labor productivity growth
Countries							
Armenia	Avg. 71-97	0.6	3.2	1.1	1.7	-1.1	-0.4
	Avg. 71-90	3.9	5.0	2.3	3.1	0.8	1.6
	Avg. 91-97	-8.8	-1.7	-2.5	-2.2	-6.5	-6.3
Azerbaijan	Avg. 71-97	-0.5	3.6	1.7	2.3	-2.8	-2.2
	Avg. 71-90	3.1	4.3	2.3	2.9	0.2	0.8
	Avg. 91-97	-10.7	1.3	-0.0	0.4	-11.1	-10.7
Belarus	Avg. 71-97	1.9	4.8	0.0	1.5	0.4	1.8
	Avg. 71-90	4.1	5.9	0.9	2.4	1.7	3.2
	Avg. 91-97	-4.4	1.9	-2.3	-1.1	-3.4	-2.1
Estonia	Avg. 71-97	0.0	3.4	-0.5	0.7	-0.7	0.5
	Avg. 71-90	2.3	4.1	0.6	1.6	0.6	1.7
	Avg. 91-97	-6.4	1.5	-3.5	-2.0	-4.4	-2.9
Georgia	Avg. 71-97	-1.4	2.3	0.2	0.8	-2.3	-1.6
	Avg. 71-90	2.6	4.0	1.3	2.1	0.5	1.3
	Avg. 91-97	-13.1	-2.5	-3.0	-2.9	-10.2	-10.0
Kazakhstan	Avg. 71-97	-1.0	3.6	0.6	1.5	-2.5	-1.6
	Avg. 71-90	1.4	5.0	1.8	2.8	-1.3	-0.4
	Avg. 91-97	-7.7	-0.5	-2.8	-2.0	-5.6	-5.0
Kyrgyz Republic	Avg. 71-97	-0.1	3.9	1.6	2.2	-2.4	-1.7
	Avg. 71-90	3.2	4.9	2.3	3.1	0.1	0.8
	Avg. 91-97	-9.5	0.8	-0.5	-0.1	-9.4	-9.0
Latvia	Avg. 71-97	-0.4	2.6	-0.7	0.3	-0.7	0.3
	Avg. 71-90	2.6	3.9	0.6	1.6	1.0	2.0
	Avg. 91-97	-9.0	-1.1	-4.3	-3.4	-5.6	-4.6
Lithuania 1/	Avg. 71-97	-0.4	3.8	-0.1	0.1	-0.5	-0.4
	Avg. 71-90	3.0	5.2	0.8	2.1	0.9	2.3
	Avg. 91-97	-6.3	-0.5	-2.4	-1.8	-4.5	-4.0
Moldova	Avg. 71-97	-2.0	3.9	-0.3	0.9	-3.0	-1.7
	Avg. 71-90	2.8	5.4	0.7	2.1	0.7	2.1
	Avg. 91-97	-14.4	-0.5	-3.3	-1.0	-13.5	-11.2
Russia	Avg. 71-97	-0.3	3.8	-0.0	1.1	-1.5	-0.3
	Avg. 71-90	2.2	5.1	0.8	2.1	0.1	1.4
	Avg. 91-97	-7.5	-0.1	-2.2	-1.6	-6.0	-5.4
Tajikistan	Avg. 71-97	-1.7	3.8	1.9	2.5	-4.2	-3.6
	Avg. 71-90	2.6	5.2	3.0	3.7	-1.1	-0.5
	Avg. 91-97	-13.8	-0.3	-1.1	-0.9	-12.9	-12.6
Turkmenistan	Avg. 71-97	-0.7	5.9	2.6	3.7	-4.4	-3.4
	Avg. 71-90	2.3	6.1	3.2	4.0	-1.7	-0.8
	Avg. 91-97	-9.5	5.3	1.2	2.4	-11.9	-10.7
Ukraine	Avg. 71-97	-1.1	2.9	-0.1	0.8	-1.9	-1.0
	Avg. 71-90	2.1	4.1	0.5	1.6	0.5	1.6
	Avg. 91-97	-10.2	-0.3	-1.7	-1.3	-8.9	-8.5
Uzbekistan	Avg. 71-97	2.4	5.0	2.7	3.4	-1.1	-0.4
	Avg. 71-90	3.7	6.0	3.3	4.1	-0.4	0.4
	Avg. 91-97	-1.5	2.2	1.3	1.6	-3.1	-2.8
Total	**Avg. 71-97**	**-0.3**	**3.7**	**0.3**	**1.3**	**-1.6**	**-0.6**
	Avg. 71-90	**2.3**	**5.0**	**1.0**	**2.2**	**0.2**	**1.4**
	Avg. 91-97	**-7.9**	**0.0**	**-1.9**	**-1.3**	**-6. 6**	**-6.0**

Table 6. Output and TFP growth, period averages

		Output growth	Capital growth	Labor growth	Factor contribution	TFP growth	Labor Productivity Growth
Sectors							
Agriculture	Avg. 71-97	-1.5	2.9	-0.4	0.9	-2.4	-1.1
	Avg. 71-90	0.1	5.0	-0.6	1.1	-1.0	0.6
	Avg. 91-97	-6.1	-3.1	0.0	-0.9	-5.2	-6.1
Construction	Avg. 71-97	-3.7	3.7	-0.5	0.8	-4.5	-3.2
	Avg. 71-90	1.2	5.5	2.2	3.2	-20	-1.0
	Avg. 91-97	-17.6	-1.2	-8.1	-6.1	-11.6	-9.5
Industry	Avg. 71-97	-0.7	4.3	-1.0	0.6	-1.3	0.3
	Avg. 71-90	2.8	5.4	0.8	2.2	0.6	1.8
	Avg. 91-97	-10.5	1.1	-6.2	-4.0	-6.5	-4.3
Services	Avg. 71-97	1.4	3.2	1.5	2.1	-0.6	-0.1
	Avg. 71-90	2.5	4.5	2.1	2.8	-0.3	0.5
	Avg. 91-97	-1.8	-0.3	0.0	-0.1	-1.7	-1.8
Trade 2/	Avg. 71-97	0.9	3.7	2.1	2.4	-1.5	-1.2
	Avg. 71-90	2.8	5.0	1.2	2.3	0.4	1.6
	Avg. 91-97	-4.2	-0.2	3.1	2.1	-6.3	-7.4
Transport	Avg. 71-97	-0.8	3.9	-0.5	0.8	-1.6	-0.2
	Avg. 71-90	2.9	5.0	0.2	1.6	1.3	2.7
	Avg. 91-97	-11.4	0.9	-2.5	-1.5	-9.9	-8.9

[1/]Based on the revised aggregate growth rates.
[2/]Assuming the growth rate of employment in the trade sector was the same in 1997 as in 1996.

An analysis of productivity developments on a year-by-year basis offers additional insights (Appendix Table A1). A distinct V-shaped pattern in TFP growth emerges. TFP growth was generally sharply negative in the early years of the transition but turned positive in most countries, in some cases very significantly so, by 1995-96, indicating that part of the initial sharp productivity decline was temporary, with production factors being less than fully used. Factors such as trade disruptions and disorganization related to the breakdown of central planning played an important role during this initial period (Blanchard and Kremer, 1997). Similarly, the rapid increase in TFP in countries and sectors where output growth turned positive again more recently likely reflects a recovery in the rate of factor utilization.

V. Sectoral Reallocation

The output decline during the transition is to a large extent accounted for by TFP losses. These losses in turn reflect a range of factors.[25] One important factor is the sectoral reallocation of inputs, which is considered to be one of the key dimensions of the

[25]Further research could consider to relate TFP movements to the same set of variables that are now commonly used as regressors in empirical work, in the vein of Berg et al. (1999) for instance, on output movements during the transition.

reallocation of inputs, which is considered to be one of the key dimensions of the transition process (Blanchard, 1997). Since the output and input data used in this study are available on a broad sectoral basis, the contribution of changes in the sectoral composition of inputs to aggregate TFP growth can be quantified.

Following Bernard and Jones (1996) and Cameron et al. (1997), aggregate TFP can be expressed as a weighted sum of sectoral TFPs, where the weights are ratios of an index of inputs in each sector to an aggregate index of inputs.[26]

$$A = Y/(K^{\alpha}L^{1-\alpha}) = \Sigma_j \omega_j Y_j/(K_j^{\alpha}L_j^{1-\alpha}) , \quad \text{where } \omega_j = (K_j/K)^{\alpha}(L_j/L)^{1-\alpha} \qquad (4)$$

and j indexes sectors. Accordingly, the change in aggregate TFP can be decomposed into a productivity change and a share effect. Between year (t-1) and year t

$$\Delta A/A = 1/A \{ \underbrace{\Sigma_j \Delta TFP_j.\omega_j^{t-1}}_{\text{within-sector effect}} + \underbrace{\Sigma_j \Delta \omega_j.TFP_j^{t-1}}_{\text{share effect}} \} \qquad (5)$$

The first effect measures the contribution of productivity changes within each of the six sectors, and the second one the contribution of changes in sectoral composition to aggregate TFP growth, which will be positive if resources are reallocated from lower to higher-productivity sectors.

Share effects computed according to Equation (5) for both the pre-transition and the transition periods are presented in Table 7. For the fifteen countries as a whole, the share effect accounts for around 8 percent of the change in TFP in the early transition years. Broadly comparable share effects are found in the fifteen countries individually. Since the initial transition years were characterized by negative TFP growth rates, these results point to a productivity reducing reallocation of resources. The share effect is relatively small, however, indicating that sectoral input reallocation did not have a major impact on productivity.

The productivity effect stemming from sectoral input reallocation during transition merits further examination. The sectoral composition of inputs changed noticeably during the transition. The shares of agriculture, trade and services in aggregate employment rose, while those of industry and, in particular, construction fell.[27] Within industry, the share of electricity and other energy branches in total sectoral employment

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[26]This expression assumes that the production process in each sector j is characterized by a common, time-invariant, Cobb-Douglas production technology.

[27]The share of agriculture in total employment rose from less than 19 percent in 1990 to over 21 percent in 1997, and that of the trade and services sector from 38 to 46 ½ percent (this increase in the services sector share in most countries mainly reflects employment trends in public health and education). The share of construction fell from 11 to 7 percent, and that of industry from 28 to 20½ percent.

Table 7. Contribution of sectoral reallocation to TFP growth (in percent)

	Pre-transition Period	Transition period1/	Avg. 71-97
Armenia	8.2	4.7	5.9
Azerbaijan	4.8	0.9	3.0
Belarus	9.6	18.4	12.8
Estonia	-2.0	7.9	3.3
Georgia	5.8	3.0	4.2
Kazakhstan	-1.1	11.1	2.3
Kyrgyz Republic	2.9	9.3	6.6
Latvia	4.6	10.0	7.3
Lithuania	5.3	13.2	9.1
Moldova	-5.1	0.9	-2.2
Russia	2.8	4.9	4.1
Tajikistan	-1.2	10.5	6.2
Turkmenistan	4.5	1.6	2.9
Ukraine	1.2	0.2	0.6
Uzbekistan	1.0	15.5	5.9
Total	**5.0**	**8.1**	**7.1**

1/TFP growth was negative in this period.

increased, while that of machine-building decreased. The sectoral composition of the capital stock also shifted, with industry and transport and communication gaining in importance and agriculture declining.[28] Since there was also reallocation of inputs during the pre-transition period, for the contribution of reallocation to aggregate TFP to be different during the transition, the reallocation process had to change.

To examine whether this has been the case, the following approach is adopted. For each sector and country, annual sectoral employment growth rates relative to the aggregate employment growth rate as well as annual sectoral investment shares are computed, according to data availability. Next, the averages of these employment growth rates and investment shares, respectively, are computed for the pre-transition and transition periods. Finally, a bootstrap methodology is applied to test the hypothesis that there was no difference between the pre-transition and transition averages.[29] The hypothesis is rejected if, based upon the frequency of the outcomes for 1000 replications, there is a probability of 1 percent or less that a random drawing from the sample corresponding to the whole period would produce a difference between the two sub-periods as large or larger than the observed one.

[28]Changes in the sectoral composition of inputs contributed to shifts in the composition of output as well. During the transition, construction and industry declined as a fraction of aggregate output, while the shares of the trade and services sectors rose.

[29]The bootstrap methodology is explained in Veall (1998). The computations were executed using the Resampling Stats software.

Table 8. Total employment shifts 1/

	Industry	Agriculture	Transport	Construction	Trade	Other
Armenia	-	+	0	-	0	-
Azerbaijan	-	0	0	-	+	0
Belarus	-	0	-	-	0	0
Estonia	0	-	0	0	+	0
Georgia	-	+	0	-	0	0
Kazakhstan	-	0	0	-	0	0
Kyrgyz Republic	-	0	0	-	0	0
Latvia	-	0	0	0	0	0
Lithuania	-	0	0	-	0	0
Moldova	-	0	0	-	0	-
Russia	-	0	0	-	+	0
Tajikistan	-	+	0	-	-	-
Turkmenistan	0	0	0	0	0	0
Ukraine	-	+	0	-	0	+
Uzbekistan	0	0	0	-	0	0
Total	-	+	**0**	-	+	**0**

1/A + denotes a significant shift towards the sector, a - a significant shift away from the sector, and a 0 the absence of a significant shift in either direction.

According to this procedure, in the fifteen successor states as a group, the average growth rate of employment fell significantly during the transition in industry and construction, while it increased in agriculture and trade (Table 8). The same pattern is observed in individual countries in all cases where changes are found to be significant, with the rare exception of agriculture in Estonia. Somewhat different results obtain for investment (Table 9). The average growth rate of investment during transition was significantly lower in agriculture—in contrast with the finding for employment growth—and construction and industry, while it was significantly higher in the housing, education, and services sector. The downward shift in investment growth in agriculture is observed in all fifteen countries, and may be related to the break-up of the collective farm system with its centralized investment decisions. The computations for the other two sectors are inconclusive at the group-wide level, but indicate significant changes in individual countries, reflecting, for instance, additional investment efforts in natural resources extraction or telecommunications projects.

More disaggregated data on the composition by major branch of the inputs used in industry shed some light on the factors underlying input shifts for the sector as a whole. For the successor states as a group, the growth rate of employment increased significantly in the electricity, fuels, metallurgy, and food industries, whereas it dropped significantly in machine-building (in part reflecting the sharp reduction in military procurement) and

Table 9. Total investment shifts 1/

	Industry	Agriculture	Transport	Construction	Trade	Other
Armenia	-	-	0	0	-	+
Azerbaijan	0	-	-	-	-	0
Belarus	0	-	+	0	0	+
Estonia	-	-	+	0	+	0
Georgia	-	-	0	-	-	+
Kazakhstan	+	0	0	-	0	0
Kyrgyz Republic	+	-	0	0	-	0
Latvia	-	-	+	0	+	0
Lithuania	0	-	+	-	0	+
Moldova	0	-	0	0	0	+
Russia	0	-	0	0	-	+
Tajikistan	0	-	+	-	0	0
Ukraine	0	-	0	-	-	+
Uzbekistan	+	-	0	-	0	0
Total	**0**	**-**	**0**	**-**	**-**	**+**

1/ A + denotes a significant shift towards the sector, a - a significant shift away from the sector, and a 0 the absence of a significant shift in either direction.

light industry (Table 10). The starkest contrast is between electricity and machine-building, with employment growth increasing significantly in the former branch in each individual country, and falling significantly everywhere in the latter branch. As regards investment, the results tend to show less of an inflection, although the machine-building branch again stands out as one from which resources are most clearly diverted (Table 11).

On the whole, these findings are consistent with a pattern of sectoral reallocation of labor inputs during the transition away from the old state firms in construction and industry toward new small-scale activities in agriculture and trade and toward service activities (including public services), and of scarce investment resources from heavy industry to infrastructure projects in the energy and transport and communications sectors. This would indicate that the negative productivity effect stemming from sectoral input reallocation during the early transition could be related to the direction of the reallocation process, as resources appeared to have moved to lower productivity occupations. [30]

[30]Evidence from other studies suggests that the new small-scale private sector activities are not a source of major productivity improvements (Commander et al., 1999).

Table 10. Industrial employment shifts

	Electricity	Other energy	Metals	Chemical	Machines	Wood and paper	Construction	Light	Food
Armenia	+	0	+	0	-	0	0	0	+
Azerbaijan	+	+	0	0	-	-	0	0	0
Belarus	+	+	+	0	-	0	0	0	+
Estonia	0	0	0	0	-	+	-	0	+
Kazakhstan	+	0	+	0	-	0	0	-	0
Kyrgyz Rep.	+	0	0	0	-	0	0	0	0
Latvia	+	0	+	0	-	+	-	0	+
Lithuania	+	0	0	0	-	+	-	0	+
Moldova	+	0	0	0	-	0	0	0	+
Russia	+	+	+	0	-	0	0	-	+
Tajikistan	+	0	+	0	-	0	0	0	0
Turkmenistan	+	0	0	0	-	-	0	0	0
Ukraine	+	+	+	0	-	0	0	-	+
Uzbekistan	+	0	0	-	-	-	0	0	0
Total	+	+	+	**0**	-	**0**	**0**	-	+

Table 11. Industrial investment shifts

	Electricity	Other energy	Metals	Chemical	Machines	Wood and paper	Construction	Light	Food
Armenia	+	-	0	-	0	-	-	-	0
Azerbaijan	0	+	0	0	-	0	0	-	-
Belarus	+	0	0	0	-	-	0	0	+
Georgia	+	0	0	0	-	0	0	-	-
Kazakhstan	0	0	0	-	-	0	-	-	0
Kyrgyz Rep.	0	-	0	0	-	0	-	0	0
Lithuania	0	0	0	0	-	+	0	0	+
Moldova	0	0	0	0	-	0	0	0	+
Russia	+	+	0	0	-	-	0	-	+
Tajikistan	0	-	+	0	-	-	-	0	0
Ukraine	0	+	0	0	-	0	0	0	+
Uzbekistan	0	0	+	-	-	0	-	-	-
Total	+	+	+	**0**	-	-	**0**	-	+

VI. Conclusions

The depth, length, and breadth of the output contractions in the Baltic and CIS countries following the breakdown of central planning have been massive, even when compared with the experience in other transition countries in central Europe. To explore the causes of these particularly sharp contractions, the analysis has put output developments in these fifteen countries in a longer-run perspective, linking the initial transition years with the last two central planning decades, with a focus on the role of factor input and productivity changes.

The analysis is based upon official statistics, with some minor corrections. These data suffer from various serious weaknesses. Moreover, the quality of the series for the transition period varies considerably across countries, as some expended more effort than others to revise initial estimates and strengthen collection and reporting procedures. However, alternative output proxies suggested in the literature appear to be of limited use to overcome the deficiencies of the official statistics. Even so, the magnitude of output and input changes is such that the main qualitative insights derived from the official data are unlikely to be affected by even major measurement errors.

The Baltic and CIS countries started out with economies that had exhausted their growth potential, as reflected in the fall in total factor productivity growth to near zero in the last two decades under central planning. Capital obsolescence and economic distortions inherited from central planning contributed to further declines in total factor productivity to significantly below zero early in the transition. The output collapse was further associated with pronounced reductions in the inputs of capital and labor, as investment spending in particular was cut deeply in the early transition years. Some of the effects of transition-related factors have been temporary, however, which helps explain the distinct V-shaped pattern observed for output and productivity as the transition unfolded.

A more detailed analysis shows that this sharp fall in investment spending, to levels substantially below what would be needed for capital renewal, has reduced both the volume and the efficiency of the capital stock. At the same time, although perhaps with the exception of the Baltics, sectoral input reallocation failed to raise productivity, as labor made redundant in industry and construction has tended to move into small-scale activities in agriculture and trade and into public services, while investment in new industrial activities has been minimal. The data used here can shed no further light on the causes underlying the investment slump and the observed pattern of sectoral resource reallocation. More research drawing on additional evidence is called for on the incentives to invest, restructure, and reallocate during transition.

Table A1. Yearly total factor productivity growth rates (in percent)

	Armenia	Azerbaijan	Belarus	Estonia	Georgia	Kazakhstan	Kyrgyz Rep.	Latvia	Lithuania	Moldova	Russia	Tajikistan
1971	1.8	0.1	4.2	1.8	-2.4	0.0	-2.9	2.9	1.3	4.0	0.0	4.3
1972	0.6	-0.5	2.7	-2.0	-1.3	4.7	1.4	0.9	1.4	-2.8	-1.3	-3.2
1973	1.8	1.9	3.2	2.4	2.7	-3.2	-0.5	1.2	-0.8	1.9	4.4	-2.5
1974	2.8	7.4	1.9	2.5	7.0	-1.6	-1.1	1.1	1.0	-0.8	1.7	2.1
1975	3.1	1.0	4.8	2.7	2.8	-5.7	-1.0	2.1	2.2	-0.4	0.4	1.2
1976	0.5	3.8	0.9	2.4	2.8	3.5	-2.0	1.7	-1.3	5.4	0.2	-3.1
1977	0.2	0.3	-0.3	-0.5	3.3	-8.0	-2.5	-1.4	-2.4	-1.7	0.2	-2.4
1978	1.7	1.9	2.0	-3.6	2.7	5.4	0.8	-2.5	-0.8	-1.8	-0.8	0.2
1979	1.6	3.7	-1.1	1.5	5.6	-1.7	-1.4	0.5	-3.0	4.7	-2.0	0.3
1980	0.4	4.0	-2.1	-0.3	-0.6	-2.1	0.9	-1.7	-4.4	-4.2	-0.7	3.0
1981	2.7	2.8	5.3	-2.2	3.1	-3.7	-0.4	1.9	4.1	-4.9	-1.1	-1.7
1982	-2.1	-2.4	-1.7	1.6	-3.0	-9.0	-4.6	-0.6	1.9	12.2	-0.7	-5.3
1983	-1.4	-2.5	3.6	0.8	1.0	1.7	5.1	0.9	-0.1	1.5	0.5	-0.9
1984	3.0	2.0	2.1	0.6	3.8	-4.1	0.7	2.8	2.2	2.0	0.2	-1.2
1985	1.9	-0.7	0.8	-1.8	2.2	-0.2	-4.7	-1.4	-3.1	-12.1	0.5	-1.1
1986	0.1	-0.9	3.9	2.1	-2.4	0.5	-0.4	4.0	5.7	8.5	1.8	1.5
1987	-1.5	-7.7	2.7	1.4	-3.3	-1.5	0.0	0.9	4.3	0.9	0.6	-4.6
1988	-4.1	7.0	-1.2	2.5	4.4	2.0	9.3	3.6	5.4	0.2	1.9	7.5
1989	7.5	-9.8	3.4	4.8	-3.8	-4.6	-1.1	6.4	1.3	4.2	-2.3	-14.5
1990	-4.7	-8.0	-0.6	-4.0	-14.3	0.7	5.8	-4.2	3.1	-2.2	-1.2	-2.2
1991	-10.2	-7.9	-0.2	-9.8	-18.3	-4.8	-6.9	-3.2	-5.9	-21.4	-4.4	-7.6
1992	-59.0	-21.0	-7.3	-28.4	-37.0	-10.4	-24.8	-41.9	-28.0	-34.4	-15.0	-25.5
1993	-7.4	-18.3	-9.6	-11.2	-18.2	-4.5	-10.7	-14.5	-33.9	8.9	-9.1	-18.9
1994	12.9	-17.5	-16.7	-1.4	-9.4	-15.2	-26.3	5.3	-8.9	-36.7	-12.8	-12.5
1995	5.7	-12.2	-6.5	5.7	-5.6	-7.6	-9.6	3.3	5.0	-6.6	-1.2	-11.0
1996	5.1	-1.5	4.1	4.0	10.8	-0.2	3.0	5.1	4.1	-5.4	-2.3	-13.2
1997	7.2	0.6	12.5	10.2	6.4	3.5	9.6	6.9	8.7	1.3	3.2	-1.2

Table A1. Yearly total factor productivity growth rates (in percent) Cont.

Turkmenistan	Ukraine	Uzbekistan	Total	Agriculture	Construction	Industry	Trade	Transport
0.7	1.1	-0.9	0.4	-3.8	0.3	1.1	0.4	3.1
-3.6	-0.7	0.9	-0.6	-10.9	-1.7	1.6	-1.0	1.4
1.0	4.8	1.1	3.7	14.7	1.0	3.4	0.4	2.6
3.0	-0.2	5.0	1.3	-5.5	-0.5	3.1	1.6	3.0
-0.9	-1.5	-1.6	0.0	-14.2	-1.1	2.1	0.8	4.7
-6.2	2.2	3.4	0.9	9.5	-2.6	-0.5	0.6	1.9
-2.3	0.5	-1.2	-0.2	1.0	-3.1	-0.2	-0.4	-1.6
-4.4	-0.2	-4.9	-0.4	1.8	-2.9	-0.9	-1.6	1.0
0.2	-2.7	-1.0	-1.7	-9.5	-4.3	-0.9	-0.2	-0.2
-6.6	-2.8	2.2	-1.1	-8.5	-1.8	-0.9	0.0	1.5
-6.0	-0.4	-2.8	-0.7	-3.9	-1.5	-1.1	-0.6	1.2
-0.7	2.0	-1.1	-0.6	6.7	-3.9	-1.0	-1.5	-1.6
-3.1	2.2	-0.9	0.8	4.2	1.1	0.3	0.8	0.8
-4.1	1.7	-5.6	0.4	-3.1	0.6	1.0	1.0	-0.1
-0.8	-1.0	1.1	-0.1	-4.5	0.7	0.3	-0.4	0.8
0.1	1.9	-2.5	1.7	9.9	2.3	1.2	-1.0	2.4
1.4	5.3	-4.1	1.0	-4.1	0.0	2.2	0.7	2.8
5.1	0.5	4.3	1.7	-0.9	-3.0	2.4	4.1	8.0
-8.7	0.7	0.4	-1.4	6.0	-13.3	-1.2	3.1	1.6
1.4	-2.7	0.5	-1.7	-5.8	-6.3	-0.3	1.8	-6.5
-6.1	-7.0	-4.2	-5.4	-12.3	-8.8	-6.1	-6.0	-7.9
-13.7	-4.8	-9.5	-14.0	-12.5	-36.2	-16.5	-11.1	-15.3
2.0	-10.2	-2.2	-9.1	0.2	-6.4	-14.6	-12.6	-20.4
-12.0	-27.3	-5.3	-15.3	-9.0	-15.5	-18.3	-8.1	-16.2
-9.7	-11.3	-2.4	-4.0	-5.2	-7.4	-0.1	-8.1	-5.0
-26.7	-0.5	-1.1	-1.3	-2.4	-8.6	1.0	-1.9	-3.6
-17.0	-1.1	3.1	3.1	5.1	1.7	8.9	-4.9	-1.1

Appendix I: Data description[31]

National accounts

The series for output, labor and the capital stock are built up starting from the data set used by Easterly and Fischer (1994), covering 1970-89. The data have been cross-checked against series on the same variables provided by the Statistical Committee of the CIS for 1980-90, and some minor corrections introduced. Output and capital data for the pre-transition period are level data and are expressed in "comparable prices", a price concept that is considered not to fully adjust for inflation. An adjustment has been applied following Unites States Congress, Joint Economic Committee (1990), Kellogg (1990), and Noren and Kurtzweg (1993). Labor data refer to total employment numbers, unadjusted for variations in hours worked.

This amended data set is supplemented for more recent years by information drawn from national statistical yearbooks (in particular for the Baltics), from various publications of the Statistical Committee of the CIS (notably its CD-ROM *Official Statistics of the CIS countries*, various issues of *The Statistical Yearbook of the CIS, The World in Figures* (1992) and its fortnightly *Bulletin*) and from the World Bank's *Statistical Handbook, States of the former USSR*; in a few cases, data have been obtained directly from the central statistical offices (data from these various sources may differ from the estimates used by IMF country desks and appearing in the *World Economic Outlook* or in the Staff Country Reports).

The output, labor, and capital stock data for the transition period are constructed to ensure consistency with the 1970-89 series. Output level data for this period are extrapolated from the pre-transition period using information on real growth rates. Labor data for the period 1990-97 continue to refer to total employment numbers, which in most cases are broadly consistent with the pre-transition numbers (with the possible exception of employment data in the trade and services sectors in 1996-97, which in a number of countries appear to reflect reclassification of occupations). The capital stock data for the transition period are obtained using 1990-97 gross investment data and applying depreciation rates that are imputed from 1970-89 capital stock and investment data and from information in Kellogg (1990).

A number of countries have substantially revised their GDP and sectoral output series, including Russia (World Bank and Goskomstat of the Russian Federation, 1995), Kazakhstan (World Bank, 1997), and Lithuania (for the aggregate output series only). In such cases, the revised series are used.

TFP computations, in addition to data on output and inputs of labor and capital, require proxies for the elasticities of output with respect to capital and labor. For this purpose, observed shares of factor payments in total product are commonly used.

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[31]Data referred to but not displayed in this paper are available from the authors on request.

Reported factor share data for the fifteen countries in the sample are, however, incomplete and, except for the most recent years, do not reflect market-determined factor payments. Share estimates that could approximate elasticities of output with respect to capital and labor can only be obtained on the basis of detailed adjustments and additional information on wages and rentals, as in Bergson (1978). Rather than introducing such adjustments, output elasticities with regard to capital and labor are posited to equal 0.3 and 0.7 respectively, for all countries, sectors, and years.

Finally, the statistical yearbooks of the Council for Mutual Economic Assistance (CMEA) are used for pre-transition data on central European comparators when no national yearbooks were available.

Alternative measures of output

Electricity consumption data are taken from various publications of the International Energy Agency, including *Electricity in European Economies in Transition*, 1994; *Energy Statistics and Balances of Non-OECD Countries 1993-1994*, 1996; *Energy Balances of OECD Countries, 1994-1995*, 1997; and *Electricity Information*, various issues. For some countries of central Europe and for the pre-transition period, those sources were supplemented by the statistical yearbooks of the CMEA.

Freight and mail data are taken from the CD-ROM *Official Statistics of the CIS countries*, and from the yearbooks published by the central statistical offices of the Baltics and of the comparator countries.

Appendix II: Alternative summary statistics for aggregate output

The chaotic nature of transition and the conspicuous deprivation of the statistical agencies have led some observers to give up altogether on any attempt at deriving GDP estimates. Rather than vainly trying to collect, adjust and aggregate economy-wide data, their line of argument goes, it is safer to use a single, relatively straightforward proxy for overall activity. While obviously imperfect, such a proxy is more relevant than more elaborate but completely opaque and deficient measures such as the official GDP estimates, they contend. This annex discusses the merits and shortcomings of alternative summary statistics, and concludes on a very skeptical note.

1. Electricity consumption

The most popular surrogate measure is electricity consumption. It is sometimes casually claimed that the long-run and even the short-run elasticity of electricity consumption with respect to real GDP is close to unity, even though cross-country empirical evidence points to numerous and significant departures from unity (IEA, 1985).[32] Based on this claim, the supporters of the electricity consumption measure have proposed to have it replace official real GDP series (Dobozi and Pohl, 1995), and have used it to estimate the size of the shadow economy (Kaufman and Kaliberda, 1996; Hernández-Cata, 1997; and Johnson et al.,1997).[33] [34]

Since electricity consumption was typically much more resilient than officially measured output during the great contractions (Appendix Table A2), those authors conclude that much of the underground activity is overlooked in the published national accounts.

Relying on overall electricity consumption as a proxy for actual GDP is a bold move, however, given the numerous reasons for divergence between the two series. On the one hand, sources of upward bias include the following:

- a significant portion of the electricity consumed by enterprises is used for overhead purposes and hence does not fall as much as output;

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[32]Such deviations do not mean that GDP is not a key determinant in econometric analyses of electricity consumption.

[33]The latter authors do not assume universal unit elasticity, but rather distinguish three groups of countries according to their presumed degree of energy efficiency. Their typology is a welcome recognition of the inadequacy of a uniform elasticity assumption, but it is derived on a completely ad hoc basis. Furthermore, they admit that massive energy substitution in Armenia and Kyrgystan prevents them from applying this methodology to those countries. They also exclude Tajikistan and Turkmenistan from the sample, lacking data on electricity use for those countries.

[34]In a related attempt for Romania, Dobrescu (1998) constructs estimates of the shadow economy in Romania based on total primary energy consumption.

- the share of electricity in the energy mix is likely to rise over time as modern, electricity-intensive industrial processes are being adopted (although arguably this may occur mainly once output and investment are recovering rather than during the earlier phases of transition);

- residential electricity consumption, which typically represented between one tenth and one fifth of total electricity use at the onset of transition, has displayed considerable inertia or has even increased in some countries (e.g., Belarus, Estonia and Tajikistan), reflecting increased use of portable electric heaters as a substitute for scarce heating oil (e.g., in Moldova) and of other electrical consumer devices (notably, kitchen appliances);[34]

Table A2. Cumulative decline in measured real GDP and electricity consumption
(percent decline between historical peak and trough of contraction or 1997)

	Real GDP contraction	Fall in electricity consumption
Armenia	56	48[1]
Azerbaijan	66	24
Belarus	37	33
Estonia	42	28
Georgia	75	around 50
Kazakhstan	42	30
Kyrgyz Republic[1]	49	-17
Latvia	53	43
Lithuania	41	45
Moldova	65	58
Russia	42	23
Tajikistan	68	20
Ukraine	60	34
Uzbekistan	19	15
Baltics and CIS	44	26
Comparator countries in central Europe		
Bulgaria	27	27
Czech Republic	21	11
Hungary	18	12
Poland	14	12
Romania	30	30
Slovakia	15	13

Sources: National statistical offices; Statistical Committee of the CIS; CMEA Yearbooks; IEA publications.
[1/]During 1990-1993.
[2/]Electricity consumption increased between 1990 and 1995.

[34]In the case of Belarus for example, the increase in household consumption of electricity was equivalent to 2.9 percent of total electricity consumption in 1989 and 4.3 percent of total electricity consumption in 1995.

- likewise, network losses have seen their share in total consumption increase, often even rising in absolute terms, owing to the deterioration of the infrastructure in a period where investment plummets and funds for maintenance are squeezed.

On the other hand, there are also reasons for the evolution of electricity consumption to understate that of activity:

- the composition of value-added shifts away from traditional heavy, energy voracious, industries to services and other activities that are less energy intensive;
- the resilience of residential electricity consumption partly results from the expansion of private entrepreneurial activity undertaken from private dwellings due to the lack of business space (e.g., in Ukraine);
- the rising share of losses partly reflects underground activity;
- the relative price of electricity typically increases, helping reduce wasteful consumption (although in practice electricity bills are often left unpaid).

When comparing electricity consumption in peak and trough years, one should furthermore take into account weather conditions, since they influence this variable more than they affect GDP. On the whole, it is thus very hazardous to assume any simple relationship between electricity use and real GDP. In the Baltics and the CIS countries as a group, where electricity consumption fell by around 27 percent between 1990 and 1997 compared with a decline in officially reported (weighted) output by 43 percent, the observed significant shift in inputs of labor and capital toward electricity production and away from other industrial activities during the transition further weakens the arguments supporting the existence of any such simple relationship.

The case for caution is reinforced by a look at Finland, which also experienced a major recession in the early 1990s (partly for reasons related to the transition in neighboring Russia). Since the quality of the national accounts data is far superior in Finland, it is safe to assume that measured GDP closely matches actual GDP in that country. The evolution of electricity use in the course of the Finnish recession (Figure A1) shows that it can be a very poor proxy for real GDP, overstating it by a considerable margin during a large-scale contraction.[36] Indeed, electricity use rose by almost 6 percent in the course of the three-year GDP contraction, with half of the increase accounted for by rising residential consumption.[37]

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[36]It also serves as a reminder that over the longer run, the elasticity of electricity consumption vis-a-vis real GDP may exceed unity.

[37]Extending the cross-country comparison beyond Finland, it can be noted that over the past two decades, Mexico, Portugal and Turkey saw electricity consumption increase during episodes of significant real GDP contraction.

2. Freight and mail

Prior to transition, freight was widely considered to be a sturdy proxy for overall economic activity, both inside the former Soviet Union and by Western analysts.[38] Some observers have argued that this remained true in the 1990s, claiming that transportation data are relatively reliable, especially as regards freight.[39] The bulk of freight traffic, it is argued, consists of rail and pipeline transport and as such is mostly correctly registered. Even road transportation, the contention goes, can be estimated fairly accurately, thanks to police records of vehicle numbers, and petrol production and sales.

In the case of Russia, there exists a roughly homogeneous series for overall freight, but only from 1991 and only for turnover (i.e., reflecting both volumes and distances).[40] It shows a cumulative decline of 38 per cent between 1991 and 1996 (which is exactly in line with the official measure of real GDP), followed by a further drop of 3.6 per cent in 1997 (in contrast with a 0.8 per cent increase in the official measure of real GDP). Interpreting this evidence one way or the other is hazardous, however, not least for several of the reasons already mentioned in the case of electricity consumption.

If in general there were to be a strong correlation between freight and real GDP, several factors would weaken it in the countries under consideration. Some of the new or expanding activities, such as financial services, are presumably less transportation intensive than traditional ones, while others, such as trade, may be more so. In some ways transportation arrangements were notoriously inefficient in Soviet Union (Holt, 1993; and Strong et al., 1996), implying that part of the decline in freight may not correspond to any decline in value-added. Changes in the relative price of transportation (adjusted for non-payments) would also have a bearing on turnover, discouraging the haulage of heavy shipments of low value over long distances. Furthermore, the intrinsic reliability of the transportation data is probably overstated by the supporters of this proxy. Even so, the case of Finland suggests that if anything, freight might be no worse a proxy for real GDP than electricity consumption, although again it declined much less than real GDP during the Finnish recession of the early 1990s (Figure A2).[41]

Another and more exotic proxy for real GDP is the number of letters, newspapers and parcels mailed. Perhaps surprisingly, given the rapid development of electronic communications, this indicator turns out to be a rather better proxy for real GDP in

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[38]It was also cherished for its timeliness and used as an advance indicator.

[39]See for instance *Russian Economic Trends*, Vol. 5, No. 4.

[40] The series for volumes shipped is consistent only from 1993 (when Goskomstat started to incorporate estimates for private road transport). It shows a cumulative decline of 44 per cent between 1993 and 1996, against a cumulative decline of 19 per cent for the turnover series.

[41]The long-run elasticity of freight to GDP is clearly less than one, though, in contrast to electricity consumption, which tends to rise faster than GDP.

Finland during the recession than the two preceding ones, even though the correlation remains rather loose, especially on the upturn (Figure A3).[42] By and large, mail traffic also moves in tandem with real GDP in other OECD countries, including during the mid-1970s recession (Bonsall and Rickard, 1988). Analogous data are available for Russia. They show mail traffic rising much less in the 1970s and 1980s than officially measured aggregate output and subsequently collapsing much more abruptly, with a cumulative decline of 83 per cent between 1990 and 1996.[43] Likewise, the collapse in mail traffic was much more pronounced than that of measured value-added in the Baltics and in all the other states of the former Soviet Union, for mail in general as well as for letters, newspapers and parcels separately.[44] It may be tempting to interpret the long-run pre-transition relationship as one more sign that the official output series may have been upward biased,[45] but it is hard to believe that the real economy would have melted down as much during the first half of the 1990s as this proxy would imply.

3. Lessons

On closer inspection, none of the three alternative proxies thus seems to constitute a trustworthy surrogate for actual GDP. Even if in advanced market economies some of them at times move closely in tandem with GDP, the correlation is too weak to warrant their use as such. Even so, the sharp falls in electricity use, freight and mail observed in the Baltic and CIS countries support the view that the magnitude of the economic contraction was indeed extreme.

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[42]Like for freight, the long-run elasticity is clearly below unity.

[43]For letters alone, the cumulative decline amounts to 70 per cent.

[44]Only for letters in Lithuania are the two indicators commensurate. In the comparator countries of central Europe, the divergence between the two indicators was much smaller, and not systematically in the same direction.

[45]Koen (1994) discusses other reasons for this probable upward bias.

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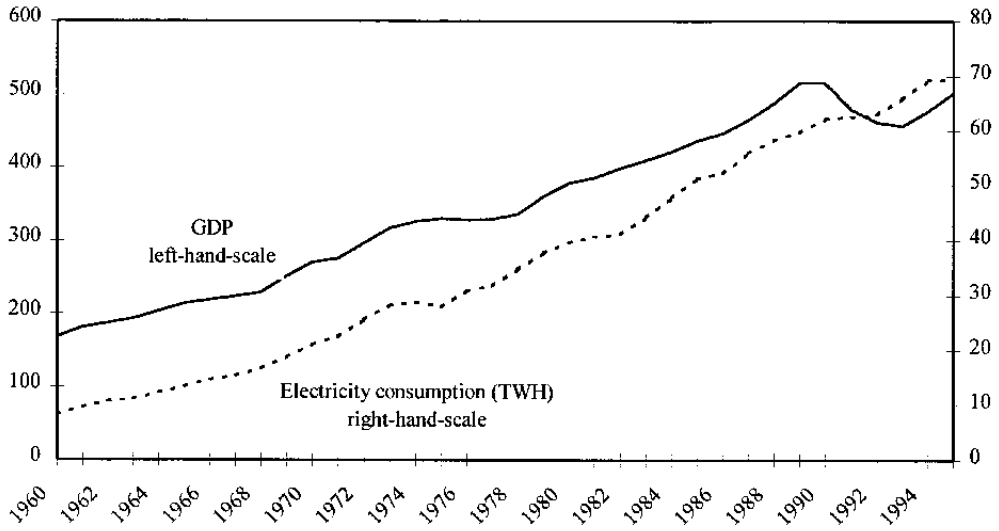
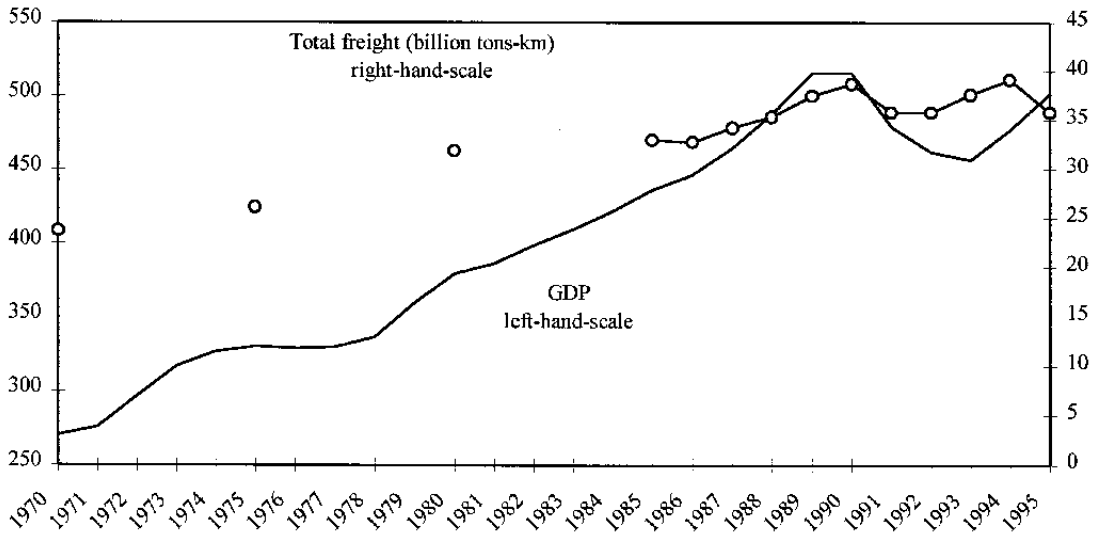
Figure A1. Finland: Real GDP and overall electricity consumption



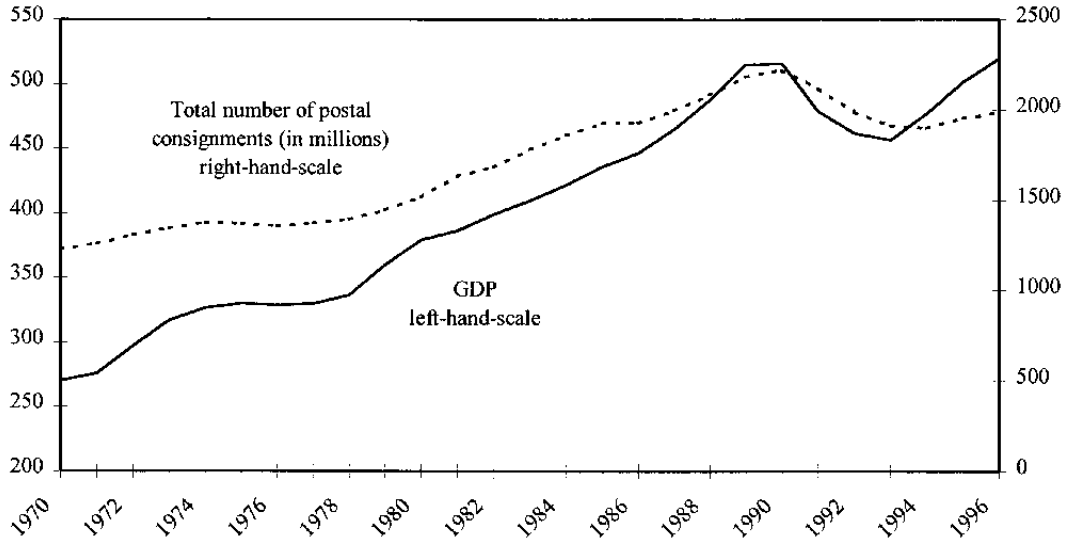
Sources: Statistics Finland; International Energy Agency.

Figure A2. Finland: Real GDP and total freight turnover



Source: Statistics Finland.

Figure A3. Finland: Real GDP and mail



Source: Statistics Finland.