

Laura Solanko

Essays on Russia's Economic Transition



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Abstract

This study comprises an introductory section and three essays analysing Russia's economic transition from the early 1990s up to the present. The papers present a combination of both theoretical and empirical analysis on some of the key issues Russia has faced during its somewhat troublesome transformation from state-controlled command economy to market-based economy.

The first essay analyses fiscal competition for mobile capital between identical regions in a transition country. A standard tax competition framework is extended to account for two features of a transition economy: the presence of two sectors, old and new, which differ in productivity; and a non-benevolent regional decision-maker. It is shown that in very early phase of transition, when the old sector clearly dominates, consumers in a transition economy may be better off in a competitive equilibrium. Decision-makers, on the other hand, will prefer to coordinate their fiscal policies.

The second essay uses annual data for 1992–2003 to examine income dispersion and convergence across 76 Russian regions. Wide disparities in income levels have indeed emerged during the transition period. Dispersion has increased most among the initially better-off regions, whereas for the initially poorer regions no clear trend of divergence or convergence could be established. Further, some – albeit not highly robust – evidence was found of both unconditional and conditional convergence, especially among the initially richer regions. Finally, it is observed that there is much less evidence of convergence after the economic crisis of 1998.

The third essay analyses industrial firms' engagement in provision of infrastructure services, such as heating, electricity and road maintenance. Using a unique dataset of 404 large and medium-sized industrial enterprises in 40 regions of Russia, the essay examines public infrastructure provision by Russian industrial enterprises. It is found that to a large degree engagement in infrastructure provision, as proxied by district heating production, is a Soviet legacy. Secondly, firms providing district heating to users outside their plant area are more likely to have close and multidimensional relations with the local public sector.

Key words: Russia, transition, regional issues, tax competition, infrastructure

Tiivistelmä

Väitöskirja koostuu kolmesta Venäjän talouden järjestelmämuutosta käsittelevästä esseestä. Niiden yhteinen teema on alueiden ja paikallis-hallinnon rooli Venäjän talouden transitiossa. Ensimmäisessä esseessä tarkastellaan teorian valossa alueiden välistä verokilpailua. Toisessa analysoidaan alueiden välistä tulotasojen lähentymistä (konvergenssia) ja kasvua. Kolmannessa esseessä hyödynnetään laajaa yritys-haastatteluaineistoa ja tarkastellaan yritysten osallistumista paikallisen infrastruktuurin tuottamiseen.

Ensimmäisen esseen tarkastelussa klassista Zodrowin ja Mieszkovskyn (1986) verokilpailukehikkoa on laajennettu kahdella siirtymätalousmaalle tyypillisellä piirteellä. Malliin on lisätty osittain Leviathan-tyyppinen päätöksentekijä sekä kaksi tuotantosektoria (uusi ja vanha), jotka ovat tuottavuudeltaan erilaisia. Hyvinvointitarkastelu osoittaa, että siirtymän alkuvaiheessa, jolloin vanhan sektorin osuus on hyvin suuri, kilpailutasapaino voi olla kuluttajien kannalta optimaalinen. Sen sijaan päätöksentekijät preferoivat aina veropäätösten koordinointia. Teoreettisen tulosten valossa alueiden välisen kilpailun tehostaminen voi siis lisätä kuluttajien hyvinvointia.

Toisen esseen analyysi tulojen hajonnasta ja Venäjän eri alueiden välisestä lähentymisestä vuosina 1992–2003 perustuu Rosstatin julkisesti saatavilla olevaan tilastoaineistoon. Keskimääräisten tulotasojen hajonta on kasvanut etenkin rikkaiden alueiden ryhmässä. Sitä vastoin köyhien alueiden osalta selvää hajonnan kasvuun tai supistumiseen liittyvää trendiä on vaikea osoittaa. Esseessä löydetään etenkin rikkaiden alueiden kesken sekä ehdotonta että ehdollista tulotasojen lähentymistä. Lisäksi havaitaan, että vuoden 1998 talouskriisin jälkeen lähentyminen on aiempaa heikompaa.

Kolmannessa esseessä keskittyy teollisuusyritysten rooliin julkisen infrastruktuurin, kuten kaukolämmön, tiestön ja vesihuollon, tuottajana. Edustavaan yritysaineistoon perustuva empiirinen analyysi osoittaa, että infrastuktuurin tuottamien on edelleen yleistä ja pitkälti neuvostoaikojen perintöä. Infrastruktuuria tuottavien yritysten suhteet paikalliseen julkisvaltaan ovat tyypillisesti tiiviitä, eivätkä yritykset halua luopua näiden suhteiden ja infrastruktuurin tuottamiseen perustuvasta järjestelmästä.

Asiasanat: Venäjä, transiio, aluetalous, verokilpailu, infrastruktuuri

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This work is dedicated to my family, with love.

Helsinki, January 2007
Laura Solanko

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Introduction

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1 Russian regions in transition

The common theme in all three papers of this dissertation is the regional and local aspect of Russia's economic transition. Russia differs from most transition economies in its large geographical size and its formally federalist structure. During the last fifteen years activities at the sub-national level in Russia have had large effects on national-level developments. Regional issues have been and continue to be crucial in shaping the country's economic performance. The aim and hope of this dissertation is that the results of the essays will better equip us to analyse and understand the regional aspect of Russia's economic transition.

This subsection provides a short and hopefully concise introduction to the broad topic of regional issues of transition, and especially those of the Russian Federation. The central earlier literature of the essays of this dissertation is presented in the following subsections. Section 2 summarizes the main findings of the essays.

1.1 On transition

The fall of the Berlin wall in November 1989 and the dissolution of the Soviet Union two years later came as a surprise to everyone, economists included. It was clear that the socialist economic system had come to an end, but it was much less clear what would follow. There was a broad consensus that after a short transitional period these economies would join the capitalist system. But there was no prior example of switching from socialism to a market-based economy.

The early literature on transition economies was policy oriented and mainly focused on how to end transition and move to a normal market economy. Three basic issues emerged fairly quickly: liberalization, stabilization and privatization. Liberalization was seen as the first element of transition, consisting of both internal and external liberalization, meaning eg price liberalization, as well as the liberalization of foreign trade and entrepreneurship in the formerly closed and state-controlled economies. Stabilization was and still is an essential part of any macroeconomic reform package. Bringing down high inflation and balancing government budgets were rightly seen as crucial preconditions for future growth (Gros and Steinherr 1995). The importance of privatization was partly based on the need to harden the

budget constraints of large enterprises. But privatization typically came with its own national flavors in each transition economy. In Russia, privatization was initially based on voucher give-aways, which generally led to insider ownership and continued political control. In numerous instances, local politicians and managers in fact seized control of privatized former state enterprises, giving rise to ‘grabbing hand privatization’¹. The second round of Russian privatization, the large auctions in the mid-1990s, on the other hand, contributed to the rise of oligarchs and raised considerable criticism, both inside and outside of the country (Boyko et al, 1995).

These three issues later formed the backbone of the so-called Washington consensus, a broad agreement – especially among the Washington institutions, the IMF, World Bank and US Treasury – on guidelines for successful transition.² Somewhat later much emphasis, both in economic theory and in policy analysis, has shifted towards reform implementation and the institutional arrangements. A wide range of institutions has been named as essential in successful transition, including property rights, law enforcement, and social norms and trust.³ A major challenge of economic transition still today concerns the role of the government and public institutions. In most variants the socialist economies were overly centralised, overly regulated and overly bureaucratic but none of the bureaucracies had any means of efficiently operating in a market environment. Therefore shifting the incentives of politicians and bureaucrats towards goals compatible with functioning market economy has become all more important (Shleifer, 1997).

Decentralization of economic decision-making has been proposed as one potentially fruitful means of tackling the issue. Due to the vast geographical area and formally federalist structure, decentralization and evolving fiscal federalism has indeed been a salient feature of Russia’s economic transition during the 1990s. The early literature on Russia’s transition stressed the importance of decentralization largely as a means of breaking with past practices and furthering overall liberalization and democratization of the economy (Wallich, 1993; and Wallich et al, 1994). As the political struggles of the time lead to a

¹ The notion of the grabbing hand was introduced by Frye and Shleifer (1997) to characterize a badly organized government consisting of several independent bureaucrats pursuing their own economic and political agendas.

² See Gelb and Gray (1991) for the original application of the ‘Washington consensus’ on transition countries. Sutela (2004) offers a well-informed and concise discussion of the actual contents of the Washington consensus.

³ Roland (2000) offers an excellent textbook presentation of economic theories of transition and OECD (2002) provides a good example of the policy concerns.

relatively weak central authority, reliant on strong regional leaders, the Russian federation did decentralize much of its decision-making, not always formally but at least in practical terms.

1.2 The fusion of economic and political decision-making

Sound fiscal federalist arrangements, however, rarely were a top priority for the decision-makers. Even President Jeltsin declared that the country ‘does not have a regional policy of any sort’. In another famous speech the President urged regional leaders to ‘grab as much power as they can swallow’. As most of the arrangements on division of (political and economic) power between the center and regions were based on individually negotiated, non-transparent agreements, it is hardly surprising that by the mid-1990s the Russian version of federalism had led to a tight web of conflicting regulations, lots of asymmetry, and an especially uneven economic playing field. Intergovernmental finances had become part of a powerstruggle between the central authority and individual regions, as documented by eg Freinkman et al (1999). As shown by Desai et al (2005), regions which enjoyed unearned income streams, particularly revenues from natural resources, used budget funds to retard reforms and to shelter certain firms from market forces.

At the same time it became clear that regionalization of the economy resulted in even tighter relations between local politicians and local enterprises. Ericson (2000) even argues that close ties of local and regional politicians with local businesses created an economic system best described as ‘industrial feudalism’, where strong regional leaders effectively control their own fiefdoms. As Russia consists of 89 regions with an average population of slightly over 1.5 million, large – usually formerly state-owned – enterprises may have considerable power in local decision-making. In many cases enterprises were able to influence regional laws and regulations in order to restrict competition, maintain their positions, or simply to protect them from interference by the central government (Hellman et al, 2003; and Slinko et al, 2003). It is believed, however, that the regional politicians were not only passive players in this game. On the contrary, the relationships between politicians and enterprises were often mutually beneficial (Desai and Goldberg, 2000; and Frye, 2002).

This inevitably led to increased corruption and non-uniform market structures across regions. Also taxation rules differed from

region to region. Even though a substantial part of lower-level revenues consisted of proceeds from federally set taxes and transfers, regions had considerable de facto powers to decide on a set of local taxes. The fiscal benefits from these local taxes were often miniscule but their existence offered local politicians a convenient way to favor local enterprises. Regional governments could also grant preferential treatment (tax breaks, investment credits, etc) to individual enterprises. This form of state capture at the regional level has adverse effects on small business growth, tax collection and federal tax arrears, as shown by Slinko et al (2003). Further, along with enterprise restructuring and increased opportunities for the few, income differentials both within and between regions widened rapidly. Indeed, much of the recent literature on the Russian transition experience points to the fusion of regional economic and political decision-making as the main cause of the country's dismal economic performance in the 1990s.⁴

This situation led to a shift in the focus of policy-oriented analysis, especially within institutions like the IMF, to towards getting fiscal federalist arrangements back into order as a vital ingredient in the promotion of economic growth in the country. Empirical research, mostly in economic geography and political economy, started to investigate regional issues like the role of regional economic policies and determinants of federal transfers in order to better understand Russia's transition.⁵

Theoretical research, on the other hand, found much inspiration from comparisons between the Russian and Chinese versions of federalism, their origins and consequences. The Soviet economy was organized along sectoral ministries whereas the Chinese model relied more on regional organization where each province was responsible for a wide array of industries. As set out by Qian, Roland and Xu (1998), the Chinese model allowed for more regional experimentation, gradual reforms and higher benefits from reforms. Some researchers have forcefully pointed towards the differing structures of inter-governmental financial policies as one of the reasons for the divergence in economic performance between these two large transition economies. Gordon and Li (1997) underline that Chinese fiscal federalism has succeeded in creating strong incentives for local politicians to support new private businesses and enterprise restructuring as a means to enlarge their local tax base. In Russia,

⁴ See eg Gregory and Lazarev (2004) on the structural change of the Russian economy during the 1990s.

⁵ For overviews, see eg Hanson and Bradshaw (2000) and Shleifer and Treisman (2000).

local governments have rarely been able to formally benefit from an increase in the local tax base (Zhuravskaya, 1998).

According to Blanchard and Schleifer (2001) differences in political organization help to explain the differing outcomes. They point out that while Chinese reforms have occurred alongside political centralization, reforms in Russia have been plagued by simultaneous political decentralization, fragmentation and democratization. As a result, the capacity of the central government in Russia to reward or punish lower-level officials or to collect accurate data on lower levels has been severely restrained. Instead, both central and regional politicians have struggled to fill the political vacuum created by the dissolution of the Soviet Union. The result is exactly the jungle of unclear and overlapping regional arrangements that has hindered economic growth in Russia. The term Chinese-style federalism has emerged as a characterization of a system of intergovernmental finances based on local autonomy combined with political centralization (Montinola et al, 1995; and Cao et al, 1999). Interestingly enough, federalism Russian-style has proved to be quite the opposite.⁶

It is therefore fair to argue that a close look at the regional and local levels can help us to better understand the process of economic change in Russia. This manuscript seeks to contribute to the literature by approaching regional aspects of Russia's economic transition from three different angles: theoretical tax competition, empirical analysis of regional convergence, and firm performance. The following subsection gives an overview of the earlier literature on these research topics.

⁶ Since Putin assumed the presidency in March 2000 the tide has, however, clearly shifted towards political centralization also in Russia. The real effects of these 'Putin reforms' on the Russian economy are yet to be seen.

2 Research topics in Russia's economic transformation

2.1 Tax competition

The early theory of local public goods provision as developed by Tiebout (1956) was a theory of efficient local tax competition. The Tiebout model describes fully mobile consumers as 'voting with their feet' and settling in jurisdictions that offer a mix of local public goods and local taxes that best suits their individual preferences. Therefore, the model assumes, competition among jurisdictions leads to a fully efficient allocation of individuals and efficient provision of local public goods. Competition can be seen as a means of replicating the beneficial effects of market forces. It has been argued that a similar logic can be applied to competition among mobile firms (as originally suggested by Fischel 1975 and White 1975). In this setup, firms benefit from local public goods – usually interpreted as public inputs such as infrastructure. In an equilibrium with several competing jurisdictions, firms are taxed at a rate equal to the marginal cost of providing those public inputs. In accordance with the Tiebout hypothesis, the resulting equilibrium is efficient.

Departures from the idealised assumptions of the Tiebout model, however, result in departures from the efficient outcome. The main source of departure is the existence of fiscal externalities, situations where capital or firms are not efficiently taxed for various reasons. The concern for potential inefficiencies was famously raised by Oates (1972), who argued that tax competition may lead to too-low levels of social spending. Much of the modern literature on tax competition has indeed emerged as an attempt to understand the potential efficiency problems of competition for mobile resources among local jurisdictions. But it was not until the mid-1980s that the literature on tax competition shifted to formal modeling of these ideas. The early literature emphasized the harmful effects of tax competition, as described by Zodrow and Mieszkowski (1986) in what has become a standard presentation of tax competition.

The Zodrow and Mieszkowski (1986) model assumes a world of several small, identical regions. Within each region perfectly competitive firms produce a single output using a regional fixed factor, called land, and a regionally mobile factor, called capital. The capital stock is fixed at the national level, so that all capital earns the

same net return (r). Each region has the same number of identical consumers, represented by a representative consumer, who owns the regional fixed factor and a share of the mobile capital. Regions provide a public good G financed by capital tax t which implies a government budget constraint $G = tK(r+t)$, where $K(r+t)$ is the region's demand for capital as a function of the before-tax return. The local governments are assumed to maximize the welfare of their representative consumer $U(C,G)$ subject to the budget constraint. The regions play a Nash game in tax rates, taking the tax rates of other regions as given. Thus, the first-order condition for the optimal public good provision can be written

$$\frac{U_G}{U_C} = \frac{1}{1 - t\phi/K} > 1 \quad (2.1)$$

where $\phi = -dK/dt > 0$ describes the change in local capital stock caused by a marginal change in the local tax rate. The formulation (2.1) is a modification the familiar Samuelson rule for the provision of public goods.⁷ The fact that the marginal rate of substitution between public good and private income is greater than one indicates underprovision of the public good in the competitive equilibrium. The right hand side of (2.1), characterising the marginal cost, is greater than one since it includes a term reflecting the cost of capital outflow caused by a unilateral increase in capital tax by any single region. The critical insight of this classical model is that this outflow causes an inflow of capital into the other regions. Tax increases in one region therefore create a positive externality by increasing capital supply for the rest of the world. Because the regional governments are interested only in the welfare of their citizens, this externality is neglected. Consequently, competing regions set tax rates and levels of public goods provision at too-low levels.

A rich body of literature emphasizing the harmful effects of tax competition has extended and enriched the basic model of Zodrow and Mieszkowski.⁸ More recently many researchers have begun to investigate situations where some of the assumptions of the classic framework are relaxed. The literature has been extended to frameworks including eg imperfectly competitive markets, vertical competition among jurisdictions, heterogeneous regions and political

⁷ The Samuelson rule for public goods provision requires equality of the marginal benefit of G and the marginal resource cost of its provision, ie $U_G = U_C$.

⁸ See Wilson (1999) for a good overview.

economy considerations.⁹ It has often been shown that tax competition may indeed be beneficial. Perhaps the most serious challenge for the outcomes of the classic model comes from the Leviathan models. The basic idea of Leviathan models, according to Brennan and Buchanan (1980), is that the decision-makers care about the size of the budgets they control. In the absence of additional constraints, a Leviathan government would lead to an excessively large public sector. A further extension of this view is that the decision-makers are not fully benevolent, as assumed earlier, but instead they seek to maximize some combination of social welfare and their private benefit.

The seminal paper on tax competition and partially benevolent decision-makers is Edwards and Keen (1997). Their model is based on the Zodrow-Mieszkowski model, but the assumption of a fully benevolent decision-maker is relaxed. It is instead assumed that decision-makers have quasi-concave preferences $V(U,C)$, defined over the welfare of the representative citizen U and personal benefit of the decision-maker C , which is financed from public expenditures. Their model confirms the classical result of social public goods being underprovided in the competitive equilibrium. Coordination, however, is not necessarily beneficial for consumers. A coordinated tax increase tends to produce two effects with opposing effects on consumer welfare. The first one, an 'income effect', tends to make coordination beneficial, as the politician and thus also the consumers are likely to be better off. The offsetting force, a 'relative price effect', is likely to lead to more resources for C as the relative price of tax revenues diverted to his own use versus the welfare of the consumers is decreased. Edwards and Keen argue that if decision-makers' preferences are best modeled as a weighted average of U and C , coordination is certain to damage the well-being of the representative consumer.

Whereas most of the literature on tax competition is concerned with the overall level of public goods provision, it is widely seen that competition may also alter the composition of public spending. One extension to the classic framework is to include competition in both tax rates and composition of public goods. This leads to overprovision of the local infrastructure public good (business public good) and underprovision of the social public good, as shown by Keen and Marchand (1997). Competition with public infrastructure goods has also been analysed in a game theory framework characterised by

⁹ See Wilson and Wildasin (2004) for a recent overview and Sinn (2003) for a thorough discussion.

commitment problems, by Qian and Roland (1998). They build a principal-agent model to show how decentralization can ease the problem of soft budget constraints typical of a transition economy. Their model confirms the result of overprovision of public infrastructure but adds a beneficial effect of competition as a commitment device.

The Qian-Roland (1998) study is a rare example of applying the ideas of fiscal competition to a transition topic. Their setup, however, is completely different from the traditional framework of tax competition and therefore there is room for further research in the field. As argued in the previous subsection, it seems reasonable to assume that especially in a transition economy the decision-makers enjoy close relations with large regional enterprises. Therefore, combining an Edwards-Keen (1997) type of decision-maker with a transition framework could produce interesting new insights.

2.2 Convergence and growth

The fundamental property of neoclassical growth models for closed economies is conditional convergence. Both the Solow & Swan and the Ramsay model predict that each economy converges towards its own steady state and that the speed of convergence is inversely related to distance from the steady state.¹⁰ Therefore, controlling for the different steady states, the models predict that economies starting with lower values of per capita income tend to grow faster.

In the neoclassical models, level of the steady state depends on the savings rate and the economy's production function. But it is often mentioned that a wide range of government policies and institutions may affect both the savings rate and the characteristics of the production function. This suggests that in order to isolate the predicted negative relationship between growth rate and initial level of income, it is necessary to hold these other determinants constant.

Only if the economies are similar in technologies, tastes, institutions and other economically relevant characteristics can one presume that they have the same steady state. In such a case, the economy with a lower current level of income is predicted to grow faster. This is referred to as unconditional beta-convergence.

The notion of conditional convergence is often confused with another meaning of convergence, namely that income dispersion

¹⁰ Solow (1956), Swan (1956), Ramsay (1928), Cass (1965), and Koopmans (1965).

across economies tends to decrease over time. Barro and Sala-i-Martin (1991) refer to this decline in cross-sectional income dispersion as sigma-convergence. What the neoclassical framework predicts, however, is that dispersion in income levels may decrease or increase depending on the relation between the current level of dispersion and its steady state value. Following Barro and Sala-i-Martin (2004, p. 50) and assuming unconditional convergence, the per capita income for economy i can be approximated by

$$\log(y_{i,t}) = a + (1 - b)\log(y_{i,t-1}) + u_{i,t} \quad (2.2)$$

where y_{it} is per capita income at time t and economy i , a and b are constants, with $0 < b < 1$ and $u_{i,t}$ is the disturbance term. The disturbance term picks up temporary shocks to the production function, savings rate, etc. It is assumed to have zero mean, constant variance σ_u^2 , and to be independent over time t and across economies i . One possible and often used measure of income dispersion is the variance of $\log(y_{it})$, denoted by σ_t^2 . The assumed properties of u_{it} imply that σ_t^2 evolves over time as

$$\sigma_t^2 = \sigma^{2*} + (1 - b)^2(\sigma_{t-1}^2 - \sigma^{2*}) \quad (2.3)$$

Since $0 < b < 1$, the level of dispersion monotonically approaches its steady state level σ^{2*} . This implies that dispersion rises or falls over time depending on whether it begins below or above its steady state level. Specifically, increasing dispersion, ie sigma-divergence, is fully consistent with absolute convergence.

Following the seminal papers by Barro (1991) on convergence across countries and Barro and Sala-i-Martin (1992) on convergence across regions, the empirical literature assessing the predictions of neoclassical theory has grown rapidly. The exact formulation of convergence depends on the assumptions of the underlying growth model, but a ‘minimal’ model for empirical analysis of convergence as suggested by de la Fuente (2000), would be like

$$\Delta y_{it} = \eta X_{it} - \beta y_{i,0} + \varepsilon_{it} \quad (2.4)$$

where y_{i0} is per capita income in economy i at the start of the period, Δy_{it} the growth rate of per capita income over the period, X_{it} a set of

variables characterising the steady state, and ε_{it} a random disturbance.¹¹ Many empirical studies use cross-sectional regressions over the average growth rate over the entire sample period. It is not uncommon to report also estimations based on pooled data for shorter periods, typically for 10–20 years. In general, the results seem to support the notion of conditional convergence over time. Even unconditional convergence has been established for fairly homogeneous groups of economies like regions within a single country (US, Japan) or within the European Union.¹²

Even though the literature on various aspects of regional issues in Russia is vast and rapidly expanding, there are still not so many studies that focus on the classical concepts of convergence and growth. As noted by Bradshaw and Treyvish (2000), a kind of consensus over the lack of convergence across Russian regions emerged even before there was much of any empirical literature on the topic. One reason for this is the short time period available for empirical analysis. Therefore, one should be cautious in interpreting the results, but there is no reason to leave the field unexplored.

There are a few recent papers on the determinants of economic growth, but none of these are much concerned with convergence. Berkowitz and DeJong (2003) look at the determinants of economic growth for a sample of 48 of the 89 regions over the period 1993 to 1997. Their interest is in determining whether regional policy reform matters for economic growth, and they do indeed find a positive correspondence between price liberalization and growth of per capita income. In a follow-up paper, Berkowitz and DeJong (2005) use a larger set of 70 regions over the years 1993–2000. They are able to establish a statistically significant link between entrepreneurial activity and growth. However, Ahrend (2005) finds that economic reform and general reform orientation explain little of the observed differences in regional growth rates. He concludes that a region's initial industrial structure and resource endowment seem to have a large impact on the region's growth prospects. A somewhat similar conclusion is drawn by Dolinskaja (2002), who analyses regional convergence in real incomes using the transition matrix approach. Her findings confirm that the initial industrial structure and natural

¹¹ Among the most popular specifications of structural convergence equations in recent literature are one derived by Mankiew, Romer and Weil (1992) and another by Barro and Sala-i-Martin (1992). The MRW 1992 is derived from an extended Solow model, whereas the B&S 1992 is based on a variant of Ramsay-Cass-Koopmans model with exogenous technological process.

¹² See Sala-i-Martin (1996) for a summary.

resources are significant in explaining regional differences in growth rates.

But there are very few studies that also cover the years after 2000. A longer timespan would be necessary for analysing the possible effects of the 1998 economic crisis on regional convergence. The 1998 crisis caused substantial changes in the country's fiscal and monetary policy, which together with increasing world market prices of raw materials, helped to revive economic growth in Russia. One would assume that these structural changes could also impact the dynamics of regional growth and convergence.

Another line of research focuses on regional inequality and poverty in Russia. In these studies the focus is on determinants of overall income inequality while convergence/divergence across regions is something of a side event in explaining inequality.¹³ This literature offers many interesting insights into the issue at hand. Kanbur and Venables (2005) conclude that differences in mean incomes across regions account for close to a third of overall inequality in incomes. They established clear divergence in incomes across regions in 1994–2000. Further, their analysis suggests that regional divergence accounts for most of the overall increase in national inequality in incomes over the same period. One of the areas left unexplored in the existing literature is the convergence performance of the poor regions vis-à-vis the rich ones.

2.3 Enterprise performance and missing infrastructure

Enterprise performance in transition economies has been associated with four main factors: ownership, competition, soft budgets and manager incentives. Most of the early micro-level research centered on the effects of privatisation and ownership changes on firm performance (state versus private and insider versus outsider). Somewhat contrary to the early wisdom on the benefits of fast privatization, empirical evidence from Russia and other CIS countries showed that ownership was not a crucial determinant of enterprise restructuring or performance. Similar results seem to emerge also from studies on the effect of competition on performance. In the CIS,

¹³ Brainerd (1998) offers an excellent early study on wage inequality. More recent contributions on inequality across regions include Fedorov (2002) and Yemtsov (2003).

contrary to results from Easter European transition economies, increased product market competition did not lead to greater restructuring (see Djankov and Murrell, 2002).

These results naturally raised the question of why these differences in outcomes appear. In policy-oriented discussions, institutions, defined in a very broad sense, have become an increasingly important topic. Gradually also the focus of academic discussion has moved to the role of institutions in shaping enterprise performance. Not incidentally, the more general literature on growth, transition and development has also had the same emphasis recently (Johnson, Kaufmann and Shleifer, 1997; Stiglitz, 1999; Acemoglu, Johnson and Robinson, 2001). Measuring and quantifying institutions has, however, turned out to be extremely difficult. On the micro-level, casual evidence on the importance of institutions, especially on the role of the public sector, suggests that the connections between enterprises and the local public sector may indeed greatly shape enterprise performance.

Further, good quality of and equal access to basic infrastructure (transportation, communications, energy networks) is increasingly cited as an essential factor in economic development, in both developing and transition countries.¹⁴ Several empirical (mainly cross-country) studies have found a robust positive relationship between infrastructure development and economic growth, even though the direction of causality is not clear.¹⁵ Up till now, the role of poor infrastructure and public services has received relatively little attention in micro-level analysis. Based on enterprise survey data from Uganda, Reinikka and Svensson (2002) conclude that poor public infrastructure significantly reduces private investment. Brown and Earle (2001), using Russian enterprise registry data, find evidence of the importance of good physical connections (roads, telecommunications networks) and market infrastructure (regulation, law enforcement) for firm productivity.

Traditionally many infrastructure items have been produced by the public sector via state-owned monopolies. The last two decades have witnessed a remarkable shift towards an increasing role of privately owned companies in infrastructure production. International institutions like the World Bank actively provide advice for the best practices increasing the efficiency of infrastructure provision by

¹⁴ World Bank (2001) and (2003) as well as EBRD (2004) give excellent overviews of the broad range of infrastructure issues in these economies.

¹⁵ See Demurger (2001) on China, Barro and Sala-i-Martin (2004), Easterly-Levine (1997), Esfahani-Ramirez (2003) for cross-country analysis.

privatization and enhanced regulation (Kessides, 2004; Estache et al, 2005). In Russia, however, some items of basic local infrastructure are provided by large industrial enterprises whose main business line does not include the infrastructure services they produce. The roots of this phenomenon lie in the way Soviet enterprises and Soviet cities were planned (Hill and Gaddy, 2003). In the Soviet Union, enterprises were responsible for a large palette of social services like housing, kindergartens and recreational facilities. Most of these social obligations were transferred to municipalities during the privatization process of the 1990s (Starodubrovskaya, 2001; Leksin and Shvetsov, 1998). Much less attention was, and still is, paid to the infrastructure services such as heating, electricity and road maintenance for which large enterprises were and continue to be responsible.

As it is known that the regulated prices for infrastructure goods like district heating are unlikely to cover even full costs of production (IEA, 2002), it seems somewhat of a mystery why enterprises continue to provide such goods. It is natural to assume that part of the explanation may be found in the close connections between local public sector and large enterprises. Enterprises generally had two non-mutually exclusive strategies to survive in transition: adapt to competitive markets or rely on good relationships with public officials. Gaddy and Ickes (2002) argue that the latter option has been widely chosen in Russia.

There is indeed some casual evidence of cases where enterprises have used their infrastructure assets as a bargaining tool vis-a-vis local government. Enterprises engaged in infrastructure provision tend to be larger and older than those relying solely on publicly provided infrastructure. And everywhere, not least in a transition economy, size tends to come with connections and influence. An influential firm would have good opportunities to engage in what Frye (2002) describes as 'elite exchange': mutually beneficial agreements with private actors and state agents. Also the characteristics of Russian fiscal federalist arrangements may lead to peculiar forms of public goods provision. Lavrov, Litwack, and Sutherland (2000) argue that the mismatch between huge expenditure requirements and a shortage of own revenues at the regional level makes regions and localities in Russia favor large incumbent firms capable of providing public goods.

Surprisingly, these concerns have not been thoroughly examined in the literature. To start with, no good overall data are available on private provision of public goods or services. No one seems to know exactly what kind of firms are engaged in infrastructure provision and how widespread the practice is. This particular way of providing infrastructure has not been addressed in the previous literature nor has

the interplay between local public sector and enterprises in these fields received the attention in any of the recent firm surveys. There has clearly been room for a thorough survey covering these issues.

The author was an active participant in the group that planned, organized and conducted a face-to-face survey on large and medium-sized Russian industrial enterprises in May–June 2003. The focus of the survey was precisely the interplay between enterprises and public sector, especially the role of private enterprises in provision of public infrastructure and social services. Our survey thus attempts to fill in the gap by collecting data on the very issues that are most likely to cause tight interactions between public and private operators. The sampling strategy was a combination of random sampling and stratification by size, and the resulting sample includes 404 industrial enterprises with at least 400 employees in 40 regions of Russia. Details of the sampling methodology and survey implementation are provided in Haaparanta et al (2003).

3 Summary of the essays and their contributions

The first essay of this thesis introduces a purely theoretical model based on the traditional theory of tax competition when the decision-maker is not fully benevolent. Regional competition is found to be beneficial at least in early transition. It is, however, reasonable to argue that when seeking to understand regional aspects in a rapidly evolving economy as vast as the Russian Federation, any attempt towards serious research should also include some empirical analysis. This implies either relying on official data provided by the Federal State Statistics Office (Rosstat) or turning to a down-to earth approach of collecting one's data by hand at the micro level. The last two essays of this dissertation offer examples of the two approaches.

The second essay analyses dispersion and convergence of regional economies based on public Rosstat data and finds strong conditional convergence, especially among the rich regions. The third paper uses firm survey evidence to show that large infrastructure-providing enterprises enjoy close connections with local officials, thereby influencing the local economic playing field.

Taking each essay in turn, this section summarizes the main contents and conclusions of the essays of this dissertation.

3.1 Tax competition in a transition economy

The first essay, ‘Tax Competition in a Transition Economy’, presents a theoretical model of tax competition in a transition economy. The model builds on the static, classical model of capital tax competition.

The model builds on the Zodrow and Mieszkowski (1986) model of tax competition between identical regions but amends the classic framework with two features typical of a transition economy. First, along the lines of Edwards and Keen (1997), the model incorporates the view of the decision-maker as maximizing a weighted average of his private benefit and the welfare of his citizens. The more fundamental extension of the classic model concerns the production side of the economy. Following Blanchard (1997), the essay sees transition as a reallocation of the economy’s resources from the old state sector to new private-sector enterprises. The two sectors of the economy use the same inputs to produce an identical good, but the productivity between the sectors is different. The new sector owes its higher productivity to successful restructuring (ie new products, product differentiation, internal reorganization and education) or new business practices, like advertising and marketing. The non-restructured old sector is characterised by lower productivity, and so it needs to retain close connections with the regional administration in its struggle for survival.

The essay builds on the assumption that the regional decision-maker can divert the old sector’s rents to his own use. Therefore the decision-maker has a private interest in the old sector’s survival.¹⁶ This formulation helps to explain why, in a static equilibrium, the low-productivity sector continues to exist. By giving the decision-maker a direct interest in the old sector, the essay also hopes to complement the Edwards and Keen (1996) model by offering a somewhat richer story of how decision-makers pursue their private interests.

Equipped with these two extensions the model of the first essay examines the properties of a symmetric competitive equilibrium. It is shown that the classic result of underprovision of local public good holds. But the magnitude of the loss in consumer welfare is likely to depend on both the relative sizes of the two sectors and the degree of

¹⁶ This fusion of economic and political decision-making at the regional level in Russia has increasingly been a subject of growing interest among both international and Russian researchers (See eg Desai et al, 2003; Yakovlev and Zhuravskaya, 2004; Slinko et al, 2003).

benevolence of the regional decision-maker. When the new sector of the regional economy is small relative to the old sector – a situation labelled as early transition – the underprovision is likely to be more severe. The welfare loss is naturally the larger, the smaller the weight given to consumer welfare. Next, the effects of a common marginal increase in the capital tax rate are examined in order to assess whether coordination would be preferred. The analysis shows that the effect on consumer welfare is non-trivial. It turns out that in early transition competition may in fact be beneficial as it promotes the reallocation of capital from old to new sector. Whether tax competition is harmful or beneficial now depends on the stage of transition and the degree of benevolence of the regional decision-maker.

The model predicts that regional competition may play a useful role in promoting the transition process and in increasing the citizens' welfare. The problem in drawing any policy conclusions is that even when competition would benefit the citizenry it clearly harms the decision-maker. If regional decision-makers are truly able to decide on coordinated tax policies, it is by no means self-evident that competition would be chosen. In the simple model of this essay, there is no mechanism to ensure that beneficial competition would emerge. There clearly would be room for a central authority – if it can plausibly be modeled as fully benevolent.

The essay has been written with the Russian Federation in mind. Being formally a federation of 89 regions with substantial de facto power in economic decision-making, Russia is indeed an interesting testing ground for several aspects of regional competition. To mention a few examples, Solanko and Tekoniemi (1999) analyse competition in the business environment between two small regions – Novgorod and Pskov, and Kolomak (2000) explores the role of regional tax exemptions in attracting investment. But the lessons of the essay could as well be applied to other large transition countries, such as China and Kazakhstan, which face very similar institutional challenges.

3.2 On convergence and growth across Russian regions

The second essay, 'On convergence and growth across Russian regions', offers an empirical contribution to the discussion on convergence or divergence across the Russian Federation. The essay applies the basic notions of neoclassical growth theory, conditional

and unconditional convergence, to data on 76 Russian regions for 1992–2003.

This essay aims to contribute to the literature by analysing a somewhat longer time period than the earlier studies and by splitting the sample into initially rich and initially poor regions. The data are from the official and publicly available publications of the Federal State Statistics Service of Russia (Rosstat, formerly Goskomstat). The major limitation of the Rosstat indicators used here is that they include only monetary income and so generally underestimate total income. To overcome this limitation one would need to rely on regionally representative household survey data, which unfortunately are not available for Russia.¹⁷ Therefore, annual data on monetary income per capita deflated by regional consumer price indices (CPI) are used as the measure of regional income. The advantage of using data up to 2003 is that one can analyse the possible effects of the 1998 economic crisis in Russia – something the earlier literature has not been able to do.

In line with the earlier literature, and general perceptions, strong sigma-divergence in 1992–2003 is found. Dispersion of regional mean incomes is found to have doubled over the period. Further, it is clear that the crisis year 1998 caused a remarkable decrease in dispersion, which turned out to be only temporary. Post-1998, the dispersion has again increased rapidly, especially among the initially poor regions.

Next, unconditional beta-convergence across regions is analysed. The results help to highlight the need for great care in selecting the initial year in convergence analysis when the period studied is fairly short and covers a major economic transition. Using the minimal model in the spirit of de la Fuente (2000), statistically significant unconditional convergence is found for 1992–2003. But for a somewhat shorter period, 1994–2003, statistically significant convergence cannot be established. Moreover, the results suggest that the crisis year 1998 was an important watershed: unconditional convergence is found to be considerably stronger before 1998 than afterwards.

Splitting the sample into two groups, those initially rich and initially poor, offers some additional insights. No evidence of unconditional convergence among the initially poor is found, whereas among the initially rich regions there is a clear trend of convergence.

¹⁷ Two household level datasets on Russia do exist. However, the RLMS survey implemented by the University of North Carolina, with the help of the World Bank and several Russian agencies, is not regionally representative. Rosstat's household budget survey, on the other hand, is not publicly available.

This may be taken as weak evidence of club convergence, ie the initially rich regions are converging among themselves. The group of initially poor regions is neither converging nor diverging. This finding is in line with the Kanbur-Venables (2005) projection that by 2010 Russia's poor will be concentrated in a few unlucky regions while the better-off will be virtually free of poverty.

The essay then proceeds to discuss possible determinants of regional steady states. Based on earlier findings in the literature and on data availability, a reasonably compact set of five variables is chosen as controls for the analysis of conditional convergence. The straightforward cross-sectional regression of income growth on the initial level of income and the control variables produces surprisingly strong results of conditional convergence. When controlling for the chosen proxies of regional steady states, the coefficient of the initial income level is negative and statistically significant, not only for 1992–2003 but also for shorter subperiods.

Once again it is noted that the results seem to differ between the rich and the poor group. The simple model of conditional convergence succeeds fairly well in explaining income dynamics within the rich group. On the contrary, the model largely fails to explain the growth experiences of the initially poor regions. Further, as in the case of unconditional convergence, the results clearly indicate that conditional convergence was stronger in 1992–1997 than in the post-crisis period 1999–2003.

To sum up, there seems to be some, if not very robust, evidence of both conditional and unconditional convergence, especially among the initially richer regions. The results on conditional convergence are particularly strong, which suggests that regions with similar initial industrial structures are converging towards similar steady states. At the same time the dispersion in mean incomes, as measured by sigma-convergence, has increased sharply. It is observed that there is much less evidence of convergence after the economic crisis of 1998. This suggests that the sharp devaluation of the ruble in 1998 and the dramatic increases in the world market prices of raw materials may have caused a permanent change in income dynamics across Russian regions. The reasons for the break clearly merit a study of their own once more data become available.

3.3 Coping with missing infrastructure

Where competition in capital tax rates or in public infrastructure goods may lead to equilibria that are not desirable from the consumers' perspective, missing or inadequate infrastructure often pose serious challenges for enterprises. The third essay 'Coping with missing infrastructure' analyses the determinants of infrastructure provision – as proxied by district heating provision – by large Russian industrial enterprises.

The essay builds on a unique survey-based dataset on large and medium-sized industrial enterprises in Russia.¹⁸ As the survey data help to highlight, infrastructure provision is still fairly widespread and largely determined by the Soviet legacy. Even though most of the social assets of the former state-owned enterprises were divested by the late 1990s, enterprises remain important players in local infrastructure (eg heat, roads, water & sanitation, waste collection) provision. It is found that close to half of the surveyed enterprises give voluntary support for maintenance or upkeep of local infrastructure. Further, three-quarters of the large Russian enterprises produce heating, and more than half provide district heating also for communal users outside their plant area.

This essay analyses the possible determinants of infrastructure provision, as proxied by district heat provision, by Russian industrial enterprises. The probit analysis provides robust evidence on the importance of both the inherited factors and relations with the public sector in determining the probability of producing and providing heating. Enterprises engaged in infrastructure provision tend to be larger and older than those relying solely on publicly provided infrastructure. And everywhere – not least in a transition economy – size tends to come with connections and influence. The results show that firms providing district heating to users outside their plant area are more likely to have close and multidimensional relations with the local public sector. First, heat producing enterprises are more likely than other firms to receive preferential treatment in the form of direct or indirect budget support. Second, heat producing enterprises seem to face a somewhat heavier regulatory burden. Further, it is found that, even if a heat providing enterprise would like to get rid of this operation, it may not be willing to take the necessary steps for fear of worsening relations with the local public sector.

¹⁸ See Haaparanta et al (2003) for data description.

The analysis further confirms that infrastructure-providing firms do not differ from other enterprises in terms of sales, profits or investment. As the regulated energy tariffs have rarely covered even the costs of supply in Russia, one is inclined to believe that infrastructure-providing enterprises have been able to use their connections with the public sector to compensate for the additional costs.

This cooperation between incumbent infrastructure-providing enterprises and local public sector is likely to lead to a mutually beneficial equilibrium from which no party has an interest in departing. New entrepreneurs or small and medium-sized enterprises will have a hard time competing with infrastructure-providing incumbents. The economic playing field in Russia may therefore remain tilted in favor of large incumbent firms. This raises an interesting policy question: should the central government wish to break the status quo, what would its options be? In order to break the status quo, the central government would need to ensure that entry costs to sectors dominated by large incumbents are reduced. Another fruitful path might be to give local politicians a greater direct interest in the fortunes of small and medium-sized enterprises. Analysing and modeling these issues is an interesting area for further study.

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Essay 1

Tax competition in a transition economy

Laura Solanko

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1 Introduction

Much of the literature on tax competition concludes that tax rates on mobile factors in an uncoordinated equilibrium tend to be too low compared to a first-best unitary (coordinated) solution. This leads to excessively low revenues and thus, from the welfare point of view, an excessively low level of public expenditure in the equilibrium. This view was formally modeled by Zodrow and Mieszkowski (1986) and by Wilson (1986). Additionally, fiscal competition may affect the composition of public goods provided by the regions. Keen and Marchand (1997) show that, in the presence of mobile capital, fiscal competition tends to lead to over-provision of public inputs in infrastructure and under-provision of items that directly affect consumer welfare such as social services. In the classic framework of fiscal federalism, this clearly implies an additional welfare loss due to fiscal competition. Thus, it seems there are strong arguments for the coordination of both tax rates and regional expenditure in the presence of competition for mobile factors. More recent contributions to the theory of tax competition have investigated the many ways in which tax competition can have desirable effects. These studies often have their roots in the Brennan and Buchanan (1980) view of government as a revenue-maximising Leviathan.¹

Nevertheless, decentralization, especially in the first half of the 1990s, was actively promoted as a necessary policy choice for most transition economies in Central and Eastern Europe and the former Soviet Union. Decentralization was portrayed as a means of exiting from the excessive centralization and politicization of economic life. While the policy discussion at the international level has recently shifted to the institutional requirements of successful decentralization, the debate over the potential benefits of decentralization is far from over.

This paper examines tax competition in a transition environment. I will argue that fiscal competition may be at least partially beneficial for a country in transition from a centrally planned socialist economy. Indeed, Qian and Roland (1998) proposed that in a transition economy decentralization combined with regional competition for mobile capital reduces subsidies to local state enterprises and is thus potentially beneficial for the transition process. This advantage, however, comes at the cost of allocative distortion because it tends to

¹ See Wilson and Wildasin (2004) for an excellent review of capital tax competition.

encourage a scarcity of local public goods and overinvestment in infrastructure – the familiar Keen and Marchand (1997) result. The model used in their paper, however, differs from the widely used fiscal competition framework.

The analysis here is based on the standard static Zodrow-Mieszkowski (1986) model of capital income taxation as interpreted by Keen and Marchand (1997). By adding certain distinctive transition features to their standard model, I hope to shed light on the interaction of regional competition and transition process. My aim here is essentially to introduce two specific transition features into a model which is simpler and conforms better to the fiscal competition literature than that of Qian and Roland (1998) and then to determine whether competition in such a framework is welfare-improving.

Section 2 discusses some details of the transition-specific features of the model. Section 3 presents a basic model of tax competition in a transition country, and section 4 concludes.

2 Modeling a transition economy

As a starting point in defining transition, I use Blanchard's (1997) view of transition as a reallocation of an economy's resources (capital and labor) from the state sector to private-sector enterprises. Blanchard applies a simple two-sector model, in which the sectors have identical production functions but goods produced by the state sector are of low quality. In my model, the two sectors of an economy in transition use the same inputs and produce an identical good, but the productivity of the old sector is lower than that of the new one. In this model, higher productivity in the new sector is a sign of successful restructuring (ie new products and product differentiation, internal reorganization and education), or new business practices (ie advertising, marketing, better management). The new, more efficient sector may include new private firms as well as restructured former state-owned enterprises. Instead of restructuring the old sector enterprises retain their old habits such as close relations with regional administration and old product lines. The old sector represents all non-restructured enterprises, privatized or not. A newly established firm may also be included in the old sector if its business practices have more in common with the old sector (eg it faces soft budget constraints) than the new sector.

Following Blanchard (1997) I further assume that in pre-transition allocation, a careful mix of taxes and subsidies encouraged state firms

to produce mediocre goods and consumers to buy them. Transition here is seen as the elimination of these taxes and subsidies (liberalization and removal of subsidies). Since the new sector is by definition more efficient, full transition will *ceteris paribus* result in an equilibrium where only a private good is produced. Since the model used in this paper is a static equilibrium model, in absence of any frictions transition should begin with an instantaneous shift from old to new sector production. The old sector vanishes and consumer welfare is maximized. The friction preventing this instantaneous shift from occurring in my model is the regional decision-maker with private interests in old-sector economic activity.

Thus the second transition feature in my model considers the objectives of decision-makers. It seems reasonable to assume that decision-makers enjoy close ties with regional old enterprises. An essential aspect of the Soviet economy and society was excessive politicization of economic decision-making. Not surprisingly Russian insider privatization did not forthrightly promote depoliticization of economic life. Privatization moves often led to insider ownership of formerly state-owned enterprises. In many instances, local politicians and managers seized control of privatized former state enterprises (grabbing hand privatization²). Indeed much of the recent literature on the Russian transition experience points to the fusion of regional economic and political decision-making as a major cause of the country's dismal economic performance in the 1990s³.

I therefore assume that decision-makers exercise a degree of control over old sector enterprises and that they divert net rents from old enterprises to their own use. Progress in transition will strip regional decision-makers of their private benefits. Giving decision-makers a personal stake in blocking transition assures that a complete transition will not occur overnight. Regional policy, taxation and public goods provision, will be used to subsidize old sector enterprises. These decision-makers are not fully benevolent, but not pure Leviathans either. Instead, as in Edwards and Keen (1996), they maximize a weighted average of consumer welfare and their private benefit⁴. By including two sectors in the model and by giving

² The notion of the grabbing hand was introduced by Frye and Shleifer (1997) to characterize a badly organized government consisting of several independent bureaucrats pursuing their own economic and political agendas.

³ See eg Hanson and Bradshaw (2000), Shleifer and Treisman (2000), Treisman (1999), and Desai and Goldberg (2000).

⁴ This formulation of decision-makers preferences is raised as a special case by Edwards and Keen (1996). Similar modeling of a semi-benevolent decision-maker is also present in many models of lobbying, eg Persson (1998), Grossman and Helpman (1994).

politicians a special interest in one of them this model complements the analysis of Edwards and Keen (1996) by offering a somewhat richer story for how politicians ‘divert money’. While this assumption seems well in line with empirical observations of transition countries and Russia in particular, it is a purely exogenous assumption. Very little, if any, formal modeling has been done on decision-maker preferences in a transition environment and certainly this seems a tempting area for further research.

To my knowledge, only Qian and Roland (1998) have attempted to offer a framework combining transition and regional competition. Their model, however, has its origins in a completely different framework than that of the standard tax competition models. In my model, the moral hazard problem – so central in Qian and Roland (1998) – is omitted. I assume that all state sector enterprises are identical, so that all firms in the sector receive an identical capital subsidy. As that subsidy must be paid by the new sector firms, to satisfy the government’s budget constraint, the negative subsidy will be modeled as a capital tax levied only on the new sector.

Much of the discussion applies to the Russian Federation, by far the largest European transition country and constitutionally a federation currently consisting of 88 regions. Certainly, there are examples of competition among Russia’s regions, especially in attracting foreign direct investment.⁵ Nevertheless, the features of insider ownership, slow restructuring and less-than-benevolent decision-makers are common to all transition countries. Other former Soviet Union countries such as Ukraine and Kazakhstan face regional problems very similar to Russia’s.

⁵ See eg Solanko and Tekoniemi (1999) and Kolomak (2000).

3 Capital tax competition in a transition economy

3.1 The basic model

Let us consider a federation consisting of several small, identical regions. Federal power is completely passive in this model. Decisions about tax levels and provision of regional public goods are made only on the regional level. Under this assumption, issues related to vertical tax competition can be excluded from the analysis. Every region has two types of firms: old and new.⁶ Both sectors use mobile capital to produce a single consumption good and by definition private sector production is more efficient, ie $F^N(K) = \beta F^S(K)$, $\beta > 1$.

Unlike with some models of tax competition, we are not particularly interested in analyzing the effects of competition and coordination on labor supply and real wages. Moreover, in the majority of transition countries – as opposed to Western European countries – taxes on labor income are negligible sources of government income.⁷ Since adding a fixed labor supply to the model does not change any fundamental results, only a one-factor model is presented.⁸

Since all regions are assumed identical, we concentrate on a representative region. Regions tax rents (profits) at rate t and private sector capital at rate T to finance provision of a single regional public good. The assumption of zero capital tax in the old sector has its origins in the non-benevolence of decision-makers. As the regional politicians have private interest in old sector production, in equilibrium a capital tax on the old sector would always be lower than on the new sector. The model would remain unchanged as long as the difference between the capital tax rates remains large enough to keep some old sector production alive. To simplify the model, I assume a zero tax rate instead of a lower capital tax on the old sector.

⁶ Old sector variables are marked with superscript S (R^S , K^S , F^S), new sector variables with superscript N. Subscripts stand for derivatives.

⁷ An excellent review of personal income taxation and the recent tax reforms in Russia is provided by Ivanova et al (2005).

⁸ Matsumoto (2000) shows that when both capital and labor are fully mobile, the basic results of the Keen and Marchand (1997) model do not necessarily hold. Empirical observations of the Russian labor markets, however, suggest that labor is quite immobile between regions; see eg Friebe and Guriev (2000).

The stock of capital used in production is fixed at the national level, but at the margin mobile among regions. Every region is assumed to be so small that no region can alone influence the net return on capital ρ . Because capital is mobile, any marginal increase in the capital tax level induces a marginal outflow of capital from that region.

3.1.1 The firms

Firms in both sectors behave competitively and maximize rents (profits) $\bar{R} = R^S + R^N$.⁹ Capital markets are assumed to be perfectly competitive in the sense that capital moves between the two sectors, so that in equilibrium the net return on capital ρ is equalized. Capital is fully mobile between sectors and regions, but fixed in supply at the national, or federal, level.

It is assumed that there is an additional fixed cost B in production in the old sector. Adding a fixed cost to the production function of the old sector is admittedly a highly simplified but a fairly powerful way of modeling full transition. It is assumed that in the old sector an enterprise needs a considerably large network of well-established contacts in order to survive in transition. To establish and maintain these relations an enterprise in the old sector needs to devote a fixed amount of resources to contacts with its beneficiary owners as well as several regulatory organs.¹⁰ The existence of a fixed cost implies that there is a ‘turning point’ or ‘no-return point’ along the transition path. Once the production in the old sector has decreased to the level where $F^S(K^S) = \rho K^S + B$, any marginal decrease in the amount of capital in the old sector makes rents negative and *ceteris paribus* destroys the old sector.

Rents in the two sectors are

$$R^S = F^S(K^S) - \rho K^S - B \quad (3.1)$$

$$R^N = F^N(K^N) - (\rho + T)K^N \quad (3.2)$$

⁹ The existence of rents in a transition economy should not come as a surprise. The source of rents in the economy could be eg relational capital or land over which enterprises have *de facto* control.

¹⁰ There is, indeed, some evidence from Russia that enterprises that are able to influence political decision-making do face greater regulatory burdens (Frye, 2002).

It is assumed that the production technology F in both sectors is strictly concave in capital. This implies the usual marginal conditions $F_K > 0$, $F_{KK} < 0$ for both sectors. The demands for capital $K^S(\rho)$, $K^N(\rho+T)$ depend on the net return on capital. Fully mobile capital earns a net return ρ in every sector and every region, so that in equilibrium

$$\rho = \beta F_K^S - T = F_K^S \quad (3.3)$$

The above condition may be treated as two distinct capital market equilibrium conditions. First, as the net return on capital is given, the equilibrium of a representative region is characterized by $\rho = F_K^N - T$. Second, the condition that $\beta F_K^S - T = F_K^S$ gives the allocation of capital between the two sectors within each region. The capital market equilibrium condition (3.3) also indicates the level of capital taxation $T = F_K^S(\beta - 1) > 0$. This can equivalently be viewed as a subsidy paid to the old sector to keep it in business. The greater the productivity difference, the higher the capital tax.

From the perspective of a small region, an increase in the capital tax in one region does not affect the net return of capital ρ in the federation. On the contrary, it only induces an outflow of new sector capital from that region. From the point of view of the nation, it is not the net return but the capital stock that is fixed. When regions can decide on a uniform increase in capital tax rate, the net return on capital is affected. As a capital tax is imposed only on capital used in the new sector, a common increase in T tips the balance between the old and the new sector in favor of the old one. Since the amount of capital is fixed at the national level, for coordinated tax changes $K_T^{N*} = -K_T^{S*}$ ¹¹. For future reference some of the main results of the comparative statics are collected in Table 1 below.¹²

¹¹ I denote change variables in the coordinated case with an asterisk*.

¹² Derivations of the results are provided in appendix 1.

Table 1.

Marginal effects of changes in capital tax T

Non-cooperative marginal changes	Cooperative marginal changes
$R_T^N = -K^N < 0$	$R_T^{N*} = -K^N(1 + \rho_T^*) < 0$
$R_T^S = 0$	$R_T^{S*} = -K^S \rho_T^* > 0$
$K_T^N = \frac{1}{F_{KK}^N} < 0$	$K_T^{N*} = \frac{1}{(1+\beta)F_{KK}^S} < 0 \forall \rho$
$K_T^S = 0$	$K_T^{S*} = -K_T^{N*} > 0$
$\rho_T = 0$	$\rho_T^* = F_{KK}^N K_T^{N*} - 1 = \frac{-1}{1+\beta} < 0$
$\bar{R}_T = -K^N$	$\bar{R}_T^* = -K^N + \bar{K} \frac{1}{1+\beta} < 0$

None of the regions in this federation are linked by trade. Everything produced in a region is consumed there, and the income on capital is consumed in the region where it is earned. This assumption assures that public good provision in one region has no spillovers to others. The total production in one region is $F^S + F^N$. Thus, the resource constraint of a representative region is

$$\bar{F} = F^S + F^N = (1 + \beta)F^S = C + G \quad (3.4)$$

If, for some exogenous reason, capital moves from old to new sector within a region, total production in that region would increase by $(\beta - 1)F_K^S \Delta K$, where ΔK is the amount of capital moving. Other things equal, as transition (interpreted here as reallocation of capital from old to new sector) proceeds, total production increases. I call this an efficiency gain from transition. Analogously, if capital moves back to the old sector, total production decreases.

In a one-sector model such as Edwards and Keen (1996) or Keen and Marchand (1997), a common change in capital tax does not alter the production level nor the rents in the economy. Contrary to the standard tax competition models, entrepreneurs in this model can always switch back to the business practices of the old sector. Consequently, a coordinated increase in T tips the balance between old and new sectors in favor of the former, thereby reducing total production.

3.1.2 The consumer and the decision-maker

There is a representative consumer in each region with preferences $U(C,G)$. The consumer's utility depends on two components: C denotes consumption of a composite good and G is a pure regional public good. The consumer's utility function is twice differentiable and both C and G are assumed to be normal goods. All capital in this federation is owned by its citizens. They are entitled to capital income $\rho\bar{K}$ and to net rents from economic activity in the new sector in their home region $(1-t)R^N$. The consumer's utility is maximized with respect to the consumer's budget constraint

$$C = M = (1-t)R^N + \rho\bar{K} \quad (3.5)$$

It is clear that for the representative consumer M is essentially a lump sum income. Thus the indirect utility function for the representative consumer is

$$V = V(G, M) = V(G, (1-t)R^N + \rho\bar{K}) \quad (3.6)$$

The decision-makers (politicians) in each region receive net rents from production in that sector. The decision-maker seeks to maximize a weighted average of indirect consumer utility V and his private benefit $\Phi = (1-t)R^S$, where R^S is defined by (3.1). The weights reflect the degree of benevolence of the decision-maker. A fully benevolent one would have $\alpha = 1$, and a pure Leviathan would maximise his private benefit with $\alpha = 0$. In reality it is fair to assume that the value of α depends on a variety of insitutional factors such as corruption and re-election prospects. The decision-makers therefore maximize W

$$W = \alpha V + (1-\alpha)(1-t)R^S \quad (3.7)$$

with respect to regional tax instruments T, t and regional public good provision G subject to the public sector's budget constraint

$$G = t\bar{R} + TK^N \quad (3.8)$$

where $\bar{R} = R^S + R^N$. The regional government cannot borrow, so its budget constraint will hold with equality.

The capital tax is a pure regional tax in the sense that regions decide on both tax base and tax rate. Regional decision-makers may

impose a positive capital tax only on the new sector but they can not differentiate between the two sectors in rent taxation. Rent taxation is regional only in the sense that regions can set the tax rate up to an upper limit \bar{t} , but the tax base is set exogenously (by federal authority). It is assumed that rents cannot be fully taxed, giving the additional constraint $t \leq \bar{t} < 1$ that regional politicians need to take into account.

In the following subsections, I analyze consumer welfare under two regimes. In one, regions compete with each other to attract mobile capital. In the other, regions coordinate their tax policies.

3.2 Competitive equilibrium

The optimization problem of a typical regional government in a non-cooperative situation is to maximize Lagrangian (3.9) with respect to government policy variables G , T , and t .

$$L = \alpha\{V[G, (1-t)R^N + \rho\bar{K}]\} + (1-\alpha)(1-t)R^S + \mu(TK^N + t\bar{R} - G) + \lambda(\bar{t} - t) \quad (3.9)$$

The first two terms are the weighted average of indirect consumer utility and the decision-maker's private benefit. The third is the government's budget constraint and the fourth a constraint on pure profit taxation. The resource constraint (3.4) holds according to Walras' law. The first-order conditions for a non-cooperative equilibrium can be written

$$G : \alpha V_G - \mu = 0 \quad (3.10)$$

$$T : \alpha(1-t)V_M R_T^N + \mu K^N + \mu T K_T^N + \mu t \bar{R}_T + (1-\alpha)(1-t)R_T^S = 0 \quad (3.11)$$

$$t : -\alpha V_M R^N - (1-\alpha)R^S + \mu \bar{R} - \lambda = 0 \quad (3.12)$$

where M denotes the lump-sum income component of the consumer's indirect utility. If consumers were entitled to all net rents in the economy, (3.12) straightforwardly yields $V_G - V_M > 0$.

Using (3.10) in (3.12), and rearranging yields

$$\alpha R^N (V_G - V_M) = \lambda - \alpha V_G R^S + (1-\alpha)R^S = A \quad (3.13)$$

Before continuing the analysis of the competitive equilibrium it might be useful to see how the equilibrium would look in our two-sector economy if the decision-maker cared only about consumer welfare, ie if $\alpha = 1$. In this benchmark case, (3.13) would become

$$R^N(V_G - V_M) = \lambda - V_G R^S \quad (3.14)$$

If the rents in the old sector are zero (ie the old sector no longer exists) is it possible to directly state that consumers marginal utility of public good consumption exceeds the cost of providing the good, $V_G - V_M > 0$. The existence of taxable rents in the old sector in fact increases consumer welfare as long as $|V_G R^S| < \lambda$. This is simply due to the fact that from the consumer's point of view part the provision of the public good is financed from an external source. Therefore it is possible that if early transition is associated with very high rents in the old sector, even in a competitive equilibrium public goods would be overprovided. This seems a very plausible result. At the outset of transition consumers clearly preferred more private consumption to more public goods.

When the decision-maker is not fully benevolent, the right hand side of (3.14) is altered in two ways. One positive term $(1 - \alpha)R^S$ is added and the negative term $-V_G R^S$ is multiplied by $\alpha < 1$. Comparing equilibrium conditions (3.13) and (3.14) it is clear that the non-benevolence of the decision-maker makes it more probable that public goods are underprovided in the sense that $V_G - V_M > 0$.

Since αR^N is always positive as long as the new sector exists $(V_G - V_M) > 0$ if $\lambda + R^S(1 - \alpha) - \alpha V_G R^S > 0$. Equivalently

$$V_G - V_M > 0 \quad \text{when} \quad A = \left(1 + \frac{\lambda}{R^S}\right) - \alpha(1 + V_G) > 0 \quad (3.15)$$

Clearly, the smaller the weight given to consumer welfare α and the smaller the rents of the old sector, the more probable it is that $A > 0$.

Finally, using (3.10) and the results in Table 1 in (3.11), and rearranging, we obtain the following first-order condition for T characterizing a non-cooperative equilibrium

$$\frac{V_G}{V_M} = \left[1 + \frac{TK_T^N}{K^N(1-t)} \right]^{-1} > 1 \quad (3.16)$$

Equation (3.16) is the familiar marginal cost of public funds expression indicating underprovision of G at the competitive equilibrium. The inequality holds since the capital tax $T > 0$ and rent tax $t < 1$, by assumption. This confirms that $A > 0$ as (3.15) and (3.16) must hold simultaneously in an equilibrium. The magnitude of the inequality, however, depends negatively on the amount of production (ie capital) in the new sector. The larger the value of K^N , the closer to one is the right hand side of equation (3.16).

Because in a non-cooperative (competitive) equilibrium an increase in the capital tax only induces capital outflows to other regions, the regional decision-makers have no tools to increase their private benefit $(1-T)R^S$ via the capital tax. Compared to a standard one-sector economy, the additional distortions emerge from the two transition features of the model: the non-benevolence of the decision-makers and the ownership structure. Even if the decision-makers would only maximize consumer welfare, public goods would be underprovided, as shown by (3.14) and (3.16) holding simultaneously. Due to the fact that public goods are partly financed by rent tax collected from the old sector, this underprovision is smaller than it would be if rents from old sector activity accrued to the consumer instead of the decision-maker.

The findings are summarized in Proposition 1 below.

Proposition 1. *When decision-makers own state sector rents, in a symmetric non-cooperative equilibrium:*

- a) Public goods are underprovided.*
- b) This underprovision is likely to be more severe in early transition when the tax base of capital taxation (capital in the new sector) is small – especially where rents in the old sector are small.*
- c) The underprovision is likely to be the more severe, the smaller is the weight given to consumer welfare.*

Given the above findings, in a non-cooperative equilibrium capital tax T is set too low. As discussed above, there is a negative relationship between T and F^N , indicating that in a non-cooperative equilibrium more is produced in the new sector. Thus, despite leading to underprovision of public goods, tax competition promotes transition.

The interesting question taken up in the following subsection is whether under certain conditions the efficiency gain from transition, ie increased private consumption, is large enough to compensate for the disutility of insufficient public goods provision.

3.3 Common increase in the capital tax

Assuming that in the non-cooperative equilibrium the public good is underprovided, a commonly suggested remedy is to centralize all or some parts of fiscal policy-making. A common increase in the capital tax used to increase the provision of the public good should be welfare improving. Centralization can be interpreted as delegating decision-making to one national decision-making body with preferences identical to those of the regional authorities. Identical results are naturally attained if centralization is seen as a fully coordinated action carried out simultaneously by all regions. In the following, I apply the notions of common or coordinated policy change to characterize centralized decision-making.

In the one-sector model, a common increase in T lowers ρ by the same amount in every region and rents are unaffected. Consequently, the welfare improvement is $\frac{dV}{dT} = K(V_G - V_M)$. If the common increase in T starts from the non-cooperative equilibrium, by (3.13) $\frac{dV}{dT} > 0$. In the two-sector economy that concerns us, the effects of a common increase in T are less straightforward.

A coordinated increase in T ensures that no capital K^N will move to other regions. But, inside each region some K^N is likely to move to the old sector until $\beta F_K^S - T = F_K^S$. Even though the total amount of capital in a region will not change, the relative share of the new sector is likely to decline, which will lead to a decrease in total production equivalent to $\bar{F}_T^* = TK_T^{N*}$.

To analyze the effects of a common marginal increase in T on welfare, I follow the technique applied in the Keen and Marchand (1997) model. As the common increase in T is used solely to finance some additional G , one can plug the government budget constraint (3.8) into the consumer's indirect utility function V to obtain

$$V = V(TK^N + t\bar{R}, (1-t)R^N + \rho\bar{K}) \quad (3.17)$$

The common marginal increase in T used to provide additional G has the following effect on consumer utility¹³

$$\begin{aligned}\frac{dV}{dT^*} &= V_G(K^N + TK_T^{N*} + t\bar{R}_T^*) + V_M(1-t)R_T^{N*} + V_M\rho_T^*\bar{K} \\ &= (tR_T^{N*} + K^N)(V_G - V_M) + \rho_T^*V_MK^S(1-t) + V_GTK_T^{N*}\end{aligned}\quad (3.18)$$

Using the results from Table 1, we note that $K_T^{N*} = \frac{\beta}{1+\beta}K_T^N$, the outflow of capital from the new sector is smaller in the coordinated case than in the non-coordinated setting.¹⁴ Since we are interested in marginal changes in consumer utility caused by a marginal common increase in capital tax starting from non-cooperative equilibrium, we can presume that the first-order conditions of the non-cooperative equilibrium are valid. Multiplying (3.16) by $\delta = \frac{\beta}{1+\beta}$ we get

$$V_GTK_T^{N*} = V_G\bar{F}_T^* = -\delta(V_G - V_M)(t\bar{R}_T + K^N)^{15}\quad (3.19)$$

Using (3.19), the fact that $1 - \delta = -\rho_T^*$, and results from Table 1 in (3.18) and rearranging we obtain

$$\frac{dV}{dT^*} = -\rho_T^*[(V_G - V_M)(K^N + tK^S) - V_M(1-t)K^S]\quad (3.20)$$

The first term on the right-hand side is always positive, and the second term is always negative. In this model the standard welfare effect of a coordinated increase in capital tax is altered in three significant ways: the extent of transition, the productivity difference, and the ownership structure all influence the direction and magnitude of the welfare change.

First, the welfare change characterized by (3.20) is likely to depend on the relative shares of the old and new sectors in the region's economy. It is clear that the increase in consumer welfare increases as transition proceeds, ie as $\frac{K^N}{K}$ increases. If the old sector is the dominant type, the volume of total production is relatively low and

¹³ The calculation are in Appendix 2.

¹⁴ $K_T^N = \frac{1}{\beta F_{KK}^S} = \frac{1+\beta}{1+\beta} \frac{1}{\beta F_{KK}^S} = \frac{1+\beta}{\beta} \frac{1}{1+\beta F_{KK}^S} = \frac{1+\beta}{\beta} K_T^{N*}$

¹⁵ The calculations is in Appendix 3.

the economy is said to be in ‘early transition.’ Because the model here is static, the notions of ‘early’ and ‘late’ transition do not refer to specific time horizons. Instead, they refer to the extent or stage of transition in the representative region. We are able to unambiguously define the direction of the welfare change in two special cases.

a) When transition is ‘over’, ie when K^S is close to zero, the result in (3.20) reduces to $-\rho_T^* \bar{K}(V_G - V_M) > 0$. Thus, as the economy approaches the classical one-sector economy, a coordinated increase in the capital tax is unambiguously welfare-improving.

b) In very early transition, when the new sector is negligible, (3.20) reduces to $-\rho_T^* \bar{K}(tV_G - V_M)$, which is negative as K^N approaches zero.¹⁶ When the share of the new sector is negligible, the transition effect dominates. Consumers would prefer a competitive equilibrium with lower taxes, lower public goods provision, and a higher share of new sector production to any coordinated marginal increase in T and G.

Second, due to the productivity difference, there is an additional multiplier $-\rho_T^* = \frac{1}{1+\beta} < \frac{1}{2}$ when $\beta > 1$. In a one-sector economy $\rho_{T^*} = 1$. The larger the productivity difference between the two sectors, the smaller the value of $-\rho_T^*$ and thus the smaller the increase in consumer utility characterized by (3.20). Even in late transition the welfare improvement resulting from a common increase in T is smaller than in the classical one-sector economy.

Third, the second term on the right-hand side of (3.20) is a consequence of the ownership structure, which differs from the standard framework. Any common marginal increase in T leaves consumers $-V_M(1-t)R^S$ worse off than in an economy where consumers are entitled to net rents from all economic activity in their region.¹⁷ Whether such a coordinated move is welfare-improving clearly depends on the level of rents and the amount of capital remaining in the old sector.

The change in a decision-maker’s objective function due to a small common increase in the capital tax rate is

¹⁶ See Appendix 4 for proof.

¹⁷ If decision-makers obtained an insignificant benefit from continued production in the state sector ($\Phi = (1-\alpha)K^S$) while consumers were entitled to all net rents in the economy, the welfare change due to a common marginal increase in capital tax rate would be $-\rho_T^* [(V_G - V_M)(K^N + tK^S)]$ instead of (3.20). Derivations are available from the author upon request.

$$\frac{dW}{dT^*} = \alpha V_{T^*} + (1 - \alpha)(1 - t)R_T^{S^*} \quad (3.21)$$

The second term is always positive as long as the state sector exists. Thus the decision-makers always favor coordination. Rearranging (3.21) yields

$$\frac{dW}{dT^*} = -\rho_T^* [\alpha(V_G - V_M)(K^N + tK^S) + (1 - t)K^S(1 - \alpha - \alpha V_M)] \quad (3.22)$$

The first term inside the square brackets is always positive, and the second term is positive if $\alpha < \frac{1}{1+V_M}$. The larger the old sector, the smaller the increase in consumer welfare and the larger is the decision-maker's private benefit from a common marginal increase in T . For small values of α , it may still be in the interests of regional decision-makers to coordinate their actions and increase the capital tax rate even if consumers would in fact prefer a coordinated decrease in the tax rate. Unless α is close to unity, it is unlikely that (3.22) would ever be negative.

The results are summarized in Proposition 2 below.

Proposition 2. *Starting from a symmetric non-cooperative second-best equilibrium where public good G is underprovided:*

- a) *A common increase in the capital tax T used to finance some additional public good G may reduce consumer welfare in early transition.*
- b) *A common increase in T may occur even in early transition, as it always increases state sector rents and consequently the private benefit of the decision-makers.*
- c) *An increase in the degree of decision-maker's benevolence α reduces the probability of a common increase in T in early transition.*

Part a) of the proposition is similar to the findings of Qian and Roland (1998). They conclude that regional competition is beneficial, as it forces state owned enterprises to restructure and increases the efficiency of the economy overall. In this framework, competition drives capital tax rates down and promotes reallocation of capital from old to new sector. When a politician cares about the rent level in the inefficient old sector, tax competition may – at least in early transition – improve consumer welfare. When allocation of the economy's

resources from old to new sector is close to final, the common increase in T will increase social welfare. Thus, as we approach a one-sector ‘normal’ economy, we are more likely to see the standard-type welfare effect.

Part b) of the proposition stems from the fact that $R_T^{S*} = -\rho_T^* K^S > 0$, as stated in Table 1. While this is self-evident from the model definition, it nevertheless has interesting implications. As regional decision-makers are stakeholders in state sector enterprises, they have a private incentive to delay transition by coordinating their tax policies and possibly overtaxing the new sector. Even if consumers prefer a coordinated decrease in T , coordination may result in an increase in the tax rate. In such a situation, consumers clearly prefer the competitive equilibrium to coordination. Thus, under certain conditions, regional competition may both promote transition and be welfare-improving for consumers, ie for citizens of the federation.

Part c) highlights the fact that decision-makers’ preferences are a central issue. Changes in α would automatically cause changes in the equilibrium outcome.

Therefore, one should be especially cautious in drawing policy conclusions from Proposition 2. Starting from a centrally planned situation, creating conditions for regional competition must include decentralizing fiscal policy-making to some extent. However, it is far from obvious that decentralizing decision-making leads to regional competition when decision-makers are not offered new incentives. Even if, contrary to the results of classical tax competition models, competition benefits the majority of the population, the decision-makers in a transition country may be prone to coordinate their tax decisions as much as possible. Further, if decision-makers can successfully coordinate their tax policies, the result may be an equilibrium with excessively high capital tax rates.¹⁸

4 Conclusion

The welfare effects of regional tax competition were analyzed in a simplified transition economy model with several regions and two distinct sectors of production with differing tax treatment. The old sector has lower productivity than the new sector. For the purposes of the proposed model, transition is seen as a shifting of the economy’s

¹⁸ See Appendix 5 for proof.

resources from the old, less productive sector to the new sector. Moving any amount of resources from old to new sector always increases total production in the region.

Another transition feature of my model helps explain why not all resources are immediately shifted to the new, more efficient sector. I assume that the regional decision-makers are not entirely benevolent, but instead seek to maximize a weighted average of the utility of their citizens and their private benefit. In line with considerable anecdotal and empirical evidence from many transition countries (especially former Soviet Union countries), I assume that decision-makers have a private interest in old sector production. They are in fact the beneficiary owners of old sector production.

Opening the borders to regional competition for mobile capital, as expected, leads to lower levels of taxation and consequently to lower levels of public goods provision. However, lowering the capital tax increases the profitability of the new sector and thus reduces production and rents in the old one. Since the new sector is more efficient, regional tax competition has an additional benefit – an efficiency gain from transition. When analyzing the welfare effects of a common increase in capital taxation, the loss of the efficiency gain, together with a reduction in private consumption, must be weighed against the benefits of increased public goods provision. I show that the direction of a welfare change from such a coordinated policy decision may be positive or negative depending on the stage of transition. A common increase in provision of the public good is always welfare-improving only in late transition. If the economy is at a very early stage of transition, with a significant share of economic activity still in the old sector, a competitive equilibrium may be preferred to a policy change involving an increase in both provision of the public good and capital taxation. This result was confirmed by the finding that, if decision-makers can successfully coordinate their tax policies, the result will be – from a consumer welfare point of view – an equilibrium with excessively high tax rates.

Perhaps the most striking finding was that in early transition, when regional competition would be socially beneficial, it is least likely to emerge. As the total amount of rents from the old sector is positively correlated with the total amount of production in that sector, it is precisely in early transition that decision-makers have least interest in engaging in competition for mobile capital. From a policy-analysis point of view, this result is somewhat disturbing. Coordination of actions by decision-makers in different regions in early transition may be detrimental to social welfare. However, if decision-makers assign little weight to social welfare, the model predicts that even in early

transition coordination will be chosen. In order to benefit from decentralization and regional competition, a transition economy needs to find ways to limit decision-makers' ability to pursue their private benefit.

One natural extension of the model would be to incorporate two kinds of public goods, a social public good and an infrastructure good. Assuming that regions compete for mobile capital also by providing infrastructure goods following Keen and Marchand (1997), one can prove that not only the level of public goods provision but also its composition will be altered. It is possible to show (Solanko, 2001) that the social public good is underprovided while the infrastructure good is overprovided. If we assume that the infrastructure good benefits only new sector production, the results are similar to the basic model. The direction of welfare change from a coordinated increase in social public goods provision financed by a coordinated decrease in infrastructure good is likely to depend on the stage of transition.

The model presented here is admittedly very simple, with rather restrictive assumptions being used to keep it tractable. While the assumptions as to decision-makers' preferences seem well in line with empirical observations of transition countries, they are purely exogenous. Very little formal modeling has been done on decision-makers' preferences in a transition environment. A political economy model with lobbying power could provide more insight into the regional decision-making process and the interaction of regional decision-makers with regional old sector enterprises. This is certainly seems an attractive area for further research.

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Appendix 1

Deriving results in Table 1

Non-cooperative case (regional action)	Cooperative case (federal action)
$R_T^N = -K^N < 0$	$R_T^{N*} = -K^N(1 + \rho_T^*) < 0$
$R_T^S = 0$	$R_T^{S*} = -K^S \rho_T^* > 0$
$K_T^N = \frac{1}{F_{KK}^N} < 0$	$K_T^{N*} = \frac{1}{(1+\beta)F_{KK}^S} < 0 \forall \rho$
$K_T^S = 0$	$K_T^{S*} = -K_T^{N*}$
$\rho_T = 0$	$\rho_T^* = F_{KK}^N K_T^N - 1 = \frac{-1}{1+\beta} < 0$
$\bar{R}_T = -K^N$	$\bar{R}_T^* = -K^N + \bar{K} \frac{1}{1+\beta}$

Proofs:

Using equation (3.3) and the definition of rents in the two sectors (3.1) and (3.2), the change in rents due to a small change in capital tax in non-cooperative setting is

$$R_T^N = K_T^N (F_K^N - \rho - T) - K^N = -K^N \quad (\text{A1.1})$$

and respectively

$$R_T^S = K_T^S (F_K^S - \rho) = 0 \quad (\text{A1.2})$$

Since a common increase in capital tax reduces net return on capital, the change in rents caused by such a policy is

$$\begin{aligned} R_T^{N*} &= K_T^N (F_K^N - \rho - T) - K^N (1 + \rho_T) \\ &= -K^N (1 + \rho_T) < 0 \end{aligned} \quad (\text{A1.3})$$

$$R_T^{S*} = K_T^S (F_K^S - \rho) - K^S \rho_T = -K^S \rho_T > 0 \quad (\text{A1.4})$$

and finally

$$\bar{R}_T^* = -\bar{K}\rho_T - K^N \quad (\text{A1.5})$$

Differentiating (3.3) with respect to T in non-coordinated situation yields

$$\beta F_{KK}^S K_T^N - 1 = F_{KK}^S K_T^S \quad (\text{A1.6})$$

and by rearranging

$$K_T^N = \frac{1}{\beta F_{KK}^S} = \frac{1}{F_{KK}^N} \quad (\text{A1.7})$$

Similarly differentiating (3.3) with respect to T* for dp = 0 yields

$$\beta F_{KK}^S K_T^{N*} - 1 = F_{KK}^S K_T^{S*} \quad (\text{A1.8})$$

and, by rearranging and applying $K_T^{N*} = -K_T^{S*}$, it is clear that

$$K_T^{N*} = \frac{1}{(1 + \beta)F_{KK}^S} \quad (\text{A1.9})$$

Differentiating (3.3) with respect to net return on capital in a coordinated setting yields

$$\rho_T = \beta F_{KK}^S K_T^{N*} - 1 = F_{KK}^S K_T^{S*} = -F_{KK}^S K_T^{N*} \quad (\text{A1.10})$$

Combining with the above, and rearranging, we finally obtain

$$\rho_T = \frac{\beta}{1 + \beta} - 1 = \frac{-1}{1 + \beta} \quad (\text{A1.11})$$

Appendix 2

Equation (3.18)

$$\begin{aligned}
 \frac{dV}{dT^*} &= V_G(K^N + TK_T^{N*} + t\bar{R}_T^*) + V_M(1-t)R_T^{N*} + V_M\rho_T^*\bar{K} \\
 &= V_G(K^N + t\bar{R}_T^*) + V_MR_T^{N*} - V_MtR_T^{N*} + V_M\rho_T^*\bar{K} + V_GTK_T^{N*} \\
 &= V_G(K^N + t\bar{R}_T^*) - V_M(K^N + \rho_T^*K^N) - V_MtR_T^{N*} + V_MtR_T^{S*} \\
 &\quad - V_MtR_T^{S*} + V_M\rho_T^*\bar{K} + V_GTK_T^{N*} \\
 &= (K^N + t\bar{R}_T^*)(V_G - V_M) - V_M(\rho_T^*K^N - tR_T^{S*} - \rho_T^*\bar{K}) \\
 &\quad + V_GTK_T^{N*} \\
 &= (K^N + t\bar{R}_T^*)(V_G - V_M) - V_M(\rho_T^*K^N - t(-K^S\rho_T^*) - \rho_T^*\bar{K}) \\
 &\quad + V_GTK_T^{N*} \\
 &= (K^N + t\bar{R}_T^*)(V_G - V_M) + V_GTK_T^{N*} \\
 &\quad - V_M\rho_T^*(K^N + tK^S - K^S - K^N) \\
 &= (K^N + t\bar{R}_T^*)(V_G - V_M) + V_GTK_T^{N*} - V_M\rho_T^*K^S(t-1) \\
 &= (K^N + t\bar{R}_T^*)(V_G - V_M) + V_GTK_T^{N*} + V_M\rho_T^*K^S(t-1)
 \end{aligned} \tag{A2.1}$$

Appendix 3

Equation (3.19)

Using the results in Table 1, we see that $V_G TK_T^{N*} = V_G T \frac{\beta}{1+\beta} K_T^N$. Denoting $\delta = \frac{\beta}{1+\beta}$, $V_G TK_T^{N*} = \delta V_G TK_T^N$. Since we are analysing small changes starting from the non-cooperative equilibrium we can assume the first-order conditions to hold. From the first-order condition (3.11), we know that $V_G TK_T^N = -K^N (V_G - V_M)(1-t) \Leftrightarrow \delta V_G TK_T^N = -\delta K^N (V_G - V_M)(1-t)$. Thus

$$V_G TK_T^{N*} = -\delta(V_G - V_M)(K^N - tK^N) \quad (\text{A3.1})$$

As we know from Table 1 that $-K_T^N = R_T^N = \bar{R}_T$, we can rewrite (A3.1) as

$$V_G TK_T^{N*} = -\delta(V_G - V_M)(K^N - t\bar{R}_T)$$

Appendix 4

Welfare change in early transition

When K^N approaches zero, (3.20) reduces to $-\rho_T^* K(tV_G - V_M)$ which is positive if $tV_G - V_M > 0 \Leftrightarrow \frac{V_G}{V_M} < t^{-1}$. From the first-order conditions we see that $\frac{V_G}{V_M} = \left[1 + \frac{TK_T^N}{K^N(1-t)}\right]^{-1}$. Thus $tV_G - V_M > 0$ holds if

$$1 + \frac{TK_T^N}{K^N(1-t)} > 1 \quad (\text{A4.1})$$

Rearranging (A3.1) yields $tV_G - V_M > 0 \Leftrightarrow -TK_T^N < K^N$. As $\lim K^N \rightarrow 0$ the last inequality does not hold as $-TK_T^N > 0$ always.

Appendix 5

Cooperative equilibrium

The first-order conditions (3.10) and (3.12) remain intact. With respect to T , instead of (3.11), they are

$$\alpha V_M(1-t)R_T^{N*} + (1-\alpha)(1-t)R_T^{S*} + \mu TK_T^{N*} + \mu K^N + \mu t \bar{R}_T^* = 0 \quad (A5.1)$$

Using (3.10) and results from the second column of Table 1, we solve for T

$$T = \frac{\alpha(V_G - V_M)(K^N(1-t) - t\bar{K}\rho_T^*) - \alpha\rho_T^*(V_M K^N + V_G tK^S) - \rho_T^*(1-\alpha)(1-t)K^S}{-\alpha\delta V_G K_T^N} \quad (A5.2)$$

As expected, T is larger than in a non-cooperative equilibrium (3.16), which implies that $T = \frac{K^N[(1-t)(V_M - V_G)]}{V_G K_T^N}$. Nevertheless, the tax rate is likely to be excessive from the standpoint of welfare maximization. If a decision-maker is entirely benevolent, ie $\alpha = 1$, T is

$$T^{\alpha=1} = \frac{(V_G - V_M)(K^N(1-t) - t\bar{K}\rho_T^*) - \rho_T^*(V_M K^N + V_G tK^S)}{-\delta V_G K_T^N} \quad (A5.3)$$

Compared to the equation above, the decision-maker's ability to increase his private benefit in a coordinated equilibrium raises the capital tax by an additional $\frac{\rho_T(1-\alpha)(1-t)K^S}{\alpha\delta V_G K_T^N} > 0$.

Essay 2

On convergence and growth across Russian regions

Laura Solanko

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1 Introduction

During the 1990s Russia experienced enormous regional differences in growth rates. For example, while total gross regional product (GRP) grew 7.6% in 2003, growth was by no means evenly distributed across regions. In altogether 13 regions GRP increased more than 10% and in 6 regions it actually decreased. Although these large differences are nowadays widely recognised, not much is known about what kinds of regions are growing fast and what may explain the strong divergence trends. This paper describes trends in convergence and divergence across Russian regions using publicly available Rosstat data for 1992–2003.

There are a few recent papers that analyse growth and convergence across Russian regions. Berkowitz and DeJong (2003) look at the determinants of economic growth for a group of 48 of the 89 regions over the period from 1993 to 1997. Their interest is in determining whether regional policy reform matters for economic growth, and they do, indeed, find a positive correspondence between price liberalization and growth in per capita incomes. Another study on regional growth by Ahrend (2005) uses a panel of 77 regions for a somewhat longer period. Ahrend finds that economic reform and general reform orientation explain little of the observed differences in regional growth rates. He concludes that a region's initial industrial structure and resource endowment seem to have a pronounced impact on a region's growth prospects. A somewhat similar conclusion is arrived at by Dolinskaja (2002) who analyses regional convergence in real incomes using the transition matrix approach. Her findings confirm that initial industrial structure and natural resources are significant in explaining regional differences in growth rates.

None of these papers, however, covers the period after 1998. In a recent paper, Yemtsov (2003) analyses poverty and inequality across Russian regions over 1994–2000. His emphasis, however, is on the determinants of inequality as measured by the Gini-index. Therefore, to my knowledge, there is no paper attempting to apply the very basic notions of neoclassical growth models, namely conditional and unconditional convergence, to Russian regional data. This short paper shows that there should be no reason for such neglect, as there seem to be many interesting phenomena which even a fairly simple analysis can reveal.

The following section briefly discusses the data and its limitations. Section 3 focuses on general trends in convergence and section 4

presents the results from simple growth regressions. The fourth section extends the growth analysis. The last section concludes.

2 Data description

While regional data tend to be problematic everywhere, Russian regional data are often regarded as dubious at best. In many instances it is, indeed, somewhat unclear exactly how regional data on production, incomes and prices are collected and what the precise relationship is between regional and national figures (which hardly ever add up to the same totals). These problems notwithstanding, the Russian Statistical Office, Rosstat, is the only feasible data source. In theory, the data collected and published by regional statistical offices may more accurately reflect local conditions, but gathering the data from 89 different units is clearly out of the question. Moreover, even if Rosstat data are not perfect, one can at least assume the same mistakes are made everywhere. The possible inaccuracies in Rosstat data should not make comparing Russian regions with each other impossible.

Ideally one would like to use gross regional product (GRP) as the indicator of regional real income level in any analysis of regional income distribution dynamics. Unfortunately, consistent time series exist only for the periods 1995–2000 or 1998–2004. Consequently, relying on GRP figures would unnecessarily shorten the time period of the analyses. A further complication with GRP data is that Rosstat does not publish regional GRP deflators. Even if the deflators would be available, the accuracy of GRP data is probably weaker than that of its components (Granberg and Zaitseva, 2002).

Fortunately, as one would suppose, both the monetary incomes per capita and the value of industrial production closely correlate with GRP. Both indicators are readily available from 1990 onwards. (The average annual correlation coefficients with GRP are reported below in Table 1.) The regional statistics on monetary income come close to describing regional national income. By definition, monetary income includes wages, social transfers, income from entrepreneurial activity and capital incomes of the household sector.

Table 1.

**Correlation of GRP with monetary income
and industrial production, 1995–2000**

YEAR	monetary income per capita	industrial production per capita
1995	(0.752)	(0.895)
1996	(0.793)	(0.873)
1997	(0.837)	(0.855)
1998	(0.854)	(0.837)
1999	(0.836)	(0.850)
2000	(0.875)	(0.806)
1995–2000	(0.893)	(0.873)

Further, regional consumer and producer price indices for 1992–2003 are easily available, which greatly facilitates the growth analysis. There is no self-evident decision-rule for determining which of the two indicators would be better for analysing convergence. Both have been used in earlier studies on regional growth. Yudaeva et al (2001) and Ahrend (2002) use both indicators, whereas eg Berkowitz-DeJong (2003), Dolinskaya (2002), Yemtsov (2003) and Carlauer-Sharipova (2001) use monetary incomes. In this paper, I have decided to use the income per capita indicator mainly because relying on industrial production makes agricultural regions and the regions where the service sector has any significance look unfairly poor. Nominal monetary income per capita is taken from Rosstat's *Regioni Rossii* publications and is available for 76 of 89 regions for 1991–2003.¹ Data for the nine autonomous okrugs (ao's) are reported only from 1997 onwards.

Nominal figures are deflated by regional consumer price indices (CPI) to arrive at real incomes measured in 2000 roubles.² The regional CPIs are arguably a fairly poor measure of price dynamics across regions, especially in a country where radical changes in pricing behavior occurred (Glushenko 2001). Nevertheless the reported CPIs do provide the best available proxies for inflation. It would be tempting to use the monetary incomes adjusted by a price

¹ Tsukotka, Ingushetia and Jewish ao are reported starting from 1993 thereby increasing the sample size to 79 between 1993–2003. No data are available for the Republic of Chechnia.

² This is done assuming that the price level in 2000 was roughly equal in all regions, as there is no consistent way to control for possible differences in the overall price levels. Glushenko (2003) shows that the variation in price levels in Russia as a whole was smallest in 1992 and 2000.

level indicator as the real income measure. Unfortunately, data limitations prevent this, as Rosstat does not provide any consistent measure of regional price level over the entire period. The price of a 19-basic-goods basket is reported for 1992–1994, the price of a 24-goods basket for 1994–1997, the regional minimum subsistence level for 1996–1999, and finally the price for a minimum food basket from the year 2000 onwards. A further complication in their use is that the baskets are not uniform across regions. Their composition varies (supposedly) according to local climatic conditions and tastes.

As Rosstat reports regional CPI only from 1992 onwards, real monetary income for 1990–1991 becomes unavailable. This certainly is not a dramatic loss of data, as the reliability of data on the very early 1990s is extremely unreliable due to the enormous economic changes. The table below gives the number of observations, standard deviation, median and mean of real per capita income for every year in the sample. The mean real income per capita is 1988.7 rubles per month and the standard deviation is 1486.7 over the whole period.

Table 2. **Summary statistics for monthly real income per capita³**

YEAR	N	med	mean	sd	skewness	kurtosis
1992	76	881.1765	1025.738	533.9026	2.558	10.052
1993	79	1107.692	1303.127	904.0181	4.664	29.656
1994	79	1472.254	1798.161	1264.457	4.199	22.467
1995	79	1470.478	1827.166	1188.835	3.897	21.886
1996	79	1759.946	2175.561	1456.075	4.496	28.637
1997	88	1976.097	2492.929	1787.602	3.603	18.922
1998	88	1174.129	1509.502	1059.356	3.030	14.161
1999	88	1358.458	1694.674	1173.823	3.271	16.422
2000	88	1472	1898.545	1372.931	3.202	15.169
2001	88	1785.689	2306.664	1635.499	2.767	11.430
2002	88	2090.202	2598.783	1655.967	2.741	11.658
2003	88	2434.439	3015.342	1884.256	2.286	8.459
1992–2003	1008	1590.8	1988.71	1486.69	3.26	16.90

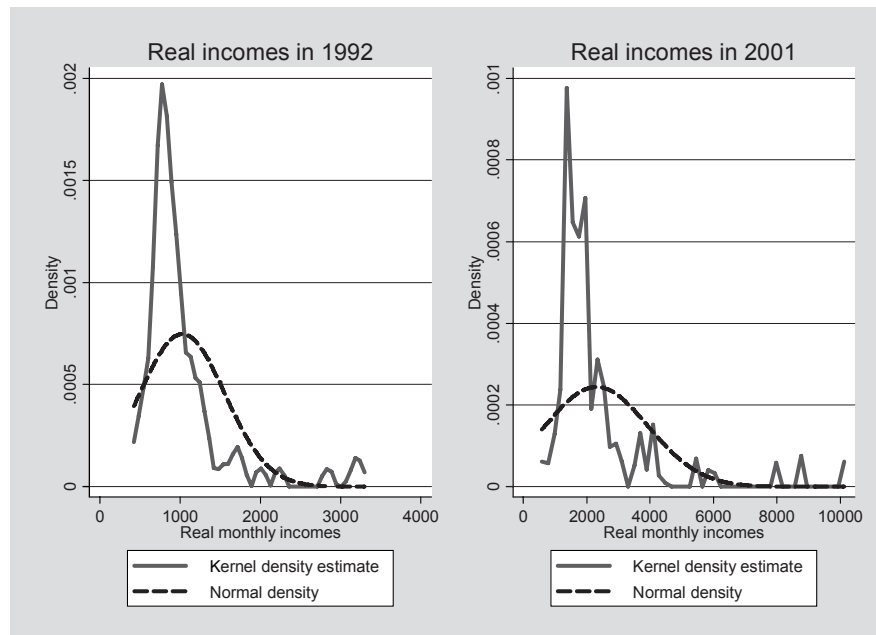
Mean real income is considerably higher than median, confirming the generally held view that a handful of regions are extremely rich. High positive values of skewness further confirm that the distribution of incomes across regions is not symmetric. On the contrary, the tail of

³ Real income is nominal personal monetary income in nominal rubles divided by the regional CPI (2000 as base year).

high values is longer than the tail of low values. The same picture is given by the kurtosis measure: the distribution of income across regions is characterized by long and thin tails.

It is interesting that the skewness and kurtosis of the income distribution increased up to 1996, but have subsequently decreased gradually. The available data seem to suggest that the distribution in 2001 was as asymmetric as it was in 1992 (see Figure 1). Compared to the mid-1990s, the distribution's tails have shortened and especially the tail of high values has become shorter again. By these indicators the crisis year 1998 does not seem to have had any significant impact. However, apart from the year 1998, the standard deviation (sd) of incomes has constantly increased, suggesting that the distribution has become more dispersed.

Figure 1. **Density distribution of real incomes, 1992 and 2001**



Clearly the mean of regional real income figures, as reported in Table 2, seem to tell a brighter story of real income developments than the national figures. This is probably due to the fact that the national figures use population weights. This should mean that several of the high-income regions have small populations. Apart from the capital city, this seems indeed to be the case. There are five regions with

mean real incomes for 1992–2003 above 4500 rubles (Moscow City, Tjumen, Hanti-Mansiski ao, Jamalo-Nenetski ao and Tsukotka). Very high mean real incomes are reported also for Nenets ao, Murmansk, Taimirsk ao, Kamtsatka, Koriakski ao, Magadan and Saha (Yakutia). Of all the above mentioned regions only Moscow City and Tjumen have populations over 1.5 million. All the others are small regions in the Russian North that are well known for rich natural resources and relatively high price and wage levels.

Not surprisingly, Moscow City, Hanti-Mansiskii ao, Jamalo-Nenetskii ao and Tsukotka also account for much of the variation (standard deviation) in real incomes. Excluding these regions from the sample would reduce the overall standard deviation of real incomes to 867.9 and the sample mean over the whole period to 1747.2 rubles. These four regions are clearly the potential outliers. As data for the autonomous okrugs are available only from 1997 onwards, three of the outliers are automatically excluded when the basic subsample of 76 regions is analysed.

3 Two concepts of absolute convergence

A key property of the neoclassical growth models, as presented by Ramsay (1928), Solow (1956) and Koopmans (1965), is conditional convergence. The models predict that per capita growth is inversely related to the starting level of income or output per capita. Therefore, an economy starting out further below its steady state tends to grow faster. Assuming similar tastes and technologies, the economies' steady states are similar and consequently poor economies tend to grow faster than richer ones. This is referred to as absolute (ie unconditional) convergence. Many empirical studies have proved that absolute convergence does not apply for a broad cross selection of countries. For a relatively homogeneous group of countries or regions, like the OECD or the states of the US, absolute convergence has been established. Two concepts of absolute convergence appear in discussions of economic growth across countries or across regions within countries: sigma-convergence and beta-convergence.⁴

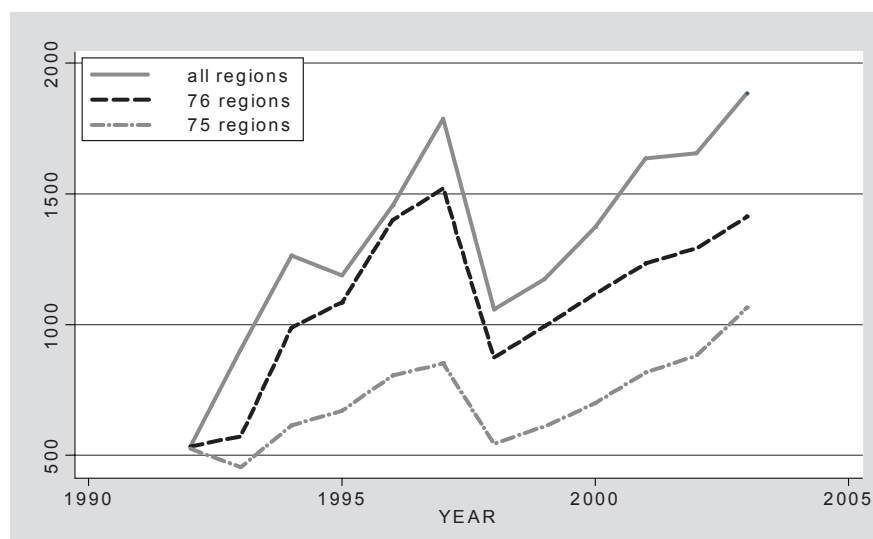
⁴ For more discussion of growth and convergence, see eg Barro and Sala-i-Martin (1995) and (2004) or de la Fuente (2000).

3.1 Sigma-convergence

In one view, convergence occurs if the dispersion in per capita incomes or per capita output tends to decrease over time. Barro and Sala-i-Martin (1991, 1995, 2004) define sigma (σ) convergence in terms of the level of income dispersion. Sigma-convergence occurs if the cross-sectional dispersion in income declines over time. This dispersion can, for example, be measured by the standard deviation (hence the name) of per capita income across regions or countries.

The Figure 2 below shows the standard deviation (ie sigma-convergence) of real incomes for three subsets of data. The solid line graphs the movement of sigma-convergence, including all available observations. The dashed line stands for the basic subset of 76 regions for which we have full data for the whole period and the last line describes sigma-convergence within the basic subset excluding Moscow City.

Figure 2. **Sigma-convergence across Russian regions, 1992–2003**



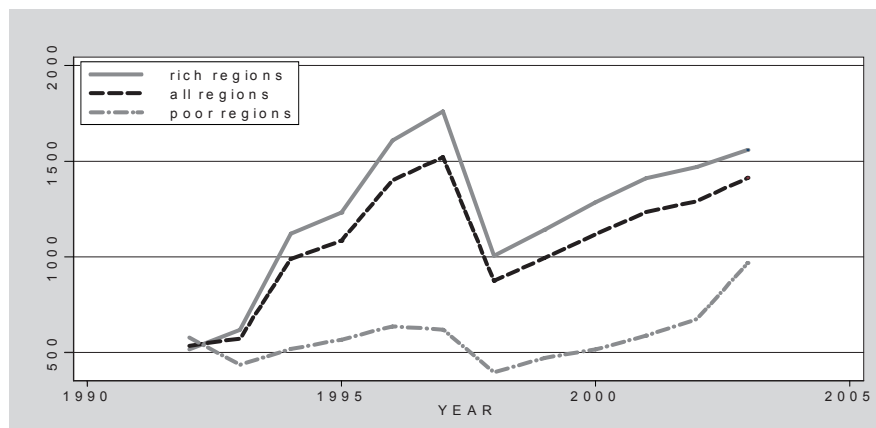
There are three immediate lessons to be learned from the data. First, there does not seem to be any evidence of sigma-convergence. On the contrary, even excluding Moscow City, the income dispersion has nearly doubled between 1992 and 2003. When the mostly resource-rich autonomous okrugs are included in the analysis, income dispersion in 2003 exceeds the level of 1998. The second observation

is that the crisis year 1998 did cause a remarkable decrease in income dispersion, but that proved to be only temporary. The variation in incomes started to grow immediately after the crises, and the level of dispersion in 2001 was about the same as in 1997. The third observation is that – as expected – removing the most obvious outlier significantly reduces the variance in real incomes but does not change the general trend of divergence.

In a recent paper, Andrienko and Guriev (2004) suggest that the poorest third of the Russian regions are poverty trapped in the sense that many people would move out if they could afford it. Elsewhere in the Russian Federation, the well-known Tiebout-hypothesis of people voting with their feet seems to have some validity. To test whether the growth experience of the poorest third differs from the majority of the regions, the sample was split in two using a dummy for the initially poorest regions. A region was classified initially poor if its income per capita divided by cost of a 19-good basket was less than one third of the national average in 1992. Note, however, that the group of 21 initially poor regions is an extremely heterogeneous composite that includes such prominent regions as StPetersburg and Novosibirsk.

The standard deviations of real income levels of the initially poor group are significantly lower than those of the rest of the Russian regions. The Figure 3 below depicts sigma-convergence for the two groups separately.

Figure 3. **Sigma-convergence for initially poor and initially rich regions, 1992–2003**



Total number of observations is 74 as data for Lenoblast and MosOblast are missing.

The figure suggests that differences in income levels among the regions that were the poorest in 1992 have increased markedly over the last couple of years. But up till year 2000 one can not detect any clear trend of either convergence or divergence for the initially poor regions. The group of initially rich regions is still considerably more heterogeneous, and – apart from 1998 – income dispersion has constantly increased.

3.2 Unconditional beta-convergence

The second concept of convergence, usually labelled beta-convergence, focuses on the speed of convergence (see eg Barro, 1997; Barro and Sala-i-Martin, 2004). Beta (β) convergence applies if a poor country or region tends to grow faster than a rich one. β -convergence implies that a poor region tends – over a long time period – to catch up with a rich region in terms of per capita income. This phenomenon is also sometimes called regression toward the mean. Unconditional beta-convergence refers to countries or regions converging to a common steady state, whereas conditional beta-convergence implies conditional convergence. Beta-convergence tends to generate sigma-convergence (reduced dispersion of per capita income), but this is by no means necessary. Sigma-convergence is easily offset by new disturbances that tend to increase dispersion. Unconditional beta-convergence has been established for regions of eg USA, Japan and EU. Unconditional beta-convergence across a cross-section of countries, however, is harder to detect. The literature offers some evidence on convergence among a group of rich countries but not across groups of rich and poor ones. Understanding the reasons for the divergence is a constantly evolving and extremely important topic. Helpman (2004) provides an excellent overview.

There is no universal way of measuring beta-convergence, as the exact formulation depends on the assumptions of the underlying growth model. Loosely speaking, unconditional beta-convergence is said to exist if the income level in the base year is negatively correlated with the average annual growth rate over the observed period. In our case the simplest measure of unconditional β -convergence is the simple correlation between the 1992 income level and the average annual income growth rate in 1992–2003. Defined in this way the simple measure of unconditional β -convergence is -0.38 for the 76 regions for which there are data over the entire period 1992–2003. Excluding Moscow City from the sample increases the

correlation to -0.48 . This cross-sectional correlation would seem to indicate that there is strong beta-convergence. Regions with initially low income levels appear, on average, to have had faster growth rates than regions which were better off initially.

Assuming for the moment that all Russian regions have a common steady state⁵, beta-convergence may be estimated by a simple equation of the form

$$(1/T)\ln(y_{it} / y_{i,t-T}) = a + b\ln y_{i,t-T} + \varepsilon_{it} \quad (3.1)$$

where $y_{i,t-T}$ is per capita real income in region i in the year 1992, $y_{i,t}$ is the real income in 2003, T is the length of the interval (11 years) and ε is the error term. If b is negative and significantly different from zero, absolute convergence is said to hold. Estimating the simple log-linear ‘model’ by OLS yields the results in Table 3 below.

Table 3. **Unconditional beta-convergence**

	Spec(1)	Spec(2)	Spec(3)	Spec(4)	Spec(5)
Lny92	-0.027 (3.78)**	-0.027 (3.31)**	-0.032 (5.28)**	-0.027 (3.31)**	-0.031 (4.85)**
Constant	0.273 (5.63)**	0.273 (5.02)**	0.311 (7.46)**	0.273 (5.02)**	0.299 (6.90)**
Observations	76	76	75	76	76
R-squared	0.16	0.16	0.25	0.16	0.24

Note: (Robust) T-statistics in parentheses, * significant at 5%; ** significant at 1%. Spec1: Standard OLS, Breusch-Pagan / Cook-Weisberg test for heteroskedasticity (P-value = 0.015) and White’s general test statistic (P-value = 0.208). Spec2: OLS with Huber/White robust standard errors. Spec3: Same as Spec2, excluding Moscow City. Spec4: OLS clustered by regions. Spec5: Iteratively reweighted least squares calculated with STATA’s `rreg`.

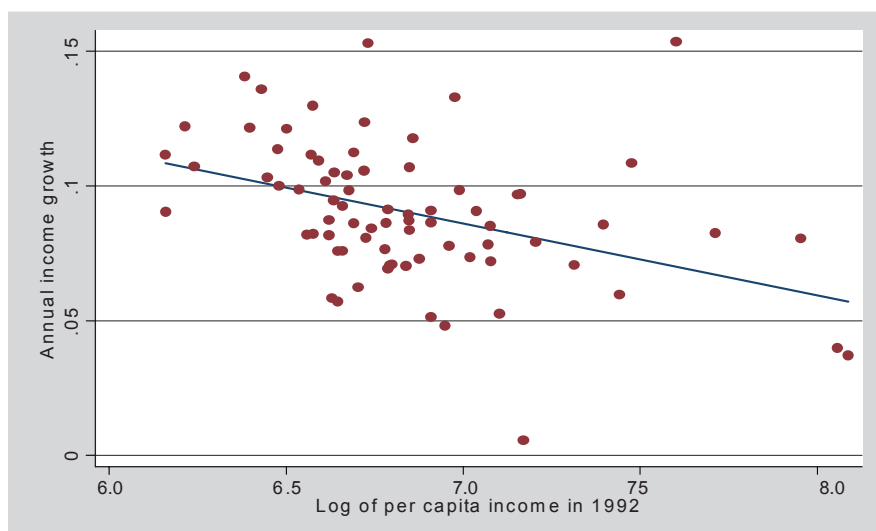
The coefficient of the initial level of per capita income (lny92) has the expected negative sign and is statistically highly significant. In all specifications the estimated magnitude of beta-convergence is 0.03, indicating annual convergence at the rate of 3%. This is broadly in

⁵ Studies focusing on regional convergence in eg the US, Spain, Japan and EU usually do assume that all regions within the same country have a common steady state. This certainly is a more realistic assumption than that all countries have a common steady state, as regions usually have similar cultures, central administration, law enforcement, language etc Homogeneity of Russian regions is, however, an open issue.

line with the magnitude of beta-convergence found in many regional studies⁶.

These results, as also suggested by Figure 4, would seem to indicate that even though on average the dispersion of incomes has increased, the incomes in the initially richer regions have not grown as fast (or have contracted more) than in the poorer regions. This somewhat surprising result, however, includes a number of caveats. The major one is rather trivial: Russian regions are not likely to have one steady state common to all and everyone. Thus, the regression above is likely to be erroneous due to misspecification and it needs to be redefined before the results can be interpreted. It is also possible that simple OLS, being fairly sensitive to outlying observations, does not produce robust estimates. The results do not change, however, if the three regions with the highest leverage (Sakhalin, Kamtsatka and Tjumen) as well as the two with especially poor fit (Moscow City and Kalmikia) are removed from the regression.

Figure 4. **Unconditional beta-convergence across Russian regions, 1992–2003**



The surprisingly strong result of convergence does, however, depend on the period studied. If the period begins after 1992, the implied rate of convergence is significantly lower, in the range of 1% annually,

⁶ For a good overview of studies on regional convergence see Barro and Sala-i-Martin (2004).

and not always statistically significant. It is therefore possible that the strong beta-convergence is at least partly due to extraordinary changes in the very early transition. The table below reports beta coefficients from simple regressions in the form of equation (3.1) for various periods.

Using the full sample of 88 observations, the beta coefficient is always negative and statistically significant for most of the periods. The existence of beta convergence is confirmed for most of the periods and for the subset of 76 regions. But, as confirmed by the results reported in the last column of Table 4, Moscow City heavily influences the result. The beta coefficients for the subsample of 75 regions excluding Moscow City are statistically different from zero only for the first and the last periods.

Table 4. **Values of unconditional beta**

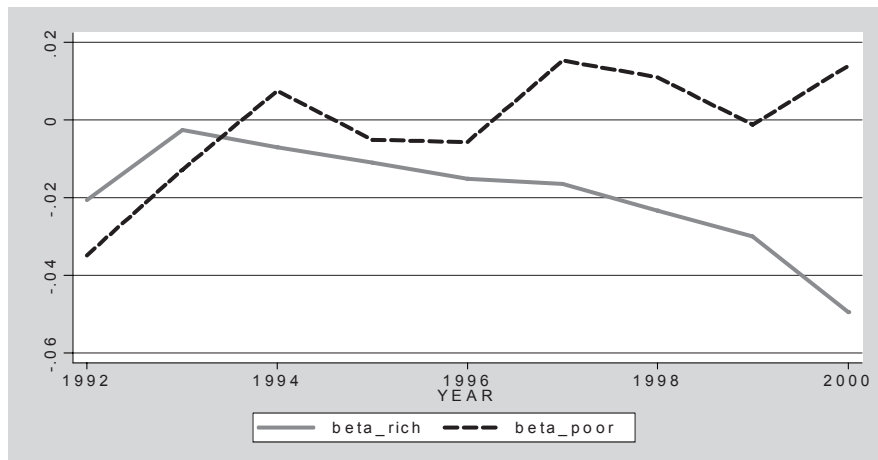
Growth period		Full sample	76 Obs	75 Obs (excluding Moscow City)
1992–2003	Lny92	-.027*** (**)	-.027*** (**)	-.032*** (***)
1993–2003	Lny93	-.015** (*)	-.007	-.011
1994–2003	Lny94	-.010	-.005	-.001
1995–2003	Lny95	-.011* (*)	-.011* (*)	-.008
1996–2003	Lny96	-.009	-.014* (*)	-.007
1997–2003	Lny97	-.007	-.010	-.000
1998–2003	Lny98	-.016*	-.017* (*)	-.010
1999–2003	Lny99	-.022*	-.024** (*)	-.018
2000–2003	Lny00	-.030** (*)	-.038** (**)	-.029* (*)

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, constant included but not reported. Heteroscedasticity robust significance levels in parenthesis.

Even though one should be especially careful in interpreting the coefficients for the very short time periods, the data seem to suggest that the growth of per capita real income is negatively related to the initial level of per capita income in the Russian regions.

The dynamics of the groups of 21 initially poor regions and the 53 initially rich ones seem to differ (see Figure 5). We are unable to establish beta convergence for the poor group, whereas beta is negative and statistically different from zero for the rich group irrespective of the period studied. Thus there may be some evidence of club convergence, ie that initially rich regions are converging among themselves. In beta-sense, the group of initially poor regions is neither converging nor diverging.

Figure 5. Values of unconditional beta for initially rich and poor regions



One further question frequently posed by researchers on Russia's recent developments is whether the effects of the economic crisis of 1998 caused permanent changes in income dynamics across Russian regions. Comparison of unconditional convergence in two cross-sections over the periods 1992–1997 and 1999–2003 suggests that convergence was considerably stronger during the earlier period.⁷

⁷ The values of beta were -0.5 and -0.2 respectively. Both are significant at the 5% level.

4 Conditional convergence and growth

4.1 Ranking regions by per capita income

I begin the analysis by ranking all regions by their incomes per capita in 1992–2003. The first observation from comparing the rankings in 1992 with the rankings in 2003 is that the relative position of practically taken all regions has changed remarkably. The rankings of 56 regions (of 76 in the sample) had changed (up or down) by more than 5 ranks. The regions whose relative position deteriorated most between 1992 and 2003 are a heterogeneous bunch, including Kalmykia, Kurgan, Mordva, Orenburg, Adygeya and Altai Krai. The regions whose relative position increased most include Moscow oblast (which has benefited from the growth in Moscow City), the independence-minded republics of Bashkortostan and Tatarstan, and a handful of ‘traditional’ regions of European Russia: Smolensk, Vologda, St. Petersburg, Astrakhan, Perm, Pskov and Voronez. The tiny Buriat republic in the Siberian federal district also saw a tremendous increase in relative position.

A standard rank correlation coefficient, Spearman’s rho, gauges whether any two given rankings are independent of another. The coefficient between a region’s rank in 2003 and in any other year is very high, causing rejection of the null hypothesis that the rankings are random and independent of each other. A region’s position in the income ranking in 2003 is dependent on its relative position in previous years. However, the rank correlation between 1992 and 2003 is significantly lower than between any later year and 2003.

As the table below indicates, (apart from the first couple of years) there is no clear difference between the two groups in how the income level rankings develop. The rank correlation with income ranking in 2003 is around 0.9 already from 1993 onwards for the initially poor regions. The rank correlations for the initially rich regions reaches the same level (0.9) in 1995.

Table 5.

Values of Spearman's rho

	rank_y2003 full sample	rank_y2003 for poor regions	rank_y2003 for rich regions
rank_y92	0.597	0.617	0.61
rank_y93	0.777	0.891	0.67
rank_y94	0.833	0.912	0.76
rank_y95	0.883	0.889	0.86
rank_y96	0.883	0.899	0.86
rank_y97	0.919	0.93	0.89
rank_y98	0.917	0.944	0.89
rank_y99	0.918	0.917	0.9
rank_y00	0.915	0.897	0.9
rank_y01	0.953	0.969	0.94
rank_y02	0.988	0.986	0.98

4.2 Possible determinants of conditional convergence

The examination of sigma-convergence in the previous section confirmed that – apart from 1998 – differences in income levels between Russian regions have grown during the last ten years. The existence of beta-convergence seems to suggest that poorer regions have grown faster. Increasing sigma, together with beta-convergence, implies that the initial value of sigma is below its steady-state value. Taking into account Soviet history, this may indeed be the case. As already mentioned above, it is, however, questionable whether all of Russia's 89 regions share a common steady state.

The common language, culture, values and socialist history notwithstanding, in the economic environment Russian regions differ considerably from each other. First, many of the regions are extremely small and may not be viable economic units even in the medium term. Several of the smallest regions are wholly dependent on a handful of large enterprises. A dramatic change in the operations of one big plant may alter annual industrial production, income and tax revenue significantly.⁸ This is indeed one of the reasons for the wide annual variations in regional growth rates. Second, much of Russia's wealth is concentrated in natural resources, which are not at all evenly

⁸ As illustrated by the Far Eastern region of Tsukotka, in-migration of a single individual (Roman Abramovitch in this case) may cause a dramatic increase in income and tax revenue.

distributed across the whole federation. It would therefore be surprising to find that all Russian regions would have a common steady state.

If regions do not converge to a common steady state, then the estimations on absolute convergence are misspecified. If the true steady state is correlated with the initial income level, then the error term will be correlated with the explanatory variable. This leads to downward-biased estimates. One widely used means to overcome this problem is to run a multivariate regression including some constant proxies for the steady states, such as geography and sectoral composition of output. Further, the cross-sectional dispersion of incomes is naturally sensitive to aggregate shocks that affect some subgroups of regions. To the extent that these shocks affect differently poor and rich regions (that is, shocks correlate with the explanatory variable) omitting them from a regression usually leads to biased estimates of beta. Controlling for possible aggregate shocks and differences in steady states (ie differences in the economy's production function) yields estimates of the so-called conditional beta-convergence.

What then are the likely determinants of regional steady states? A first guess could be that geography matters for the steady state. If possible shocks always affect different parts of the country differently, adding regional dummies to the regression should improve the fit. Shocks that affect different sectors of the economy differently may also cause divergence across regions. A measure of the economic structure of each region may thus help to explain some of the variation in incomes. Further, depending on whether one has a neoclassical or endogenous growth model in mind, proxies for investment in physical and human capital should turn out to have statistically significant coefficients. And finally, regional economic policy could matter for growth and convergence.

Geography has indeed been a significant regressor in several cross-sectional growth studies. In the case of the US states, the main census regions have been used as a geography proxy. In the case of China, it has become almost standard to impose a dummy for coastal regions.⁹ Whether geography matters is probably more of an open question in Russia than in many other countries. At least two groupings could be used: administrative division into the federal districts and distance from Moscow. The eleven federal districts imposed by President Putin

⁹ See Demurger et al (2002) for China and Barro and Sala-i-Martin (2004) for the US and Japan.

in 2001 have nothing to do with economic logic and so are not likely to be helpful in economic analysis. Distance from the capital may sound like a fairly strange explanatory variable in a growth regression, but taking into account the overly centralized nature of the Soviet economy, with all roads leading to Moscow, that might still turn out to be interesting. The distance-variable measures the distance in kilometres from regional capital to Moscow City.

Regarding Russian regions, there are strong reasons to suppose that a region's initial economic structure matters very much for growth. The initial economic structure inherited from Soviet times did not necessarily have much to do with economic efficiency or productivity. Regions typically specialized in production within a few industrial branches, which rendered them extremely vulnerable to the dramatic price changes of the early transition. And, as noted above, regions with notable natural resources in oil, natural gas or metals gained a huge comparative advantage immediately when foreign trade was liberalized. As no good federation-wide measure of natural resource endowments is available, one needs to find an indirect proxy for that. All in all, when it comes to the economic structure of a region, we need to work with extremely incomplete data. In the ideal case we would have the relative shares of all basic economic sectors in average regional per capita income over the whole period. Unfortunately, we are far from that. The best available proxies are the relative share of extractive industries in a region's industrial output in 1995 (ext95) as well as the number of people employed in agriculture in 1995 relative to the total regional population (agri_pc).

Extractive industries are composed of (both black and color) metallurgy and energy & fuel (oil, gas, coal) production. This is roughly the same classification as the one used by Dolinskaya (2002). The share of extractive industries is the closest available proxy for the valuable natural resources. A priori, one would thus assume that regions with relatively higher shares of manufacturing fared worse during the 1990s compared with regions in which the share of extracting industries is higher. Even though the data are for 1995, we can fairly safely take that to represent the inherited industrial structure at the outset of transition. The level and value of industrial production may have changed dramatically in the early 1990s, but changes in regional composition have been remarkably slow. The share of agriculture in regional product and employment probably changed much more during the early 1990s, but unfortunately we have data only for 1995.

Regional figures for fixed investment in Russia are generally considered very unreliable. And as most of fixed investment is in any

case concentrated in the oil and gas sectors, even accurate figures would not produce an especially good explanatory variable. There is also some uncertainty as to whether investment drives economic growth or vice versa, especially in the short run¹⁰. The same considerations apply equally well to foreign direct investment. Therefore we refrain from using a proxy for investment in physical capital. On the other hand, the data on investment in human capital (education) is supposedly fairly accurate, and several possible explanatory variables are available for the whole period. A potential problem is that in primary and secondary schooling regional differences in Russia are extremely small. Therefore the number of students graduating from higher education establishments per capita (*edu_pc*) is used.

One of the generally accepted results of the voluminous literature that emerged in the 1990s on determinants of cross-country growth, including Acemoglu et al (2001, 2002), Easterly and Levine (2003) and Rodrik et al (2004), is that institutions do matter. Corruption and good governance, as well as measures of good economic policy, have proved to be significant in explaining growth in transition countries as well as across a wider selection of countries¹¹. Measuring institutional quality is cumbersome at best. Glaeser et al (2004) in fact argue that most measures of political institutions used in the literature are not very well suited for the purpose. Variables measuring government effectiveness are most often mere outcome measures and are not suitable proxies for institutions, which according to North (1990), are in essence constraints on governance. Precisely because objective measurement of institutional quality is highly problematic and the exact ways in which political institutions interact with other growth determinants, such as human capital, are not well established, an alternative view has been expressed. The idea that growth in income and human capital causes better institutions is often associated with work by Lipset (1960). Empirical support for his ideas has come from eg Barro (1999).

Whether economic policies of Russian regions have actually affected regional growth dynamics is a highly debated issue. On the one hand, our focal time period is rather short for any changes in economic policy to show up. And most of the 1990s has been a very turbulent time, not very conducive to long-term planning in any case. Moreover, regional policies and practices do differ widely across

¹⁰ For example, Barro (1997) finds that growth spurs investments.

¹¹ See eg Havrylyshyn and van Rooden (2000) on transition countries.

Russian regions. Due to the lack of any consistent data on regional economic policies or business climate in Russia, this issue will remain open for the time being. I feel obliged to make an attempt to proxy regional policies by some means. One readily available proxy for a region's general reform orientation is provided by the population's voting behavior in federal elections. Unfortunately, the share of votes for reform-minded parties or candidates has proved to be completely insignificant in almost all existing studies on Russian regions. There are various rankings of the regions which could probably be used to measure regional policies and attitudes. None of them, however, has the advantage of covering all regions. To cite an example, Transparency International published jointly with Russian IMDEP a corruption ranking of Russian regions in 2002, but this covers only a small portion of the regions.

Consequently, one is tempted to stick with Rosstat data in searching for a measure of regional economic policies. The one most often used is the number of small and medium-sized enterprises (employing less than 250 persons). The number of SMEs is roughly equivalent to the number of new businesses. New business formation can be taken as an important outcome of market-friendly or growth-promoting policies. Thus, I will use the number of registered SMEs per capita (*sme_pc*) to proxy regional policies and business environment. The inherent problem with this variable is that it is bound to be endogenous, as shown by Berkowitz and DeJong (2003). Growth in income spurs emergence of SMEs, which typically operate in the service and retail sectors. Therefore the results will be presented both with the regional policy-proxy and without it.

The increase in both between and within-region income inequality in Russia has been particularly large in the last decade or two. The determinants of income inequality have been examined by eg Yemtsov (2003). Overall there is, however, fairly little consensus on whether inequality is harmful for growth or not. Based on cross-country evidence, Persson and Tabellini (1994) showed that there is a definite negative relationship between inequality and growth. Their results were rejected by eg Deininger and Squire (1996), who used a much richer panel dataset. Barro (1990) noted that inequality seems to affect different counties differently. A recent article by Banerjee and Duflo (2003) investigates the issue using non-parametric methods. They conclude that familiar OLS and fixed-effects models are inappropriate for analysing the relationship between inequality and

growth, which is one good reason for our leaving the issue outside of the simple regressions of this paper.¹²

4.3 Simple growth regressions

Following the tradition in growth literature, the dependent variable is average annual growth in income measured by $\ln(\text{growth}) = (1/T)\ln(y_{it}/y_{i0})$, where T is the length of the interval and y is per capita income in region i. To measure beta-convergence, the initial level of income ($\log y_{92}$) is included as the first explanatory variable, followed by proxies for different steady states. The regions differ considerably eg with regard to per capita income and the share of agriculture, as shown in Table 6 below. As the available data on education and SMEs cover the whole period, unweighted averages over the period 1992–2003 are used as the dependent variables.

Table 6. **Descriptive statistics for regional cross-section, 1992–2003**

Variable	Obs	Mean	Std. Dev.	Min	Max
Annual income growth	76	.090	.0260	.0056	.1533
Initial income	76	6.844	.3929	6.159	8.086
Distance to Moscow, km	76	2211.895	2612.468	0	11876
Share of extractive industries, %	76	20.836	20.895	.2	80.4
Share of workforce employed in agriculture, %	76	5.968	2.705	.139	13.313
University graduates per capita	76	2.066	1.030	.0352	7.804
SMEs per capita	76	.0048	.0029	.0019	.0207

We first run a simple cross-sectional OLS on the full sample of 76 regions. Results are reported in Table 7 below. The immediate finding is that when supplemented with the other variables, the absolute value of the coefficient on initial income becomes larger in explaining growth. Moreover, the explanatory power of the regression is very high. The variables characterising the economic structure of a region (share of extractive industries and agriculture) are significant and have the expected signs. A larger share of extractive industries causes

¹² The other reason being poor data availability for our purposes.

higher average growth whereas a larger share of agriculture induces lower growth rates. The distance and education variables are not significant. The fact that education is not significant is probably not surprising, given the fairly small variation across regions and the short time period studied. The variable on SMEs per capita is significant and has the expected sign but, as discussed earlier, it is possibly endogenous. Removing the insignificant variables does not alter the magnitude or significance of the other variables. The results seem to be fairly robust to the exclusion of Moscow City as seen from Spec (3) in the table below. As the endogeneity of *smen_pc* can not be easily treated with instrumental variables, the preferred model is the one presented in the last column of Table 7.

Table 7. **OLS on average annual growth rate, 1992–2003**

	Spec(1) Ln(growth)	Spec(2) Ln(growth)	Spec(3) Ln(growth)	Spec(4) Ln(growth)
Lny92	-0.056 (7.93)**	-0.053 (9.11)**	-0.054 (9.25)**	-0.047 (6.09)**
Extraction95	0.000 (3.79)**	0.000 (3.73)**	0.000 (3.75)**	0.000 (2.08)*
Distance	0.000 (0.95)			
smen_pc_mean	4.497 (3.87)**	4.423 (5.00)**	3.433 (5.36)**	
edu_pc_mean	0.000 (0.04)			
Agri_pc95	-0.003 (2.79)**	-0.003 (2.78)**	-0.003 (2.95)**	-0.005 (4.37)**
Constant	0.459 (8.91)**	0.440 (9.92)**	0.452 (10.06)**	0.434 (8.29)**
Observations	76	76	75	76
R-squared	0.61	0.61	0.59	0.44

Robust t statistics in parentheses: * significant at 5%, ** significant at 1%

As noted in the previous section, we should be careful not to overvalue the results based on the 1992–2003 period. To address this problem we once again run cross-sectional regressions for several growth periods ending with the most recent year of our data. Table 8 reports the beta coefficients from OLS regressions of the reduced-form regression: $\ln(\text{growth}) = a + b \log(\text{initial income}) + c \text{ext95} + d \text{agri_pc} + e$. Contrary to the results on unconditional convergence, these results strongly suggest that, with control for initial industrial

structure, a region with a lower initial income level will have grown faster in every period.

Table 8. **Conditional betas**

Growth period		Full sample	76 obs	75 obs
1992–2003	Lny92	-.047***	-.047***	-.052***
1993–2003	Lny93	-.040***	-.043***	-.050***
1994–2003	Lny94	-.043***	-.045***	-.050***
1995–2003	Lny95	-.037***	-.038***	-.043***
1996–2003	Lny96	-.038***	-.039***	-.043***
1997–2003	Lny97	-.037***	-.038***	-.041***
1998–2003	Lny98	-.102***	-.112***	-.127***
1999–2003	Lny99	-.154***	-.171***	-.198***
2000–2003	Lny00	-.172***	-.192***	-.225***

Significance levels calculated using robust standard errors, *** significant at 1%

How about the initially poor versus the rest of the regions? As one would expect, the share of extracting industries in total industrial production is much lower in the initially poor regions. The the reduced-form model $\ln(\text{growth}) = a + b \log(\text{initial income}) + c \text{ext95} + d \text{agri_pc} + e$ performs fairly well in explaining the growth of the initially rich regions. On the contrary, the model fails to explain the growth experiences of the initially poor regions, (see Appendix 1).

Finally, I checked whether the determinants of income growth have changed since 1998. The data clearly indicate that conditional convergence was stronger in 1992–1997 than in the post-crisis period 1999–2003¹³. Further, after 1998 the proxy for the initial share of agriculture in a region’s economy ceases to be significant.

¹³ The values of beta were -0.9 and -0.3 respectively. Both coefficients are significant at the 1% level.

5 A robustness check using panel analysis

The preceding analysis suggests that during the period 1992–2003 Russian regions have converged in the beta sense. The result is especially strong when we control for a few determinants of regional steady states. Since some of the data are available for the whole period, or at least for a large part of it, one is tempted to use the panel feature of the data to see if the main results would change. Ismail (1995) uses average income growth for 5-year periods as the dependent variable in convergence analysis. Since his seminal paper, the five-year average has become a fairly standard variable in panel estimations. Due to the short time-series in this paper, the only feasible alternative is to use annual changes in real per capita income as the dependent variable. This certainly risks being far too short a period since normal business cycle movements are likely to drive the results. Being fully aware of the limitations of using such a short period, the following exercise is to be taken only as a robustness check for the previous results.

I will use standard fixed-effects pooled OLS to estimate both unconditional and conditional beta convergence.¹⁴ As annual growth is highly likely to depend also on the growth rate of the previous year, the lagged value of annual growth is added to the regressions. There are slightly differing views on whether models with lagged dependent variables can be estimated with standard fixed-effects models. Fixed-effects models are not extremely sensitive to violations of the strict exogeneity assumption, especially with large T . Assuming that the time series process is appropriately stable and weakly dependent, the inconsistency from using fixed effects when the strict exogeneity assumption fails is of the order $(T)\exp^{-1}$. Thus, with large T the bias may be minimal (Wooldridge, 2002). In our data $T = 11$, so the bias may be of magnitude $1/11$.

One easily available possibility to correct for partial endogeneity is to use the dynamic panel data estimator derived by Arellano and Bond (1991). The Arellano-Bond estimator first eliminates the fixed effects by using first differences. Then an instrumental variable GMM estimation is performed using lagged levels of dependent variables to instrument for the lagged differences in endogenous variables.

¹⁴ The Hausman test rejects the random effects model at the 1% level in all specifications.

Consistency requires the absence of second order serial correlation in the residuals.

We first run fixed-effects pooled OLS and then Arellano-Bond dynamic panel model to see if the results on unconditional convergence in the previous section would change. The equations to be estimated are

$$Y_{it} = (1/T)\ln(y_{it} / y_{i,t-T}) = a + b \ln y_{i,t-T} + u_i + \varepsilon_{it}, \quad (5.1)$$

T = 1 (fixed-effects model) and

$$\Delta Y_{it} = a + b\Delta Y_{it-T} + c\Delta \ln y_{i,t-T} + \Delta \varepsilon_{it}, \quad (5.2)$$

T = 1 (first-difference form)

A regression allowing for fixed effects, which captures unobserved region-specific factors, confirms that regional growth is significantly correlated with the level of initial income and has the expected sign. The result is confirmed by the Arellano-Bond methodology, which allows for dynamic effects by introducing lagged dependent variables. The coefficients on the initial income are much higher than in the cross-section analysis and they are indeed suspiciously high. Therefore we suggest reading the results only as a confirmation of the signs on initial income level. Table 9 below reports only results using an unbalanced panel of 88 regions. The results remain quantitatively the same when a balanced panel of 76 regions and only 834 observations is used.

The 1998 financial crisis clearly blurs the picture in the panel analysis. Introducing a dummy for the crisis year immediately reduces the beta coefficient to about -0.2 in the fixed-effects model. The coefficient on difference in initial income in the dynamic panel model decreases by more than a half, to -0.4. Therefore it is worthwhile to include a dummy in the model for the crisis year 1998.

Table 9.

**Unconditional beta-convergence
with panel data, 1992–2003**

	Fixed-effects model	Fixed-effects model	GMM	GMM
	Growth (Yit)	Growth (Yit)	Growth (ΔY_{it})	Growth (ΔY_{it})
Initial income	-0.428 (17.23)**	-0.220 (14.83)**		
Dummy98		-0.591 (42.14)**		
$\Delta(\text{growth})$			0.300 (9.99)**	0.112 (6.00)**
$\Delta(\text{initial income})$			-0.890 (23.68)**	-0.389 (14.84)**
$\Delta\text{Dummy98}$				-0.546 (35.92)**
Constant	3.248 (17.69)**	1.768 (16.19)**	0.035 (12.48)**	0.012 (6.40)**
Observations	913	913	737	737
Number of regions	88	88	87	87
R-squared	0.26	0.77		

Absolute value of t (and z) statistics in parentheses, * significant at 5%, ** significant at 1%

Next, conditional convergence was analysed. Here the data limitations are even more severe. We have the values for extract for 1995 and 1997–2003. The missing year, 1996, was approximated by the average of the preceding and following observations. The data for *smen_pc* and *edu_pc* are available for 1995–2003, but unfortunately we could not obtain values for the share of agriculture. As the variable characterizing the industrial structure of a region (*extract*) is only available from 1995 onwards, the panel analysis only covers the period 1995–2003. As there is no knowledge of the appropriateness of the estimate for the value of *extract* in 1996, a dummy for that year is included.

The main results of the previous section seem robust. Growth depends negatively on the level of initial income and positively on the share of extractive industries in regional industrial output. The results reported in Table 10 show that the coefficient of the lagged value of income is more reasonable, some 17%. Rates of convergence in the range of 12 to 20 are not uncommon in the literature of panel analysis on regional data.

Table 10.

**Conditional beta-convergence
with pooled OLS 1995–2003**

	Spec(1), balanced panel	Spec(2), balanced panel	(3), unbalanced panel	(4), unbalanced panel
	Growth (Yit)	Growth (Yit)	Growth (Yit)	Growth (Yit)
Initial income	-0.175 (8.72)**	-0.175 (8.70)**	-0.171 (8.49)**	-0.171 (8.49)**
Extract, 1996 estimated	0.002 (4.35)**	0.002 (4.29)**	0.002 (4.30)**	0.002 (4.27)**
Smen_pc	-4.825 (1.60)		-2.809 (0.93)	
Edu_pc	-0.023 (9.82)**	-0.023 (9.87)**	-0.023 (9.71)**	-0.023 (9.75)**
Dummy98	-0.558 (47.14)**	-0.557 (47.05)**	-0.558 (47.12)**	-0.558 (47.13)**
Dummy96	0.080 (7.82)**	0.081 (7.95)**	0.081 (7.95)**	0.082 (8.05)**
Constant	1.416 (9.23)**	1.393 (9.11)**	1.381 (8.96)**	1.368 (8.92)**
Observations	706	706	680	680
Number of regions	82	82	76	76
R-squared	0.88	0.88	0.88	0.88

Absolute value of t statistics in parentheses; * significant at 5%, ** significant at 1%

Surprisingly, the SME variable is not significant in the panel model, but as before, removing it does not change the results reported. The coefficients of education have unexpected signs. This may be a result of the current value of the education proxy being in fact more of a burden for current growth. A one-period lagged value of the education proxy remains negative and significant but much smaller in value. The results from the dynamic panel regression, reported in Table 11 below, largely confirm the results.

Table 11.

**Conditional beta-convergence with
Arellano-Bond, 1995–2003**

	Spec(1)	Spec (2)	Spec (3)	Spec (4)
	Growth	Growth	Growth	Growth
	(ΔY_{it})	(ΔY_{it})	(ΔY_{it})	(ΔY_{it})
Δ Growth	0.020 (1.24)	0.020 (1.24)	0.015 (0.93)	0.015 (0.90)
Δ Initial income	-0.287 (11.54)**	-0.287 (11.55)**	-0.279 (11.00)**	-0.278 (11.00)**
Δ Extract, 1996 estimated	0.000 (0.49)	0.000 (0.50)	0.001 (0.60)	0.001 (0.62)
Δ smen_pc	-9.020 (2.21)*		-3.722 (0.90)	
Δ edu_pc	-0.018 (6.55)**	-0.018 (6.59)**	-0.018 (6.48)**	-0.018 (6.52)**
Δ Dummy98	-0.522 (44.75)**	-0.521 (44.76)**	-0.523 (44.38)**	-0.523 (44.42)**
Δ Dummy96	0.118 (11.45)**	0.121 (11.81)**	0.119 (11.46)**	0.120 (11.64)**
Constant	0.016 (8.50)**	0.016 (8.61)**	0.015 (8.18)**	0.015 (8.19)**
Observations	621	621	603	603
Number of regions	80	80	76	76

Absolute value of z statistics in parentheses; * significant at 5%, ** significant at 1%. All specifications pass Sargan test of over-identifying restrictions and the AB test of autocovariance in residuals of order 1 at 1% level.

6 Conclusions

This paper used publicly available Rosstat data on Russian regions to analyse convergence or divergence and regional growth between 1992–2003. The apparent data problems notwithstanding, a number of interesting phenomena were found. Firstly, as expected, income dispersion across Russian regions has increased dramatically over the period studied. The economic crisis in 1998 caused a sudden and large drop in the level of dispersion, but the drop turned out to be only a temporary phenomenon. Dispersion, or sigma-divergence as Barro and Sala-i-Martin call it, began to increase immediately after the crisis and reached the pre-crisis level in a few years. This general picture, however, does not quite tell the whole truth. Differences in incomes have widened first and foremost among the group of regions that was initially better off. Among the initially poor regions a clear trend of

divergence was detected only in recent years. This is considered as weak evidence of possible club convergence among the regions.

Next, unconditional and conditional convergence were analysed. The measure of the speed of convergence obtained, beta-convergence, points towards surprisingly strong convergence across regions. The estimated magnitude of unconditional beta convergence was close to 3%. One of the reasons behind the surprisingly strong beta-convergence may be interregional migration. During the 1990's internal migration towards wealthier and climatically more favourable locations was noticeable. Migration may therefore have strengthened convergence considerably. These results, however, come with several caveats. Firstly, it was shown that it is first and foremost the initially rich regions which exhibit convergence. The regions with income levels below the 30th percentile in 1992 have neither converged nor diverged over the period examined. Second, even for the initially rich regions beta-convergence depends on the choice of growth period. This result highlights the fact that when one must rely on very short time-series in convergence analysis, the choice of the starting point in time is crucial for the results.

In addition to the initial income level, a number of other explanatory variables were found significant in explaining regional growth. In conformity with the empirical growth literature, a region's industrial structure was found to significantly affect growth across Russian regions. As expected, the share of extracting industries in total industrial production of a region turned out to have a strong positive effect on the growth rate. The result was confirmed also with panel analysis. This is clearly in line with much of the transition literature arguing that initial conditions and especially the initial industrial structure matter for growth. In the Russian circumstances, the share of extracting industries can also be interpreted as a proxy for natural resources, as most of what was classified as extracting industries is mining, along with oil, gas and fuel production.

The existence of some club convergence was further confirmed by the finding that we could not establish conditional convergence for the initially poor regions separately. The regions initially better-off, however, showed strong conditional convergence. This seems to suggest polarization among Russian regions. One of the underlying reasons for this development could be that the poor regions are locked in poverty traps, as suggested by Andrienko and Guriev (2004). They show that in the poorest regions an increase in income spurs (instead of reducing) outmigration. These phenomena, if continued, could lead to a federation consisting of two kinds of regions. The majority of regions would be relatively well-off, converging towards their

respective steady states. The minority, however, might be doomed to permanent poverty. The federal government's policy challenges arising from this kind of projections are considerable, but beyond the scope of this brief study.

Differences in real income levels across Russian regions widened during the 1990s, but in the crisis years 1998–1999 the gap between rich and poor regions was temporarily narrowed. Therefore a frequently posed question is whether the 1998 crisis resulted in some kind of a structural break in income dynamics across the regions. The results of this study suggest that this may indeed have been the case. Both conditional and unconditional convergence were stronger before 1998 than after it. A set of possible explanations is that the sharp devaluation of the ruble and dramatic increases in world market prices of raw materials, together with changes in overall macroeconomic policies after 1999, may have caused a permanent change in income dynamics across the Russian regions. But this issue also clearly merits a study of its own.

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Appendix 1

Conditional convergence for the initially poor and initially rich regions

The Table A1 below reports the magnitudes and significance levels of the beta coefficients and the value of R2 for the estimated model $\ln(\text{growth}) = a + b \log(\text{initial income}) + c \text{ extraction} + d \text{ agri_pc} + e$ for the group of initially poor and initially rich regions separately.

Table A1. **Values of conditional beta by poor**

Growth period		Poor regions	R ² _poor	Rich regions	R ² _rich
1992–2003	Lny92	-.056***	0.50	-.044***	0.39
1993–2003	Lny93	-.029*	0.22	-.021	0.29
1994–2003	Lny94	-.010	0.23	-.018**	0.26
1995–2003	Lny95	-.015	0.18	-.015*	0.20
1996–2003	Lny96	-.023	0.35	-.026***	0.18
1997–2003	Lny97	-.007	0.26	-.027*	0.15
1998–2003	Lny98	.002	0.13	-.039***	0.26
1999–2003	Lny99	-.011	0.05	-.046**	0.22
2000–2003	Lny00	.023	0.04	-.064**	0.24

Note: * p<0.05; ** p<0.01; *** p<0.001. Number of observations for the poor group is 21 and for the rich group 53.

Essay 3

Coping with missing public infrastructure: an analysis of Russian industrial enterprises

Laura Solanko

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Preface

This work is part of the project ‘Infrastructure and Welfare Services in Russia: Enterprises as Beneficiaries and Service Providers’ financed by the Academy of Finland, the World Bank and the Yrjö Jahnsson Foundation. The project has also received support from BOFIT and benefited from close cooperation with CEFIR in Moscow.

1 Introduction

One can attribute Russia’s dismal economic performance in the 1990s to many causes, but poor institutions and cumbersome bureaucracy are increasingly mentioned among the main culprits. The transition of the public sector from a Soviet-era producer and regulator to a market-supporting institution clearly has not succeeded. It is even questionable whether this goal was ever taken seriously during the 1990s. The Russian public sector – especially at regional and local levels – is often described as a ‘grabbing hand’, a phrase coined by Frye and Shleifer (1997). Many Soviet-era practices continue and politics still have considerable influence on economic activities. Regional politicians and large firms may collude to eg avoid bankruptcies or optimise tax payments. Small and medium-sized enterprises along with foreign-owned companies, in contrast, generally consider tax administration, government regulations and inspections as their major headaches.

Although there are signs that administrative reform and reducing bureaucracy are finally on the way, the reforms are far from completed (CEFIR 2005). Businesses continuously need close contacts with regional and local governments to alleviate regulatory burdens. One area of close cooperation between enterprises (especially large and medium-sized ones) and the local public sector is the provision of public infrastructure.

Based on unique data from a firm survey carried out in 2003 covering 404 large and medium-sized enterprises in 40 Russian regions, this paper aims to deepen our knowledge of the relationship between firms and the public sector at the local level. I will concentrate on the causes and consequences of infrastructure provision, as proxied by heat production, for this relationship. It is

increasingly acknowledged that well-functioning public infrastructure is important for growth and development in its own right. This is especially true in a country as large and sparsely populated as Russia. I believe that the repair and maintenance of the basic infrastructure networks like roads as well as oil, gas and water pipelines is bound to become a major issue if economic growth is to continue in Russia.

The role of poor infrastructure and deficient public services has, indeed, lately received more attention in the economic literature. This is largely due to increased interest in structural reforms and infrastructure delivery in developing countries. The World Bank, in particular, has been active in promoting discussion of infrastructure development and the role of infrastructure in promoting economic growth and welfare (World Bank 2002, 2004, EBRD 2004). Infrastructure, especially provision of basic services and access to modern technology, is increasingly seen as an integral part of development. Most studies of cross-county growth include infrastructure indicators in the analysis and many find them significant (Barro and Sala-i-Martin 1995). The existing empirical evidence, however, indicates that the effects of public spending and investment on growth are mixed at best. This may be due to difficulties in measurement and identification: more spending does not necessarily turn into more public capital or services of uniform quality. This concern has caused increased interest in micro-level studies that are better equipped to cope with these issues. Reinikka and Svensson (2002), in fact, show that poor public infrastructure, as proxied by unreliable and inadequate electricity supply, significantly reduces private investment.

As much of the development literature focuses on countries situated in much milder climatic conditions, heating has received little, if any attention in recent literature on infrastructure and development. Heating is, however, a necessary precondition for industrial activities anywhere, especially anywhere north of 50° latitude. Our survey data reveals that in 2002 three quarters of the large and medium-sized Russian enterprises produced their own heating. Of those, over half also provided district heating for users outside their plant area. District heating is, therefore, the area where the engagement of the enterprise sector in infrastructure provision is clearly most widespread. Further, based on the survey results, we know that heat-producing enterprises are, on average, more likely to provide support for the maintenance of many other types of public infrastructure such as roads, railways and hot steam pipelines. Therefore, engagement in district heating production can be used as a

meaningful proxy for engagement in infrastructure provision at large in Russia.

The data offer us a unique opportunity to examine relations between heat-producing enterprises and the local public sector in many dimensions. Because less than 40% of the enterprise managers named profit generation as a reason for heat deliveries, it seems natural to inquire more deeply into the determinants of heat production and of heat delivery. I will analyse here the effects of heat production on firm performance in order to answer the critical question of whether engagement in public infrastructure service provision is a burden for the enterprise sector. Two conflicting hypotheses are possible. H1: enterprises that are, due to historical reasons, forced into operations far beyond their main business suffer in terms of productivity and investments and H2: enterprises that engage in heat and infrastructure provision do so in exchange for favors from local government. The results of this study seem to be much more in line with the latter option.

The rest of the paper is organized as follows. The following section discusses public-private relations in Russia and characterises the general framework of the analysis. Section 3 describes the data used. Section 4 presents the empirical results, and section 5 concludes.

2 Enterprises, district heating and the public sector in Russia

Following Reinikka and Svensson (2002), complementary capital can be defined as capital that provides support services necessary for the operation of productive private capital. Especially in low- and medium-income countries, complementary capital (eg transport infrastructure or utilities) is typically provided by state monopolies or publicly owned companies. To some degree, a firm can substitute for mediocre public services by investing privately in complementary capital (eg private electric power generators). Heating is undoubtedly an integral component of complementary capital. In most parts of Scandinavia, Russia and a number of other countries of the former Soviet Union, heating is perceived as a semi-public good. The reason is that these countries have historically relied heavily on district heating, usually provided by municipal heat and power plants.

In Russia, infrastructure provision by enterprises has its roots in the planning of Soviet cities. A standardized model of Soviet

municipal infrastructure whereby a city of a certain size is linked to a certain number of electric power and heating plants emerged as a by-product of central planning. In fact, most of the classical social infrastructure items like heating utilities, housing, schools, hospitals, water and sanitation were designed on a district-wide or city-wide basis. The heating and power plants, as well as the other infrastructure, would be operated either by the city or by individual enterprises according to the plan (Hill and Gaddy 2003).

Even today large enterprises remain critically important in some areas of infrastructure provision, notably in district heating. In many cases an enterprise continues to be the monopoly heat provider for the apartment blocks it used to own or for a whole district. As an example, at the beginning of the heating period 2004–2005, the main concern of the city of Petrozavodsk (Republic of Carelia) was to ensure that two large companies currently in financial difficulty – the Avangard shipyard and the tractor factory Onega – would be ready for the heating season (Karjalan Sanomat, September 2004).

There are two different reasons for private enterprises to engage in the production of complementary capital (heating) in Russia. First, some firms have been forced to invest in their own boilers to substitute for or to complement low-quality municipal district heating. It is widely known that the district heating pipelines are in a sad state, with frequent leakages and considerable thermal losses. News about interruptions in heat delivery due to broken pipes or even a lack of fuel are not uncommon. At least in theory, combined heat and power (CHP) generation is the most efficient method of district heat production. Thus, apart from enterprises for which steam or hot water is a by-product of the production process, investing in enterprises' own heat-only-boilers may cause an efficiency loss compared to a situation where the enterprise can rely on heating produced by a (municipal) CHP plant.

Secondly, as noted above, enterprises sometimes are, by design, responsible themselves for providing district heating for their surroundings. This unavoidably leads to a somewhat special relationship between enterprises providing district heating and the local administration. The consumer price for heat is determined by regional energy commissions and municipalities. In most cases the tariffs have not been sufficient to cover the costs of supply and consequently heat supply has not been profitable even for local energy companies generating both heat and power (IEA 2002). Thus it has been argued that the implicit obligation to provide for municipal district heating is an excessive burden for industrial enterprises struggling to survive in the emerging market environment.

On the other hand, there is anecdotal evidence of cases where enterprises use their boilers as a bargaining tool vis-à-vis the local administration (interview with Starodubrovskaya in Moscow 2002). Further, Juurikkala and Lazareva (2006) show that enterprises have been able to use their social assets as leverage to extract benefits from the local public sector. As our survey results show, heat-providing enterprises are on average larger and older than enterprises not producing heat. And, especially in a transition economy, size tends to come with connections and influence.¹ An influential firm would typically be a large firm, employing a large share of the local population and consequently affecting directly the local wellbeing and political mood (eg Hellman et al 2003).

An influential firm has good opportunities to engage in what Frye (2002) describes as elite exchange. That is, enterprises which receive favorable treatment also provide some benefits to state agents. It is highly probable that at least some heat-providing firms have been able to negotiate with the local government for favors to compensate for the costs of heat production. This would suggest that these enterprises have simply adapted to existing institutions and infrastructure. The Soviet legacy of firms providing complementary capital not only for themselves may seem strange to an outside observer. But if firms have found their way around the local administration, infrastructure provision may not be a big obstacle to growth. Indeed, as pointed out by Rodrik (2003), a wide variety of even fairly unorthodox institutional setups may be compatible with economic growth.²

There are several possible reasons for the public sector to be interested in cooperation with enterprises in the provision of public goods and complementary capital. The self-evident reason is of course that the local public sector in Russia has very little money available for new investments, and it is in everyone's interest to use existing capacity whenever possible. Even if a municipality could manage public infrastructure without the help of local enterprises, maintaining close relations probably enables local politicians to obtain some private benefits.

The mismatch between considerable expenditure requirements and the lack of own revenues at the regional level also results in peculiar forms of public goods provision. In their analysis of Russian fiscal federalism, Lavrov, Litwack, and Sutherland (2000) argue that regions and localities in Russia favor large incumbent firms capable of

¹ This is naturally true for any economy, especially if the legislative framework is in a state of flux and corruption is widespread.

² See also Hausman et al (2004).

providing public goods. As cash-constrained regional and local governments must provide traditional public goods such as education and health care, as well as heating and road upkeep, local administrations have an incentive to cooperate with local enterprises in providing statutory public services.

One channel for informal budget operations is to have large firms contribute directly to the provision of some public services such as road maintenance or health care. In exchange, regional governments may tolerate large tax arrears with no expectation of ever being paid.³ At the regional level, everyone is happy; firms roughly pay in some form most of the taxes they would otherwise have to pay, consumers get some public services, and regional leaders have independent discretion over budget operations. The obvious loser here is the federal government, which is effectively deprived of its share of tax revenue, (see also Haaparanta and Juurikkala 2004). Frye (2002), indeed, offers survey evidence that the economic playing field in Russia is tilted in favor of large (formerly state-owned) enterprises and against smaller de novo firms, especially at the regional level.

3 Data

3.1 Data sources

Most of the data are from the firm survey of large Russian industrial enterprises in April-June 2003. The survey was organized by a joint research team of Helsinki School of Economics, Bank of Finland Institute for Economies in Transition (BOFIT) and Centre for Financial and Economic Research (CEFIR) in Moscow. The survey focused on enterprises' role in providing social services and infrastructure. The survey, thus, includes many questions on firm involvement in the provision of a wide variety of social services, as well as assessments of public infrastructure, the generation of heat and

³ Tax collection is the duty of the Federal Tax Ministry, but local tax offices have considerable power in implementing tax rules, as supervision and guidance from the higher-level tax administration have been rather weak. Employees of regional and local branches of the tax ministry often depend on regional or local governments for their premises, transportation, communications, office equipment, etc. This creates an informal system of dual subordination that may allow regional and local governments to influence decision-making by local tax offices.

electricity, as well as regulation and competition. Detailed balance sheet data were not collected.

The survey covered 404 large and medium-sized industrial enterprises in 40 regions in Russia. Apart from energy production and minerals extraction, which were excluded, the sample is representative of industrial distribution (on a 2-digit level) in Russia. The majority of firms in the sample employ between 500 and 5000 employees. Appendix 1 gives a more detailed description of the survey design and implementation.

3.2 The two dependent variables

The general manager of each firm surveyed was asked if his enterprise currently produces heat and if heating is provided to outside users. Three quarters of the enterprises surveyed produced heating in 2003. Of those who produced heating, over half also provided heating to outside users, mainly to the local housing and utilities sector (*predpriyatii zhilizno-kommunalnava hozjaistva*). There are no trading houses in the sample, ie no enterprises providing heating to outsiders but not producing heat. The general managers' answers, reported in Table 1 below, are used to construct two discrete dependent variables, one for heat production (heatprod) and another for district heat provision (heatsell).

Table 1. **Production and provision of heating**

	Firm owns heating boilers	Firm produces heat (heatprod)	Firm provides heat to outsiders (heatsell)
Yes	306	300	167
No	98	104	130
N.obs	404	404	397

Note: Due to missing responses, the sum of responses is sometimes less than the total number of firms in the sample.

The general manager was also asked about the reasons for the firm's own production of heating and for providing district heating to outside users. The answers seem to reflect the fact that in most cases a firm's heat-producing capacity (ie boilers) was inherited from the socialist period. The majority of managers failed to give any reason for heat production apart from 'history' or 'technological needs'. Out of the

167 firms providing district heating, only 69 considered it to be profitable. This result notwithstanding, the large majority did not wish to get rid of their heat-generating capacity. This led us to go deeper into the determinants of district heat provision.

3.3 The main independent variables

First and foremost a set of basic enterprise-level controls are used. One wishes to control for the firm size, industrial branch, ownership and size of municipality. To control for enterprise size, data on employment in 2002 are used, since employment data are always reported and are less prone to irregular reporting than sales or other accounting measures. The 2-digit level industry classification is used to construct dummies for the 9 main industries in the Russian classification. The number of inhabitants of a locality was obtained from the CEFIR municipal database. In the empirical analysis, the log of the population, as well as the log of employment, is used in order to smooth the distribution.

In the survey, the general manager was asked for details of the firm's ownership structure. Given the generally low transparency and unwillingness to reveal the firm's owners, the response rate to this question was quite high: more than three quarters of firms provided information about their owners. A dummy was constructed for the largest shareholder (insiders, private, state, foreign, other). The category 'insiders' includes employers and managers and the category 'private' includes both private individuals and private Russian companies. The category 'state' includes all three levels of government in Russia. The data confirm the increased concentration of industry ownership in Russia. Of the 342 firms for which we have ownership data, in only 31 cases did no single shareholder group own the absolute majority (over 50% of the shares). Further, in only six firms were two ownership groups in control of equal amounts of shares. Typically, a large Russian firm is controlled by a single type of owner.

The survey provides us with data on whether the enterprise had boilers before 1990. Given the a priori assumption that history and inheritance play a large role in infrastructure services in Russia, one can easily assume that a dummy variable indicating whether a firm had boilers before 1990 is a powerful determinant of heating production also today. Given that housing entities are still the largest customers of the district heating produced within firms, one might

presume that enterprises with housing on their books in 1990 are likely to provide district heating even today. Consequently, a dummy indicating whether the enterprise had housing in 1990 is included.

The main variables of interest include a set of variables on regulation and government support, as well as on the business environment. It is also possible that heat producers have closer and multidimensional relations with the state sector. Each of the top managers interviewed was asked how many working days they personally spent on dealing with regulative agencies.⁴ This allows one to use a variety of different variables to measure the regulatory burden a firm faces. The variable used in the analysis is the time spent personally by the general manager in dealing with various licensing, certification and inspection agencies, with customs, and with local officials regarding the use of public infrastructure. Further, the survey asked if the enterprise had received credits or, tax breaks, or engaged in restructuring of tax debts, or had received subsidies or other support from the state budget during the last three years (2000–2002). This is used to define a dummy variable that takes the value one if the enterprise received any form of budget assistance. The hypothesis is that firms engaged in heat production and district heat provision to outside users are more likely to receive budget assistance (especially if heat provision is not profitable).

Further, we asked if the firm gives voluntary financial or non-financial support, ie makes payments on top of compulsory taxes and fees, for the construction or maintenance of certain items of public infrastructure. The results are reported in Table 2 below. A dummy variable indicating whether the enterprise gave support to any of the infrastructure items (infrasup) was constructed.

Table 2. **Support for public infrastructure**

	Municipal district heating	Municipal electricity system	Local gas network	Municipal water networks	Municipal waste collection	Roads outside the plant area	Railroads not owned by the firm	Any of these (infrasup)
Yes	67	48	34	70	62	97	31	173
No	336	356	369	334	341	306	372	231
N.obs	403	404	403	404	403	403	403	404

⁴ Partly due to the formulation of the questions, managers sometimes cite amounts exceeding 250 working days per annum. In these cases the answers are coded as 250.

Finally, the sample includes subjective assessment by the chief engineer of the quality of outside-provided infrastructure. An unweighted average of the assessments is used to proxy the quality of the surrounding infrastructure (*infra_assess*) (1-good, 2-satisfactory, 3-poor). One might reasonably assume that the enterprises that see the quality of outside-provided services as poor are more prone to produce some *infra* items within the plant. We also have data on the proportion of state sales in total sales for three consecutive years (2000–2002) and the firm’s share in the regional market.

Table 3a. **Descriptive statistics for the main explanatory variables**

Variable	Obs	Mean	Std.Dev.	Min	Max
L <i>n</i> employment	402	6.87	0.923	1.61	10.53
L <i>n</i> population	401	5.85	1.635	2.75	9.02
Boilers90	404	0.609	0.489	0	1
Housing90	404	0.77	0.412	0	1
Est.year/10	401	193.61	4.380	171.8	200.2
Regulation/10	338	5.38	5.726	0	25
Budget support	403	0.598	0.491	0	1
<i>Infra_assess</i>	404	1.68	0.392	1	2.86

Table 3b. **Descriptive statistics for employment, population and heat production**

	heatprod = 0	heatprod = 1	P>t	N.obs
mean of employment	1329	1817	0.20	402
mean of city population	1 528 119	1 138 803	0.16	401

Note: p-value refers to t-test of the equality of means, corrected for unequal variances

4 Empirical results

4.1 Heat production

From the descriptive statistics in Tables 3a and 3b, it seems clear that firm size, as measured by total employment, could well be significant in explaining the probability that an enterprise produces heat within the plant. Also the size of the locality where the enterprise is located should indeed matter for heat production.

It is assumed that the probability of a firm producing heat (heatprod) depends on various enterprise characteristics, inheritance controls, relations with the public sector, and a normally distributed error term. The analysis is based on standard probit regression using STATA 8.2 statistical software. The results are reported in Table 4.

Table 4. **Probit results for heat production**

	(1) Baseline	(2) Baseline plus ownership	(3) Baseline plus relations with public sector	(4) Preferred model	(5) Preferred model plus Federal Districts
Lnemployment	0.039 (2.50)**	0.041 (2.79)***	0.038 (2.58)***	0.037 (2.70)***	0.040 (2.77)***
Lnpopulation	-0.022 (2.21)**	-0.016 (1.44)	-0.016 (1.65)*	-0.018 (2.12)**	-0.016 (1.86)*
Boilers90	0.579 (13.14)***	0.563 (11.66)***	0.598 (14.73)***	0.590 (14.45)***	0.595 (14.91)***
Housing90	0.005 (0.14)	0.019 (0.54)	-0.011 (0.34)		
Est.year	0.001 (0.30)	0.001 (0.23)	-0.001 (0.30)		
Owner (Insiders is the omitted category)					
Private		-0.032 (0.97)			
State		-0.001 (0.04)			
Foreign		0.092 (0.99)			
Other		-0.128 (3.16)***			
Regulation			-0.006 (2.21)**	-0.005 (2.29)**	-0.005 (2.15)**
Budget support			0.070 (2.51)**	0.076 (2.71)***	0.082 (2.93)***
Federal Districts (Central is the omitted category)					
Northwest					0.018 (0.36)
South					0.070 (1.17)
Volga					-0.015 (0.42)
Urals					0.066 (1.33)
Siberia					0.022 (0.51)
Far East					0.167 (3.22)***
Infrasup			0.022 (0.72)		
Sales to state sector in 2000			0.003 (1.08)		
Sales to state sector in 2001			-0.007 (1.44)		

	(1) Baseline	(2) Baseline plus ownership	(3) Baseline plus relations with public sector	(4) Preferred model	(5) Preferred model plus Federal Districts
Sales to state sector in 2002			0.003 (1.14)		
Share of regional market			0.048 (0.81)		
Industry dummies	Included	Included	Included	Included	Included
Observations	313	270	313	313	313
Pseudo R2	0.63	0.66	0.66	0.65	0.67

Results reported in average marginal effects on Prob(heatsell = 1) calculated using delta method by STATA's `margeff` after `probit, robust`. Absolute value of z statistics in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%. The preferred model (4) is derived from (3) stepwise, dropping insignificant variables one at a time. Every step was also confirmed by AIC and BIC tests.

As expected, firm size is significant. The larger the firm, the more probable it is that it produces heat. Further, it is evident that the firm's size relative to the surrounding population matters. The larger the municipality, the less probable it is that an individual enterprise produces district heating. The variation between different industrial branches is surprisingly small. Only the food processing industry differs somewhat from the general picture, having a higher probability of producing heat and a smaller probability of selling it outside. Even this variation is not statistically significant.⁵

Current ownership does not seem to be a decisive factor in determining a firm's probability of producing heat. Enterprises in which the state (whether federal, regional or local government) still is the largest shareholder are less likely to produce heating. The contrary is true for foreign-owned firms which seem to favor autarky, at least for heating. This finding may be explained by the fact that foreign owners tend to favor self-sufficiency over possibly time-consuming negotiations with an outside provider. But the differences are statistically insignificant, most likely because our sample includes only large firms. In practical terms all of them are former state-owned enterprises, mostly established during the Soviet period. The explanatory power of the ownership dummies is generally not very high and, disturbingly enough, their levels of significance are not at all robust to the choice of omitted variable. Consequently, ownership dummies are not used in the subsequent analysis. This also enables a big increase in sample size.

⁵ This can be seen from Figure A2.1 in Appendix 2.

In explaining heat production, I therefore prefer to control for size of firm and of locality, as well as for industry, but not for the firm's ownership structure. The dummy for having heating boilers in 1990 is naturally included. These four variables together explain a fair amount of the total variation, as indicated by the high pseudo-R squared. The dummy for having housing in 1990, as well as the year in which the enterprise was founded (*est.year*), turned out to be insignificant in explaining the probability of producing district heating.

A wide range of additional variables characterising relations with the public sector were included in the regression. The only variables that seem to make a real difference are the dummy for receiving budget assistance and our measure of the regulatory burden. Heat-producing enterprises seem to face a slightly smaller regulatory burden than other firms, but the economic significance of this variable is extremely small. Nonetheless, heat producers are, somewhat surprisingly, significantly more likely to receive budget assistance from public funds. This would be natural if heat producers were very poor performers. But the result holds even if we control for the enterprise's profit level during the same period or during a longer period (1998–2002). One explanation is that the heat-producing enterprises are powerful in negotiating with the administration and so are able to gain additional benefits from the local public sector. But the possibility of reverse causality (receiving of budget support being determined by whether a firm is a heat producer or not) cannot be ruled out.

As the sample covers regions in all of the seven federal districts, we have the opportunity to test whether geography affects the picture. The initial hypothesis was that enterprises located further north and east, ie in harsher climatic conditions, are more likely to produce heating at least for themselves. This seems to be partly true; firms located in the Urals and Far Eastern federal districts are more likely to produce heating. The result, however, is likely to stem from the fact that we also control for inheritance, ie whether a firm had boilers in 1990. Firms situated in the Urals, Siberian and Far Eastern federal districts were less likely to have boilers in Soviet times. This may indicate that the average type of locality where a firm is situated differs between those districts and the European part of the country. Many Siberian industrial towns were in fact established only after WWII and they tended to be planned as an entity, including specialised electricity and heat production companies (Hill and Gaddy 2002). One might, therefore prefer to control for climatic conditions directly by using a variable measuring the mean January temperature of the region. But this variable does suffer from a similar problem.

Enterprises located in colder regions were less likely to have their own boilers in 1990.

Also the variable measuring the quality of outside-provided infrastructure was significant and had the expected sign, indicating that a firm which more highly rate the quality of publicly provided infrastructure is less likely to produce heating. This variable is, however, negatively correlated with size of locality and so is not reported. Firms situated in bigger cities tend to rate the quality much better than firms in smaller localities. It is therefore not surprising that including the `infra_assessment` variable reduces the coefficient of the size of locality, making it statistically significant only at the 15% level. Finally, a large set of additional variables reflecting competitive pressures and financial strength of enterprises was included in the model, but these variables were not significant in any specification.

4.2 Model specification and results for district heat provision

When analysing the determinants of district heating provision, one should keep in mind that we are examining the subsample of heat-producing enterprises, ie large enterprises which tended to have boilers already during the Soviet period and which are nowadays likely to receive budget support in various forms. Therefore one could view an enterprise as facing three alternative choices: not produce heat at all, producing heat only for itself or producing heat for both its own needs and those of outsiders. This setup leads to a multinomial model. A multinomial logit model was estimated using the explanatory variables found significant in individual logit models for `heatprod` and `heatsell` was estimated.⁶ The estimated model fails the independence of irrelevant alternatives (IIA) assumption (tested with a Hausman test, as suggested by Hausman and McFadden 1984, and by the Small-Hsiao test), which is indeed a very strong assumption. Therefore an alternative formulation is needed. It would be tempting to move to a nested logit model as a two-level choice problem, where a firm first chooses between producing and not producing heat and then makes the final choice from that set. A nested logit model, however, assumes one has both firm and choice-specific data, which

⁶ The results confirm earlier findings on the importance of inherited factors, having boilers in 1990 especially. See Appendix 3 for details.

we do not have. I thus need to concentrate on treating the two discrete choices separately.

It is possible to argue that some enterprises have chosen not to produce heating because they know they would not be able to sell it outside the plant. Ignoring the selection bias would lead to imprecise estimates and therefore it would be advisable to use the Heckman correction for the possible bias. The practical problem we are faced with is, however, that due to the nature of the data we do not have a clear single selection variable. As both the selection and the main equation are in probit, even the functional form cannot be used as the selection criterion. I do argue, however, that the selection bias is likely to be extremely small if it exists at all, as the decision to produce or not to produce seems to be largely determined by inherited factors, as shown in the previous section.

The basic control variables are again found to have the expected signs, as reported in Table 5. The size of enterprise and municipality population are significant in explaining the probability of providing district heating. The results concerning the ownership structure are unchanged from the analysis of heat production and are therefore not repeated here. Larger enterprises situated in smaller municipalities are significantly more likely to provide district heating for outside users than are other heat-producing enterprises. Further, the enterprises which had boilers or housing in 1990 are more likely to provide district heating 13 years later. For district heating provision, also the age of the enterprise seems to matter. Older firms are somewhat more likely to provide district heating for outside users.

Table 5.

Probit results for district heating provision

	(1) Baseline	(2) Baseline plus relations with public sector	(3) Preferred model plus relations	(4) Preferred model plus regulation
	heatsell	heatsell	heatsell	heatsell
Lneployment	0.076 (1.81)*	0.054 (1.28)	0.061 (1.46)	0.076 (1.85)*
Lnpopulation	-0.055 (3.03)***	-0.045 (2.54)**	-0.048 (2.60)***	-0.046 (2.50)**
Boilers90	0.388 (4.97)***	0.355 (3.92)***	0.385 (4.64)***	0.376 (4.60)***
Housing90	0.159 (1.69)*	0.200 (1.97)**	0.165 (1.74)*	0.160 (1.71)*
Est.year	-0.014 (1.70)*	-0.010 (1.97)**	-0.011 (2.64)***	-0.014 (2.18)**
Divest		0.109 (1.45)	0.141 (1.90)*	0.141 (1.86)*
Infra_assess		0.195 (2.52)**	0.177 (2.16)**	0.190 (2.33)**
Regulation		0.005 (1.07)		0.008 (1.71)*
Budget support		0.005 (0.08)		
Infrasupp		0.031 (0.56)		
Sales to state sector in 2000		-0.011 (1.04)		
Sales to state sector in 2001		0.019 (1.77)*		
Sales to state sector in 2002		-0.007 (1.05)		
Share of regional market		-0.065 (0.58)		
Relations		0.084 (1.09)	0.140 (1.84)*	
Industry dummies	Included	Included	Included	Included
Observations	179	179	179	179
Pseudo R2	0.31	0.37	0.35	0.35

Results reported in average marginal effects on Prob(heatsell = 1) calculated using delta method by STATA's `margeff` after probit, robust. Absolute value of z statistics in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%. The preferred models, spec (3) and (4) are derived from (2) stepwise, dropping the insignificant variables one at a time. Every step was also confirmed by AIC and BIC tests.

Next, the set of variables characterising the public-private relationship is included (second column in Table 5). In addition to the variables used earlier, we have at our disposal two potentially interesting indicator variables. `Divest`-dummy takes the value of one if the general manager said the enterprise would like to get rid of their heating boilers. The other dummy variable, `Relations`, takes the value of one if the general manager thinks their relations with the local administration would worsen if they sold their boilers to a third party.

Once again the insignificant variables are removed from the model one at the time in order to arrive at the preferred model. Unfortunately, the relations dummy is correlated with the regulation variable and including the former always makes the latter insignificant. Therefore, in the final stage, it was decided not to include them both in the same specification.

The high significance level of the divest-variable suggests that delivering district heating is not a money-maker. The probability of being a heat seller increases by 21% if a firm wants to get rid of its boilers, holding other variables at their mean. Here one is inclined to believe that the result is indeed driven by reverse causality. Being a district-heating provider may increase the possibility of wishing to divest the boilers. Either way, the relation between the wish to divest and district heating provision is interesting. It seems to confirm the hypothesis that heat provision is not a profitable line of business that the enterprises would like to maintain.

The effect of the assessment on local infrastructure quality (infra_assess) is significant and fairly large. A change in infra_assess from poor to satisfactory decreases the probability of delivering district heating by 21%. We may thus conclude that where the local infrastructure is of poor quality, the enterprises are bound to engage in providing some parts of it by themselves. Due to a lack of suitable instruments, we cannot, however, rule out the possibility of the result being driven by reverse causality.⁷

The relations dummy has a positive effect on the probability of being a heat provider. Here the interpretation is fairly clear. If an enterprise not engaging in district heat provision were to divest its boilers, its relations with local administration would not change, whereas, if an enterprise engaging in this type of infrastructure provision were to divest or sell its boilers, the local administration would likely oppose it. In most cases there is no alternative district heating provider available. This means that anyone in possession of the boilers is, at least temporarily, a monopoly provider for the surrounding districts. The local administration has presumably created a mutually beneficial relationship with the current monopolist. Even if the enterprise engaging in infrastructure provision would like to get rid of this function, it may not be willing to do that for fear of worsening relations with the local administration.

⁷ The firms selling district heating to outside users are simply more engaged in infrastructure issues and consequently the quality of infrastructure matters for them.

Heat-producing enterprises seem to face a somewhat higher regulatory burden. The effect of regulation is positive and statistically significant. The economic significance, however, is minor. An increase of 10 days in the general manager's time spent with various regulative agencies increases the probability of providing district heating by 0.01%. Here one should note that the general manager's time with regulative agencies is not necessarily a burden for the firm at large. Time spent with local agencies may also be one of the main tasks of management, garnering considerable financial benefits for the enterprise. What the regulation variable indeed tells us is that managers of enterprises providing district heating have more contacts with local agencies that regulate and licence their line of business.

Analogous to the preceding subsection, a large set of additional variables characterising the business environment and competition was added. None of these turned out to be significant in explaining district heat provision.

4.3 Robustness and some additional results

The results presented in this section are robust for the inclusion of a large set of additional variables, as described in previous subsections. The endogeneity of the variables characterising relations with the public sector was tested using industry means as instruments. The Rivers-Vuong (1988) two-step procedure does not reject the null hypothesis of the divest dummy being exogenous. Similar tests were run for the regulation, divest and relations variables in the heat provision equations. Based on the test results, exogeneity cannot be rejected.⁸ Further, all of the interesting variables do raise some degree of concern about reverse causality. As there is no way to exclude the possibility of reverse causality, I prefer to speak of the connection between heat deliveries and the variables characterising relations with the public sector – not about causality.

The preceding analysis revealed that the decisions to produce and sell heating are largely determined by inherited factors. In addition, heat-producing firms are, on average, more likely to receive budget assistance. Firms selling heat to outside users, on average, face a heavier regulatory burden and more often would like to get rid of their boilers. Do the firms engaged in district heating provision suffer in terms of sales, growth or investments?

⁸ Details on endogeneity testing are provided in Appendix 4.

We have data on sales, labour productivity and profits for the five-year period 1998–2002 for most but by no means all of the enterprises in our sample. On average, it seems that heat-producing enterprises are characterised by higher sales, higher investments and higher profits per employee than non-heat-producing ones. Among the heat-producing enterprises, those providing district heating for outside users have, on average, somewhat lower sales, lower investments and lower profits per employee. These differences are, however, fairly small and usually not statistically significant. Only sales per employee turn out to be statistically significant in explaining heat provision, but their economic significance is close to zero.⁹ One is therefore inclined to draw the conclusion that enterprises providing district heating are able to cover the costs associated with heat production and delivery either directly from their consumers or indirectly via closer ties with the local public sector.

The survey provides us with interesting additional information about the engagement of large enterprises in infrastructure provision. In addition to providing district heating, enterprises give voluntary support to many other types of public infrastructure such as road construction and maintenance. One can reasonably assume that decisions regarding heat provision and infrastructure support are made simultaneously and therefore a seemingly unrelated bivariate probit model was used. Surprisingly, the results suggest that these two issues are not determined simultaneously. The available data is not very helpful in analysing the determinants of support for public infrastructure. What we can say, based on the results reported in Appendix 6, is that large firms are no more likely to support public infrastructure, but firms located in smaller municipalities certainly are.

Finally, the sample of heat-sellers was splitted into two groups according to whether the general manager estimates heat deliveries as being profitable or not. At the descriptive level, the only notable differences between these two types of heat providers are found in firm size as well as in the size of the locality. Only the size of locality remains significant in the simple probit model reported in Table 6. Enterprises situated in large cities are significantly more likely to provide district heating profitably. This result may be caused either by firms situated in large cities being better negotiators or by the fact that generally smaller cities are simply poorer and more cash-constrained. We do, however, have some indication that ownership matters in being profitable. Insider-owned firms are less likely to consider heat

⁹ Basic results are provided in Appendix 5.

provision profitable and, especially in comparison to state-owned enterprises, the difference is statistically significant.

Table 6. **Probit results for probability of being a profitable heat distributor**

	(1) Baseline	(2) Ownership
Lnemployment	-0.004 (0.08)	-0.014 (0.29)
Lnpopulation	0.076 (3.06)***	0.072 (2.94)***
Boilers90	-0.008 (0.05)	
Housing90	0.128 (0.95)	
Infra_assess	-0.169 (1.63)	
Divest	-0.152 (1.67)*	
Industry dummies	Included	Included
Ownership (Insiders is the omitted category)		
Private		0.109 (1.23)
State		0.303 (2.35)**
Foreign		0.248 (1.42)
Other		0.357 (2.31)**
Observations	141	141
Pseudo R2	0.11	0.12

Results reported in average marginal effects on Prob(heatsell = 1) calculated using delta method by STATA's `margeff` after `probit, robust`. Absolute value of z statistics in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%.

5 Conclusions

In this paper heat production and district heat provision by Russian industrial enterprises was analysed on the basis of new survey evidence. First, three quarters of the surveyed enterprises produce heating in one way or another. Of those, over half produce heat in such magnitudes that they are able to provide heating for users outside their plant area. As only less than 40% of the enterprise managers stated that heat deliveries generate profits, it seems natural to inquire more deeply into the determinants of those activities.

Compared to firms relying solely on municipal district heating, heat-producing firms are on average larger, situated in smaller municipalities, and had boilers and housing in Soviet times. Further, compared to other heat-producing firms, firms providing district heating are on average larger, situated in smaller municipalities and had housing in Soviet times. These inherited factors explain a great deal of the variation in heat production. District heating, however, is not the main business of any of the surveyed firms and only a few consider it to be profitable. Therefore it seems fair to conclude that most heat producers are somewhat locked into the situation. For historical reasons, public district heating is occasionally missing and some enterprises are obligated to provide heating, not only for their own use but also for the surrounding community. Thus one would suppose that heat production and provision comprise an additional financial burden for an enterprise. Our data does not, however, support that view. In terms of productivity or productivity growth, there is no statistically significant difference between heat producers, heat sellers and other firms.

Therefore one is inclined to believe that heat producers are on average better placed to negotiate for benefits in some other areas. There is indeed robust evidence on heat producers being more likely to receive budget assistance. This result remains even if we control for profits or sales per employee. Thus I infer that heat producers are successful in negotiating for direct or indirect financial aid in the form of budget assistance to – possibly – cover the costs of heat production. The survey data reveal that firms providing district heating are on average more likely to face a high regulatory burden. The reason may be that the enterprises have adapted to institutional requirements by building up good relations with the local administration. Many a firm engaged in district heating provision would like to get rid of their heat-generating capacity, but they are locked into the status quo for fear of losing valuable connections.

In short, enterprises producing and providing heating are more likely to have close ties with the local public sector. These enterprises both receive benefits in the form of increased budget assistance or better connections with local administration and face additional costs in the form of contributions to public infrastructure. If district heat provision is an additional burden for an enterprise, the results show that the enterprises have found their own ways to accommodate the costs. The performance of enterprises engaged in heat deliveries and production, as measured by sales and productivity, is no worse than that of the other firms. The results indicate that close ties with the local administration may compensate for the direct costs of heat delivery.

This result is not necessarily good news for reforming, repairing and updating Russian municipal infrastructure. The results indicate that infrastructure provision by large enterprises has created a situation where enterprises have a continued interest in maintaining close connections with the local public sector. As Russian municipalities generally lack resources for infrastructure investments, it is probably in their interest to ensure that the enterprises continue to engage in infrastructure provision. This unavoidably leads to an equilibrium that no party has a direct interest in departing from. The economic playing field therefore will remain tilted in favor of large, incumbent firms. New entrepreneurs or small and medium-sized enterprises will have a hard time competing with infrastructure-providing incumbents.

This raises an interesting policy question: should the central government wish to break the status quo, what options would it have? The situation could be analysed as an outcome of a lobbying game, where ailing firms lobby self-interested local politicians by providing public infrastructure (see Solanko 2003). In order to break the status quo, the central government would need to ensure that entry costs to sectors dominated by large incumbents are minimised. Another possibly fruitful path could be to give the local politicians a greater direct interest in small and medium-sized enterprise development. The differences between Russia and China indicate that linking regional tax revenues to the success of new enterprises can create powerful incentives for favoring those firms (Gordon and Li 1997). The emergence of a new SME sector as an important regional revenue source could greatly level the economic playing field.

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Appendix 1

Data description¹⁰

The results are based on a survey of 404 middle-sized and large manufacturing firms from 40 Russian regions in April-June 2003.¹¹ In the survey we examined the extent of social service and infrastructure provision by the firms and the firms' assessment of the quality of public infrastructure and regulatory environment. Background information on ownership, investment, performance, competition, and financing decisions of the firms was also collected.

The source of information for the population of firms is the enterprise registry maintained by Goskomstat (State Committee of the Russian Federation on Statistics). In the construction of our sample we concentrated on the industrial sector, and within it manufacturing firms for which energy production is not a regular line of business. We set a minimum size limit of 400 employees, as pilot interview rounds indicated that smaller firms are unlikely to provide infrastructure or social services. Constructed in such a way, our sample frame contained 3523 firms. Our sampling technique includes a combination of clustering by region and systematic sampling by size. In the firms in our final sample, the general manager and managers responsible for social and infrastructure affairs were interviewed face-to-face. Reporting of accounting information was left to the chief accountant.

In our sample, compared to the population of Russian firms, the majority of industries are adequately represented in terms of share of firms, as are the federal districts. The fact that we surveyed medium and large enterprises explains the bias towards metallurgical firms in the distribution of industrial employment. The size distribution of our final sample is close to the population with the median establishment having 784 and the average being over 1600 employees.

Only 5% of the firms in the sample are relatively new, created during the 1990s. The majority of firms are open joint stock companies, which is not surprising, as most of the formerly state-owned firms were turned into open joint stock companies during the mass privatization of the early 1990s and some 80% of the sampled firms were privatized in 1991–1994. Lastly, similar to many previous

¹⁰ For details see Haaparanta et al (2003).

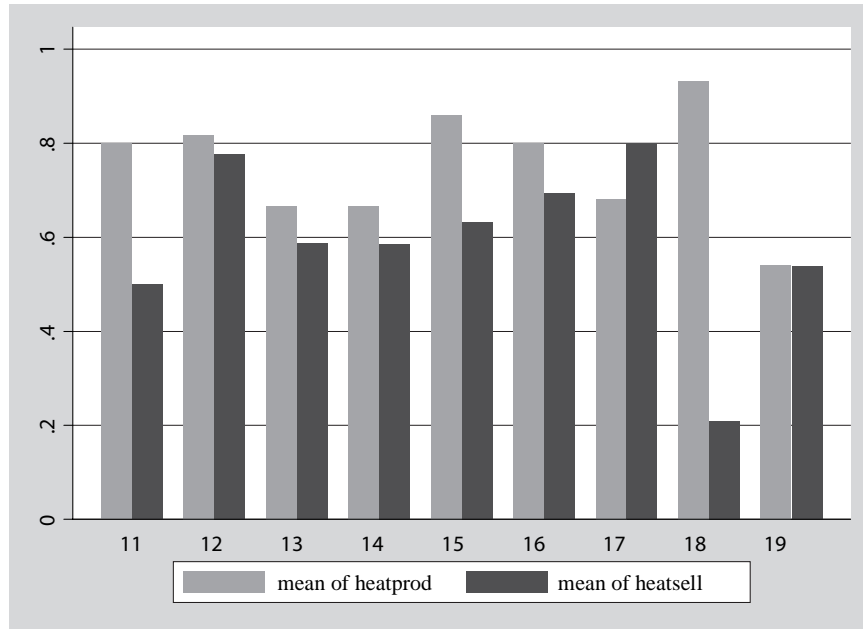
¹¹ Several face-to-face pilot interviews were carried out in 2002.

surveys, the sample contains some degree of selection bias towards the better-performing firms.

Appendix 2

Heat production by industry

Figure A2.1 **Probabilities of being a heat producer and a heat provider by industry**



- 11 Power & fuel
- 12 Metallurgy
- 13 Chemical industries
- 14 Machinery
- 15 Forestry, paper & pulp
- 16 Construction materials
- 17 Light industries
- 18 Food industries
- 19 Other

Appendix 3

Multinomial logit

Table A3.1 **Multinomial logit on heat production choices**

Prod_choice =1 (no heat production) is the comparison group	Prod_choice2 (heatprod, no heatsell)	Prod_choice3 (heatsell)
Boilers90	5.922**	7.961**
Housing90	0.154	0.909
Lnemployment	0.688*	0.809*
Lnpopulation	-0.090	-0.458*
Budget support	1.382**	1.506*
Infra_assess	1.577*	2.023**
Regulation	-0.125*	-0.068
Industry dummies	Included	Included
Observations	331	
Pseudo R2	0.49	

Absolute value of z statistics in parentheses; * significant at 5%, ** significant at 1%

Tests of IIA

Omitted choice	Hausman tests of IIA assumption P>Chi2	Small-Hsiao tests of IIA assumption P>Chi2
2	1.000	0.000
3	0.598	0.000

Ho: Odds(Outcome-J vs Outcome-K) are independent of other alternatives

Appendix 4

On Rivers-Vuong testing

There could be a variable unknown to us, like managerial ability, that affects both the amount of regulation a firm faces and a firm's decision to provide district heating. Or maybe the probability of wanting to divest heating boilers and a firm's decision to provide heating are in fact determined simultaneously. To test the possible endogeneity, we need to consider an alternative model for the suspected endogenous variable including at least one exogenous variable (instrumental variable) correlated with the suspected variable but uncorrelated with the dependent variable. The problem is that the survey data do not provide us with abundant alternatives for reliable instruments. I will instrument the suspected variables by the industry means. The industry mean certainly is correlated with the individual variable, but any single firm is unlikely to have any (much) influence on the mean. Since we have only one possible instrument for every endogenous variable, overidentification is not an issue. To test for endogeneity, we use the Rivers-Vuong (1988) two-step procedure as defined in Wooldridge (2002).

Assume the model is

- 1) $y_1 = b_1x_1 + ay_2 + u_1$, $y_1=1$ if $y_1^* > 0$, 0 otherwise
- 2) $y_2 = b_1x_2 + b_2x_2 + u_2 = bx_2 + u_2$
- 3) $\text{Var } u_1 = \text{Var } u_2 = 1$

Then the Rivers-Vuong (1988) two-step procedure is a) to run a linear OLS regression on the endogenous variable y_2 explained by the instrumental variable and the exogenous variables b_1 and save the residuals \hat{u}_2 and b) run probit y_1 on the exogenous variables b_1 , on y_2 and on the residual term \hat{u}_2 , to get consistent estimators of the scaled coefficients. The usual t-statistic on \hat{u}_2 is a valid test of the null hypothesis of y_2 being exogenous.

The two-step procedure suggests that the budget support-dummy in the probit regression on heat production is indeed exogenous. The estimated scaled coefficient of the residual term is insignificant and therefore the null hypothesis cannot be rejected. Further, when compared to probit estimation without the residual term, the estimated scaled coefficients of the other variables are largely unchanged but somewhat smaller. This is additional evidence for the null hypothesis.

Assuming that the instruments themselves are exogenous (and that y_2 and u_2 are not correlated or that the residuals u_2 are normally distributed), we cannot reject the null hypothesis of the dummy being exogenous.

The exogeneity of the regulation, divest and relations variables in the probit models for heatsell (Table 5 in the text) were tested similarly. The residuals were insignificant and so I feel that the assumption of exogeneity can reasonably be retained.

Appendix 5

On sales, profits, investments and heat provision

Table A5.1 **Financial variables and heat production and district heating provision**

Heatprod	0	1	P>t	N.obs
Mean of sales per employee in 2002, ths rbls	344.8	370.8	0.72	355
Mean of profits per employee in 2002, ths rbls	25.7	31.2	0.50	344
Mean of investments per employee in 2002, rbls	16.2	25.6	0.29	340

Heatsell	0	1	P>t	N.obs
Mean of sales per employee in 2002, ths rbls	461.2	306.9	0.07	264
Mean of profits per employee in 2002, ths rbls	40.4	24.9	0.19	260
Mean of investments per employee in 2002, rbls	40.2	15.3	0.2	251

Note: P-value refers to t-test on equality of means corrected for unequal variances

Table A5.2 **Probit results for district heating provision**

	Spec(1)	Spec(2)	Spec(3)
Lnemployment	0.101**	0.087*	0.071
Lnpopulation	-0.059***	-0.054**	-0.057***
Boilers90	0.337***	0.295***	0.276***
Housing90	0.154	0.163*	0.136
Sales per employee	-0.000*	-0.000	-0.000**
Infra_assess		0.223***	
Regulation		0.009	
Divest		0.191**	0.164**
Relations			0.245***
Industry dummies	Included	Included	Included
Observations	169	169	169
Pseudo R2	0.27	0.32	0.32

Results reported in average marginal effects on Prob(heatsell = 1) calculated using delta method by STATA's margeff after probit, robust. Absolute value of z statistics in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%

Appendix 6

District heating provision and voluntary support for public infrastructure

Table A6.1 **Seemingly unrelated bivariate probit results**

	Heatsell	Infrasupport
Lnemployment	0.369 (2.59)***	-0.028 (0.25)
Lnpopulation	-0.196 (3.05)***	-0.165 (2.97)***
Boilers90	1.298 (4.96)***	-0.132 (0.60)
Housing90	0.485 (1.86)*	
Infra_assess	0.582 (2.11)**	0.386 (1.77)*
Regulation	0.048 (2.85)***	0.024 (1.56)
Divest	0.595 (1.99)** (0.52)	(0.17)
Industry dummies	Included	Included
Constant	-4.562 (3.37)***	0.286 (0.24)
Observations	249	249
Rho	0.23 (0.116)	

Wald test rejects the null hypothesis of $\text{Rho} = 0$ at 10% level. Robust z statistics in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%.

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