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Growth in Russia's federal districts, 1994–2003

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Russian macroeconomic growth in the transition era is analysed across federal districts using a neoclassical production function often found in studies of Soviet-era economic growth. An adjusted capital stock series for Russian regions is created and used in the aggregate production function for 1995–2003 to analyse growth across the 11 federal districts in Russia. Federal district output growth is found to be explained well by neoclassical growth theory, indicating that poorer regions may converge to richer regions, thereby strengthening the Russian Federation. Federal districts also have high capital/labour ratios, suggesting that expanded regional domestic and foreign investment across Russia in the future will enhance growth.

While economic growth in the former Soviet Union (FSU) was often measured using Solow's standard growth accounting framework, the growth of the individual 15 former Soviet republics was analysed to a much lesser degree. With the collapse of the Soviet Union, studies of the 15 newly independent former republics have increased but rarely use the production function framework employed to measure Soviet economic growth with few exceptions (e.g. Kushnirsky 2001). Recent work by Izyumov and Vahaly (2008) expands this literature and provides an adjusted capital stock series for each of the 15 former Soviet republics for 1991–2005 in the spirit of 'adjusted' net national product series developed by Bergson (e.g. Bergson 1989) and others during the Soviet era. Their work also adds to aggregate capital stock estimates used to compare market and planned economies (Moroney and Lovell 1997) as well as many countries with their institutions (Adkins *et al.* 2002). While some scholars believe the lack of regional capital stock data requires other methods to examine regional growth in a transition country (e.g. Ahrend 2005, 2008), adjusted regional capital stock data exist for large transition economies such as China (Wang and Szirmai 2008) and have been found to be useful in examining regional growth there (e.g. Perkins and Rawski 2008). Though analysis of Russia's regions has considered shock therapy vs. gradualism (Popov 2000, 2007) and inequality (Dolinskaya 2002, Solanko 2008), a production function approach to regional growth has been hampered by the lack of regional aggregate capital stock series, which is a problem not unique to Russia.

The purpose of this article is to create an adjusted capital stock series for Russia's regions and to examine federal district economic growth using the production function method that has been used for decades at the Russian national/republic level (Weitzman

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1970, Bairam 1987), single regions and raiony (e.g. Brock 1993, 2002) and even within a single city (Brock 1995) in the FSU.

Administrative areas above the level of the 89 'subjects of the federation' or simply 'regions' have a long history in Russia. Khruschev implemented a *sovnarkhoz* reform in the late 1950s in an attempt to go around the vertical line ministries by empowering some regions more than others. With his ouster, regions (*oblasti, kraya*, republics) lost importance until the late 1990s when presidential representatives were assigned to oversee federal districts (FD), in part to better control elected regional governors who had increased regional power. Until recently, Russian statistical handbooks divided Russia into these 11 federal districts – North, North-west, Centre, Volga-Vyatka, Central Black Earth, Volga, North Caucasus, Urals, West Siberia, East Siberia and Far East. Cut off from the rest of Russia, Kaliningrad *oblast'* is listed separately but placed in the North-west district. These federal districts were merged again for political reasons into seven federal *okruga* by President Putin, though by now the regional governor issue is resolved by appointing rather than allowing elections for the post. We will use the older, 11 districts plus Kaliningrad division as this allows historical comparison and more detail.

When the adjusted regional capital stock data are aggregated at the FD level and compared with Soviet era data on FD capital stocks over a 30 year period, the FD capital shares remain fairly constant except for two shifts toward energy rich Western Siberia, in the late 1970s and around 2000 (Table 1).[1] Despite foreign direct investment (FDI) and domestic investment, the FD capital stock shares' consistency suggests that the Soviet-era macro economy has not fundamentally restructured away from energy sector-led growth.

Table 1. Regional captital stock shares.

Eral district	1972	1985	1990	1991	1992	1993	1994	1995
North-west	11.1%	11.2%	10.9%	10.9%	10.8%	11.2%	10.3%	9.6%
Centre	17.0%	18.2%	17.7%	17.6%	17.5%	18.5%	16.7%	15.1%
Volga-Vyatka	4.5%	4.9%	4.9%	4.9%	4.6%	4.4%	4.6%	4.4%
Central Black Earth	4.1%	4.9%	4.7%	4.7%	4.9%	4.6%	5.4%	4.2%
Volga	16.7%	11.6%	11.4%	11.4%	10.9%	10.8%	10.8%	11.8%
North Caucasus	7.1%	8.4%	8.3%	7.9%	7.9%	7.7%	7.5%	4.8%
Urals	15.7%	13.7%	13.4%	13.2%	13.3%	13.3%	13.5%	16.8%
West Siberia	9.7%	12.3%	14.4%	14.7%	15.7%	15.2%	16.6%	17.8%
East Siberia	8.1%	7.1%	7.0%	6.9%	6.8%	6.5%	7.5%	8.7%
Far East	6.1%	7.3%	7.5%	7.3%	7.0%	7.1%	6.7%	6.4%
	1996	1997	1998	1999	2000	2001	2002	2003
North-west	10.8%	10.4%	10.4%	10.6%	10.2%	9.7%	10.2%	10.7%
Centre	18.7%	19.2%	20.5%	21.4%	20.4%	19.9%	19.6%	21.9%
Volga-Vyatka	4.7%	4.7%	4.7%	4.7%	4.4%	4.1%	4.3%	4.0%
Central Black Earth	5.3%	5.0%	4.9%	4.9%	4.6%	4.3%	4.2%	4.0%
Volga	11.6%	11.0%	11.1%	11.1%	11.1%	10.5%	10.7%	10.6%
North Caucasus	7.5%	8.2%	8.0%	7.7%	8.2%	7.7%	7.4%	7.0%
Urals	13.9%	13.7%	13.4%	13.6%	13.5%	13.2%	13.2%	12.5%
West Siberia	13.9%	14.0%	14.6%	13.1%	14.7%	18.3%	18.8%	17.5%
East Siberia	6.9%	7.0%	6.8%	6.5%	6.2%	6.0%	6.1%	5.7%
Far East	6.8%	6.7%	6.1%	6.5%	6.6%	6.2%	5.7%	5.9%

Note: No estimate for Kaliningrad *oblast*' capital stock is available for 1972 so this region is excluded. In this table the North-west FD includes the North FD.
Sources: Gillula (19981, p. 18), Regions of Russia, Goskomstat (various years).

These data support the idea that there was and perhaps still is little overall technological progress in the Russian economy, perhaps owing to institutional factors locked in from the planned economy era (e.g. Narula and Jormanainen 2008) or simply procrastination because of temporarily high energy prices until very recently.

The first section describes the input/output data. Next we outline the production function methods. Then we discuss the results. The final section concludes.

The data

The capital stock series begins with the all-Russia capital stock series presented in Izyumov and Vahaly (2008). They adjust the official capital stock series for inflation and depreciation using investment flows. We take their annual adjusted all-Russia capital stock number in a given year and create region-by-region capital stock numbers for that year by using the official *oblast'* capital stock *shares* reported by Rosstat (Regionii Rossii various years) to approximate the true but unknown regional capital stock. A similar approach is adopted by Moroney (1990) at a more aggregate level for the USSR to adjust for inflation and depreciation in the series. The use of such an adjusted series is similar to the US experience, where capital stock series for individual states also require various assumptions and adjustments as no official series exist. Once the US series were developed, state level economic growth analysis using an aggregate production function was possible (e.g. Holtz-Eakin 1993, Crain and Lee 1999, Mulligan and Sala-i-Martin 2000, Sharma *et al.* 2007). Derived physical capital stock data are also used in the general economic growth literature with a relatively new series for countries developed by Dhareshwar and Nehru (1993) being widely cited (e.g. Benhabib and Spiegel 1997).

Unlike these country studies, a region by region capital stock series for Russia needs only to be calculated back to 1994 as regional output series for Russia (gross regional product, GRP) are available only from 1994.[2] The GRP data series are adjusted for inflation using the official regional consumer price index series which, because of Soviet-era pricing controls, is also available only back to the early 1990s. The labour input is the number of economically active workers series found in the regional data handbooks of Roskomstat. The three series can then be used as inputs and output in a traditional production function analysis.

As regional output growth in the transition era has been well studied (e.g. Popov 2000), along with the impact of the declining population and labour force (e.g. Andrienko and Guriev 2004), we focus immediately on describing regional (*oblast')* capital stock growth. Dividing the overall time period (1995–2003) into an early (1995–98) and a late (1999–2003) period separates the data at the natural break of the 1998 financial crisis. Capital stock growth was generally negative in both shorter periods as well as overall across federal districts and the nation (Table 2). The North, North-west, Volga-Vyatka, Central Black Earth, Volga, Urals, East Siberia and Far East FDs and Kaliningrad *oblast'* had consistently negative growth. The Centre, North Caucasus and West Siberia FDs had at least one period with positive growth, but only the Centre had positive growth overall. These descriptive results are not surprising given that the Centre includes Moscow city and Moscow *oblast'*, which received most foreign and domestic investment during this period. Only these two regions have consistently positive capital stock growth. West Siberia and to a lesser extent the North Caucasus are important militarily and with energy resources, which are the two biggest investment sectors. The Tyumen region swings from negative to positive by a huge 20%, reflecting the immense importance of the oil and gas industry in this large region. Interestingly, El'tsin's home region of Sverdlovsk has positive capital

Table 2. Average annual growth of capital, labour and output, 1995–2003.

	Capital stock			Labour			Output (GRP)		
	1995–98	1999–2003	1995–2003	1995–98	1999–2003	1995–2003	1995–98	1999–2003	1995–2003
Russia	**−1.35**	**−1.60**	**−1.49**	**−1.16**	**1.43**	**0.28**	**14.16**	**7.64**	**10.54**
North	**−3.63**	**−0.99**	**−2.16**	**−2.22**	**0.10**	**−0.93**	**10.14**	**5.52**	**7.57**
Karelia	−5.87	−3.32	−4.46	−0.94	0.01	−0.41	5.06	7.63	6.49
Komi	0.94	0.23	0.55	−3.51	0.04	−1.54	12.31	2.85	7.06
Arkhangelsk	−1.89	−0.24	−0.97	−2.10	0.34	−0.75	9.96	8.46	9.13
Vologda	−6.15	0.47	−2.47	−0.92	0.62	−0.06	9.78	10.28	10.06
Murmansk	−6.74	−3.51	−4.95	−3.33	−0.73	−1.89	10.70	−2.35	3.45
North-West	**−0.47**	**−1.13**	**−0.84**	**−1.05**	**1.35**	**0.28**	**17.60**	**8.44**	**12.51**
St Petersburg	−0.91	−0.52	−0.69	−1.24	1.60	0.34	18.87	7.94	12.80
Leningrad	1.63	−0.67	0.35	−0.71	1.47	0.50	15.36	10.79	12.82
Novgorod	−3.86	−2.26	−2.97	−0.12	0.50	0.23	17.17	6.44	11.21
Pskov	0.04	−5.73	−3.16	−1.49	0.21	−0.55	9.76	9.24	9.47
Centre	**3.76**	**−0.27**	**1.52**	**−0.92**	**2.08**	**0.75**	**18.33**	**9.54**	**13.45**
Bryansk	4.59	−9.00	−2.96	−1.69	0.71	−0.36	6.77	4.25	5.37
Vladimir	0.92	−5.04	−2.39	−1.96	0.95	−0.34	9.44	4.96	6.95
Ivanovo	−4.40	−6.44	−5.54	−1.79	−0.49	−1.06	6.53	3.55	4.87
Kaluga	3.08	−5.24	−1.54	−1.95	1.65	0.05	6.52	7.49	7.06
Kostroma	3.22	−3.52	−0.53	−1.71	0.33	−0.58	9.75	1.62	5.23
Moscow	7.35	2.98	4.92	1.03	3.88	2.61	22.96	11.90	16.81
Moscow oblast	2.39	1.18	1.72	−1.73	2.04	0.37	19.19	4.70	11.14
Orel	−9.23	−2.71	−5.61	−1.82	1.97	0.29	14.97	7.69	10.92
Ryazan	−0.38	−1.46	−0.98	−2.78	0.88	−0.75	4.60	7.06	5.97
Smolensk	−0.85	−4.88	−3.09	−0.52	0.50	0.05	8.86	5.62	7.06
Tver	6.26	−5.20	−0.11	−1.59	0.01	−0.70	10.45	4.63	7.22
Tula	−0.28	−6.88	−3.94	−2.01	−0.07	−0.93	10.67	4.27	7.12
Yaroslavl	3.71	−2.49	0.26	−2.34	1.54	−0.19	8.08	6.22	7.05
Volga-Vyatka	**−0.43**	**−4.81**	**−2.86**	**−1.73**	**1.18**	**−0.11**	**9.68**	**3.26**	**6.11**
Mary-El	2.47	−7.98	−3.34	−2.95	2.26	−0.05	10.11	2.33	5.79
Mordva	−0.15	−1.35	−0.82	−2.82	1.02	−0.69	16.24	2.82	8.78
Chuvash	−0.90	−2.50	−1.78	−1.35	1.88	0.44	11.52	2.25	6.37

Kirov	1.62	−6.96	−3.15	−1.27	1.09	0.04	11.89	2.92	6.91
Nizhnii Novgorod	−1.98	−4.86	−3.58	−1.57	0.81	−0.25	7.57	3.79	5.47
C. Black Earth	**−3.53**	**−5.54**	**−4.65**	**−1.85**	**1.63**	**0.08**	**10.72**	**7.75**	**9.07**
Belgorod	−2.18	−6.05	−4.33	−0.38	2.19	1.05	13.89	5.99	9.50
Voronezh	−2.89	−5.96	−4.59	−2.35	1.88	0.00	10.75	7.98	9.21
Kursk	−7.29	−6.52	−6.86	−2.09	0.50	−0.65	11.90	−0.54	4.99
Lipetsk	−4.54	−3.28	−3.84	−0.18	1.17	0.57	7.12	13.47	10.65
Tambov	0.03	−5.68	−3.14	−4.15	2.16	−0.64	9.86	9.49	9.65
Volga	−0.56	−2.67	−1.73	**−1.18**	**1.04**	**0.05**	**13.08**	**5.60**	**8.93**
Kalmykia	−4.07	−9.63	−7.16	−0.20	−0.88	−0.58	10.98	4.16	7.19
Tatarstan	−0.54	−3.29	−2.07	−1.17	1.60	0.37	20.14	6.97	12.82
Astrakhan	2.50	−2.98	−0.55	−1.50	2.43	0.68	15.68	7.51	11.14
Volgograd	−3.86	−2.44	−3.07	−1.78	1.88	0.25	9.18	5.90	7.36
Penza	0.66	−4.63	−2.28	−0.94	−0.22	−0.54	9.21	6.84	7.89
Samara	2.39	−0.65	0.70	−0.67	1.01	0.26	12.30	4.06	7.73
Saratov	−1.84	−1.12	−1.44	−0.70	0.30	−0.14	8.19	8.42	8.32
Ulyanovsk	−3.10	−7.87	−5.75	−2.46	0.09	−1.04	8.82	−4.46	1.44
North Caucasus	**0.24**	**−4.18**	**−2.22**	**−0.71**	**2.59**	**1.12**	**14.38**	**6.70**	**10.11**
Adygeya	11.97	−16.73	−3.98	−4.17	3.08	−0.14	15.14	−2.45	5.37
Dagestan	17.53	−3.64	5.77	3.79	5.26	4.61	13.30	18.92	16.42
Karbardino-Balkar	−0.97	−6.19	−3.87	0.46	3.52	2.16	22.48	7.28	14.04
Karachevo-Cherkess	2.34	−4.66	−1.55	−1.39	1.39	0.15	12.50	5.16	8.42
North-Ossetia	6.45	−1.97	1.78	−1.93	4.10	1.42	13.73	11.38	12.43
Krasnodar	0.40	−2.22	−1.06	−0.60	1.89	0.78	15.42	8.10	11.35
Stavropol	−0.36	−7.02	−4.06	−1.85	3.19	0.95	13.85	2.07	7.31
Rostov	−1.98	−3.78	−2.98	−1.47	1.47	0.16	12.75	4.32	8.07
Urals	**−1.54**	**−2.91**	**−2.30**	**−1.23**	**1.18**	**0.11**	**10.77**	**5.34**	**7.75**
Bashkortostan	−1.76	−6.74	−4.53	−1.16	2.09	0.65	14.12	5.79	9.49
Udmurt	−0.40	−5.27	−3.11	−1.12	0.94	0.02	11.88	5.63	8.41
Kurgan	−0.42	−3.87	−2.34	−1.54	0.61	−0.35	7.25	2.09	4.38
Orenburg	−3.95	−3.33	−3.61	−1.48	1.43	0.14	8.50	8.43	8.46
Perm	−8.21	2.07	−2.50	−0.99	−0.14	−0.52	11.29	1.53	5.87
Sverdlovsk	4.18	−3.29	0.03	−1.40	1.43	0.18	10.37	4.54	7.13

Table 2 – *continued*

	Capital stock			Labour			Output (GRP)		
	1995–98	1999–2003	1995–2003	1995–98	1999–2003	1995–2003	1995–98	1999–2003	1995–2003
Chelyabinsk	−2.09	−1.41	−1.71	−1.11	1.07	0.10	8.25	8.34	8.30
West Siberia	**−4.56**	**2.04**	**−0.89**	**−1.11**	**1.26**	**0.20**	**15.54**	**11.46**	**13.27**
Altai Rep	26.99	−35.76	−7.87	−0.38	1.95	0.91	15.57	8.27	11.51
Altai Krai	−3.01	−10.11	−6.95	−1.32	1.48	0.24	9.10	6.57	7.70
Kemerovo	1.30	−7.91	−3.82	−0.70	0.36	−0.11	6.82	6.25	6.50
Novosibirsk	1.64	−5.56	−2.36	−1.19	1.13	0.10	11.41	10.45	10.88
Omsk	−0.68	−8.40	−4.97	−1.09	0.52	−0.19	13.09	7.99	10.26
Tomsk	−2.37	−4.96	−3.81	−1.50	0.57	−0.35	14.37	5.71	9.56
Tyumen	−10.58	10.54	1.15	−1.20	2.55	0.88	20.51	14.03	16.91
East Siberia	**−3.80**	**−4.94**	**−4.43**	**−1.97**	**0.72**	**−0.48**	**11.15**	**2.58**	**6.39**
Buryatia	−3.57	−2.27	−2.85	−3.75	1.52	−0.83	5.55	8.31	7.08
Tuva	−3.76	−12.72	−8.74	−4.28	3.20	−0.13	6.43	11.16	9.06
Khakasia	−3.53	−4.18	−3.89	−3.11	2.62	0.08	7.55	3.68	5.40
Krasnoyarsk	−1.90	−7.00	−4.73	−0.10	−0.28	−0.20	13.29	0.05	5.93
Irkutsk	−5.48	−5.21	−5.33	−2.97	1.60	−0.43	12.38	2.87	7.10
Chita	−5.70	1.16	−1.89	−2.47	−0.56	−1.41	5.24	5.52	5.40
Far East	**−3.59**	**−2.22**	**−2.83**	**−2.99**	**0.05**	**−1.30**	**12.83**	**5.48**	**8.74**
Sakha	3.84	−1.85	0.68	−3.08	−0.11	−1.43	12.55	9.51	10.86
Jewish	−10.47	−1.62	−5.55	−4.03	0.33	−1.61	−1.36	11.45	5.75
Primorskii	−13.78	2.05	−4.99	−1.75	−0.05	−0.81	12.93	6.25	9.22
Khabarovsk	4.21	−1.40	1.09	−3.09	1.00	−0.82	17.24	1.78	8.65
Amur	−1.04	−0.46	−0.72	−1.80	−0.51	−1.09	7.24	5.73	6.40
Kamchatka	−5.59	−9.06	−7.52	−4.03	0.10	−1.74	16.52	−6.03	4.00
Magadan	−5.69	−11.54	−8.94	−6.21	−3.04	−4.45	8.92	4.69	6.57
Sakhalin	−5.44	−6.38	−5.96	−6.24	0.38	−2.56	10.73	9.06	9.80
Kaliningrad	−7.50	−0.59	−3.66	0.59	1.05	0.84	8.51	11.93	10.41

stock growth while he is president (early period) but swings negative in the early Putin era (1999–2003). A few regions known for more extensive reforms, such as Yaroslavl and Samara, behave somewhat differently from the FD of which they are a part, but these are exceptions. The lack of growth in the Russian capital stock can be expected to have long-term consequences for productivity and economic growth. Economic growth can be analysed using the Solow neoclassical model recently applied by Izyumov and Vahaly (2008).

Methods

The method used to analyse growth has two parts. First, a non-statistical Cobb–Douglas production function is assumed with 'a' as the capital share and '$1 - a$' being the labour share; dY/Y, dK/K and dL/L are the average annual growth rates of output, capital and labour and dA/A is the average annual growth rate of total factor productivity (TFP). The capital share is assumed to be 0.4 with a sensitivity test done by adjusting the share to 0.3.

$$\mathrm{d}Y/Y = a^{*}\mathrm{d}K/K + (1 - a)^{*}\mathrm{d}L/L + \mathrm{d}A/A \tag{1}$$

The production function is used by grouping the regions into the 11 FDs found until recently in regional statistical handbooks. This first part follows the same method as Izyumov and Vahaly (2008) and is simply computational, requiring no regressions. The 0.4 capital share is commonly found in studies of developing countries as a reasonable estimate of capital's contribution to growth.

The second part is to apply a statistical Cobb–Douglas production function to these same data using Solow's standard formulation.[3] The production function is

$$\mathrm{Ln}(Y/L)_{it} = a_{it} + b_{it}\mathrm{Trend} + c_{it}\mathrm{Ln}(K/L)_{it} + e_{it} \tag{2}$$

A panel production function is estimated with all 'i' regions and 't' years for each FD separately. 'Ln' is natural logarithm and 'e' is a classical error term corrected for heteroskedasticity using White's standard correction. Within some FDs dummy variables are used for a few exceptional regions. These are in the, North-west, City of St Petersburg (the second city) and Kaliningrad (isolated from the rest of Russia); in the Centre, Moscow city (the first city and the region receiving most FDI in Russia) and Moscow city and Moscow *oblast'* together (a greater Moscow dummy reflecting the fact that the two regions are closely linked); and in West Siberia, Tyumen (large size and energy resources). This second part of the analysis uses only the full time period 1995–2003 to capture the most variation with the sample size similar to that in such studies as Weitzman (1970) and Moroney (1990). Technological progress or intensive growth is represented by the trend term, which is expected to be insignificant, reflecting the inability of Russia to achieve high, intensive economic growth despite reforms. Each of these FDs contains enough pooled regional data to have a large sample as the transition period is still too short to permit a region by region analysis using time series only. As most regions are similar to others culturally and institutionally, dummy variables are used instead of a more complex institutional difference index more appropriate to comparing across countries. No other studies that treat the federal district as the core unit of analysis could be found in the English language literature.

Table 3. Contributions to economic growth in federal districts of Russia, 1995–2003.

	Output growth			Capital growth		
	1995–98	1999–2003	1995–2003	1995–1998	1999–2003	1995–2003
Russia	14.16	7.64	10.54	−1.35	−1.60	−1.49
North	10.14	5.52	7.57	−3.63	−0.99	−2.16
North-West	17.60	8.44	12.51	−0.47	−1.13	−0.84
Centre	18.33	9.54	13.45	3.76	−0.27	1.52
Volga-Vyatka	9.68	3.26	6.11	−0.43	−4.81	−2.86
C Black Earth	10.72	7.75	9.07	−3.53	−5.54	−4.65
Volga	13.08	5.60	8.93	−0.56	−2.67	−1.73
North Caucasus	14.38	6.70	10.11	0.24	−4.18	−2.22
Urals	10.77	5.34	7.75	−1.54	−2.91	−2.30
West Siberia	15.54	11.46	13.27	−4.56	2.04	−0.89
East Siberia	11.15	2.58	6.39	−3.80	−4.94	−4.43
Far East	12.83	5.48	8.74	−3.59	−2.22	−2.83
Kaliningrad *oblast*'	8.51	11.93	10.41	−7.50	−0.59	−3.66
	Labour growth			TFP growth (capital share = 0.4)		
	1995–1998	1999–2003	1995–2003	1995–1998	1999–2003	1995–2003
Russia	−1.16	1.43	0.28	15.39	7.42	10.96
North	−2.22	0.10	−0.93	12.93	5.86	9.00
North-West	−1.05	1.35	0.28	18.42	8.08	12.68
Centre	−0.92	2.08	0.75	17.38	8.40	12.39
Volga-Vyatka	−1.73	1.18	−0.11	10.89	4.47	7.33
Central Black Earth	−1.85	1.63	0.08	13.24	8.98	10.88
Volga	−1.18	1.04	0.05	14.01	6.05	9.59
North Caucasus	−0.71	2.59	1.12	14.70	6.82	10.32
Urals	−1.23	1.18	0.11	12.13	5.79	8.61
West Siberia	−1.11	1.26	0.20	18.04	9.89	13.51
East Siberia	−1.97	0.72	−0.48	13.85	4.12	8.45
Far East	−2.99	0.05	−1.30	16.06	6.33	10.65
Kaliningrad *oblast*'	0.59	1.05	0.84	11.16	11.54	11.37

Results

Real output growth was positive across FDs as the economy recovered from an initial slump in output following the collapse of the USSR (Table 3). Output also dipped during the 1998 recession across FDs but recovered strongly thereafter. The capital stock declined in almost all FDs while labour declined in the early period but then showed mostly positive growth in the later period. Growth results using the computational method that forces the capital stock share to be equal to 0.4 indicate that capital never contributed to growth except in the Centre, North Caucasus and West Siberia FDs (Table 4).[4] Capital growth in the Centre was strong enough to yield a positive contribution throughout the entire period 1995–2003. North Caucasus capital stock growth in the early period and West Siberia capital stock growth in the latter period were not sufficient to prevent negative growth overall. Labour's contribution (with a 0.6 weight) switches from negative to positive over the two shorter periods leading to a mixed impact for the overall period.

Somewhat unexpectedly, the dominant factor in output growth appears to be total factor productivity (TFP) during the transition period, suggesting intensive rather than extensive growth. While a similar result across FSU republics was found by Izyumov and Vahaly (2008) we do not accept their idea that this represents improving capital quality that is somehow not captured in the capital stock data. A more cautious view of TFP recalls that Solow's famous '*A*' term has also been interpreted as a measure of what we do not know or cannot explicitly measure. TFP is best interpreted here as a measure of institutional changes and reforms that enabled the economy to grow after the initial shock therapy. Regional growth also became labour-extensive in the later period but with little improvement in technology and the capital stock in most regions. The growth results must be tempered with two known features of the output. First, some of the output was still 'value subtracting' as firms continued to produce output inefficiently as they had during the Soviet era. Second, low energy prices caused the energy sector to overproduce to maintain revenue in a period of declining world prices. A statistical production function now allows us to relax the fixed capital share of 0.4 to see whether the results are sensitive to the computational approach.

The statistical production function results support the computational results (Table 5). Except for the relatively backward Volga-Vyatka FD, technological progress represented by the trend term is positive and significant, supporting the first method's result of factors other than capital and labour causing growth. All dummy variables had the expected positive sign given that these regions are exceptional, though Kaliningrad's coefficient is insignificant, suggesting that being physically cut off from the rest of Russia has had no impact on economic growth there.[5] Great variation is found in how well the production function fits a FD, with adjusted *R*-squares ranging from 0.1 to 0.82.

Setting aside the outlying result for the Volga-Vyatka FD with a low *R*-squared and negative capital/labour (*K*/*L*) coefficient, the *K*/*L* ratio is always positive and significant as well except for West Siberia FD. A reversal of the negative capital stock growth rates found in most FDs would increase output. Most regions would benefit from additional investment to achieve larger capital stocks. Russia needs to expand domestic and foreign investment outside the greater Moscow area more to improve growth. A neoclassical production function is a useful method in understanding FD growth and fits some of the most important FDs (Centre and West Siberia) that have been the recent engines of Russian economic growth quite well.

Table 4. Contributions to economic growth in federal districts of Russia, 1995–2003.

	1995–1998			1995–2003			1995–2003		
Capital share = 0.4	Contribution of capital (%)	Contribution of labour (%)	Contribution of TFP (%)	Contribution of capital (%)	Contribution of labour (%)	Contribution of TFP (%)	Contribution of capital (%)	Contribution of labour (%)	Contribution of TFP (%)
Russia	−4	−5	109	−8	11	97	−6	2	104
North	−14	−13	127	−7	1	106	−11	−7	119
North-West	−1	−4	105	−5	10	96	−3	1	101
Centre	8	−3	95	−1	13	88	5	3	92
Volga-Vyatka	−2	−11	113	−59	22	137	−19	−1	120
Central Black Earth	−13	−10	124	−29	13	116	−21	1	120
Volga	−2	−5	107	−19	11	108	−8	0	107
North Caucasus	1	−3	102	−25	23	102	−9	7	102
Urals	−6	−7	113	−22	13	109	−12	−1	111
West Siberia	−12	−4	116	7	7	86	−3	1	102
East Siberia	−14	−11	124	−77	17	160	−28	−4	132
Far East	−11	−14	125	−16	1	116	−13	−9	122
Kaliningrad *oblast*'	−35	4	131	−2	5	97	−14	5	109

Table 5. Federal district panel production function results, 1995–2003.

	Intercept	Trend	Redgum1	Redgum2	Log(*K*/*L*)	Adj. *R*-sq.
North	** − 91.06 (−4.7769)	**0.048 (5.053)			*0.495 (4.1423)	0.36
North-West	** − 152.376 (−8.5925)	**0.079 (8.704)	0.0718 (0.638)	**0.511 (7.428)	*0.582 (2.517)	0.69
Centre	** − 83.559 (−6.383)	**0.0447 (6.742)	**1.156 (15.917)		**0.598 (5.937)	0.82
Volga-Vyatka	*81.752 (−2.206)	* − 0.0402 (−2.1376)			** − 0.7045 (−3.072)	0.1
C. Black Earth	** − 142.814 (−3.6734)	**0.0751 (3.783)			**1.0289 (3.629)	0.24
Volga	** − 171.263 (−5.9227)	**0.0905 (6.184)			**1.775 (9.246)	0.5
North Caucasus	** − 94.9299 (−3.186)	**0.0503 (3.327)			**0.593 (3.245)	0.16
Urals	** − 78.435 (−3.937)	**0.0432 (4.294)			**1.197 (5.68)	0.27
West Siberia	** − 65.311 (−2.638)	**1.192 (3.703)	**0.035 (2.818)		0.325 (1.54)	0.81
East Siberia	** − 109.917 (−4.392)	**0.058 (4.641)			**0.883 (6.404)	0.56
Far East	** − 139.996 (−4.402)	**0.073 (4.599)			**0.782 (7.983)	0.42

Notes: ** = 1%, * = 5% significant.

Conclusions

Analysis of economic growth in the FSU using the former republics as the observational base can be extended within Russia by using the federal districts as the unit of observation. Neoclassical growth theory using a production function at the federal district level of aggregation reveals that growth of output following the initial shock therapy was widespread regionally. Adjusted capital stock series embedded in both a computational and a statistical production function indicate that many FDs would derive further output growth from increases in their capital stocks. With the current population decline likely to continue and any future in-migration by Russians from former Soviet republics being small, the capital labour ratio will continue to be quite high. Wide variation is found in production function coefficients at the FD level, suggesting more research is needed to examine intra-FD economic growth. As the neoclassical model appears to explain FD growth well, poorer FDs can catch up with richer ones over time with the convergence the neoclassical theory predicts. Questions such as the future role of FDI, how efficient economic growth is, and the interaction of existing human capital with labour and physical capital are left for further research.

Notes

1. Official capital stock data could not be obtained for 2004 and 2005 at the time of this study. The regions of Chechnya and Ingushetia are never included.
2. Kushnirsky's (2001) estimates of capital stock suggest that it may be possible to use Soviet-era regional data to create a capital stock series for both the FD and even regions themselves using work by Kantorovich and others on Soviet-era capital stock. It also may be possible to build a measure of aggregate capital stock from microeconomic firm data which were unavailable to these authors (e.g. see Uzun (2008) for farm capital stock data). However, we leave these tasks for further research.
3. Most aggregate studies of planned economies (e.g. Moroney 1990) and other studies of market economies at this aggregate level defend the use of the Cobb–Douglas (CD) functional form which imposes constant returns as reasonable given that returns to scale arguably have little meaning at an aggregate level. We find these arguments compelling but also tested Bairam's (1987) variable returns production function as a sensitivity test as at least one aggregate study rejects the CD function in favour of a more general form (Adkins *et al.* 2002). Results, perhaps because of some multicollinearity, either yielded no evidence of variable returns or an unrealistic estimate of the K/L coefficient.
4. As in Izyumov and Vahaly (2008), changing the capital share to 0.3 does not change the results, so those results are not reported here.
5. The dummy variable results shown for the Centre FD are for the combined Moscow city and Moscow *oblast'* region. Moscow city only results are similar and available from the author.

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