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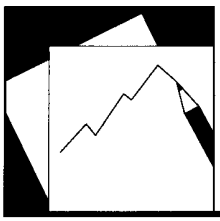

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Russia's Output Collapse and Recovery: Evidence from the Post-Soviet Transition

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Abstract

The health of the Russian economy still depends heavily on natural resource revenues. The history of the economic collapse and recovery in 1970–2004 provides new evidence on the sources of Russian economic growth, while a survey of the economic literature suggests that the Russian economy could be viewed as a weighted combination of virtual and normal forces. If the Russian economy is considered to be dominated by normal market economy forces, higher energy export receipts provide an opportunity for structural reforms while compensating for social costs, making the economy less vulnerable to decline in world energy prices. However, the domination of virtual forces—value transfers from the energy sector to strategic enterprises—suggests that high world energy prices are masking an inefficient manufacturing sector, and that the Russian economy is highly vulnerable to energy price declines.

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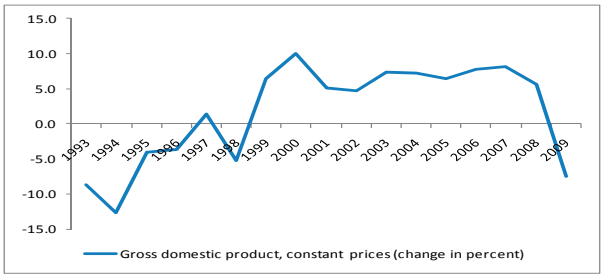
I. INTRODUCTION

The resilience of the Russian economy still depends on what its energy exports earn. Falling prices for oil contributed to the timing of the crisis in 1998 and a steep reduction in output in late 2008 and 2009.[1] President Medvedev in his address to the nation in November 2009 highlighted the need for the Russian economy to modernize away from its dependence on oil and gas exports: "Instead of a primitive economy based on raw materials we will create a smart economy."[2]



A review of the history of economic collapse and recovery from 1970 through 2004 produces possible explanations for why the Russian economy is still vulnerable to declines in world energy prices. There is general agreement that Russia's output collapse in the early 1990s resulted mainly from the disruption of the planned economy,[3] but the subsequent recovery of output is less easily explained. One line of research contends that a market economy based on new institutions allocated resources more efficiently.[4] On this view, Russia is rapidly becoming a "normal" market economy,[5] but that does not square with the fact that enterprises continued to rely heavily on nonmonetary transactions early in the transition. Another school of thought holds that Russia now has a "virtual" economy, in which planners have a reduced but significant role in sustaining complex enterprises through transfers from the energy sector, which avoids the high social and political costs of restructuring.[6] This view contends that central planners have sustained industrial output through transfers financed by high energy prices.

The Russian economy could be viewed as a weighted combination of virtual and normal forces. The two concepts provide an interesting perspective on how increases in world prices for Russia's energy exports might affect the Russian economy. The implications depend on which of the two forces, normal or virtual, dominates. If normal forces are in control, higher energy exports offer an opportunity for structural reforms while compensating for social costs, which would make the Russian economy less vulnerable when energy prices fall. However, if virtual forces are prevailing, high world energy prices in good times mask an

[1] Berglof, Plekhyanov, and Rousso (2009).

[2] Presidential address to the Federal Assembly of the Russian Federation, November 2009.

[3] Blanchard and Kremer (1997); Djankov and Murrell (2002); Eilat, Sachs, and Zinnes (2001): and Brown and Earle (2006).

[4] Gregory and Lazarev (2004).

[5] Shleifer and Treisman (2005): Brown and Earle (2006).

[6] Ericson and Ickes (2000); Linz and Krueger (1998); Hendley et al. (1997) Commander and Mumssen (1998); Calvo and Corricelli (1993); Marin and Schnitzel (2003); and Erickson and Ickes (2000).

inefficient manufacturing sector, which in bad times would make the Russian economy highly vulnerable to falling world energy prices.

This paper presents new evidence on the sources of Russian growth, defines areas of agreement, and identifies questions still unanswered. Section II presents stylized facts about the initial conditions and the transition process in Russia. Section III describes the sources of Russian economic growth in detail. Section IV discusses theoretical explanations for the Russian output collapse and recovery and identifies areas of agreements and unresolved puzzles.

II. Output Collapse and Recovery in Russia, 1970–2004

The disintegration of the Soviet Union and the establishment of the Russian Federation[7] as an independent state marked the beginning of the transition from a planned to a market economy.[8] Before the Cold War ended, the Soviet Union, consisting of 15 republics including Russia, was highly integrated both politically and economically. The state bureaucracy enforced production and delivery of goods to industrial activities that were widely dispersed and specialized regionally across different republics. A nonmonetary inter-enterprise transaction (NMT) system supported this production structure.[9] Price controls and state orders managed economic activities. Every component of the production structure was publicly owned and controlled by the planner. Institutions supporting private sector activities were undeveloped; the few that existed were informal. The transition policy package, designed to change the planned economy to a market one, freed most prices, liberalized trade, introduced a tax system, closed the budget deficit, tightened monetary policy, called for rapid and massive privatization, and liberalized foreign exchange.

The early transitional period in Russia was characterized by a significant drop in output, though output recovered later in the transition. In 1989–98 Russian output contracted by 6.3 percent annually. Devaluation in 1998 provided the substantial boost to the Russian export and import-competing industries[10]. After the 1998 crisis the economy grew at an annual rate of 6.8 percent through 2004. In the period before the transition, 1970–89, output had grown on average only 2.1 percent annually.

After the end of the cold war, disorganization of the planned production systems caused underutilization of production factors and changes in the sectoral composition of the

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[7] Referred to as Russia afterwards.

[8] See Linn (2004); Commander and Mummssen (1998); Gregory and Lazarev (2004); Djankov and Murrell (2002); and Schleifer and Treisman (2005) for discussion of characteristics of the pre-transition Soviet economy.

[9] Commander and Mumssen (1998) explain that offsets and barter were commonly used to clear obligations between groups of firms, firms and the government, firms and utility companies, and utility companies and the government. See also Marin, Dalai, and Schnitzel (2003): Linz and Krueger (1998): and Hendley et al. (1997) for discussions of NMTs.

[10] See Owen and Robinson (2003).

economy. The industrial sector was an engine of Soviet economic growth, and the planner had targeted maximization of industrial capacity. The capital-intensive industrial sector was designed as a complex chain of producers and suppliers linked by infrastructure networks specifically created to support industrial production.[11] Because agriculture, transport, construction, and other sectors did not rely on elaborate production networks, they were far less complex. In the new market reality, sectors like service and trade began to boom, but only part of the Russian industrial sector became competitive. As planned production systems fell apart during the early transition period (1989–98), decline in industrial capital utilization rates accelerated dramatically, reaching -4 percent. However, the next transition stage (1998–2004) was characterized by a fast recovery in capital utilization rates, to an average of 5 percent growth (Table 1). Nevertheless, the industrial sector's share in output declined as the shares of other sectors increased consistently (Table 2).

Table 1. Utilization of Capital and Labor in the Industrial Sector
(average growth rate)

	Labor	Capital
1970-1989	-0.6	-0.8
1989-1998	-0.6	-3.6
1998-2004	2.7	5.1

Table 2. Russia: Sectoral Shares of Output and Employment Share

	Sectoral Shares of Output		Employment Share	
	Industry	All Other Sectors	Industry	All Other Sectors
1970	60	40	32	68
1990	67	33	30	70
1999	61	39	22	78
2004	44	56	22	78

III. GROWTH ACCOUNTING

A growth accounting exercise is useful for understanding the sources of Russian output growth during the Soviet and transition periods. Such an exercise helps us to see how the sources of growth changed with the transition, and how they relate to scholarly understanding of the transition process in Russia and its outcomes. We compare the sources of economic growth for the pre-transition period (1970–89), the early transition period (1989–98), and the late transition period (1998–2004). We also study the effects of sector reallocation on growth. The source of Soviet economic growth had been capital accumulation, which was no longer the case during the transition. Previously industry was the engine of the Soviet economy, but during the transition other sectors of the economy became increasingly important. Theoretical studies have explained some of the changes but have not been able to explain some peculiarities of the Russian transition.

We adjust our growth accounting exercise for factor utilization rates. Following Dolinskaya (2002) and Oomes et al. (2005), we adjust the Cobb-Douglas production function

[11] See Linn (2004) for discussion of the industrial production networks in the Soviet economy.

for utilization rates of capital and labor (u^K, u^L).[12] Otherwise, the standard growth accounting framework misrepresents the sources of growth, particularly when changes in utilization rates are large (Table 1).

$$Y = A\left(u^K K\right)^a \left(u^L L\right)^{1-a} \text{ and } \hat{y}^U = \alpha \hat{k}^U + \hat{A},$$

where $\hat{y}^U$ is growth in output per worker adjusted for utilization, $\hat{k}^U$ is growth of capital per worker adjusted for both capital and labor utilization, and $\hat{A}$ is growth in the total factor productivity (TFP) residual.

We study sectoral decomposition of the sources of growth to see whether reallocation of production factors across sectors contributed significantly to growth in output per worker. A high output share of more productive sectors and reallocation of production factors to relatively high productivity sectors increases aggregate labor productivity. We apply sectoral decomposition to aggregate labor productivity growth to separate sectoral reallocation effects from the sectoral composition effect.[13]

A. Data Sources

The process of transition from a planned to a market economy affected the quality and consistency of official data reporting. An overview of how various sources were used in the literature provides useful input into our growth accounting exercise:[14]

Output: In our growth accounting we use Goskomstat's raw data on real output for 1992–2004 and the data of De Broeck and Koen (2000) for 1970–91. These historical data are not available in Goskomstat publications and the *World Economic Outlook* (WEO) database[15].

Employment: We use the De Broeck and Koen (2000) aggregate and sectoral employment data for 1970–97 and updated this dataset using reported employment levels in the Statistical

[12] It is a common practice in growth accounting to adjust labor input for human capital quality. We have not done that because in Russia the transition process did not cause any significant change in educational attainment (see the UN Human Development Report, 2006).

[13] See detailed description in WEO (2006). Employment shares are denoted by s and sectoral output shares by s^y, sectors are denoted by j. Bosworth and Collins (2007) used a similar approach to show reallocation effects in the growth accounts of India and China. $\hat{y} = \sum_j \hat{s}_j y_j + \sum_j s_j^y \hat{y}_j$

[14] Appendixes A and B provide detailed description of various data sources.

[15] See Appendix B for detailed description and comparisons of various databases.

Yearbooks of Goskomstat for 1998–2004, using the same source for sectoral shares of employment for the same period.[16]

Physical capital: We update the De Broeck dataset on capital stock by extrapolating capital stock levels for 1998–2004 period using growth rates for capital stock reported by Goskomstat; we then use the following formula to extrapolate levels of capital stock:

$$K_t = K_{t-1} * (1 + growth),$$

where growth rates are observed variables from the Goskomstat Statistical Yearbook Goskomstat (2006).[17] Oomes (2005) and Dolinskaya (2002) used the same method, but the method generates imprecision in estimates of capital stock due to rounding errors in the growth rates. A more widely used method for estimating capital stock levels is a perpetual inventory method:

$$K_t = K_{t-1} * (1 - d) + I_t,$$

where K_{t-1} is the initial capital stock, I_t is investment, and d is the depreciation rate. Using this method would require extrapolation of real capital investment levels using the real growth rates in capital investment reported by Goskomstat plus an assumption about the depreciation rate of the capital. Assuming the capital depreciation rate to be constant would not be a valid approach for calculating levels of capital stock in Russia, since the capital stock was dramatically underutilized at the outset of the transition, and rates of capital stock depreciation vary depending on the characteristics of the capital stock and its utilization.

Factor shares*:* We use 0.65 for labor share and 0.35 for capital share. De Broeck and Koen (2000), Dolinskaya (2002), and Oomes et al (2005) use the same assumptions. Factor share studies for a wide range of countries have concluded that the capital share is about 0.3 and the labor share about 0.7 (e.g., Sarel (1997) and Senhadji (1999)). Gollin (2001) disagrees with the common assumption of constant factor shares across time and space. In estimating labor share for 42 countries, he finds some variation, but for most countries they fall in the range of 0.65 to 0.80 percent.

Utilization rates**:** We use the capital utilization rates for the Soviet period reported by Malle (1987) and for the transition period capital and labor utilization rates from Russian Economic Barometer (REB), the Center for Economic Analysis (CEA), and the Institute for the Economy in Transition (IET) to construct a complete data set on factor utilization rates for 1970–2004.[18] We use the trend of industrial factor utilization rates as a proxy for factor

[16] During the Soviet period, enterprises kept no records of the effective number of workers; only attendance was registered. Attending but idle workers were controlled through ad hoc investigations by representatives of the communist party within the enterprise.

[17] Goskomstat, *Statistical Yearbook* (2006), p. 327.

[18] See Appendix B for the complete dataset on annual utilization rates from all three sources. Choice of the data for utilization rates affects levels of factor inputs but not trends and the main conclusions of the growth accounting exercise.

utilization trends in other sectors, and we apply the factor utilization rates observed for the industrial sector to all other sectors of the economy. Oomes et al. (2005) and Dolinskaya (2002) took the same approach. It is difficult to judge how the transition process altered capacity utilization rates for sectors other than the industrial. We could reasonably expect that utilization rates of production inputs for other sectors and the degree of discrepancy may vary depending on the period and the sector. Unfortunately, none of the current surveys on factor utilization rates (see Appendix B) report observations for sectors other than the industrial[19].

B. Growth Accounts Adjusted for Utilization

Investment in capital stock was the main driver of growth in the pretransition period, and TFP was the main driver during the late transition period. The Soviet economy grew because of heavy investment in capital stock. The transition process disrupted the planned production systems, causing underutilization of production factors and a significant decline in productivity. As the transition advanced, productivity started to recover. Early in the transition, a decline in TFP of more than 3 percent was the main reason for the decline in output per worker. In the late transition period, 2.7 percent growth in TFP was driving recovery in output per worker, and capital per worker also recovered (Table 3). Using capital utilization rates from different surveys produces similar conclusions about the sources of Russian economic growth. We present results for REB in the text below, and results from other surveys in Appendix C, Tables A5-A7.

Table 3. Russia: Sources of Growth, Adjusted for Utilization, 1970-2004
(Average Growth Rate)

					Contribution of:	
	Output	Employment	Capital	Output per Worker	Capital per Worker	Factor Productivity
1970-1989	2.1	0.2	4.5	1.9	1.6	0.4
1989-1998	-6.3	-2.5	-3.5	-3.8	-0.4	-3.4
1998-2004	6.8	3.4	5.3	3.4	0.7	2.7

Growth accounting adjusted for utilization tells a strikingly different recovery story than the same exercise without that adjustment. As expected, and similar to the findings of Dolinskaya (2002) and Oomes et al. (2005), the TFP residual is significantly overestimated during the recovery period if there is no adjustment for factor utilization rates (Table 4). Capital per worker recovered by on average of 1.1 percent with the adjustment but there was an almost 1 percent decline without it. Utilization-adjusted TFP had almost 6 percent average growth, which is about half the TFP recovery when it is not adjusted for utilization. Dolinskaya (2002) and Oomes et al. (2005) also find that the TFP residual was overestimated if utilization of production factors is not taken into account.

[19] It is likely that newly emerging non-industrial enterprises had somewhat higher utilization rates than Soviet-style industrial enterprises. If this were the case, the assumption of common utilization rates would potentially bias the results of the growth accounting exercise: the contribution to growth from non-industrial sectors would become more significant, while cross sector reallocation (residual) effects less so.

Table 4. Russia: Sources of Growth, Adjusted and not Adjusted for Utilization, 1970–2004
(Average Growth Rate)

	Output	Employment	Capital	Output per Worker	Contribution of: Capital per Worker	Factor Productivity
Drop 1/						
Adjusted for Utilization	-8.4	-2.7	-8.1	-5.7	-1.9	-3.8
Not Adjusted	-8.4	-2.8	-5.3	-5.6	-0.9	-4.7
Recovery 2/						
Adjusted for Utilization	13.1	5.9	8.8	7.1	1.1	6.1
Not Adjusted	13.1	2.6	0.1	10.4	-0.9	11.4

1/ Difference in average growth rates in Soviet period (1970-1989) and the early transition period (1989–1998).
2/ Difference in average growth rates in the early transition (1989-1998) and in the late transition periods (1998–2004).

C. Reallocation Effects

With the transition, sectors for whose products there was relatively little market demand were expected to shrink and release production factors that could be reallocated to sectors confronting increased demand. Earlier, the planners had determined the sectoral distribution of the Soviet Russian economy. With the transition, as market forces started to shape the Russian economic system the sectoral distribution was expected to align with relative market demand. At the outset of the transition some sectors found themselves producing goods for which there was little demand while others faced higher demand than had been expected. Changes in the shares of different sectors had implications for aggregate economic productivity.[20]

[20] In our growth accounting exercise we do not capture productivity gains or losses generated by factor reallocations between firms within sectors because subsectoral or enterprise level data are not available to us.

Table 5. Russia: Sectoral Sources of Growth, Adjusted for Utilization, 1970–2004
(Average Growth Rate)

	Output	Employment	Capital	Output per Worker	Contribution of: Capital per Worker	Contribution of: Factor Productivity
Industrial Sector						
1970-1989	2.6	-0.1	5.0	2.8	1.9	0.9
1989-1998	-8.4	-6.0	-2.7	-2.4	1.2	-3.6
1998-2004	3.1	3.4	5.4	-0.3	0.8	-1.1
All Other Sectors						
1970-1989	1.2	0.3	4.3	0.8	1.4	-0.6
1989-1998	-3.0	-1.3	-4.0	-1.7	-1.0	-0.7
1998-2004	10.6	3.4	5.2	7.2	0.7	6.5

Transition brought a contraction in the growth of industrial sector output per worker and a boom in all other sectors (Table 5). Pre-transition the Russian industrial sector had been growing more than twice as fast as all other sectors, mainly driven by capital investment. During the early transition industrial TFP declined annually on average 3 percent more than in all other sectors. Industrial output per worker continued to decline during the late transition period but much more slowly, while for all other sectors annual growth in output per worker averaged 7 percent, of which 6.5 percent was contributed by TFP.

Although its growth rates declined during the transition, output per worker in the industrial sector remained much higher than in all other sectors of the Russian economy (Table 6). Labor productivity was three times higher in industry than in all other sectors in 1970 and five times higher in 1990. From 1990 to 1999 labor productivity decreased in every sector, but in industry, it continued to be five times higher than elsewhere in the economy. After 1999, while industrial labor productivity continued to decline, productivity in other sectors rose, so that by 2004 it was again just three times higher in labor than in all the other sectors.

Table 6. Russia: Output per Worker, Adjusted for Utilization
(in 2000 prices, millions of roubles)

	Output per Worker		
	Industry	All Other Sectors	Total
1970	242	76	130
1990	410	86	184
1999	340	63	125
2004	316	114	158

During the early transition period, factor reallocation effects were negative because both productivity growth and the relative share of the industrial sector in the economy plunged. Although the industrial sector was shrinking fast, its productivity was still highest. Thus, production factors released by the industrial sector were being absorbed by sectors with lower productivity, so that contribution to growth from factor reallocation effects was -1.6 percent and decline in industrial output was the most significant contributor to output decline generally (Table 7).[21] The contribution to growth of all other sectors was also negative but less significant because at the beginning of the period their average growth was lower than the industrial sector and their share in output had been only 33 percent.

Table 7. Russia: Growth in Output per worker, Adjusted for Utilization, 1970–2004
(Average Growth Rate)

	Output per Worker			Contribution to Growth		
	Industry	All other sectors	Total	Industry	All other sectors	Reallocation
1970-1989	2.8	0.8	1.9	1.7	0.3	-0.1
1989-1998	-2.4	-1.7	-3.8	-1.6	-0.5	-1.6
1998-2004	-0.3	7.2	3.4	-0.2	2.8	0.8

Later in the transition period, the reallocation effects became positive because of the dramatic increase in all other sectors of both productivity growth and relative share in the economy as the industrial sector continued to shrink and its productivity declined. Production factors released from the shrinking industrial sector were now reallocated to sectors with faster growth in productivity and increasing market share. Sector reallocation effects thus became positive as average output growth per worker exceeded the average growth of industry and all other sectors weighted by their respective output shares at the beginning of the period. High growth in other sectors overcompensated for the negative contribution of the industrial sector. Even though productivity in the industrial sector was still higher than in all other sectors, changes in relative productivity were dramatic: all other sectors doubled their output per worker from 1999 to 2004.

[21] We measure the contribution to growth of the industrial sector and of all other sectors by multiplying average growth in output per worker by the sector's output share at the beginning of each period.

Box 1. Growth Accounting Exercise Findings

- Capital accumulation was driving output growth in the Soviet period, but during the transition TFP was the main contributor to output decline and recovery. Utilization rates of capital and labor declined early in the transition and recovered later.
- The relative distribution of output shares across the industrial and all the other sectors of the economy changed during the transition. If before the transition the capital-intensive complex industrial sector was the engine of Russian economic growth, as the transition accelerated the industrial sector started shrinking fast.
- The industrial sector was the most significant contributor to growth in output per worker into the early transition period; in the late transition the contributions of all other sectors became dominant and overcompensated for the negative contribution to growth of the industrial sector. At first decline in industrial output was driving output collapse, but then growth in other sectors led to output recovery late in the transition.
- With the transition the relative productivity growth of industrial and all other sectors of the economy changed dramatically. Industrial sector productivity continued to sink throughout the transition period; productivity in all other sectors averaged 7 percent growth annually in the late transition period.
- With the transition the effects of factor reallocations across sectors became important. Reallocation effects during the early transition were negative as the industrial sector's share and productivity began falling, but the factors it released went to sectors with low and declining productivity. During the late transition the reallocation effects became positive as productivity and the shares in the economy of all other sectors began to grow. At this point, factors released by the shrinking industrial sector were reallocated to sectors with faster productivity growth and an increasing relative share in the economy.

IV. Explaining the Collapse and Recovery

There is general agreement among scholars that Russia's output collapse in the early 1990s resulted mainly from disruption of the planned economy. A theoretical model of disorganization developed by Blanchard and Kremer (1997) is often used to explain the process of transition from a planned to a market economy.[22] In this model the centralized system of production management disappears, to be replaced by decentralized bargaining between suppliers and buyers of intermediate goods. The model distinguishes two forces driving the disorganization: (1) the planner no longer enforces the production system; and (2) alternative market opportunities make participation in the old production chain no longer attractive to individual firms.

[22] De Broeck and Koen (2000) and Dolinskaya (2002) use this model to explain the collapse of Russian output.

The disorganization model predicts the collapse of the complex production system previously enforced by the planner. The planned production system consisted of many suppliers and buyers linked to each other; if the planner disappears, decentralized bargaining between individual firms emerges. At the same time, if individual firms have alternative market opportunities, exogenously given by the model, it becomes possible to seek contracts outside the old network, which exacerbates the disorganization. Also, if one intermediate producer opts out of the old network, alternative suppliers are difficult to identify, causing the entire network to collapse.

As this model predicted, transition in Russia caused a deeper decline in industrial labor productivity than in other sectors of the economy (Box 1). The industrial sector was characterized by many intermediate producers linked in the network. Because the industrial sector had a very high share in the planned economic system, maximization of industrial capacity was a planning target. Once the planning system was on the way out, industrial capacity maximization targets were no longer relevant; what potentially did become relevant were competitiveness and production efficiency in the new market environment. Because only part of the vast Russian industrial sector passed the competitiveness test, as the disorganization model predicted industrial output collapsed.

The collapse in Russian output could also be explained by the slow organization of private production networks compared to the rapid disorganization of the complex state production networks. At the outset of the transition attractive private opportunities were hard to find because there were few if any institutions supporting private sector development. The private sector took time to become organized. Immediately imposing market economy rules on the planned structure and letting market forces emerge and self-regulate launched mass privatization in Russia in the early 1990s. At the outset of the transition the short-term effects of privatization have been found to be mostly negative, and many privatized enterprises also collapsed.[23] Eilat and Sachs (2001) argue that the speedy transfer of ownership from state to private hands without developing key institutions for the private sector may not have generated gains in economic performance. Basically, the new private owners were expected to make productivity-enhancing decisions and generate a demand for institutions that would help their activities. However, development of institutions conducive to private-sector activities proceeded too slowly. When privatization started, there were no protection of property rights, no ways to enforce contracts, no banking adequacy requirements, and no bankruptcy procedures. Many other essential components of market institutional infrastructure were also missing. Brown and Earle (2006), building on the arguments of Eilat and Sachs (2001), state that privatization works best where property rights are protected and contracts can be enforced. They find that in Russia, the effect of privatization on productivity was increasingly negative until 1998. Djankov and Murrell (2002) argue that ownership also matters. They explore ownership structures of post-privatized enterprises and argue that sales to workers and diffused ownership were more prevalent in the former Soviet countries, including Russia, which may explain poorer post-

[23] See, e.g., Djankov and Murrell (2002); Eilat and Sachs (2001); Brown and Earle (2006); Schleifer and Treisman (2005); and Gregory and Lazarev (2004).

privatization performance than in other parts of Eastern Europe; where foreign investors had a larger share in privatized enterprises, short-term privatization effects were positive.

Growth accounts do not capture factor reallocation from state to private activities within sectors. The private sector share in GDP increased during the transition due to mass privatization early in the process, but there are no data on output and factor inputs in state and private production with which to analyze the implications of factor reallocation for sectoral growth.

Researchers have divergent views on what supported the recovery of Russian output in 1998–2004. Some accept a normal economy concept: the old planner-enforced relationships were broken down, and new market relationships among economic agents were established. Others accept a virtual economy concept: the planning system did not disappear but reorganized itself and started to enforce the complex production chain in a liquidity-constrained environment.

The transition process converges to a normal state when the market is operational and the planner can no longer be said to exist. Disorganization is temporary, ending once planner-enforced production systems are replaced with market ones. Shleifer and Treisman (2005) characterize Russia's current economic state as a normal middle-income democracy that "has probably destroyed enough of the vestiges of central planning to stay a market economy, albeit one with flawed institutions and much counterproductive state intervention."[24] Brown and Earle (2006) posit that the Russian private sector could start to benefit from new market institutions only after those institutions had reached a certain level of development, which happened only after the 1998 crises. The 1998 devaluation also improved trading position of export and import-competing enterprises in general. Djankov and Murell (2002) also find that longer-term effects of privatization have become positive since 1998. Gregory and Lazarev (2004) find that transformations in sectoral composition brought the Russian economic system closer to that of a normal middle-income country.[25]

Some observable irregularities early in the transition, such as reliance of enterprises on NMTs, are less easily explained. One view is that reliance on NMTs caused output collapse because they cause a shortage of cash to enterprises, which was not remedied by credit provision. Calvo and Corricelli (1993) were the first to look into effects of NMTs on enterprise performance in Eastern European countries. They found the reliance of enterprises on the old mechanism of transaction, NMTs, made them less creditworthy and reduced output—in Poland's case by 2 to 6 percent. Their argument holds for the Eastern European countries, where market fabric was much more developed at the beginning of the transition than in Russia. Russian enterprises were just starting to restructure and needed credit to become part of the new market fabric, which was also just being formed. Without cash

[24] Page 27, para 1.

[25] The planner-enforced economic structure was quite different from market-economy structures of similar size. The Soviet economy had more capital-intensive industry and less activity in all other sectors than market economies of a similar size.

injections, enterprises in a market reality could not survive, so collapse of their output is a natural outcome:

$$\text{NMTs} \rightarrow \text{Shortage of cash payments to enterprises} \rightarrow \text{Lack of credit to enterprises} \rightarrow \text{Decline in output}$$

The alternative view is that NMTs temporarily staved off collapse and helped to sustain production when the banking sector was not functioning (Marin & Schnitzel, 2005). Their theory connects the output collapse to surge of NMTs by combining the Calvo and Corricelli (1995) study with the Blanchard and Kremer (1997) disorganization model. Introducing liquidity and credit constraint into the disorganization model, they argue that NMTs sustain the production system when enterprises no longer have injections from the state budget and do not yet have access to credit. Thus, the collapse due to disorganization may not have been as deep as the Blanchard and Kremer (1997) model would predict because NMTs helped to keep the chain of production going without cash injections. A logical extension of this argument is that because of incomplete reforms in the financial sector, enterprises that did not have access to credit could rely on NMTs to sustain production, thus keeping actual decline of output less than it would otherwise have been.[26] Linz and Krueger (1998) in their survey of Russian enterprises find that the increase in NMTs was driven by liquidity constraints, and that firms in machinery and light industry used more NMTs than food producers.

$$\text{Incomplete reforms in the financial sector} \rightarrow \text{Lack of credit to enterprises} \rightarrow \text{Surge in NMTs} \rightarrow \text{Maintain existing production structure} \rightarrow \text{Less deep actual decline in output than there would otherwise have been}$$

NMTs relation to growth is not monotonic. Marin and Schnitzel (2005) used enterprise survey data from Ukraine to explain NMT effects on output growth in Russia. Depending on the share of NMTs in transactions of enterprises, they can have either a positive or a negative effect on growth. NMTs could temporarily remedy shortages of cash and help to avoid disturbance of production, but high reliance on them could worsen enterprise balance sheets and make them less creditworthy. More than 70 percent reliance on NMTs undermined enterprise growth but less than 30 percent reliance promoted growth. For all enterprises, access to credit has a positive effect on output. High-performing firms, those that are growing faster than GDP, use a combination of NMTs and credit effectively. A weakness of this study, however, is that characteristics of Ukrainian firms are directly applied to Russian

[26] Montiel (2003) argues that in order for financial sector openness and reform to result in sustainable growth, the following sequence of reforms may be appropriate: first macroeconomic stabilization; then domestic financial sector reforms; and finally financial opening. In this way a prudently regulated and adequate banking sector could allocate resources to productive rather than speculative activities, thus enhancing the growth of the economy. Macroeconomic stabilization did precede financial opening in Russia but only by a year. Russia adopted an exchange rate peg with a preannounced corridor in 1995 and then in 1996 opened the door to foreign private capital. Because reform of the financial sector was incomplete, the centralized credit system benefited only privileged commercial banks, and few enterprises had any access to credit.

output. Even though Russia and Ukraine have similar economic structures, using data on Russian enterprises would have been more appropriate.

In the virtual economy model, an NMT is a mechanism through which the government preserves the economic structure and may perhaps extract additional surplus through price discrimination. Ericson and Ickes (2000) develop a model of Russia's virtual economy where the government controls the actions of economic agents. The government is reluctant to restructure large manufacturing enterprises because that has high social and political costs, given the regional concentration of large enterprises and the social development network built around them that supports local communities. These enterprises are usually referred to as "strategic." Manufacturing enterprises are price-takers; the energy sector (e.g., Gasprom) is a monopolist that uses price discrimination in supplying energy to manufacturers. Some pay cash for energy and others pay a below-market virtual price by using NMTs. Strategic enterprises have an incentive to make their production appear viable to avoid costly restructuring. One way to do so is to keep prices of the main input, energy, below the market. The state does not issue these enterprises direct energy subsidies but instead pressures the energy sector to use an NMT price, virtual below-market pricing, for these enterprises, while other domestic enterprises and importers of Russian energy pay in cash.[27] The state has almost unlimited options for punishing an energy supplier that does not cooperate, from a change of management to denial of access to export markets.

In this model, the energy monopoly's selection of the value of exports is constrained by the need for transfers to strategic enterprises. The energy monopoly maximizes revenues generated from hard-currency exports traded at world market price, domestic sales for cash, and domestic sales at a virtual/NMT price by choosing the volumes of energy it will trade at virtual and at market prices. The virtual economy hypothesis assumes that world prices apply to Russia's energy exports, and the government controls the energy monopoly's choice of volumes for virtual and normal market transactions by controlling the monopoly's access to export markets. The energy sector maintains its profitability with price discrimination. In choosing how much energy to supply to strategic enterprises at virtual prices, the sector sets the market price for other energy consumers. Thus, consumers of Russian energy that make monetary payments are penalized with a higher price than strategic enterprises that pay in NMTs. That is why reliance on NMTs makes strategic enterprises reluctant to restructure.[28]

The virtual economy provides an interesting context for analyzing the implications of world energy price variations for the Russian economy at large. When prices for Russian energy exports are high, value transfers to strategic enterprises are abundant, which helps to sustain economic performance generally. It is reasonable to assume that sustaining the operating capital of strategic enterprises becomes increasingly inefficient as they

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[27] Large enterprises were built in remote regions, without consideration of transportation costs, primarily to create jobs there. Usually, health care, school, and other social development programs were built around them to support local communities. Restructuring these enterprises would thus have implied restructuring the social infrastructure of the region, which would have been costly in terms not only of livelihood but also of political stability.

[28] Hendley et al. (1997); Linz and Krueger (1998).

continuously delay their restructuring. Facing an increasing need for value transfer to strategic enterprises, the state could charge foreigners more for its energy exports, especially when Russia controls the pipeline systems in neighboring countries. A higher price paid by foreigners for energy indirectly subsidizes strategic enterprises that have failed to restructure, which then have even less incentive to restructure. A decline in prices for energy exports would reduce value transfers to strategic enterprises and undermine their economic performance.

V. CONCLUSIONS

The sources of growth show that capital accumulation was driving output growth in the Soviet period and TFP was the main contributor to output decline and recovery during the transition. If before the transition the capital-intensive industrial sector was the engine of Russian economic growth, as the transition accelerated the contribution of all other sectors became dominant, overcompensating for industry's negative contribution to growth. With the transition, the effects on growth from factor reallocation across sectors became important. Reallocation effects during the early transition were negative: industrial share and productivity declined fast, and the factors this released were reallocated to sectors with low and declining productivity. Late in the transition, reallocation effects became positive due to a dramatic increase in the productivity and share in the economy of all other sectors. Factors released from the shrinking industrial sector were reallocated to sectors with faster productivity growth and an increasing relative share in the economy.

The disorganization model could explain some aspects of the collapse. As the model would predict, growth accounts show that collapse in the industrial sector was more prominent than in all other sectors of the economy, driving the collapse of the entire Russian economy. However, it is unclear how far the disorganization process has gone in replacing the planned mechanism with market mechanisms.

There are divergent explanations for the recovery of the Russian economy. Some researchers believe that Russia converged to a normal middle-income market economy as the disorganization of the state sector ended and the market developed. Others think that Russia may have become a virtual economy where the planner sustains the existing production system without restructuring by providing enterprises with a value transfer from the energy sector. The virtual economy came into existence because economic agents that were responding to financial and liquidity constraints during the transition continued to rely on NMTs to settle inter-enterprise obligations and avoid restructuring, thus buffering the output collapse and making it shallower than it would otherwise have been. The planner has no incentive to restructure certain strategic enterprises because the social and political costs are high, and so uses the energy sector for value transfers to these enterprises to sustain their output. Recovery of Russian output since 1998 could have been stimulated by an instantaneous increase in value transfers to strategic enterprises due to higher world prices for Russia's energy exports.

The present Russian economy could be viewed as a hybrid economy with both virtual and normal elements. The direction in which the economy evolves will depend on which path dominates future development. The virtual economy concept could provide an

interesting context for analyzing the implications of energy price variations for Russian output. High prices for Russian energy exports could increase value transfers and sustain Russia's production system without restructuring, producing continued high growth performance on the virtual path. In the latter case, the Russian economy could be highly vulnerable to a drop in world energy prices. On the other hand, if Russia follows the normal economy path it could take advantage of wealth accumulated through energy exports and finance restructuring of enterprises using energy profits as a social cushion.

Future research could provide enough evidence to support or deny normal and virtual economy concepts. This paper suggests some indirect evidence for both views. To systematically evaluate predictions of the normal economy line of thought by using the growth accounting framework would depend on data on output and factor inputs in the public and private sectors that is not currently available. If we observe that the negative contribution of the state at the outset of the transition was replaced with increasingly positive contributions of the private sector, we would have evidential support for the normal economy line of thought. Comparing sources of growth in the energy and manufacturing subsectors and studying reallocation effects between them could help to quantify the virtual hypothesis. Studying energy-sector's quasi-fiscal deficits could help understandings of virtual hypothesis. More detailed data on NMTs between the energy and manufacturing sectors would be necessary to fully prove or deny the virtual aspect of the Russian economy.

Appendix A. Data Sources

Output: The primary source of Russian real output series is State Statistical Agency of Russia (Goskomstat). The IMF World Economic Outlook (WEO), De Broeck and Koen (2000), Dolinskaya (2002), and Oomes et al. (2005) use output data reported by Goskomstat in their papers. The WEO dataset is the most complete, with series on Russian real output for 1992–2004. Oomes et al. (2005) have a series on real output levels for 1995–2004 in 2000 prices. A comparison of real output and growth rates for this period shows that the Oomes et al. dataset is an extraction from the WEO database, which has a longer time series.

Table A1. Russia: Output Growth, 1970-2004
(average growth rate)

	Output	
	Sources: De Broeck 1970-1991 Goskomstat 1992-2004	Sources: De Broeck 1970-1997 Goskomstat 1998-2004
1970-1989	2.1	2.1
1989-1998	-6.3	-6.1
1998-2004	6.8	6.6

Source: Goskomstat, De Broeck (2000) and own estimations.

The De Broeck and Koen (2000) dataset contains observations for 1970–1997, measured in 1973 prices, for five sectors: industry, agriculture, construction, transportation, and other sectors. De Broeck and Koen constructed the dataset on output levels for the transition period using the real growth rates published by Goskomstat.[29] There are two weaknesses with the De Broeck and Koen data: (1) The dataset has not been updated since 2000; its real output growth rates for 1993, 1994, and 1995 were different from those currently reported by Goskomstat; (2) Instead of using the underlying raw data on output, De Broeck and Koen used real GDP growth rates reported by Goskomstat to extrapolate levels of output: $Y_t = Y_{t-1} * (1 + growth)$.

Using growth rates to generate data on output has limitations. Applying output growth rates that are reported with one decimal point precision to base year output that is denominated in billions of rubles generates variation in the estimates of output once the base effect is carried to subsequent years. If the rounding errors persist, imprecision in the output calculations will increase for each subsequent year. We observe that on average the database that relies more on data from De Broeck and Koen (2000) (column 2, Table A1) suggests a 0.2 percent higher recovery in the late transition period and a 0.2 percent lower decline in the early transition period.

Goskomstat does not report sectoral levels of real output; the De Broeck and Koen dataset contains observations on sectoral real outputs for 1970–1997. We construct sectoral output levels as follows: first, we update the De Broeck and Koen (2000) levels for 1998–2004 using the real sectoral output growth rates reported by Goskomstat. Then we derive sectoral output shares for each year. Finally, we apply these shares to the total output levels derived using the Goskomstat data for 1992–2004 and De Broeck and Koen data for 1970–1991 period (column 1, Table A1). The sectoral output calculations are subject to imprecision due to rounding errors in sectoral real growth rates.

[29] De Broeck and Koen (2000), Appendix I, p. 25, para. 3.

The standard way to calculate real output is to use official data on nominal output and apply an output deflator. The technical annex to the national accounts chapter of the Goskomstat *Statistical Yearbook* (2006) explains that sectoral real output growth series are constructed by using the sectoral output deflators. The technical annex recognizes imprecision in derivations of sectoral output deflators for the Soviet period with controlled prices, the early transition period with price liberalization and three-digit inflation, and the late transition period.[30]

Data Sources:	
Output	1992–2004: Data on real output levels is downloadable from the IMF WEO database. 1970–1997: De Broeck (2000) database downloadable from http://ddcn.prowebis.com/. 1998–2004: Data on output growth rates can be downloaded directly from Goskomstat web-page http://www.gks.ru. Complete datasets are published in *Statistical Yearbooks* (Российский статистический ежегодник) of Goskomstat.
Capital	1970–1997: De Broeck (2000) database downloadable from http://ddcn.prowebis.com/. 1998–2004: Data on capital growth rates, aggregate and sectoral, is published in the Goskomstat *Statistical Yearbooks* (Российский статистический ежегодник) of Goskomstat, pp. 320–330 (depending on the year of publication). These data are not directly downloadable from the Goskomstat web page.
Labor	1970–1997: De Broeck (2000) database downloadable from http://ddcn.prowebis.com/. 1998–2004: Data on employment, including sectoral shares, can be downloaded directly from Goskomstat, http://www.gks.ru. Complete datasets on employment are published in the *Statistical Yearbooks* (Российский статистический ежегодник).
Utilization Rates	Observations on capital utilization rates for 1970–1983 period are available from Silvana Malle, 1987, "Capital Utilization and the Shift Coefficient of the Soviet Planning," *Economics of Planning*, Vol. 21, p. 81, Table 7. Capital utilization rates for 1992–2006 are published in the *Russian Economic Barometer*, Vol. XVI, No. 1, 2007, p. 30, downloadable from http://site.securities.com. Labor utilization rates for 1994–2006 are published in the *Russian Economic Barometer*, Vol. XVI, No. 1, 2007, p. 31, downloadable from http://site.securities.com.

[30] *Statistical Yearbook* (2006), p. 331.

Appendix B. Capital and Labor Utilization Rates

The dataset on factor utilization rates for 1970–2004 was constructed using capital utilization rates reported by various sources: Malle (1987), *Russian Economic Barometer* (REB), the Center for Economic Analysis (CEA), and the Institute for the Economy in Transition (IET). The REB, IET, and CEA surveys of factor utilization rates discussed below started in the early transition period so give no information on rates during the Soviet period. Malle (1987) reports official Soviet statistics on capital utilization for 1970, 1975, 1978, 1980, 1982, and 1983. For years with no raw data, we used a simple linear interpolation method to connect the closest observation points. Data on labor utilization rates for the Soviet period are not available because enterprises kept no records on effective numbers of workers.[31]

Our baseline assumption is that capital utilization equals labor utilization for 1970–1983. Capital and labor utilization rates were not equal in the transition period, and it is reasonable to assume that during the Soviet period the rates also differed. But data limitations do not allow us to use a better proxy for labor utilization during the Soviet period than the capital utilization rates reported by Malle (1987). The raw data as reported by Malle (1987), REB, CEA, and IET are shaded in Table A2.

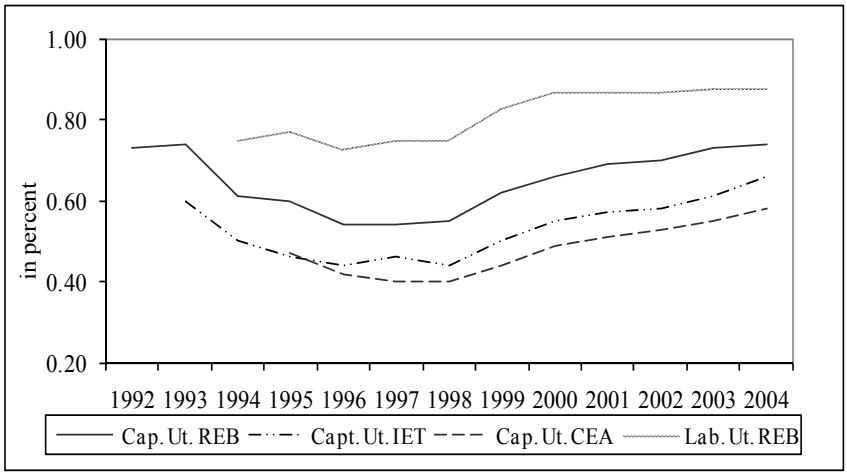
Table A2. Russia. Utilization Rates of Capital and Labor for the Industrial Sector (in Percent)

	Labor	Capital, REB	Capital, IET	Capital, CEA
1970	0.90	0.90	0.90	0.90
1971	0.90	0.90	0.90	0.90
1972	0.91	0.91	0.91	0.91
1973	0.91	0.91	0.91	0.91
1974	0.91	0.91	0.91	0.91
1975	0.92	0.92	0.92	0.92
1976	0.91	0.91	0.91	0.91
1977	0.91	0.91	0.91	0.91
1978	0.90	0.90	0.90	0.90
1979	0.89	0.89	0.89	0.89
1980	0.87	0.87	0.87	0.87
1981	0.86	0.86	0.86	0.86
1982	0.84	0.84	0.84	0.84
1983	0.85	0.85	0.85	0.85
1984	0.83	0.83	0.82	0.81
1985	0.83	0.82	0.79	0.78
1986	0.82	0.80	0.77	0.75
1987	0.81	0.79	0.75	0.72
1988	0.80	0.78	0.72	0.69
1989	0.79	0.77	0.70	0.66
1990	0.78	0.75	0.67	0.63
1991	0.78	0.74	0.65	0.59
1992	0.77	0.73	0.62	0.56
1993	0.76	0.74	0.60	0.53
1994	0.75	0.61	0.50	0.50
1995	0.77	0.60	0.46	0.47
1996	0.73	0.54	0.44	0.42
1997	0.75	0.54	0.46	0.40
1998	0.75	0.55	0.44	0.40
1999	0.83	0.62	0.50	0.44
2000	0.87	0.66	0.55	0.49
2001	0.87	0.69	0.57	0.51
2002	0.87	0.70	0.58	0.53
2003	0.88	0.73	0.61	0.55
2004	0.88	0.74	0.66	0.58

Source: REB, IET, CEA and Malle (1987)

[31] Malle (1987).

Though the surveys suggest different levels of capital utilization, they show a similar pattern. Three different sources report capital utilization rates for Russian industrial enterprises. The REB is the only source that also reports labor utilization rates. It also reports higher levels of capital utilization than the other surveys. Decline in capital utilization was much deeper and recovery faster than decline in labor utilization. After collapsing by nearly half in the mid-1990s, capital utilization rates quickly rose to 74 percent in 2004. Labor utilization has improved from 75 percent in the mid-1990s but since 2000 has flattened out at about 86 percent. That may be the natural rate of labor utilization for the Russian economy (see Oomes et al., 2005).



One explanation of the differences between surveys is that they have different sample distribution across small, medium, and large enterprises. The REB survey has the most small and medium-size enterprises, IET relies more on larger enterprises (Table A3), and CEA on older enterprises. Considering the official data on the size distribution of industrial enterprises for 2003, REB may be over-representing small enterprises and IET large ones.[32] The CEA sample is closest to the official distribution, but it is the only survey that has not been updated regularly since 1995, and the fact that its sample distribution is very close to the official data reported in 2003 may imply that the official data are not updated regularly either.[33] If data on changes in sample size distributions over the years were available, we might be able to form a better judgment on how biased the different surveys are.

Table A3. Russia: Sample Size Distribution of Russian Industrial Enterprises, 2003
(in percent)

	Population 1/	IET	REB	CEA
Small (< 500 employees)	38	9	58	33
Medium (500-1000 employees)	18	17	20	23
Large (> 1000 employees)	44	74	22	44
Total	100	100	100	100

Source: Oomes et al (2005)

1/ Total set of registered industrial enterprises, Goskomstat

[32] Oomes et al. (2005), p. 29, para. 22.

[33] See Oomes et al. (2005) for more detailed description of the surveys.

Table A4. Sources, Samples, and Data on Capital and Labor Utilization Rates

Source	Sample	Data
The Institute for the Economy in Transition (IET)	The sample: 1,200 industrial enterprises: 9 percent small enterprises and 74 percent large. The sample is updated monthly to replace up to 50 closed and nonresponding enterprises. Response rate is 65–70 percent. Disadvantage: Large enterprises may be over-represented.	Quarterly capital utilization rates for the industrial sector since 1992
Russian Economic Barometer (REB)	The sample: 1,000 enterprises randomly selected from the list of registered enterprises (30,000–40,000); 58 percent small enterprises and 22 percent large. Response rate is 50 percent. Disadvantage: Small enterprises may be over-represented.	Quarterly capital utilization rates for the industrial sector since 1991 and labor utilization rates since 1994
The Center for Economic Analysis (CEA)	The sample: 1,400 industrial enterprises, 33 percent small enterprises in the sample and 44 percent large. The sample is not updated systematically. The response rate is 85 percent. Disadvantage: Old enterprises may be over-represented due to insufficient updating.	Monthly capital utilization rates for the industrial sector since 1993

Appendix C. Growth Accounts Using Different Surveys

Table A5. Russia: Sources of Growth, Adjusted for Utilization, 1970-2004
(Average Growth Rate)

	Output	Employment	Capital	Output per Worker	Contribution of: Capital per Worker	Factor Productivity
REB						
1970-1989	2.1	0.2	4.5	1.9	1.6	0.4
1989-1998	-6.3	-2.5	-3.5	-3.8	-0.4	-3.4
1998-2004	6.8	3.4	5.3	3.4	0.7	2.7
IET						
1970-1989	2.1	0.2	4.0	1.9	1.4	0.6
1989-1998	-6.3	-2.5	-4.9	-3.8	-0.8	-2.9
1998-2004	6.8	3.4	7.2	3.4	1.4	1.9
CEA						
1970-1989	2.1	0.2	3.7	1.9	1.3	0.7
1989-1998	-6.3	-2.5	-5.3	-3.8	-1.0	-2.8
1998-2004	6.8	3.4	6.6	3.4	1.2	2.2

Source: Goskomstat, De Broeck (2000) and author's estimations.

Table A6. Russia: Sources of Growth, Adjusted and not Adjusted for Utilization, 1970-2004
(Average Growth Rate)

	Output	Employment	Capital	Output per Worker	Contribution of: Capital per Worker	Factor Productivity
Drop 1/						
Adjusted for Utilization						
REB	-8.4	-2.7	-8.1	-5.7	-1.9	-3.8
IET	-8.4	-2.7	-8.9	-5.7	-2.2	-3.5
CEA	-8.4	-2.7	-8.9	-5.7	-2.2	-3.4
Not Adjusted	-8.4	-2.8	-5.3	-5.6	-0.9	-4.7
Recovery 2/						
Adjusted for Utilization						
REB	13.1	5.9	8.8	7.1	1.1	6.1
IET	13.1	5.9	12.1	7.1	2.3	4.9
CEA	13.1	5.9	11.8	7.1	2.2	5.0
Not Adjusted	13.1	2.6	0.1	10.4	-0.9	11.4

Source: Goskomstat, De Broeck (2000) and author's estimations.

1/ Difference in average growth rates in Soviet period (1970-1989) and the early transition period (1989-1998).

2/ Difference in average growth rates in the early transition (1989-1998) and in the late transition periods (1998-2004).

Table A7. Russia: Sectoral Sources of Growth, Adjusted for Utilization, 1970-2004

(Average Growth Rate)

	Output	Employment	Capital	Output per Worker	Contribution of: Capital per Worker	Factor Productivity
Industrial Sector						
1970-1989	2.6	-0.1	5.0	2.8	1.9	0.9
1989-1998	-8.4	-6.0	-2.7	-2.4	1.2	-3.6
1998-2004	3.1	3.4	5.4	-0.3	0.8	-1.1
All Other Sectors						
1970-1989	1.2	0.3	4.3	0.8	1.4	-0.6
1989-1998	-3.0	-1.3	-4.0	-1.7	-1.0	-0.7
1998-2004	10.6	3.4	5.2	7.2	0.7	6.5
			IET			
Industrial Sector						
1970-1989	2.6	-0.1	4.5	2.8	1.7	1.1
1989-1998	-8.4	-6.0	-4.1	-2.4	0.7	-3.1
1998-2004	3.1	3.4	7.4	-0.3	1.5	-1.8
All Other Sectors						
1970-1989	1.2	0.3	3.7	0.8	1.2	-0.4
1989-1998	-3.0	-1.3	-5.3	-1.7	-1.4	-0.2
1998-2004	10.6	3.4	7.1	7.2	1.4	5.8
			CEA			
Industrial Sector						
1970-1989	2.6	-0.1	4.2	2.8	1.5	1.2
1989-1998	-8.4	-6.0	-4.5	-2.4	0.5	-2.9
1998-2004	3.1	3.4	6.8	-0.3	1.3	-1.6
All Other Sectors						
1970-1989	1.2	0.3	3.4	0.8	1.1	-0.3
1989-1998	-3.0	-1.3	-5.7	-1.7	-1.6	-0.1
1998-2004	10.6	3.4	6.5	7.2	1.2	6.0

Source: De Broeck (2000), Oomes (2005), Goskomstat and author's estimations.

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