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Explaining Russia's Output Collapse

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This paper explores sources of the output collapse in Russia during transition. A modified growth-accounting framework is developed that takes into account changes in factor utilization that are typical of the transition process. The results indicate that declines in factor inputs and productivity were both important determinants of the output fall. The contribution of the productivity drop was critical, but significantly smaller than previously reported. [JEL E2, O4, P2]

All the transition economies of Eastern Europe and the Baltics, Russia, and other former Soviet Union countries (hereinafter referred to as BRO) have experienced major declines in output after the launch of economic reforms. The magnitude and the duration of the "transition recession" varied greatly across countries; thus, Poland's GDP fell 14 percent over 2 years while Ukraine's GDP fell 58 percent over 6 years.[1] The BRO countries were generally hit harder during the reform period, with the average fall in output nearly twice as large as in Eastern Europe. As much as 75 percent of the total BRO output during this period was accounted for by Russia, by far the largest economy in the region. Decisive reforms in Russia started in 1992 and were accompanied by a fall in officially estimated output that continued uninterrupted till 1997, resulting in a cumulative decline of Russia's GDP of 40 percent since 1991.

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[1]Based on the recession immediately following the launch of reforms and not including the effects of the Russian crisis of 1998.

Russia's growth performance had already worsened before the beginning of economic transformation. The fundamental reason for the slowdown was the nature of Soviet economic growth, which was based on mobilization of resources rather than increases in productivity. It is well established in the growth-theory literature that this kind of input-led growth is unsustainable in the long run (see Romer, 1996, for a review). The standard neoclassical model shows that in the absence of technological progress, diminishing returns to capital lead to eventual exhaustion of the economy's growth potential. Technological progress, however, results from innovation and adoption of new technologies, for which central planning could not provide the appropriate incentives.

High growth of the Russian economy in the 1950s was achieved by increasing labor force participation rates and working hours; increasing labor quality through education; and, most importantly, heavy investment. The Soviet Union still had one of the highest investment rates in the world in the 1960s, 1970s, and 1980s, although its growth performance deteriorated. The Soviet economy had become more and more inefficient over time, with productivity growth showing a strong declining trend since the 1960s (Easterly and Fischer, 1994). After the initial period of high returns to capital accumulation, the economy got saturated with capital, and continued investment led to over-accumulation. Capital was inefficiently allocated and increasingly outdated (as indicated by its very poor substitutability for labor), resulting in rapidly falling returns on investment starting in the 1960s. The slowdown resulted from not only extensive growth as such but also an extraordinarily low payoff on it. The situation was aggravated by the burden of defense spending and demoralization resulting from the distorted incentives of central planning.

Thus, the stage for the output decline of the 1990s was set by the extensive growth of the preceding decades. The output collapse during transition was far too dramatic, however. So what was the driving force behind the "transition recession"? Was it factor unemployment or a productivity drop? It is widely acknowledged that although reallocation of resources across sectors and individual firms that accompanies the transformation to a market economy ultimately improves efficiency, it entails considerable transition costs (Blanchard, 1997). Market-oriented reforms undermine the functioning of state-owned firms, while the new private sector takes time to emerge. Unemployment climbs as a fall in the labor demand of state firms is not immediately compensated for by a rise in the labor demand of private firms. Besides, the former state sector workers often need to be retrained before they can find work in the new private sector. In addition, the process of transition is likely to cause underemployment of capital (Hernández-Catá, 1997). While the declining state sector releases its capital stock, the emerging private sector cannot employ it unless it undergoes some time-consuming restructuring. In fact, part of the capital stock inherited from the socialist era is so outmoded it will never be used again and thus has to be replaced, which requires time and resources.

The productivity effects of transition may be mixed over the short term. Although market liberalization can boost the development of more productive private firms, it can further reduce the productivity of the remaining state enterprises. An important consequence of transition is a breakdown of economic relations among firms, or "disorganization" (Blanchard and Kremer, 1997). A prominent feature of central planning had been the prevalence of highly specific relations among economic agents. The effect of transition was to eliminate the enforcement mechanism that made such structures work before the market-based contract enforcement mechanism was in place. Thus, market liberalization opened up new private opportunities that undermined established production networks. Roland and Verdier (1999) put forward a similar argument based on search frictions generated by the liberalization of supplier-customer relations. If enterprises do not undertake capital investment until a long-term partner is found, output may fall owing to the fall in investment and failure to replace outdated capital.

Some recent empirical work (De Broeck and Koen, 2000) found that a productivity drop played the dominant role in the "transition recession" in the BRO countries. The analysis below shows that the productivity effect—while very important—tends to be overstated in such studies. This paper looks closely at Russia's output contraction during transition with the aim of gaining a deeper understanding of the reasons for it. Explaining the collapse is important for developing the appropriate policy response, particularly in light of the financial crisis of 1998, which highlighted fragilities of Russia's economy. The recent recovery has been driven by the ruble depreciation, which gave a boost to both import-competing and exporting sectors, as well as by a surge in world energy prices. Sustainability of this recovery cannot be assured unless internal structural imbalances are eliminated and a solid foundation for economic growth is put into place.

I. Methodology

Basic Framework

Growth accounting is a technique based on the standard neoclassical growth model (Solow, 1956) that seeks to identify sources of economic growth. The standard aggregate production function that gives rise to the growth-accounting equation is:

$$Y = AF(L,K), \tag{1}$$

where Y denotes output; A (total factor productivity, or TFP) measures the efficiency level at which factor inputs are transformed into output; and L and K denote labor and capital inputs, respectively. The production function is assumed to have constant returns to scale, and markets are assumed to be perfectly competitive.

In this framework, the growth rate of output can be represented as:

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \left(\frac{\partial Y}{\partial L}\frac{L}{Y}\right)\frac{\dot{L}}{L} + \left(\frac{\partial Y}{\partial K}\frac{K}{Y}\right)\frac{\dot{K}}{K}. \tag{2}$$

Using the perfect-competition assumption gives:

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \left(\frac{wL}{Y}\right)\frac{\dot{L}}{L} + \left(\frac{rK}{Y}\right)\frac{\dot{K}}{K}, \tag{3}$$

where w stands for the real wage and r stands for the real rental rate of capital. Under the assumption of constant returns to scale, the factor shares add up to one, hence:

$$\frac{\dot{Y}}{Y}=\frac{\dot{A}}{A}+\alpha\frac{\dot{L}}{L}+(1-\alpha)\frac{\dot{K}}{K}, \tag{4}$$

where α and $1-\alpha$ stand for the labor share and the capital share, respectively.

In other words, the growth rate of output can be decomposed into the growth rates of inputs weighted by their respective income shares and the growth rate of total factor productivity. TFP growth is a residual that represents the component of growth that is not explained by increases in the factors of production but rather may be attributed to productivity gains.

For the use in discrete time (relevant for most practical applications) this becomes:

$$\left[\frac{\Delta Y_t}{Y_{t-1}}\right]=\left[\frac{\Delta A_t}{A_{t-1}}\right]+\overline{\alpha}\left[\frac{\Delta L_t}{L_{t-1}}\right]+(1-\overline{\alpha})\left[\frac{\Delta K_t}{K_{t-1}}\right], \tag{5}$$

where $\overline{\alpha}$ denotes the average labor share over the periods $t-1$ and t.[2]

Extended Framework

As will become apparent below, it is crucial to explicitly account for factor utilization in the context of transition economies. Within the basic framework, changes in factor utilization would be picked up in TFP, which could make interpretation of results especially difficult. The massive reallocation of resources from the state to the private sector during transition is associated with significant underutilization of labor and capital. In this case the basic framework would tend to understate the decline in inputs and overstate the decline in TFP.

In order to reflect changes in factor utilization explicitly, the standard production function is modified in the following way:

$$Y=AF\left(u^L L,u^K K\right), \tag{1′}$$

where u^L and u^K denote the shares of, respectively, labor and capital actually utilized. Accordingly, equation (3) becomes:[3]

$$\frac{\dot{Y}}{Y}=\frac{\dot{A}}{A}+\left(\frac{wL}{Y}\right)\left(\frac{\dot{L}}{L}+\frac{\dot{u}^L}{u^L}\right)+\left(\frac{rK}{Y}\right)\left(\frac{\dot{K}}{K}+\frac{\dot{u}^K}{u^K}\right), \tag{3′}$$

[2]Note that the log approximation may not be appropriate in this case, since it requires that the growth rates in question be sufficiently small, which is not always the case in Russian data.

[3]Note that in this case the real wage and the real rental rate of capital reflect not only marginal factor products but also respective utilization rates.

and taking discrete approximation under the constant-returns assumption yields the following modified version of equation (5):

$$\left[\frac{\Delta Y_t}{Y_{t-1}}\right] \simeq \left[\frac{\Delta A_t}{A_{t-1}}\right] + \overline{\alpha}\left[\frac{\Delta L_t}{L_{t-1}} + \frac{\Delta u_t^L}{u_{t-1}^L}\right] + (1-\overline{\alpha})\left[\frac{\Delta K_t}{K_{t-1}} + \frac{\Delta u_t^K}{u_{t-1}^K}\right]. \qquad (5')$$

Another important consideration not captured by the basic framework is that the transition process affects different economic sectors differently. Thus, labor tends to shift from lower-paid, less productive sectors to higher-paid, more productive sectors. This also implies different labor-utilization rates in different sectors. Likewise, capital utilization also differs across sectors. In addition, modernization of the capital stock occurs more slowly in declining sectors and more rapidly in emerging ones, implying increasing differentiation in the quality of capital. A failure to explicitly account for the differences in quantity and quality of productive factors across economic sectors leads to biases in estimated TFP.[4]

Barro (1998) describes extensions of the basic growth-accounting framework that allow disaggregation across different factor types. Incorporating multiple factor types into the utilization-augmented production function gives:

$$Y = AF\left(u_1^L L_1, \ldots, u_n^L L_n;\ u_1^K K_1, \ldots, u_n^K K_n\right), \qquad (1'')$$

where i indexes economic sectors. Under the perfect-competition assumption, this yields:

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \sum_{i=1}^{n}\left(\frac{w_i L_i}{Y}\right)\left(\frac{\dot{L}_i}{L_i} + \frac{\dot{u}_i^L}{u_i^L}\right) + \sum_{i=1}^{n}\left(\frac{r_i K_i}{Y}\right)\left(\frac{\dot{K}_i}{K_i} + \frac{\dot{u}_i^K}{u_i^K}\right), \qquad (3'')$$

or, in discrete time,

$$\left[\frac{\Delta Y_t}{Y_{t-1}}\right] \simeq \left[\frac{\Delta A_t}{A_{t-1}}\right] + \sum_{i=1}^{n}\overline{\alpha}_i\left[\frac{\Delta L_{it}}{L_{it-1}} + \frac{\Delta u_{it}^L}{u_{it-1}^L}\right] + \sum_{i=1}^{n}\overline{\beta}_i\left[\frac{\Delta K_{it}}{K_{it-1}} + \frac{\Delta u_{it}^K}{u_{it-1}^K}\right], \qquad (5'')$$

where $\overline{\alpha}_i$ and $\overline{\beta}_i$ denote, respectively, average labor and capital shares in sector i. Under the assumption of constant returns, $\sum_{i=1}^{n}\overline{\alpha}_i + \sum_{i=1}^{n}\overline{\beta}_i = 1.$

Some methodological caveats ought to be emphasized (Barro and Sala-ì-Martin, 1995). TFP reflects a whole range of factors, since it captures everything that is not accounted for by measured input growth. It is hard to distinguish the effect of technological change from that of improved resource allocation or even from biases resulting from general model deficiencies and poor data quality. Thus, TFP estimates are affected by scale economies and sensitive to data perturbations. The growth-accounting technique therefore should be treated with caution and

[4]Besides differences across economic sectors, the transition process causes differences within sectors, most importantly between state, privatized, and newly created private enterprises. Owing to data limitations, however, these phenomena are harder to capture empirically, so the present work focuses exclusively on sectoral variations.

regarded as a useful way of examining the data rather than as a model of the growth process.

II. Measurements

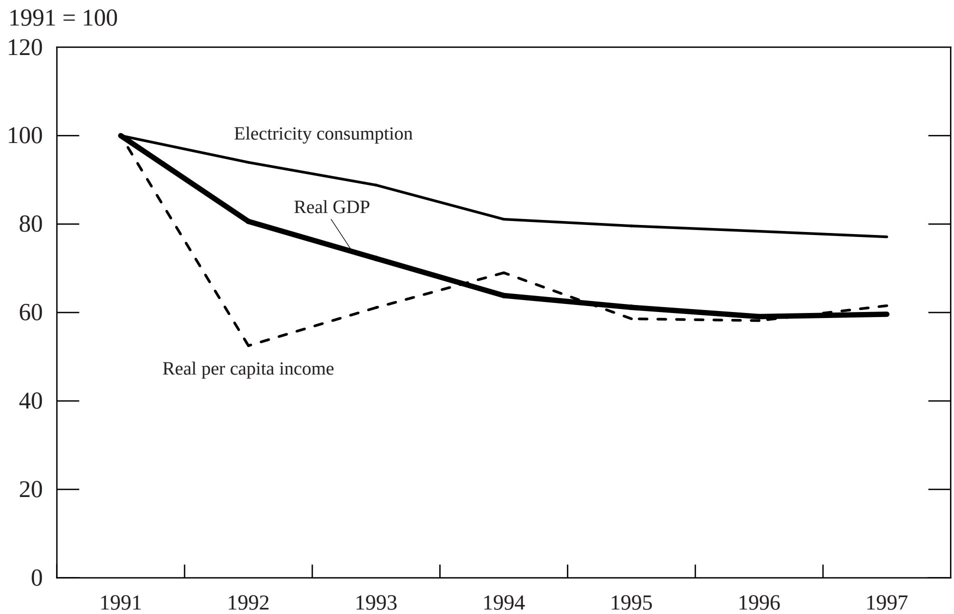
Data Issues

In transition economies in general, and in Russia in particular, output tends to be poorly measured, even though certain corrections have been made by the statistical authorities. Official statistics reflect mainly the performance of declining large and medium-sized state (or formerly state) enterprises and tend to neglect newly emerging private activities. This, as well as underreporting owing to notorious tax evasion, leads to overstatement of the output fall. It is exacerbated by the likely overreporting that took place under central planning. Informal activities are widespread and include, for example, street trading, small-scale renovations and repairs, and small-scale smuggling. Allowances made in the statistics to account for the informal economy are largely arbitrary, since its size is hard to measure. It is worth noting that the presence of the informal economy distorts measurements of both factor inputs and output. Labor and capital used in the informal sector are often not properly registered and, hence, not properly accounted for. It is conceivable that unrecorded output is produced from unrecorded inputs. Finally, inflation and relative price shifts introduce difficulties in assessing real values, which appear to be sensitive to different sets of prices used for deflating nominal values (Gavrilenkov and Koen, 1994).

A number of proxy indicators of output change have been suggested in the literature, with electricity consumption being the most popular of these (Dobozi, 1995; Dobozi and Pohl, 1995). It has been used, in particular, to estimate the size of the shadow economy in transition countries, which is not accounted for in the official statistics (Kaufmann and Kaliberda, 1996). The use of this indicator is based on the conjecture that in market economies, the electricity-GDP elasticity is close to one. This is not uniformly the case, however, and in transition economies departures from this conjecture are particularly likely (De Broeck and Koen, 2000). On the one hand, one might expect to find a rise in electricity efficiency in transition economies, since the newly emerging private sector is likely to be more energy efficient; traditional power-intensive sectors have been hit hard by reforms; and energy prices have risen substantially as a result of liberalization (although nonpayment of energy bills is widespread). On the other hand, a drop in capacity utilization and lack of basic maintenance could have diminished the efficiency of electricity utilization, although a significant portion of electricity consumption is accounted for by lighting and heating (including residential) and hence has little relation to output.

In addition, during transition, output measures may not be good indicators of welfare. Having access to fewer unwanted goods does not make consumers worse off, but having access to a greater variety of, and better-quality, goods makes them better off. Average money income, for example, has been put forward as a better measure of the standard of living in Russia (Gavrilenkov and Koen, 1994). This indicator reflects significant adjustments in wages and other social payments, as

Figure 1. Russia: Output and Welfare Indicators



well as the emergence of new kinds of income, such as entrepreneurial earnings and dividends. Real income data are highly sensitive to inflation measurement, however, and suffer from misreporting as a consequence of tax evasion and widespread payment arrears and use of in-kind remuneration.

Figure 1 shows the dynamics of GDP as compared with those of electricity consumption and real money income over the transition period. It is evident that per capita income was considerably more volatile and electricity consumption experienced a visibly weaker decline than GDP during 1992–94. The preceding discussion, however, suggests that using proxies may pose more dangers than using GDP as reported by the statistical authorities. The analysis presented below is therefore based on the official data.

The main data source for the present exercise is the 1999 *Yearbook of the State Committee for Statistics of the Russian Federation* (Goskomstat Rossii, 1999). These data are supplemented with survey data from *Russian Economic Trends* (2000) on factor underutilization and GDP data from the International Monetary Fund (IMF, 2000) reflecting the latest updates. Both aggregate data and data for individual economic sectors (industry, agriculture, construction, and services[5]) are used.

[5]The services sector data are taken as a residual and therefore include all economic activity except industry, agriculture, and construction.

Figure 2. Russia: Dynamics of Output Indices, by Sector

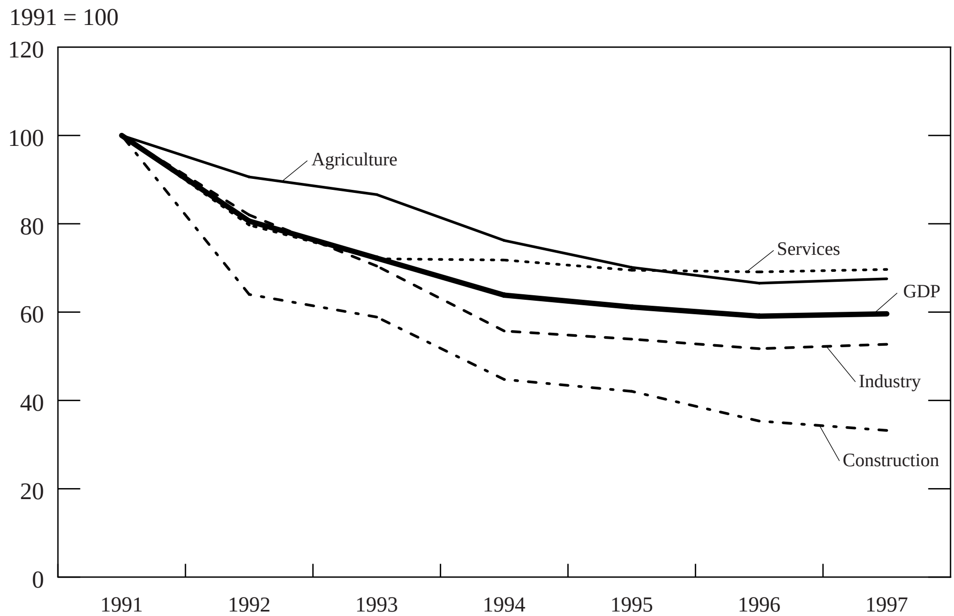


Figure 2 presents output changes by sector, measured in constant prices. It shows that construction has experienced the largest drop, followed by industry, while agriculture and services fell by less than the total output. (The decline in agriculture was relatively slow, and the decline in services had largely bottomed out by 1993.) Note also that although output shares in current prices of all goods sectors—and, in particular, industry—declined since the beginning of economic reforms, those in the services sector increased dramatically from less than 40 percent in 1991 to about 60 percent in 1997. This reflects the natural transition from an overindustrialized economy with a neglected services sector to a more balanced one.

Labor Input

Representation of labor input by overall employment is misleading in the Russian context owing to labor hoarding. It has become common to put workers on shortened working days or compulsory leave while formally maintaining their employment. Hence, the official employment statistics overestimate actual labor input, which has fallen faster than formal employment. Table 1 shows that underemployment has indeed been substantial, as compared with official unemployment data.

Such hidden unemployment may to some extent be a reflection of unemployment that had effectively existed under central planning. Disguised unemployment—defined as employment in very-low-productivity occupations (see Eatwell, 1997)—

Table 1. Official and Hidden Unemployment
(millions)

	1993	1994	1995	1996	1997
Unemployment	4.0	5.2	6.0	6.8	7.9
Workers on shortened workdays	1.6	2.0	2.1	3.4	2.6
Workers on compulsory leave	1.7	2.8	2.4	2.4	1.5

Notes: Unemployment data cover the whole economy, while shortened-workday and compulsory-leave data cover only large and medium-sized enterprises.

had been a common feature of a central planning system that strived to provide jobs to all. This means that some of the unemployment observed during transition had been present before the launch of reforms and was revealed once the systemic transformation began. A more detailed examination of this issue requires additional research and is beyond the scope of this paper.

The data on compulsory leaves and shortened working hours are scarce, so only a rather crude adjustment is feasible. The available data cover large and medium-sized enterprises (where most of this kind of underemployment takes place) beginning in 1993. The data on shortened working hours do not specify the actual number of hours worked, so a uniform half-day assumption was maintained in the adjustment.[6] In order to obtain labor-utilization rates during the entire period being considered here, the degree of underemployment prevailing in 1991 was used as a benchmark for normalization. Utilization rates by sector were estimated by fitting a linear function to the aggregate utilization and output growth rates (with the standard error appearing in parentheses):

$$\dot{u}^L / u^L = \underset{(0.04)}{0.12}\, \dot{Y}/Y \quad \left(R^2 = 0.56\right) \tag{6}$$

The estimated relationship is rather strong (though based on very few data points), but imprecision stemming from its uniform application to economic sectors should be kept in mind when interpreting the results.

Table 2 shows employment levels by sector and utilization rates estimated from the aggregate utilization rate using equation (6). Industry and construction have experienced the largest falls in both employment and labor utilization, while the services sector has actually gained employment and the estimated labor-utilization drop was slight. These observations suggest, however, that movement of labor between sectors has been sluggish: laid-off workers seem to have joined the unemployment pool rather than having sought alternative jobs in more prosperous sectors. However, some shifting of workers, particularly from industry to

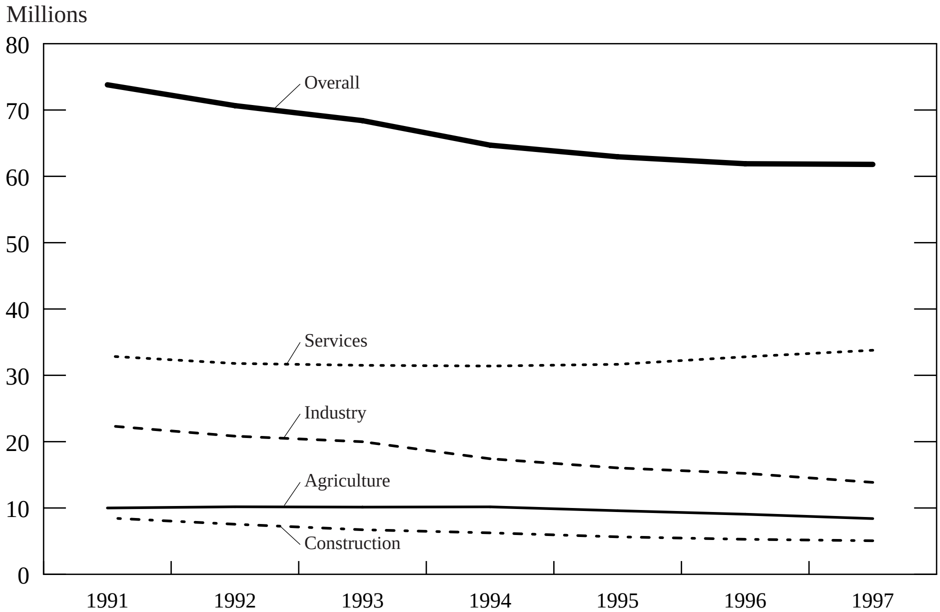
[6]The actual length of shortened working days has varied greatly across enterprises, so while the half-day assumption is admittedly arbitrary, it is hard to improve on it given the data at hand. It is also unclear whether there has been a discernible trend in the number of working hours per day or working days per week. The results, however, appear robust to perturbations of this condition.

Table 2. Employment and Labor Utilization, by Sector

	1991	1992	1993	1994	1995	1996	1997	Total Change 1991–97
Industry								
Employment *(millions)*	22	21	21	19	17	16	15	–7
Utilization *(percent)*	100	98	96	94	93	93	93	–7
Agriculture								
Employment *(millions)*	10	10	10	10	10	9	9	–1
Utilization *(percent)*	100	99	98	97	96	95	95	–5
Construction								
Employment *(millions)*	8	8	7	7	6	6	6	–2
Utilization *(percent)*	100	96	95	92	91	89	89	–11
Services								
Employment *(millions)*	33	33	33	33	33	34	35	2
Utilization *(percent)*	100	98	96	96	96	96	96	–4
Total								
Employment *(millions)*	74	72	71	68	66	66	65	–9
Utilization *(percent)*	100	98	96	94	95	94	96	–4

Note: Overall estimation error (average mismatch between $u^L L$ and $\sum_i u_i^L L_i$): 0.5 percent.

Figure 3. Russia: Utilization-Augmented Employment, by Sector



services, has taken place (see Figure 3). Note that the magnitude of the increase in labor underutilization is rather small, possibly in part because labor hoarding was already common in 1991.

Capital Input

Although there are reasons to believe that the value of the fixed capital stock is underestimated (similarly to the value of GDP) owing to insufficient coverage of the emerging private sector, the official data still grossly overstate the actual amount of capital used in production, since a large part of the fixed capital stock has become obsolete. The data on the share of idle capital are scarce, so only an imperfect adjustment is feasible. Some survey-based capacity-utilization data are available from 1992 onward for industrial companies, which allows one to amend the fixed capital stock figures. According to these data, capacity utilization in industry fell from 75 percent of its "usual level" in 1992 to 60 percent of that in 1997. For the purposes of this exercise, capacity utilization was assumed to be at its "usual level" in 1991. The overall utilization rate and those for the rest of the sectors were estimated similarly to those for labor by fitting a linear function to utilization and output growth rates in industry (with the standard error appearing in parentheses):

$$\dot{u}^K/u^K = \underset{(0.26)}{0.75}\,\dot{Y}/Y \quad (R^2 = 0.42). \tag{7}$$

Table 3. Capital Stock and Capacity Utilization, by Sector

	1991	1992	1993	1994	1995	1996	1997	Total Change 1991–97
Industry								
Capital stock *(index)*	100	101.9	102.6	102.7	102.8	102.8	101.8	1.8
Utilization *(percent)*	100	75	69	64	57	54	60	–40
Agriculture								
Capital stock *(index)*	100	101.1	99.5	95.1	91.3	88.4	84.1	–15.9
Utilization *(percent)*	100	93	90	82	77	74	75	–25
Construction								
Capital stock *(index)*	100	103.3	103.1	103.8	100	97.9	96.6	–5.4
Utilization *(percent)*	100	73	69	56	54	47	45	–55
Services								
Capital stock *(index)*	100	102	102.9	103.3	104.7	105.3	106	6
Utilization *(percent)*	100	85	79	78	77	76	77	–23
Total								
Capital stock *(index)*	100	101.9	102.4	102.1	102.3	102.2	101.8	1.8
Utilization *(percent)*	100	85	79	72	70	68	68	–32

Note: Overall estimation error (average mismatch between $u^K K$ and $\sum_i u_i^K K_i$): 1.8 percent.

Table 3 shows real changes in the capital stock by sector and utilization rates estimated from the industry utilization rate using equation (7). (Note that the estimates obtained are slightly less precise than those for labor.) All sectors have undergone major drops in capacity utilization. Construction has experienced the largest fall, followed by industry, while agriculture and services have had the smallest, but still significant, falls. The capital stock in industry and services has been growing throughout the period, while it has declined in the other sectors examined, most notably agriculture. The observed capital growth in industry points to the overaccumulation inertia inherited from the Soviet era. The growth of the capital stock in services is more likely to reflect the expansion and modernization of the sector and thus the newly accumulated capital may be of better quality than the previously existing stock. This difference, however, is very hard to quantify.

In general, it is plausible that new capital investment undertaken during transition is of higher quality than capital investment undertaken during the central planning era. If the quality change was indeed significant, a failure to account for it would bias the TFP estimates. In order to address this issue, the growth rate of capital can be split into investment and depreciation components in line with the standard perpetual-inventory-accounting method.[7] This approach allows one to represent the capital-stock data using the following formula:

$$K_t = I_t + \left(1 - \delta_{t-1}\right) K_{t-1}, \tag{8}$$

where K stands for the capital stock, I for investment, and δ for the rate of depreciation. In order to account for the increasing quality of investment during transition, a quality factor $\varepsilon_t \geq 1$ can be introduced into the formula:

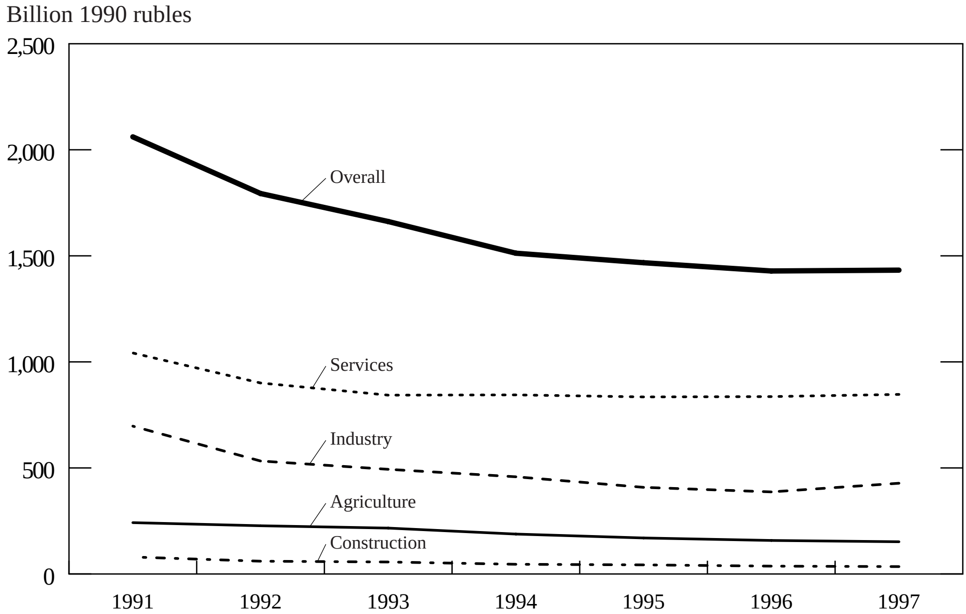
$$K_t = I_t \varepsilon_t + \left(1 - \delta_{t-1}\right) K_{t-1}. \tag{8'}$$

This approach is somewhat similar to that of vintage-capital models (see, for example, Bliss, 1968), in which output is obtained from investments of various "vintages." Measuring ε_t is problematic, however, given the available data. Hence, in the current analysis, the improved quality of capital will be picked up in the TFP estimates.

Figure 4 shows the dynamics of the utilization-augmented capital stock by sector. In utilization terms, the overall capital stock dropped by about one-third between 1991 and 1997, with industry exhibiting the steepest decline.

[7] In Russian capital accounting (Poletayev, 1997), the rate of growth of the gross fixed capital stock in constant prices equals the difference between "the coefficient of renewal" (the ratio of the value of new facilities created during the year to the capital stock) and "the coefficient of depletion" (the ratio of fixed assets that are depleted during the year to the capital stock). The coefficient of renewal is reported as a share of capital at the end of the year, while the coefficient of depletion is reported as a share of capital at the beginning of the year. These coefficients therefore need to be recalculated uniformly as shares of the capital stock at the end of the previous year.

Figure 4. Russia: Utilization-Augmented Capital Stock, by Sector



Factor Shares

According to the national accounts data, employees' gross wages in Russia amounted, on average, to 45 percent of GDP during 1991–97. This figure probably grossly understates the labor share, since it does not include the compensation of entrepreneurs, self-employed persons, and so on. Indeed, in comparison with adjusted wage shares in Poland and Hungary in the early 1990s—which, according to the IMF data, were close to 70 percent—this number seems to be a substantial underestimation. In view of the questionable quality of the available data, in what follows typical factor shares of 0.7 for labor and 0.3 for capital are assumed.[8] The factor weights are thus estimated under the assumptions of perfect competition and constant returns to scale.

In order to capture changes in relative productivity across sectors, sectoral labor shares were assumed to be proportional to sectoral wage shares, while sectoral capital shares were assumed to be proportional to sectoral output shares in constant prices. This way, the differences in labor remunerations across sectors are taken into account while the capital remuneration is effectively assumed to be

[8] Some justification for this assumption is provided by econometric estimates (not reported here) on a cross-section dataset of Russia's subnational regions. The factor shares were estimated from the Cobb-Douglas production function under the constant-returns-to-scale restriction. While admittedly crude, the exercise yielded the shares of 0.7 for labor and 0.3 for capital.

Table 4. Labor and Capital Income Shares, by Sector

	1992	1993	1994	1995	1996	1997
Industry						
Labor share	0.26	0.23	0.18	0.20	0.20	0.21
Capital share	0.11	0.11	0.10	0.10	0.10	0.10
Agriculture						
Labor share	0.11	0.10	0.08	0.07	0.06	0.06
Capital share	0.05	0.05	0.05	0.05	0.05	0.05
Construction						
Labor share	0.11	0.08	0.06	0.06	0.05	0.04
Capital share	0.02	0.02	0.02	0.02	0.02	0.02
Services						
Labor share	0.22	0.29	0.37	0.37	0.39	0.39
Capital share	0.12	0.12	0.13	0.13	0.14	0.14
Total						
Labor share	0.7	0.7	0.7	0.7	0.7	0.7
Capital share	0.3	0.3	0.3	0.3	0.3	0.3

the same in all sectors.[9] To ensure comparability with the aggregate case, the coefficients of proportionality were scaled so as to preserve the aggregate labor share of 0.7 and the aggregate capital share of 0.3. Table 4 shows that labor income shares in industry, agriculture, and construction declined dramatically, while the share in services significantly increased, over the period.

III. Results

The results of the growth-accounting exercise are shown in Tables 5–7. Table 5 reports the outcome of the basic setup without corrections for factor utilization. In this framework, 82 percent of the output drop is due to a collapse in TFP. The average contribution of labor is 19 percent, while that of officially recorded capital is slightly negative.[10] A sensitivity analysis based on alternative assumptions on factor shares yielded TFP estimates ranging from 79 percent (labor share 0.8, capital share 0.2) to 85 percent (labor share 0.6, capital share 0.4). The TFP estimate is therefore sufficiently robust and, as expected, substantially overstates the actual TFP drop, as is demonstrated below.

Table 6 shows the results of the extended growth-accounting exercise with factor underutilization separated from general productivity effects. On average,

[9]In other words, the share of capital in sectoral output is fixed, while the share of capital in total output is proportional to the sectoral output share. A more accurate accounting for differences in capital shares by sector is not feasible owing to the lack of information.

[10]These results are very similar to those obtained by De Broeck and Koen (2000), who found that the TFP drop accounted for 80 percent of the output decline in Russia between 1991 and 1997.

Table 5. Decomposition of GDP Growth in Basic Framework

(percent)

	1992	1993	1994	1995	1996	1997	Average	Contribution
Output growth	–19.4	–10.4	–11.6	–4.2	–3.4	0.9	–8.0	100
Labor growth	–1.6	–1.2	–2.4	–2.1	–0.4	–1.5	–1.5	19
Capital growth	0.6	0.2	–0.1	0.1	0.0	–0.1	0.1	–1
Total factor productivity	–18.4	–9.4	–9.1	–2.1	–2.9	2.5	–6.6	82

Note: Growth rates of labor and capital are weighted.

Table 6. Decomposition of GDP Growth in Extended Framework

(percent)

	1992	1993	1994	1995	1996	1997	Average	Contribution
Output growth	–19.4	–10.4	–11.6	–4.2	–3.4	0.9	–8.0	100
Labor growth	–3.0	–2.3	–3.8	–1.9	–1.2	–0.1	–2.0	25
Capital growth	–3.8	–2.2	–2.7	–0.9	–0.8	0.1	–1.7	21
Total factor productivity	–12.6	–5.9	–5.1	–1.4	–1.4	0.9	–4.3	53

Note: Growth rates of labor and capital are weighted and utilization augmented.

the drop in aggregate labor accounts for 25 percent, while the drop in aggregate capital accounts for 21 percent, of the output fall, confirming that both factors played an important role in the contraction. The contribution of the productivity drop is substantially reduced but still critical: TFP accounts for 53 percent, which may still be an underestimate if the assumption of constant returns to scale is inaccurate.[11]

A sensitivity analysis conducted in this case included a robustness check on the estimated utilization rate of capital, as well as on the factor-shares assumptions. The sensitivity of the results to alternative estimates of the utilization rate of capital was assessed by using bounds of a 90 percent confidence interval for the regression coefficient in the capital utilization equation.[12] This yielded—for a labor share of 0.6 (0.8) and a capital share of 0.4 (0.2)—TFP estimates ranging from 30 percent (47 percent) at the upper bound for the coefficient to 70 percent (67 percent) at the lower bound for the coefficient. Thus, the failure to account for changes in factor utilization may lead to an overestimation of the TFP contribution by anything between 12 and 55 percentage points.

The sectoral disaggregation produces very similar results (Table 7). The contributions of labor and capital are slightly larger, so that TFP amounts to 50 percent of the average output drop. These findings suggest that the main source of bias in TFP estimation for a transition economy is not aggregation across sectors but the failure to explicitly account for underutilization of factor inputs. The relatively modest impact of factor reallocation shows that this process is sluggish. Interestingly, labor and capital do not tend to be reallocated to more productive uses (as would be signified by their increased contributions).[13] Table 7 shows, however, that the movement of labor and capital into the more productive services sector intensified in the later years covered by this study.

A sensitivity analysis for the disaggregated case included confidence bounds investigations for both capital and labor utilization rates by sector,[14] and alternative assumptions about factor shares. The lowest estimate of 32 percent was obtained when sectoral utilization rates for both labor and capital were calculated using the upper confidence bounds for the respective regression coefficients, and labor and capital shares of 0.6 and 0.4, respectively. The highest estimate of 65 percent was obtained when sectoral-utilization rates for both factors were calculated using the lower confidence bounds for the regression coefficients, and labor

[11]It may be argued that, in fact—at least at most state and former state enterprises, which still comprise the most significant part of the economy—returns to scale are likely to be decreasing, and while returns are probably increasing in the newly emerging private sector, it still constitutes the smaller part of the economy.

[12]The 90 percent confidence interval for the regression coefficient in the capital-utilization equation (7) is $0.75 \pm 1.94 \times 0.26$, or [0.25; 1.25].

[13]This paradox was also obtained by De Broeck and Koen (2000). Note, however, that this result may be sensitive to the assumptions on factor shares by sector.

[14]The 90 percent confidence interval for the regression coefficient in the labor-utilization equation (6) is $0.12 \pm 1.94 \times 0.04$, or [0.05; 0.20]. Note that capital utilization in industry was given, while all the other sectoral utilization rates were estimated from equation (6) for labor and from equation (7) for capital.

Table 7. Decomposition of GDP Growth in Extended Framework with Sectoral Disaggregation

(percent)

	1992	1993	1994	1995	1996	1997	Average	Contribution
Output growth	–19.4	–10.4	–11.6	–4.2	–3.4	0.9	–8.0	100
Labor growth in:								
Industry	–1.7	–1.0	–2.7	–1.5	–1.0	–1.8	–1.6	20
Agriculture	0.2	–0.1	0.0	–0.4	–0.4	–0.5	–0.2	2
Construction	–1.2	–1.1	–0.5	–0.6	–0.4	–0.2	–0.7	8
Services	–0.9	–0.2	–0.1	0.3	1.4	1.2	0.3	–3
Capital growth in:								
Industry	–2.6	–0.8	–0.7	–1.1	–0.5	1.1	–0.8	10
Agriculture	–0.3	–0.2	–0.7	–0.5	–0.3	–0.2	–0.4	4
Construction	–0.6	–0.1	–0.4	–0.1	–0.3	–0.1	–0.3	3
Services	–1.6	–0.7	0.0	–0.1	0.0	0.2	–0.4	5
Total factor productivity	–10.7	–6.1	–6.5	–0.2	–1.9	1.2	–4.0	50

Note: Growth rates of labor and capital are weighted and utilization augmented.

and capital shares of 0.8 and 0.2, respectively. These findings are very similar to those obtained in the aggregated case.

The findings described above make it clear that the standard approach to the analysis of the sources of the output decline substantially overstates the role of total factor productivity when applied to transition economies. Even when adjusted for underutilization of factor inputs, however, the productivity drop remains a very important component of the output collapse during "transition recession."

IV. Conclusion

This paper has analyzed sources of the output fall in Russia during transition prior to the financial crisis of 1998. The standard growth-accounting methodology was extended to explicitly account for underutilization of labor and capital during transition. The factor contributions to output contraction were measured with adjustments reflecting their estimated utilization rates. The results were assessed using robustness checks on utilization rates and factor shares.

The productivity drop was found to account for approximately half of the output fall in Russia, as compared with common estimates of around 80 percent. Although the change in productivity is a major component of the "transition recession," whichever way it is estimated, its contribution is, in fact, comparable to that of factor inputs. The difference is due to the failure to separate the idle parts of labor and capital stock from productive inputs, thus incorrectly attributing a fall in factor utilization to a fall in productivity. This paper provides a framework with which to carry out an explicit accounting for underutilization of factor inputs, which is a distinctive feature of the transition process.

While evaluation of specific policy prescriptions is outside the scope of this study, the analysis presented above does suggest some directions for future policy. It reveals the scope for investment-led growth created by a large portion of Russia's capital stock having become unusable and needing to be replaced by modern equipment. To finance the required investment, development of the financial system will be crucial for mobilizing domestic resources, and regaining the confidence of world capital markets will be necessary for attracting foreign savings. Growth will also be fostered by measures that facilitate further shifts of labor from inefficient state enterprises to new private firms. It is well established in the economic literature that sustainable economic growth must be based on innovation and productivity improvements. Therefore, reversing the downward trend in productivity is of fundamental importance for Russia, and unless this is achieved, any resumption of growth will prove transitory.

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