ABSTRACT

Title of Dissertation: FISCAL DECENTRALIZATION AND ECONOMIC TRANSITION IN THE RUSSIAN FEDERATION: THE DETERMINANTS OF REGIONAL PUBLIC AND PRIVATE INVESTMENT

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The dissertation comprises two essays examining the determinants of public and private investment at the regional (oblast) level during the first decade of Russia's transition to market democracy, focusing on the effects of federal institutions, regional government policies, factor mobility and regional economic structure.

The first essay addresses the debate within the fiscal federalism literature as to whether fiscal redistribution among subnational governments creates a disincentive for them to promote local economic growth through public investment. A model of local government expenditure allocation with asymmetrical regional endowments shows that revenue redistribution from rich to poor regions diverts public spending from investment to consumption, because raising private income

through infrastructure investment results in higher taxes and/or reduced subsidies. Random effects estimation of a 74-region panel covering 1994-1997 shows that, controlling for regional income, the budget share and per capita level of regional public investment depends negatively on federal subsidization. This effect is particularly strong for wealthier oblasts and non-republics, whose income from subsidies is more volatile than that of poorer regions and republics.

The second essay explores the determinants of regional private investment, comparing domestic and foreign investment, with emphasis on the effects of regional government policies and local economic structure. A general equilibrium model of a regional economy with non-traded goods, industrial specialization and public inputs is constructed to predict the impact of economic liberalization on regional capital returns. Random effects estimation of a 73-region panel covering 1995-1999 shows that, whereas foreign direct investment in the Russian regions follows the pattern predicted by the model, flowing into regions with better endowments and public policies, domestic investment is tightly linked with local income and largely unresponsive to the regional policy environment. However, some increase in domestic capital's elasticity to regional government market-orientation is detectable in the last two years of the test period. Analysis of the effect of the 1998 ruble devaluation, which constituted a large relative price shock in favor of import-competing goods, shows that it shifted investment from regions rich in natural resources to those with more dynamic industrial sectors.

FISCAL DECENTRALIZATION AND ECONOMIC TRANSITION IN THE RUSSIAN FEDERATION: THE DETERMINANTS OF REGIONAL PUBLIC AND PRIVATE INVESTMENT

by

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DEDICATION

For Stefan

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1 Introduction

Transition to capitalist democracy in the Russian Federation was marked by two concurrent processes: political and economic power was radically decentralized, and public and private investment collapsed. Just as the fifteen union republics in 1991 disintegrated the Soviet Union by proclaiming local sovereignty and withholding public revenues, the 89 subjects of the Russian Federation to varying degrees seized control over local assets and legislative authority, seriously challenging at times Moscow's capacity to govern. Meanwhile, as shown in Figure 1, total capital investment by firms and governments plummeted by more than three quarters from its 1990 level during the first five years of transition, threatening the political viability of Russia's liberalization by deterring economic recovery (Tikhomirov, 1999).

The processes of decentralization and disinvestment were not independent: the demise of central authority and the uncertainty produced by the proliferation of conflicting policy regimes created a strong disincentive for long-term capital commitment. Potential investors in transitional Russia, whether public or private, domestic or foreign, faced a thicket of fiscal and regulatory restrictions that not only overlapped and contradicted each other but were also subject to frequent revision (Craig, et al., 1997; Aslund, 1997; Polishchuk, 1999; Ahrend, 2000). Improving Russia's investment climate therefore requires rationalization of its federal structures in a manner that spurs subnational governments to promote local market-based growth.

Despite generally poor investment performance during the first several years of transition, some of Russia's regions outperformed others in terms either of attracting private investment or of committing funds to public investment. While much of the variation in investment rates derives from initial differences in regional economic endowments and incomes, a significant portion depends upon policy variables tractable to institutional reform. This dissertation therefore examines the determinants of regional public and private investment, with a particular focus on the influence of federal structures and regional public policies, in order to identify reforms most likely to stimulate regional investment and growth.

The first essay seeks to account for variation in regional public investment, concentrating on the effects of interregional fiscal redistribution as well as regional political status and orientation. A model of local government expenditure is constructed to gauge the effects of regional economic asymmetries and fiscal redistribution on allocation of funds between public consumption and public expenditure; an increase in local assets or population is predicted to increase public investment, while an increase in federal fiscal redistribution is predicted to reduce it. In empirical tests, I find evidence that higher rates of federal subsidization reduce the level and budget share of regional public investment - particularly among wealthier regions and non-republics. I also find that Russia's ethnic republics, with their greater pro-communist political bias and higher public ownership of regional enterprises, have higher rates of public investment despite generally higher levels of poverty and unemployment.

The second essay studies systematic differences between the determinants of private domestic investment and foreign direct investment in the Russian regions. A general equilibrium model of a regional economy with industrial specialization, non-traded goods and productivity-enhancing public inputs is constructed to project the impact on regional capital returns of terms of trade shocks and variation in regional levels of education and public infrastructure. The model predicts that capital will flow into regions with more dynamic industries, better educated workforces, and superior public infrastructure. Empirical investigation of the determinants of regional private domestic vs. foreign investment finds that, while foreign investment reacts to both economic and political factors conditioning local capital productivity, domestic investment depends almost exclusively on economic factors and is tightly linked to local income. This suggests that, due to poor financial sector development as well as deliberate policy interventions by regional governments, Russia's regional capital markets are highly fragmented, preventing domestic investors from arbitraging differences in regional investment climates. The resultant inelasticity of private investment to regional policy environment reduces incentives for regional governments to enact pro-market reforms.

Since the mid-1990s, federal relations in Russia have stabilized substantially, although major jurisdictional conflicts among federal, regional and municipal authorities persist. The sharp devaluation of the ruble following the 1998 financial crisis has also stimulated investment, setting Russia on a path to recovery. In the past two years, the main regional policy issues addressed in this dissertation - rationalization of Russia's fiscal redistribution system, banking and financial sector reform, and harmonization of federal and regional legislation - have been targeted by the Putin administration for reform. This study suggests two benchmarks by which the success of these reforms may be measured: a reduction of the public investment disincentive from federal subsidization, and increased responsiveness of domestic private investment to regional policy environment.

2 Fiscal Redistribution and Regional Public Investment in the Russian Federation, 1994-1997

2.1 Introduction

This essay studies the determinants of regional (oblast-level) government public investment in transitional Russia, focusing on the effects of federal fiscal redistribution. Economists are divided over the benefits of fiscal redistribution, some supporting it as a means of equalizing local public service provision in the presence of regional income disparities, while others stress the disincentive it creates for subnational governments to promote local income growth. To elucidate these effects, I first construct a model of local government expenditure allocation in the presence of regional income asymmetries and fiscal redistribution, which shows that revenue redistribution from wealthy to poor regions can create a disincentive to invest in productivity-enhancing public infrastructure. I then test the predictions of this model using random effects estimation of panel data covering 75 of the 89 Russian regions during 1994-1997.

My results support the existence of a disincentive effect from federal subsidization on the regional public investment: regions which finance a higher share of their public expenditures through federal transfers allocate a lower share of spending to public investment. I also find that two subsets of regions in particular - those with above-mean per capita income and non-republics - have a lower marginal propensity to invest out of transfer income than out of own income. This is likely due in part to the fact that transfer income for these two groups is more volatile relative to own income than it is for poorer regions and republics. A further discovery is that Russia's ethnic republics, despite generally higher rates of poverty and unemployment, allocate both a higher share of their expenditures and a higher level of funds per capita to public investment than non-republics. This pattern is likely determined by their stronger pro-communist bias as well as by their correspondingly lower privatization rates and traditionally greater political autonomy, which may give republican governments a more encompassing interest in their local economies than their non-republican counterparts.

To the best of my knowledge, there is only one previous study of Russian regional public investment, Freinkman and Haney (1997). Running annual cross-sectional regressions regional public investment on per capita income and federal transfers, the authors discover that total regional public investment relates positively to total federal transfers, but negatively to the budget share of transfers. This study confirms the latter finding and improves upon the previous work 1) by tying analysis of regional public investment more closely to a formal model of local government expenditure allocation; 2) by using panel data with random effects to exploit both temporal and spatial regional variation; 3) by addressing the endogeneity of regional income to public investment using measures of regional fixed assets as well as lagged endogenous variables; and 4) by investigating the relative incentive effects of fiscal redistribution for specific subgroups of regions, namely rich vs. poor and republic vs. oblast/krai.

The following section describes Russian federalism in light of prevailing theories of fiscal redistribution and local government investment incentives. Section three constructs a model of regional government expenditure allocation in the presence of regional income asymmetry and federal fiscal redistribution. Section four tests the hypotheses developed in section three as well as others drawn from the literature, and section five concludes.

2.2 Russian Federalism in Theoretical Perspective

This study relates to two branches of economic literature: the debate within the fiscal federalism literature over the impact of fiscal redistribution on subnational governments, and the literature on the political economy of Russia's regions. The traditional view within the literature on fiscal federalism has been that, where resources are immobile - i.e., where natural resources are unevenly distributed across jurisdictions, and/or where internal migration is constrained - redistribution of public revenues is required to equalize fiscal capacity across regions (Boadway, et al., 1983; Stewart, 2000). Conversely, economists investigating the relationship between devolution and economic development argue that fiscal redistribution undermines subnational governments' incentives to promote local development, since any increase in local income will be partially siphoned off through higher taxes and/or reduced subsidies (Weingast, 1995)[1]. The primary goal of this essay is to examine the impact of fiscal redistribution on public investment by local governments using data on the regional (oblast-level) governments of the Russian Federation.[2]

This essay also provides empirical evidence regarding two major concerns of the literature on Russian regional economics: what determines regional government policies (Freinkman and Haney, 1997), and what are their implications for regional income levels? (Le Houerou and Rutkowski, 1996; Berkowitz and De Jong, 1998; Ahrend, 2000; Popov 2001) These questions are important because divergence in regional incomes, which has increased since Russian independence and was further exacerbated by the 1998 financial crisis, creates political tensions between rich and poor regions. It is the major impetus behind Russia's system of fiscal redistribution, which imposes costs from taxation and incentive distortion at both regional and federal levels. It is therefore of interest whether prevailing patterns of regional public investment are likely to alleviate or heighten interregional income disparities, and what

[1]The latter perspective also emphasizes the role of factor mobility as a constraint on local governments to enact "good" policies: policies such as public investment that enhance private factor returns attract mobile resources, thereby raising local income and tax revenues, while policies such as excessive taxation that reduce private returns result in capital flight.

[2]Russia comprises 89 regions: 21 republics, 49 oblasts, 6 krais, 10 autonomous okrugs, one autonomous oblast, and two federal cities, Moscow and St. Petersburg.

policy steps could be taken to promote convergence.

The remainder of this section describes Russia's regional political economy in terms of the issues outlined above. Transitional Russia offers a promising laboratory in which to test contemporary theories about the relationship between decentralization and economic development. Russia's 89 regional (oblast-level) governments exercise substantial discretion over economic policies within their jurisdictions, so that regional policies reflect local rather than central government preferences. Regional factor endowments vary sharply and regional factor markets are fragmented, creating a strong impetus for interregional fiscal redistribution; however, rates of fiscal redistribution vary widely across regions, permitting analysis of their influence on local economic policies. In particular, this study will measure these factors' impact on subnational investment in public infrastructure, which is widely viewed as promoting factor productivity and income growth (Munnell, 1990; World Bank, 1994; Aschauer, 2000).

Russian federalism also exhibits features which complicate the analysis of regional government investment incentives: first and foremost, the political environment of transitional Russian was chaotic. Throughout Yeltsin's tenure, both the political and the fiscal divisions of power between Moscow and the regions were in a constant state of flux (Hahn, 1997; McFaul and Petrov, 1997; Craig, Norregaard and Tsibouris, 1997). This rendered regional governments' political horizons short and their fiscal resources and responsibilities uncertain, reducing both their incentive and their capacity to invest. Furthermore, the country as a whole was in steep economic decline, placing tremendous pressure on governments at all levels to focus on stopgap welfare spending rather than longer-term development initiatives. Nonetheless, substantial differences among both the budget shares and per capita levels of regional public investment existed during 1994-1997, and an examination of their determinants may help illuminate the effects of federal fiscal structures on subnational government expenditure policy.

Russia's 89 regions differ starkly in terms of their economic endowments due not only to the natural diversity of Russia's immense territory but also to the spatial concentration of sectoral investment under Soviet central planning. For example, out of total 1993 industrial output, 80.9 percent of Tyumen oblast's output was concentrated in oil and gas production, 72.4 percent of Kamchatka's in food processing, 65 percent of Magadan's in nonferrous metals, 58.4 percent of Lipetsk's in steel, and 56.5 of Ulyanovsk's in machinery and metalworking.[3] This economic specialization produced divergence among regional incomes following the relative price shocks induced by economic liberalization. The coefficient of variation of per capita gross regional product (GRP) rose from 0.34 to 0.43 between 1994 and 1998, evincing not only the asymmetri-

[3] An index of regional industrial concentration developed by Ickes and Ryterman (1995), in which 0 represents total regional diversification and 1 total specialization, accords Russia a score of 0.46, vs. 0.34 for Western Europe, 0.26 for the United States, and 0.20 for China.

cal regional impact of liberalization, but also the existence of extensive interregional factor market fragmentation.[4]

Interregional labor mobility in Russia, at about one percent per annum, is very low compared even to its historical level of five percent under the Soviet Union (Mitchneck and Plane, 1995). Factors inhibiting labor mobility in transitional Russia include high transportation costs, extensive wage arrears and in-kind compensation, underdeveloped private housing markets, and the persistence of the Soviet "propiska" system of residential registration (Friebel and Guriev, 1999; Sutherland and Hanson, 2000). Regional capital markets also suffer from varying degrees of isolation: Pyle (1997), using data on average interest rates for the 11 greater economic regions[5] for 1993-1996, finds evidence of extensive segmentation among these "super-regional" credit markets due to the underdevelopment of private financial markets as well as to deliberate policy interventions by regional governments, such as local capital controls and the issuance of regional currency surrogates.

Steep income differentials across Russia's regions coupled with poor factor mobility render fiscal redistribution politically compelling. In a series of essays exploring the determinants of net regional transfers between 1992 and 1996, Treisman (1996, 1998a,b) finds a robust posi-

[4]This compares with a coefficient of variation of 0.16 for 1993 state per capita income in the United States (Bureau of Labor Statistics, www.stats.bls.gov.) and 0.41 for Brazil (Brazilian Statistical Bureau, www.ibge.gov.br).

[5]Russia's 89 regions are divided into 11 greater economic regions, plus Kaliningrad: North, Northwest, Central, Volga-Vyatka, Black Earth, Volga, North Caucasus, Urals, West Siberia, East Siberia, and the Far East.

tive correlation between regional per capita income and net federal budgetary taxes (taxes minus transfers). On average, during 1994-1996 regions with above-mean per capita GRP paid positive net taxes, while regions with below-mean income received a net subsidy. Correspondingly, richer regions received federal transfers equal to an average of 14 percent of their total expenditures, whereas poor regions' transfers accounted for nearly one third of their expenditures. (There was far less difference between rich vs. poor regions' average federal tax remittances of 36 vs. 32 percent of total revenue collections, respectively.) The impact of federal taxes and transfers on regional budgets can be highly significant: federal tax remittances range from zero to as much as 67 percent of total regional collections, while subsidies range from zero to more than one hundred percent of regional expenditures. It is also important to note that, at least during the period under study, federal transfers to the regions are effectively unconditional grants (Freinkman and Haney, 1997); they therefore do not alter the slope of the regional budget constraint except insofar as they alter incentives for promoting regional income growth, which issue I will explore in greater depth in the following section.

Despite a partial attempt to rationalize federal fiscal redistribution in 1994 (Le Houerou and Rutkowski, 1996), the Russian system for determining regional tax and transfer rates remained largely ad hoc and subject to political influence throughout Yeltsin's tenure. Regional governments lobbied the central government aggressively for lower taxes and/or higher transfers, both of which were used as instruments of fiscal redistribution (Stewart, 2000). This resulted in a lopsided assemblage of federal tax breaks and transfers in which some wealthier regions, such as Tatarstan and Sakha-Yakutia, operate in near autonomy while others either heavily subsidized or were subsidized by the federal budget (Solnick, 1995; Mau and Stupin, 1997). This essay will exploit this unsystematic variation in regional taxation and subsidization rates to gauge the impact of fiscal redistribution on regional expenditure policies, controlling for factors affecting regional income.

In order to render an analysis of regional expenditure policies meaningful, regional governments must have a reasonable amount of autonomy over their budget allocation decisions. From a starting point of nearly complete centralization under communism, Russia's transition to a market democracy has been integrally linked with devolution of political and economic power to the 89 "subjects of the Russian Federation." Early transition was marked by a clear shift of fiscal authority from the center to the regions[6]: while central government revenues fell from 18.8 percent of GDP in 1992 to 14.6 percent in 1996, consolidated regional revenues rose from 13.8 to 15.5 percent of GDP[7].

[6]This was due in no small part to the regions' withholding tax revenues from Moscow, in a manner analogous to the Union Republics' actions in bringing down the Soviet Union. Ensuing data on central and regional budgets are from Freinkman, et al. (1999).

[7]Consolidated regional government budgets include regional and municipal revenues and expenditures combined.

In correspondence with the shift in revenues, expenditure authority shifted from the center to the regions as Moscow, under pressure to stabilize Russia's macroeconomy, rapidly devolved both capital investment and social spending responsibilities (Wallich, 1994). Central government spending fell from 40.9 percent of GDP in 1992 to 18.2 percent in 1996, while subnational expenditure rose from 15.2 to 18.8 percent over the same period.[8] The federal share of total government spending on social protection fell from 71.8 to 31.2 percent between 1992 and 1996, while the federal share of education spending fell from 33.8 percent to 14.5 percent. Meanwhile, subnational government spending on administration and justice rose from 19.5 percent of total government spending in this category to 36.3 percent, in testimony to the rapid expansion of regional governments' political authority during this period. As a result of this devolution of spending responsibilities, regional budgets, which on average ran a slight surplus in the first two years of independence, slipped increasingly into deficit during 1994-1996.

Greater fiscal independence from Moscow enabled the regions to exercise considerable discretion over local economic policies, including liberalization measures such as privatization and price liberalization (Slider, 1994; Berkowitz, et al., 1996). Despite Yeltsin's decrees ending price controls and mandating privatization of state enterprises in 1992, five years later more than 15 percent of the regions still controlled one

[8] Approximately five percent of the decline in central government spending was due to military cutbacks.

fifth or more of all prices, and 30 percent of the regions maintained state ownership of at least one fifth of small enterprises in their territories (Lavrov, 1997). This diversity of policy regimes testifies to the political autonomy of the regions vis a vis Moscow.

A particular subset of the regions, Russia's 21 ethnic republics, enjoy greater independence from federal influence than do the rank-and-file oblasts and krais (De Bardeleben, 1997). Created under the Soviet policy of permitting greater local autonomy for ethnically non-Russian enclaves, the Russian republics have a tradition of relative independence which they augmented during early transition. Whereas Moscow generally maintained the right to appoint regional governors, republican presidents were usually chosen by local elites or popular elections. Republics also generally seized greater control over their regional natural resource bases and capital stocks. Given their generally more conservative political character, greater control over regional enterprises resulted in less privatization among the republics.[9] In terms of fiscal relations, the republics' greater independence translated into lower rates of taxation and higher rates of subsidization by the federal government, as republics used political intransigence (including secession threats) to extract concessions from the center.[10] As these distinctive characteristics - greater

[9]The share of the vote for conservative political parties - the Communist party and its rural counterpart, the Agrarian party - in the 1993 parliamentary elections was higher among the republics than among oblasts and krais at 27 vs. 20 percent; the rates of both service sector and industrial privatization among the republics are also lower, at 64 and 81 percent vs. 84 and 89 percent among the oblasts/krais. (IEWS, 1998; Lavrov, 1997; Goskomstat, 1998).

[10]The average rate of federal tax remittance for republics during 1994-1997 was 29

political and fiscal independence, political conservatism and higher rates of capital stock ownership - likely influence local expenditure patterns, republic status will be controlled for in the empirical investigation presented in section four.

Regional governments' relationships with their constituent municipalities are a microcosm of the national governments' relationship with the regions. Municipalities bargain aggressively with regional authorities to retain larger shares of the revenue raised in their territories and to receive higher transfers. Municipal budget constraints are also soft; higher income growth or revenue effort often results in higher regional appropriations or reduced transfers (Zhuravskaya, 2000). Expenditure responsibilities between regional and municipal governments are moreover often ill-defined, with overlapping competencies (Freinkman, et al., 1999). The analysis in section four will therefore consider consolidated regional investment (i.e., investment expenditure by both regional and municipal governments within each region), controlling for the extent of regional fiscal decentralization.

Taken together, these conditions provide a meaningful context in which to study the impact of fiscal redistribution on regional economic development policies. The following section presents a simple model of regional public expenditure allocation with asymmetrical endowments and fiscal redistribution. The empirical portion of the essay then tests

percent of collections, vs. 36 percent for oblasts/krais; and the average ratio of transfers to expenditures for the two groups was 36 percent vs. 18 percent, respectively.

whether fiscal redistribution affects regional public investment in the manner predicted by the theory.

2.3 A Model of Local Expenditure Allocation with Regional Asymmetries and Fiscal Redistribution

The purpose of this section is to formulate theoretical hypotheses regarding the effect of asymmetrical regional endowments and fiscal redistribution on regional government expenditure allocation to be tested in the following section. The following model depicts the optimal spending allocation between public investment (infrastructure) and public consumption (social services) by a regional government that is subject to income-dependent fiscal redistribution. Regions have asymmetrical endowments of a fixed asset, N_j. The regional production function is of the form $Y_j = I_j^{\beta} N_j^{\alpha} L_j^{1-\alpha}$, where I_j is public infrastructure, L_j is labor, and $\alpha < 1$ and $\beta < 1$.[11] Labor is assumed to be immobile across regions, permitting interregional differences in per-capita income[12], $y_j = I_j^{\beta} n_j^{\alpha}$, where $n_j = \dfrac{N_j}{L_j}$.[13]

The regional government chooses public investment, I_j, and public goods provision, G_j, to maximize the utility of its (identical) con-

[11]This type of production function was introduced by Barro (1990).

[12]Because consumer utility depends not only on private but also on public consumption, differences in after-tax per capita income could persist even with perfect mobility, given different levels of public goods provision as in Flatters, et al. (1974).

[13]Therefore, $\frac{\partial y_j}{\partial I_j} = y_I > 0$, $\frac{\partial y_j}{\partial N_j} = y_N > 0$, $\frac{\partial y_j}{\partial L_j} = y_L < 0$, $\frac{\partial^2 y_j}{\partial I_j^2} = y_{II} < 0$ and $\frac{\partial^2 y_j}{\partial I_j \partial N_j} = y_{IN} > 0$.

stituents, $U(C_j, G_j)$, which depends upon both public consumption G_j and private consumption, C_j.[14] Private consumption is simply equal to after-tax private income: $C_j = (1-T)y_j = (1-T)I_j^{\beta} n_j^{\alpha}$. It is conventionally assumed that $U_C > 0$, $U_G > 0$, $U_{CC} < 0$ and $U_{GG} < 0$.

Regional revenues derive from two sources: local own revenues net of tax remittances to the federal government and federal transfers. There is a uniform centrally imposed tax rate, T, levied on the entire regional product Y_j (or $y_j L_j$), as well as a federal redistribution rate, γ. Regional governments collect a portion of their region's output, Ty_jL_j, "share up" the amount $\gamma_j y_j L_j$, and receive a transfer in the amount of $\gamma_j \bar{y} L_j$, where $\bar{y}$ is the national average per capita income. Regional governments take $\bar{y}$ as given; they do not consider the impact of their expenditure allocation decisions on average national per capita income. The federal government thus redistributes fiscal resources among regions depending on their level of per capita income relative to the national average: regions with above-average per capita income pay a net federal tax, while regions with below-average income receive a net subsidy.[15] Normalizing

[14] I have chosen to represent regional governments as maximizing their constituents' income because during 1994-1997 Russia's regional legislatures and most of its regional executives were popularly elected, and therefore had to concern themselves to at least some degree with their constituents' well-being. An earlier version of this model, however, explored the possibility that regional governments self-interestedly sought to extract the maximal fiscal surplus from their constituents, assuming some interregional mobility. The regional governments therefore maximized Equation 1 subject to some reserve level of constituent utility, effectively inverting the terms of Equation 2. Notably, this formulation produces the same first-order conditions for marginal efficiency as the current formulation.

[15] The classic comparison would be to lump-sum fiscal redistribution, in which case every region would receive an exogenous net federal tax or subsidy, τ_j. The budget constraint would then be of the form $Ty_jL_j + \tau_j - I_j - G_j$, and there would be no allocative distortion in favor of public consumption due to lump-sum fiscal redistribution.

the unit cost of both G and I to one, the regional government budget constraint is therefore

(1) $[Ty_j - \gamma_j(y_j - \bar{y})]L_j - I_j - G_j$

It is assumed that $1 > T > 0$, and that the regional federal tax/transfer rate cannot exceed the general tax rate: $T - \gamma_j > 0$. Note that the formula for fiscal redistribution automatically satisfies the federal government budget constraint (assuming the federal government's only role is to redistribute income): $\Sigma_j \gamma(y_j - \bar{y})L_j = 0$. For simplicity, the regional index j will henceforth be suppressed.

The regional government thus maximizes the following function with respect to I and G:

(2) $U(C, G) + \mu\{[Ty - \gamma(y - \bar{y})]L - I - G\}$

The first order conditions are

(3) $I: \quad U_C(1-T)y_I + \mu[(T-\gamma)y_I L - 1] = 0$

and

(4) $G: \quad U_G - \mu = 0$

Solving the two equations for μ and rearranging produces

(5) $$\frac{U_C}{U_G} = \frac{1 - (T-\gamma)y_I L}{(1-T)y_I}.$$

The ratio of the marginal utility of private consumption relative to that of public consumption is equal to the ratio of the marginal resource

However, because the fundamental rationale for fiscal redistribution is to reallocate public revenues from rich to poor regions, a system of income-independent transfers is not a plausible basis for a model of central or regional government behavior.

cost of I, $1-(T-\gamma)y_I L$, which is less than one due to I's efficacy in raising regional income, to the marginal cost of G in terms of private income, $(1-T)y_I$. I will henceforth abbreviate the term $1-(T-\gamma)y_I L$ as P_I. Note that, ceteris paribus, it is increasing in the extent of federal redistribution, γ, which raises the cost of public investment by $\gamma y_I L$, the marginal fiscal outflow from increasing regional per capita income through infrastructure investment.

Comparative statics of the system can be used to gauge the impact of changes in the rate of federal redistribution on regional public investment and consumption. In deriving the following equations, I have assumed that the number of regions is large, and that therefore small changes in regional investment, fixed assets, and population do not significantly affect national average per capita income, so that $\frac{\partial \bar{y}}{\partial I}, \frac{\partial \bar{y}}{\partial N}$, and $\frac{\partial \bar{y}}{\partial L}$ are all approximately zero. Equations (1), (3) and (4) then form a system of three equations in three unknowns, which can be differentiated and solved for the following results:

$$(6) \qquad \frac{dI}{d\gamma} = \frac{-\mu y_I L + P_I U_{GG}(y-\bar{y})L}{D}$$

$$(7) \qquad \frac{dG}{d\gamma} = \frac{P_I \mu y_I L + \Phi(y-\bar{y})L}{D}$$

where $\Phi = U_{CC}(1-T)^2 y_I^2 + [U_C(1-T)+\mu(T-\gamma)L]y_{II}$, which is negative, and $D = -\Phi - P_I^2 U_{GG}$, the determinant of the bordered Hessian, which is positive.

The signs of Equations (6) and (7) depend asymmetrically on the level of a region's equilibrium income. The first terms of both numerators can be unambiguously signed: an increase in γ reduces regional expenditure on I and increases its expenditure on G; these terms capture the disincentive or "substitution" effect of fiscal redistribution on local government investment. The signs of the second terms, which capture redistribution's income effect, depend upon whether a region's equilibrium income is above- or below-average - that is, whether increased redistribution tightens or loosens their budget constraint. Regions with above-average income experience a loss of revenues from increased redistribution, rendering the sign of $\frac{dI}{d\gamma}$ unambiguously negative for this group. Regions with below-average income, conversely, reap higher revenues from increased redistribution, making the sign of $\frac{dG}{d\gamma}$ unambiguously positive. In the other two cases, $\frac{dI}{d\gamma}\mid_{y<\bar{y}}$ and $\frac{dG}{d\gamma}\mid_{y>\bar{y}}$, the signs of the first and second terms of the numerators differ, indicating that the substitution and income effects are working in opposite directions, and the expressions can therefore not be signed. Based upon this analysis, I derive the following hypothesis regarding the relationship between fiscal redistribution and regional government expenditure allocation:

Proposition 1 *Controlling for income effects, an increase in fiscal redistribution reduces regional government expenditure on public investment relative to public consumption.*

This proposition will be tested in the following empirical section by investigating the relationship between fiscal redistribution (taxation and subsidization) and the regional budget share of public investment, controlling for regional income and/or related factors affecting expenditure allocation.

In contrast to the model, the empirical investigation in section four disaggregates the fiscal redistribution rate, γ, into federal taxation and subsidization rates for each region. The budgetary impact of a change in either of these rates will not, therefore, depend on regional income levels; an increase in the federal tax rate always tightens the regional budget constraint, and an increase in the subsidization rate always loosens it. The income and substitution effects from an increase in the regional tax rate should therefore both work in the same direction to reduce public investment; however, the income and substitution effects of an increase in the subsidization rate work in opposite directions: the increased income from subsidies promotes higher investment spending, while the incentive effect deters it. Therefore,

Proposition 2 *Increased federal taxation will reduce the level of regional government investment, while increased federal subsidization may either increase or decrease investment, depending on the relative magnitude of the income and substitution effects.*

This proposition will be tested in the following section by an investigation of whether there is a negative correlation between the level of a region's investment spending and its federal tax rate, and a positive correlation between its investment level and subsidization rate. Because the theory suggests that the effects of taxation and subsidization may depend on whether a region is rich or poor, the slope of the regional tax and subsidy rates will be allowed to differ for regions with above- and below-mean per capita income.

The influence of local economic structure on regional economic policies and performance being a central concern of the literature on Russian federalism (Van Selm, 1998; Berkowitz and De Jong, 1998; Popov, 2001), an investigation of the impact of regional endowments on public expenditure allocation is desirable. The total derivative of public investment expenditure with respect to changes in regional fixed assets yielded by this model,

$$\frac{dI}{dN} = \frac{U_{GG}(T-\gamma)y_N L[(T-\gamma)y_I L - 1] + \Psi}{D} \tag{8}$$

where $\Psi = U_{CC}(1-T)^2 y_I y_N + [U_C(1-T) + \mu(T-\gamma)L]y_{IN}$, is not signable in this general form. However, imposition of a log-linear utility function, $U(C,G) = lnC + lnG$, allows $\frac{dI}{dN}$ to be signed as positive.[16] Therefore,

Proposition 3 *The level of regional public expenditure depends positively on regional fixed assets.*

This proposition will be tested in the following section by an investigation of whether there is a positive correlation between a region's

[16]With log-linear utility, Ψ reduces to $\mu(T-\gamma)y_{IN}L > 0$. Using the fact that with log-linear utility Eqs. 6 and 7 can solved to yield $G = \frac{y(1-(T-\gamma)y_I L)}{y_I}$ and therefore $\mu = \frac{y_I}{y(1-(T-\gamma)y_I L)}$, it can then be shown that $\frac{dI}{dN} = \frac{1}{D}[\frac{2y_{IN}(T-\gamma)y_I L}{y(1-(T-\gamma)y_I L)}]$, which is positive.

economic endowment and its level of investment spending. The total derivative of public consumption with respect to regional assets, $\frac{dG_j}{dN_j}$, can also be shown to be positive given log-linear utility[17]; however, as its magnitude relative to $\frac{dI_j}{dN_j}$ is indeterminate, no hypothesis on the relative share of public investment spending as a function of regional wealth can be formulated. The relationship between investment's budget share and fixed assets will therefore be left to empirical determination.

Because infrastructure is a public (albeit potentially congestible) good, population size may also influence its provision. It is therefore of interest to determine the impact of changes in L on public investment expenditure. Again assuming log-linear utility, the total derivative of I with respect to L reduces to

$$(9) \qquad \frac{dI}{dL} = \frac{1}{D}[\mu(T-\gamma)(1-\alpha)y_I - \frac{1}{G^2}((T-\gamma)(1-\alpha)y+\gamma\bar{y})((T-\gamma)y_I L-1)]$$

which is positive. Holding fixed assets constant, a rise in regional population lowers per capita income, thereby raising the marginal productivity of public infrastructure; a larger population also increases the aggregate benefit from provision of a public good. Therefore,

Proposition 4 *Controlling for regional fixed assets, the level of public investment depends positively on regional population.*

Because the sign of $\frac{dG}{dL}$ is indeterminate (even assuming log-linear

[17]Specifically, it can be shown that $\frac{dG}{dN} = \frac{1-\beta+(1-\beta(T-\gamma))y_I L}{D}$.

utility[18]), the effect of changes in population on the budget share of regional public investment will be investigated empirically in the following section.

2.4 The Determinants of Regional Public Investment

This section seeks to explain the variation in the share and per capita level of Russian regional allocations to public investment in light of the hypotheses developed in the previous section as well as elsewhere in the literature. To recapitulate the previous section's findings, Proposition 1 posits that fiscal redistribution, as measured by the share of federal taxes in total regional tax revenues (TAX) and the share of federal subsidies in total regional expenditures (SUB), should reduce the budget share of regional public investment (PISHARE). According to Proposition 2, federal taxation should reduce the level of per capita public investment (PIPC)[19], while subsidization may either increase or decrease it, depending on the relative magnitudes of the income and "substitution" effects of fiscal redistribution.

Propositions 3 and 4 state that the regional level of public invest-

[18] With log-linear utility, $\frac{dG}{dL} = \frac{1}{D}[(T-\gamma-1)(\mu(1-\alpha)(T-\gamma)y_I - \mu(T-\gamma)y_{II}((T-\gamma)(1-\alpha)y + \gamma\bar{y})]$

[19] Although the model in section three pertains to aggregate rather than per capita regional public investment, I chose to focus on per capita investment in the empirical work because it is more readily linked to per capita income growth, a central concern of Russian regional economics. Regressions of aggregate investment using aggregate (rather than per capita) regional capital stock, however, yield very similar results, the major difference being higher estimates of the sign and significance of regional population.

ment should relate positively to both regional fixed assets and population (POP), although their effects on budget share are a priori indeterminate. Four different measures of regional fixed assets were incorporated: the log of beginning-of-period regional per capita capital stock (KSTOCK); an index of "natural resource potential" compiled by the Expert Institute (NATURE); an index of initial public infrastructure comprising measures of regional road density and telecommunications connectivity (INFRA); and an index of regional industrial structure compiled as the sum of 10 major industrial sectors' lagged output indices weighted by their shares in total regional industrial output (INDUST).[20]

Two additional controls were added to account for the effect of regional financial conditions not captured by the model in section three: the regional unemployment rate (UNEMP) and the percentage of the regional population living on less than the minimum subsistence income (POVERTY). A higher local unemployment or poverty rate is likely to put pressure on a regional government to increase welfare spending at the expense of public investment. Taken together, the asset stock measures and unemployment and poverty rates account for 74 percent of the variation in the log of per capita GRP (GRPPC), and have the following signs and significance in relation to GRPPC (t-statistics in parentheses):

$GRPPC = 3.79 + 0.15(5.09) * POP + 0.051(1.76) * KSTOCK + 0.001(2.24) *$

[20]This is a standard method of describing regional industrial composition used by Borts and Stein (1964), Berkowitz and De Jong (1998) and Van Selm (1998). See appendix for details.

$NATURE + 0.002(1.43) * INDUST - 0.004(0.33) * INFRA - 0.015(12.39) * POVERTY - 0.026(6.41) * UNEMP$

Alternatively, one could control directly for per capita GRP; however, the model suggests that regional per capita income is simultaneously determined with regional investment. Lagged values of GRPPC may be used, provided that the error terms are not serially correlated. Because Russia began calculating GRP in 1994, however, use of lagged values requires dropping a year's observations, significantly altering the estimation sample. This alternative specification will therefore be presented as a test of robustness.

Two additional controls capture the effects of regional political structure on investment: a dummy variable which takes on the value of one for republics (REPUB), and the share of consolidated regional revenues retained by municipal governments (MUNI). As discussed in section two, Russia's ethnic republics enjoy greater political and economic autonomy than oblasts and krais; they also tend to be more leftist and to have correspondingly lower rates of privatization. However, despite the existence of a few wealthy republics (e.g., Sakha-Yakutia and Tatarstan) they also have higher-than-average unemployment and poverty rates. The net influence of these factors on regional public investment is unclear: whereas higher poverty and unemployment are likely to reduce investment, adherence to communist paradigms, lower federal tax rates and greater local capital stock ownership may promote higher rates of investment.

The expected sign of REPUB is therefore indeterminate.

Because the available data on Russian regional investment aggregate regional and municipal government investment spending within each region, it is necessary to control for the extent of regional fiscal decentralization within each region. I therefore use municipal governments' share of consolidated regional tax revenues, which is likely highly correlated with their expenditure share, as a measure of regional fiscal devolution (MUNI). The coefficient on MUNI is a priori indeterminate: assuming that capital is more mobile within regions than between them, devolution of regional expenditures should produce competition for intraregional capital, and therefore to increase total regional investment. However, if there are significant positive spillovers from local public infrastructure - which are more likely at the local than at the regional level - then the coefficient on MUNI could be negative. Regional devolution could also be correlated with unobserved regional characteristics influencing public investment, such as the rule of law.

Finally, I test the theory put forth by Weingast (1995) and developed by Qian and Roland (1998) that interregional capital mobility spurs subnational governments to increase their allocation to public investment in order to attract private investment. To measure this effect, I use two indices of Russian regional financial development compiled by Klimanov (1995), either of which may positively influence local capital mobility: an index of regional financial market development comprising the number, assets and foreign exchange capacity of local bank and non-bank financial institutions (FINDEV); and a measure of regional financial sector openness measured as the ratio of extra-regional to locally based financial institutions (FINOPEN). Descriptive statistics of the regression variables are presented in Tables 1 and 2.

The literature on fiscal federalism posits that public investment is likely to be correlated across jurisdictions due to spillover effects (Gordon, 1983). Unless controlled for, this could produce spatial autocorrelation in a regression of regional public investment. In addition to own infrastructure, I therefore controlled for the average initial level of infrastructure in spatially contiguous regions. However, proximate initial infrastructure was never significant in either the share or the level of regional public investment regressions, suggesting that spatial autocorrelation is not a serious concern for Russian regional investment. This variable was therefore omitted in the results presented.

Non-nested tests for model specification indicated that a logistic transformation of the PISHARE variable and a log-linear specification of the PIPC model were appropriate.[21] Specifically, P_E tests (Greene, 1993) were used in which the difference between the predicted value of the dependent variable from the log-linear (logistic) regression and the log (lo-

[21]The logistic transformation, $y = ln(x/(1-x))$, changes a dependent variable such as budget share whose values are restricted to the 0-1 (or 0-100, in percentage terms) interval to one which covers the entire range of real numbers. Its inverse function is $x = \frac{e^y}{1+e^y}$.

gistic transformation) of the predicted variable from the linear regression is included as a regressor in the linear regression. Significance of this regressor indicates that the log-linear (logistic) form provides a better description of the dependent variable. Conversely, the test is performed on the log-linear (logistic) regression, inserting as a regressor the difference between the predicted value of the dependent variable from the linear regression and the anti-log (inverse logistic) of the predicted value from the log-linear (logistic) regression. Since the difference between the predicted values was significant in the linear regressions and insignificant in the log-linear and logistic regressions, the P_E test indicates that the log-linear and logistic forms are preferable.

Regression of the residuals from the OLS regressions of the budget share and per capita level of public investment (Table 14) on their lagged values estimates significant autocorrelation coefficients of 0.65 and 0.70, respectively. However, the appearance of positive autocorrelation in these two models turns out to be a by-product of regional heterogeneity, generated by the clustering of region-specific error terms above or below zero. The existence of substantial regional heterogeneity argues for the use of a model which permits variation in regional intercepts: i.e., either fixed or random effects. Because NATURE, MUNI, REPUB, FINDEV and FINOPEN are time-invariant, I therefore use random effects. If one estimates the two models using random effects, which decomposes each error term into a time-invariant regional random intercept, u_i, plus an i.i.d. error term, e_{it}, a regression of e_{it} on its lagged values returns estimated coefficients (t-statistics) of 0.14 (1.73) for the budget share regression and 0.20 (1.91) for the per capita level regression. Estimation of these statistics for the corresponding regressions using GRPPC returns coefficients (t-statistics) on lagged residuals in the PISHARE and PIPC regressions of -0.13 (1.68) and -0.14 (1.93), respectively. I therefore conclude that autocorrelation is not a serious concern and use of lagged endogenous variables is an acceptable way to avoid endogeneity bias.

Standard diagnostics of the random effects model, the Breusch-Pagan Lagrange multiplier test and the Hausman test, indicate that the specification is appropriate. The Breusch-Pagan Lagrange multiplier statistic (Breusch and Pagan, 1980; Batagli and Li, 1990), which tests the null hypothesis that the variance of the region-specific error term (u_i) is zero, rejects that hypothesis at a less than one percent level of confidence for all random effects models presented, confirming the regional heterogeneity of the dependent variables.[22] The Hausman test (Hausman, 1978) checks for systematic differences between the vector of coefficients estimated by the random-effects model and those estimated by the corresponding fixed-effects model (omitting time-invariant regressors) to determine whether the u_i's are correlated with the independent vari-

[22]The test statistic, $\lambda = \frac{n\bar{T}^2}{2}(\frac{A_1^2}{(\Sigma_i T_i^2) - n\bar{T}})$
where $A_1 = 1 - \frac{\Sigma_{i=1}^{n}(\Sigma_{t=1}^{T_i} v_{it})^2}{\Sigma_i \Sigma_t v_{it}^2}$, is distributed $\chi(1)$.

ables (X_{it}).[23] For both dependent variables and all samples considered, the null hypothesis that u_i and X_{it} are uncorrelated cannot be rejected at any conventional level of significance, indicating that the more efficient random effects specification is appropriate.

Because the model in section three suggests that the effects of fiscal redistribution may differ depending on whether a region has above- or below-average income, two specifications were estimated for each model and sample: the first in which the coefficient on TAX and SUB was constrained to uniformity across regions, and the second in which it was allowed to differ according to regional income. The regions were ranked according to their 1994 levels of per capita GRP, and dummy variables RICH, which takes on a value of one for the top 37 regions in the sample, and POOR, which has a value of one for the bottom 38 regions, were constructed. TAX and SUB were then interacted with each of these dummies to construct the variables RICHTAX, POORTAX, RICHSUB and POORSUB, which replace TAX and SUB in the alternative specifications. An analogous process was followed, interacting TAX and SUB with REPUB and its converse, a dummy variable taking on the value of one for non-republics, to ascertain whether the

[23]The Hausman test checks for systematic differences between the vector of coefficients estimated by the random-effects model, $\hat{\beta}_{RE}$, and those estimated by the corresponding fixed-effects model (omitting time-invariant regressors), $\hat{\beta}_{FE}$. The test statistic, $(\hat{\beta}_{FE} - \hat{\beta}_{RE})'\hat{\Sigma}^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE})$, where $\hat{\Sigma}$ is the difference between the estimated fixed- and random effects regressions' variance matrices, is a $\chi(k)$ variable, where k is the number of coefficients estimated in the fixed-effects regression excluding the intercept.

incentive effects from fiscal redistribution vary for republics and non-republics.

Three different samples were considered: the full sample of 75 regions for which there was complete data for at least two years during the period 1994-1997:[24] the subset of 73 regions excluding the two federal cities of Moscow and St. Petersburg, which are generally deemed exceptional within Russia due to their status as political, financial, commercial and international hubs; and the subset of 69 regions excluding the eastern republic of Sakha-Yakutia and the Caucasian republics of Adgyeya, Dagestan, Kabardino-Balkaria, Karachaevo-Cherkessia and North Ossetia.[25] The exclusion of Sakha-Yakutia was made on empirical grounds; examination of regression residuals, particularly those of the public investment share regressions, showed Sakha to be a significant outlier. In 1995, Sakha possessed both the highest value of PISHARE - a somewhat incredible 47.7 percent of total expenditure - and the lowest value of TAX, 0.54 percent, reflecting Sakha's short-lived side treaty with Moscow for fiscal independence; inclusion of Sakha thus tends to

[24]Regions included in the full sample are the Republics of Adgeya, Bashkortostan, Buryatia, Chuvashia, Dagestan, Gorno-Altai, Kabardino-Balkaria, Karachaevo-Cherkessia Karelia, Kalmykia, Khakasia, Komi, Marii-El, Mordovia, North-Ossetia, Sakha-Yakutia, Tatarstan, Tyva and Udmurtia; the Amur, Arkangel, Astrakhan, Belgorod, Bryansk, Chelyabinsk, Chita, Irkutsk, Ivanovo, Kaliningrad, Kamchatka, Kemerovo, Kirov, Kaluga, Kostromo, Kurgan, Kursk, Leningrad, Lipetsk, Magadan, Moscow, Murmansk, Nizhny Novgorod, Novgorod, Novosibirsk, Omsk, Orenburg, Orlov, Perm, Penza, Pskov, Rostov, Ryazan, Sakhalin, Saratov, Smolensk, Sverdlovsk, Tambov, Tomsk, Tula, Tver, Tyumen, Ulyanovsk, Volgagrad, Vologda, Vladimir, Voronezh, and Yaroslavl oblasts; the Altai, Khabarovsk, Krasnodarsk, Krasnoyarsk, Primorskii, and Stavropol krais; and the cities of Moscow and St. Petersburg.

[25]The Caucasian republics of Chechnya and Ingushetia are excluded from both samples.

depress the coefficient on TAX. The ethnic republics of the North Caucasus were excluded due to a priori concerns that the political strife afflicting the region might override the economic behavior described in Section 3. Because they are poor as well as politically volatile, these republics tend to have high rates of subsidization. Political uncertainty due to the war in Chechnya, local ethnic separatism and high rates of emigration might also deter public investment. Including these regions in the regressions might therefore contribute to estimation of a negative correlation between federal subsidization and public investment that had nothing to do with the disincentive effects of fiscal redistribution described in the model in section three.

The results of the basic random-effects regressions of PISHARE and PIPC using both capital stock measures and GRPPC are presented in Tables 3 and 4. As can be seen from comparing R-squared for the two specifications, they do a roughly comparable job of explaining regional variation in investment budget shares and levels: the model using asset stock measures does a slightly better job of predicting PISHARE, while the model using GRPPC does a better job of predicting PIPC.

The first column of both tables show the basic model: assets, population, poverty and unemployment, and fiscal redistribution rates. Both natural resources and initial infrastructure have a positive influence on both the share and level of regional investment, while the unemployment rate has the expected negative influence. Correspondingly, the second columns, which present the alternative specification of both models using lagged GRPPC, show a strong positive influence of regional per capita income on both the share and the level of regional investment. A one percent increase in regional per capita income produces a greater than one percent increase in per capita investment. These results support Proposition 3, which posits a positive relationship between the level of regional investment and regional asset endowments. There is also a strong positive influence on both PISHARE and PIPC of regional population, confirming Proposition 4's contention that population size should positively influence regional government allocations to public investment. A one percent increase in regional population size corresponds with a 0.2-0.3 percent increase in per capita investment and a 0.3-0.4 percent increase in investment's budget share.

Inclusion of the political variables MUNI and REPUB in the third and fourth columns of Tables 3 and 4 reduces the significance of NATURE and INFRA, while augmenting somewhat that of INDUST. In all regressions, MUNI is insignificant, but REPUB is positive and highly significant. The impact of republican status on the share and level of investment is moreover large, being roughly equivalent to one standard deviation of the dependent variable. These results demonstrate that republics' greater autonomy, etatist political bias and higher ownership share of regional assets produce substantially higher allocations to public investment. Further research is required to understand precisely what republican characteristics cause this pattern. Whereas inclusion of regional measures of privatization and support for communist political parties in the PISHARE and PIPC models without REPUB produce significant negative and positive coefficients, respectively, inclusion of the republic dummy renders both insignificant. This suggests that, while an important determinant of republican investment rates, privatization and pro-communist sentiment do not entirely account for their difference from oblasts' investment patterns. Given the republics' generally lower rates of privatization and higher rates of poverty and unemployment, their higher rates of public investment may also be inefficient.

Both model specifications discover a significant negative effect of federal subsidies on the share of regional expenditures allocated to investment, corroborating Proposition 1, which posits that the budget share of regional public investment should depend negatively on the extent of federal fiscal redistribution. While the basic regression using GRPPC (column 2) finds a negative significant coefficient on TAX (and no significance for SUB), inclusion of MUNI and REPUB shifts the negative effect from TAX to SUB. Neither specification finds a significant effect of the redistribution variables on the per capital level of public investment; however, the coefficient on SUB is negative and near-significant in the full models incorporating MUNI and REPUB, suggesting that the disincentive effect of federal subsidies more than offsets its income effect (Proposition 2).[26] This result corroborates Freinkman and Haney's (1997) finding of a negative relationship between the expenditure share of subsidies and the aggregate level of regional public investment, demonstrating that Russian regions have a lower marginal propensity to invest out of transfer revenue than out of own revenues. One reason for this asymmetry may be the relative invisibility of transfer revenues to regional constituents, which gives regional politicians greater discretion in disposing of transfers than of own income.

Tables 5 and 6 present the sample sensitivity analysis for the full models of PISHARE and PIPC. As can be seen, the significant results from the sample excluding the federal cities (subsample 1) are broadly comparable with the full sample estimates: the signs on GRPPC, POP and REPUB are positively related to both the share and the level of public investment; UNEMP is negatively related to both, while POVERTY is negatively related to PIPC; and SUB is negatively related to PISHARE (and weakly so to PIPC). In subsample 2, which excludes the outlier Sakha-Yakutia as well as the North Caucasian republics, the estimated slopes on SUB are, as predicted, less negative and significant, although the finding of a negative significant influence of federal subsidization on PISHARE remains significant at a five percent level in a one-tail test. I therefore continue to compare the results of the full-sample estimates with those of subsample 2 in analyzing the differential impact of fiscal

[26]Since the sign of SUB was a priori indeterminate, it is subjected to a two-tail test, and is therefore not significant at a five percent level in these regressions.

redistribution on regional subgroupings, but drop consideration of subsample 1 due to its closeness to the full sample.

Tables 7 and 8 present the results of the PISHARE and PIPC regressions in which the slopes of the fiscal redistribution variables TAX and SUB are permitted to differ between regions with above- and below-median per capita GRP. The results of the two model specifications - GRPPC vs. asset stock measures - diverge in these estimates due to the change years covered by each sample. In the asset stock regressions covering 1994-1997, it can be seen that the majority of the negative effect on investment shares and levels derives from subsidization's influence on regions with above-median per capita income. The existence of a particularly strong disincentive effect from federal subsidization for wealthy regions suggests that the existence of a political market for transfers in Russia may create perverse incentives for wealthier regions to pursue fiscal redistribution rather than invest in productivity-enhancing infrastructure (Mau and Stupin, 1997). The particularly negative effect of RICHSUB disappears, however, in the regressions using GRPPC, which cover only 1995-1997. (Restricting the asset stock regressions to these years produces similar results.) The discrepancy between the results produced by the two samples may result from the partial reform of Russia's fiscal redistribution system in 1994, which reduced opportunities for richer regions to obtain subsidies. Extending the data set to include 1992-1993 would permit better tests of this hypothesis.

Also notable in Tables 7 and 8 is the perverse positive coefficient on RICHTAX in the asset stock specifications. To rule out the possibility that this variable is picking up an income effect which is better controlled for in the alternative model, I ran the same regression on a restricted sample excluding observations from 1994 (i.e., the same sample as the regressions using GRPPC); the coefficient on RICHTAX loses significance in these tests, indicating that the discrepancy relates to the subsample, not to the model specification. One reason why the correlation between public investment and federal tax remittances could be positive in 1994 is that TAX measures de facto rather than de jure federal tax rates. Measured as the percentage of total regional revenues passed up to the federal government, TAX understates the actual tax rate for regions which withhold revenues from Moscow, raising the possibility that unobserved regional political characteristics such as the extent of the rule of law or bureaucratic efficiency, may be affecting both regional tax remittances and public investment (Manaenkov, 2000). The fiscal reforms of 1994 and the increased centralization which ensued may therefore have reduced the positive correlation between tax and public investment measures in subsequent years.

Tables 9 and 10 present the results of the PISHARE and PIPC regressions in which the slopes of the fiscal redistribution variables TAX and SUB are permitted to differ between republics and non-republics. The major finding of these regressions is insensitive to model specification or time period sampled: the disincentive effect of federal subsidization is clearly shown to derive from the effect of transfer income on non-republics. Whereas oblasts and krais show a markedly lower marginal propensity to invest out of federal transfers than out of own income, republics do not appear to differentiate between the two income sources in allocating investment revenues.

Why should wealthier regions and non-republics in particular have a lower marginal propensity to invest out of transfers? One reason may be the relative volatility of transfers vs. regional own revenues. As shown in Table 11, whereas on average the coefficient of variation of revenues from federal transfer is substantially higher than the coefficient of variation of own revenue for all regions, the ratio of the two is somewhat lower for poorer regions and republics. Since public investment requires long-term planning and continuous funding, volatility of public revenue is likely to reduce investment commitments. Republics and poorer regions, which have a stronger political claim on federal transfers experience more stable transfer revenue, and may therefore have a higher marginal propensity to invest out of transfers. Further research is necessary to determine more precisely the causality between federal fiscal structures and regional policy incentives.

Tables 12 and 13 present the results of estimating the full PIPC and PISHARE models including the variables describing regional financial sector. As can be seen, neither FINDEV nor FINOPEN is ever significant. Conceivably, the two indices are poor measures of the true extent of regional capital mobility; they may also suffer from endogeneity bias, since regional governments choose both how much to invest in public infrastructure (which attracts private capital) as well as how much interregional capital mobility to permit. Further research is therefore necessary to isolate instruments for the regional financial market development.

2.5 Conclusions

This study finds evidence consistent with the existence in transitional Russia of a disincentive effect from federal fiscal redistribution for subnational governments to invest in local economic development. As predicted by the model of regional government expenditure allocation in section three, the higher was a region's subsidization rate, the lower was its budget share of regional public investment. There also appears to be a negative effect of federal subsidization on regional per capita public investment for two subsets of regions: those with above-mean income, and non-republics. These groups experienced a higher volatility of transfer income relative to own income than poorer regions and republics, which likely increases the investment disincentive created by the soft budget constraint.

These results highlight the cost in terms of foregone regional investment of federal redistribution in general, and of ad hoc, politically negotiated systems of redistribution in particular. Regions which had more consistent claims to federal transfers - poor regions and republics, which are generally poorer but also possess more political leverage vs. Moscow due to their ethnic and legal distinction - experienced less of a disincentive effect from subsidization that others. This suggests that, where fiscal redistribution is necessary to redress regional resource disparities, as is arguably the case in Russia, adherence to clearly established formulae for subsidization will reduce the disincentive effect for local investment by reducing income volatility. An alternative means of redressing regional income disparities, of course, is to focus on integrating regional factor markets to eliminate regional disparities in factor returns, which policy would likely prove highly beneficial in Russia given its generally poor labor and capital mobility.

The second significant finding of this study is the discovery of a strong pro-investment bias among Russia's republican governments, which requires further investigation to determine both its causality and the productivity of the investments being made. Stronger pro-communist tendencies among republican populations and their representative may preserve Soviet expenditure patterns, which were heavily tilted toward capital investment, while lower rates of privatization and higher political risk may require higher public investment to offset a dearth of private investment. It is also possible that the republics' greater political and economic control gives them an encompassing interest in local economic development which is lacking in regions more subject to federal influence and taxation as well as to tax evasion by private firms.

Finally, this study's finding that regions with higher per capita income invest more both per capita and as a share of total expenditures presages continued income divergence among the Russian regions. Given the distortive effects of fiscal redistribution confirmed in this study, it is likely that income divergence would be more effectively countered with policies promoting interregional factor market integration.

3 Domestic vs. Foreign Investment in Russia's Regions, 1995-1999

3.1 Introduction

This essay studies the determinants of domestic and foreign direct investment (FDI) in Russia's regions to ascertain whether capital is being allocated in a manner consistent with economic theory, and whether regional public policies such as privatization and infrastructure investment influence that allocation. A general equilibrium model describing the impact of regional industrial structure, public infrastructure and education on local capital returns is constructed to predict regional investment flows. Random-effects regressions are then run on panel data covering 73 of the 89 (oblast-level) regions for the year 1995-1999 to determine the effects of regional economic and political factors on the allocation of domestic and foreign investment across Russia.

I find that foreign capital gravitates to regions with better educated workforces and telecommunications connectivity, more privatization and less political risk. Conversely, domestic capital is linked to regional income and economic structure, but remains largely unresponsive to local public policies. This suggests that Russian capital is interregionally immobile, which weakens the incentive for regional governments to enact pro-market reforms. This study furthermore confirms the existence of a structural change in the pattern of Russian investment following the financial crisis of 1998. The thousand-fold ruble devaluation that ensued appears to have shifted both domestic and foreign investors' focus from natural resource extraction to investment in industry. There is also some evidence that domestic investors became somewhat more sensitive to regional government market-orientation in the last two years of the Yeltsin regime.

To the best of my knowledge, this paper is the first empirical analysis of Russian domestic private investment to date. Two previous studies of aggregate regional FDI in Russia, Brock (1998) and Broadman and Recanatini (2001), have similar findings with respect to regional political risk and market size; the latter work also finds evidence of a structural shift in FDI determinants following the 1998 ruble devaluation.[27] This essay seeks to improve upon previous studies' methodology by tying the analysis of regional investment to a formal model of local capital productivity; by using panel data with random effects estimation to control for regional heterogeneity and improve efficiency; and by using improved measures of regional economic structure, public infrastructure, and geographic and political characteristics.

The following section summarizes the regional economic model with public inputs presented in Appendix A to predict the pattern of Russian regional investment in response to the price shock induced by economic liberalization. Section 3 then tests these hypotheses, along with oth-

[27] A third study by Manaenkov (2000) analyses the regional location decisions of Russian joint ventures during 1992-1997.

ers drawn from the regional and FDI literatures, to ascertain the determinants of domestic and foreign direct investment in Russia's regions during 1995-1999, and Section 4 draws conclusions from the analysis.

3.2 Regional Theory and Private Investment in Russia

This section describes the general equilibrium model of a specialized regional economy detailed in the Appendix A and derives its implications for the interregional allocation of private investment in transitional Russia. These predictions will then be tested in the empirical analyses of domestic and foreign direct investment undertaken in the following two sections. The propositions derived from the model have been formulated in such as way as to be testable with the available data, which includes regional wages but not regional interest rates. Regional capital inflows must therefore be regressed on the putative determinants of capital rents, rather than directly on interest rates. In general, it is assumed that capital will flow into regions where risk-adjusted returns are higher, unless inhibited by practical or political restrictions.

Regional theorists seeking to model the flow of goods and factors among subnational jurisdictions have made extensive use of the Heckhser-Ohlin-Samuelson (HOS) trade model (Ohlin, 1933; Samuelson, 1948). The basic HOS model, which posits that capital will flow from capital-rich, high-wage areas into low-wage areas, has had notoriously poor predictive power for factor flows at both the regional and international levels. The flow of foreign investment from capital-rich OECD countries into low-wage developing nations has been much lower than such a model would predict (De Mello, 1997). Analyzing U.S. interstate capital flows between 1919 and 1953, Borts and Stein (1964, henceforth cited as BS) find that capital flowed into low-wage states, producing convergence in regional per capita income, only during the subperiod 1929-1947. In the previous and subsequent periods, capital flowed into high-wage regions, resulting in interstate income divergence. Analysis of per capita investment in the Russian regions reveals that it, too, correlates positively with the per capita capital stock: during 1996-1998, the correlation coefficient between investment and the depreciated per capita capital stock was 0.87 (Goskomstat, 1999); relative capital intensity does not, therefore, appear to determine the pattern of regional investment in transitional Russia.

Failure of the basic HOS model to account for net investment flows into high-wage regions prompted Borts and Stein to construct a more complex model incorporating regional industrial specialization and non-traded goods. In the modification of their regional general equilibrium model presented in the appendix, each region's economy consists of a capital-intensive manufacturing sector and a labor-intensive non-traded goods sector. (Although BS identifies the non-traded sector with agriculture, in Russia's case it is more aptly identified with the nascent service sector.) Conventionally, the price of the manufactured good is exogenous, while the price of the non-traded good is endogenously determined by regional demand. Regions specialize in the production of certain types of manufactures, some of which are exported to pay for imports of other manufactures, so that each region has unique terms of trade. Labor is mobile between the manufacturing and service sectors within each region, but immobile between regions. To derive the effect of price and productivity shocks on regional factor returns, I also assume that regional capital is initially fixed and that regional trade is therefore balanced. The change in regional capital rents produced by the price and productivity shocks then determines interregional rent differentials and hence the direction of incipient interregional capital flows.

Starting from an initial equilibrium in which interregional factor returns are equal, relative price shocks among manufacturing sectors create divergence in regional factor returns.[28] In section 4.1 of Appendix A, I show that, holding import prices and regional factor stocks constant, a positive relative price shock to a region's manufacturing sector raises local real wages and interest rates: $\frac{\hat{w}}{\hat{P}_1} = \frac{\hat{r}}{\hat{P}_1} = 1$. The model thus accounts for the positive correlation between regional wages and capital inflows that Borts and Stein discovered in their study of the United States.

Proposition 5 *Capital flows into regions whose industries have received a positive relative price shock.*

[28]This regional manufacturing specialization precludes factor-price equalization on the basis of goods trade alone, as regions are by presumption outside of the "cone of diversification" necessary for factor price equalization to result from free trade (Ethier, 1972; Bond, 1993).

In the following section, this proposition will be tested by regression of regional domestic and foreign capital investment on indices of regional industrial and natural resource endowments, as well as by gauging the impact on regional investment patterns of the 1998 ruble devaluation.

A regional model based on industrial specialization and relative price shocks applies well to the case of transitional Russia. Russia's 89 regions are highly economically specialized relative to other large developing and industrialized countries (Ickes and Ryterman, 1995). The relative price shocks unleashed by economic liberalization, in which the vector of relative prices chosen by central planners was supplanted by market-driven prices, therefore affected Russia's regions highly asymmetrically. Whereas Russian industrial output as a whole declined by 47.1 percent from 1991 to 1997, this rate varied from as little as 3.6 percent to as much as 89.4 percent at the regional level (Goskomstat, 1998). Accordingly, regional per capita incomes and factor returns diverged: the coefficient of variation of per capita gross regional product (GRP) rose from 0.34 to 0.43 between 1994 and 1998, while the coefficient of variation of the regional real wage rose from 0.24 to 0.28 between 1994 and 1999.[29] In the empirical analysis, one would therefore expect to see regions with a higher initial endowment of relatively dynamic industries

[29]Real wages and per capita GRP are calculated by deflating nominal values with the regional minimum subsistence wage (Goskomstat, 1998-2000). Comparable statistics for the U.S. are 0.16 for state-level per capita income and 0.18 for state-level wages. U.S. data are from the U.S. Bureau of Labor Statistics' website, www.stats.bls.gov.

attract more investment than regions with a less favorable endowment.

The devaluation of the Russian ruble in September 1998 also constituted a sharp relative price shock impacting regional capital productivity. As shown in Figure 2, consumer inflation outstripped ruble depreciation from 1992 through 1997, affecting a real appreciation of the currency that depressed demand for domestic goods in favor of imports. The ruble's sudden loss of more than two thirds of its value during the 1998 financial crisis reversed this trend for the first time since independence, to some extent restoring the import competitiveness of Russian manufactures. This development could be expected to favor industrialized regions vs. those whose economies are geared toward natural resource extraction, a hypothesis which will be explored in the following section by splitting the sample into periods before and after the 1998 financial crisis.

The inadequacy of relative factor endowments to explain regional and international investment and growth patterns has prompted exploration of numerous other determinants, notably human capital and physical infrastructure. Human capital (Uzawa, 1965; Lucas, 1988) has obvious implications for labor productivity: true regional labor costs can therefore not be gauged from nominal wage levels without taking into account the local workforce's level of education. Education measures have thus become a standard control in models seeking to explain investment and/or growth rates (Levine and Renelt, 1992). Analogously, numerous theorists including Barro (1990) and Qian and Roland (1998) posit that public infrastructure increases private capital productivity, so that regions or nations with better infrastructure development should attract greater investment. Empirical studies have corroborated a significant positive link between public infrastructure, private investment, and economic performance (Munnell, 1990; Aschauer, 2000).

The BS model can straightforwardly be modified to reflect the impact of regional education and infrastructure levels on local factor returns. Following Bhagwati, Panagariya and Srinivasan (1998, henceforth cited as BPS), I introduce these factors as technical change parameters affecting regional labor and capital productivity, μ_L and μ_K, respectively. In section 4.2 of Appendix A, I demonstrate that increases in regional education and infrastructure levels represented by μ_L and μ_K are associated with higher regional wages and rents. There are notable differences, however, between the impact of technical change parameters on the HOS and BS models. In the HOS model modified in BPS, regional wages and rents demonstrate unit elasticity with respect to changes in μ_L and μ_K, respectively, and the cross-elasticities of labor and capital returns with respect to changes in the other factor's technical parameter are zero: $\frac{\hat{w}}{\hat{\mu}_L} = \frac{\hat{r}}{\hat{\mu}_K} = 1$ and $\frac{\hat{w}}{\hat{\mu}_K} = \frac{\hat{r}}{\hat{\mu}_L} = 0$.

In the BS model, by contrast, at least some of the benefit from improved labor (capital) productivity spills over into increased rents (wages), due to the offsetting movement of non-traded goods prices in response to changes in relative factor productivity. As shown in Equation (17) of the modified BS model, $\hat{P}_2 = \hat{X}_1 + \hat{P}_1 - \hat{X}_2$, non-traded goods prices relate negatively to service-sector output. Since an increase in μ_K (μ_L) lowers (raises) output and employment in the labor-intensive service sector, it puts upward (downward) pressure on the price of the non-traded good and therefore also on wages. Part of the gains from improved capital or labor productivity are therefore redistributed to the other factor, as shown in Equations (22), (23), (26) and (27) in Appendix A:[30]

$$\frac{\hat{r}}{\hat{\mu}_K} = 1 - \frac{\Theta_{L1}\xi_2}{\Theta(\lambda - \kappa) + \xi_1} \tag{22}$$

$$\frac{\hat{w}}{\hat{\mu}_K} = \frac{\Theta_{K1}\xi_2}{\Theta(\lambda - \kappa) + \xi_1} > 0 \tag{23}$$

$$\frac{\hat{w}}{\hat{\mu}_L} = 1 - \frac{\Theta_{K1}\xi_2}{\Theta(\lambda - \kappa) + \xi_1} < 1 \tag{26}$$

$$\frac{\hat{r}}{\hat{\mu}_L} = \frac{\Theta_{L1}\xi_2}{\Theta(\lambda - \kappa) + \xi_1} > 0 \tag{27}$$

Because of these spillovers, the elasticity of capital rents with regard to education is positive, as shown in Equation (27), but the elasticity of rents with regard to public infrastructure is less than one (and could even be negative), as show in Equation (22). These results suggest the following relationships among education, infrastructure and capital returns:

Proposition 6 *Capital flows into regions with better educated populations, and possibly also those with better public infrastructure.*

[30]The magnitude of this redistribution depends on the relative size of the manufacturing and service sectors and the elasticities of substitution in the two sectors: Equations (22), (23), (26) and (27), show that the greater the elasticities of substitution (which determines the size of ξ_1) and the smaller the share of the service sector (which determines the size of ξ_2), the less will be the spillover from improved productivity of one factor to the other factor's compensation.

The relationship of regional infrastructure and education to regional capital returns will be tested for empirically in the following section by regressing domestic and foreign investment flows on measures of regional higher education rates and transport and telecommunications infrastructure. Controlling for the effects of the regional terms of trade shock and interregional variation in education and physical infrastructure levels, investors should be attracted to regions which offer the lowest costs of doing business. In the BS model, these are determined by the regional wage. Therefore,

Proposition 7 *Controlling for the effects of regional industrial structure, labor and capital productivity, capital should flow into regions with lower wages.*

The following section will test Propositions 5-7, along with others derived from the relevant literature, using data covering the Russian regions during 1995-1999.

3.3 The Determinants of Domestic and Foreign Investment

The purpose of this section is to discover whether private investment in Russia follows the patterns predicted by the regional economic model described in the previous section as well as elsewhere in the literature. Ideally, to test these hypotheses one would analyze net interregional capital flows. As these are unavailable, however, I will instead compare the behavior of aggregate domestic private investment and foreign direct investment in the Russian regions. One reason why investment in Russia might fail to follow the patterns predicted by the BS model is that the country's regional capital markets are fragmented. Although it is usually assumed that capital is perfectly mobile within countries, the underdeveloped state of the Russian banking sector - as well as deliberate policy interventions by regional governments and financial institutions - frequently inhibit interregional capital flows (Pyle, 1997; Lapidus, 1999). Since foreign investment is far less likely than domestic investment to be captured by local capital market rigidities, comparison of domestic vs. foreign investment patterns should illuminate the extent of their influence. Assuming that both Russian and foreign investors seek the highest risk-adjusted returns, and controlling for special factors likely to influence foreigners, the two types of investment should display similar locational patterns.

Propositions 5-7 posit that investment in a region should relate positively to the relative price shock received by its industries, its infrastructure and education levels, and negatively to the average regional wage (WAGE). I use two variables to control for regional economic structure: an industrial sector share-weighted index of relative sectoral performance (INDUST) and an index of regional natural resource endowments (NATURE) compiled by the Expert Institute (1998).[31] Since the

[31] For detailed descriptions of data, see Appendix B.

types of infrastructure of greatest importance to investors are telecommunication and transportation, this study uses two measures of regional infrastructure: paved road density (ROAD) and the percentage of urban households with telephone lines (TELECOM).

In addition to the factors derived directly from the Borts-Stein model, the literature suggests several other important determinants of domestic and foreign investment location. First, investment should be positively influenced by the size of the regional economy (GRP). In the FDI literature, market size has been shown to be an important determinant of investment, particularly where trade barriers are high. In a recent survey, European firms doing business in Russia cite market size as their top reason for investing there (Ahrend, 2000). It is less clear, however, why the size of a particular region's economy within Russia should induce foreign investment, since there is presumptively free trade among the regions.[32] Nonetheless, Russia's vast territory creates substantial interregional transport costs which may act as trade barriers. GRP is also simply an important scaling factor when explaining gross investment flows: even if foreign investment were entirely uniform across Russia, regions with larger economies would receive more FDI. In the case of domestic investors, particularly in regions with insular financial markets, the size of the regional economy will largely determine the amount of capital

[32]Berkowitz, et al. (1996) find evidence that although regional goods markets are fragmented during early transition, they show evidence of increasing integration within the first three years of transition.

available for investment. Indeed, a high correlation between regional domestic investment and GRP coupled with insignificance of other factors affecting capital productivity would constitute evidence of regional capital market fragmentation.

Secondly, regional political risk (RISK) and the market orientation of regional government policies are likely to influence local investment rates. In addition to theoretical models showing that political risk deters investment and growth (Barro, 1990), numerous studies confirm this relationship empirically (Knack and Keefer, 1995; Biswas, 1998). Because the Russian regions vary greatly in terms of political climate and have considerable discretion over economic policies, these factors could have a significant impact on investors' locational decisions. A contending theory in the literature on Russian regionalism, however, posits that because poor federal-level policies discourage foreign investment, regions have no incentive to enact good policies in order to attract foreign capital (Brock, 1998; Polishchuk, 1999). Similarly, the ability of regional governments to isolate their regions' financial markets could also enable them to escape the disciplining effect of capital flight. If these theories hold, then regional political factors should have no influence over investment flows.

This study uses measures of Russian regional political risk compiled by the Bank of Austria.[33] It also controls explicitly for two key mea-

[33] I also tested the other available index of Russian regional risk, a ranking of the

sures of regional government market orientation compiled by Lavrov (1997): privatization (PRIVATE) and price liberalization (PLIB). Note that while both policies should have a positive effect on regional investment by signalling the pro-market orientation of local government and stimulating growth of services upon which businesses depend, price liberalization could also conceivably result in higher local business costs. The expected sign on PLIB is therefore ambiguous.

Thirdly, Russia's geography influences the spatial distribution of investment in several ways. Climate differences impose higher costs on firms operating in colder regions. In addition to its influence on wages, which must be higher in cold regions to compensate workers for unpleasant living conditions as well as higher living costs, climate imposes direct costs on firms in terms of required energy consumption (Manaenkov, 2000). Average January temperature (CLIMATE) is therefore expected to relate positively to regional investment. As mentioned above, Russia's vast size also imposes high transport costs on firms doing business in remote regions. Kilometer distance to Moscow (KM), Russia's principal commercial and financial hub, should therefore relate negatively to investment. For foreign investors, distance to the investor country is most relevant, but because regional FDI data are aggregated, this cannot be directly measured. Although the United States is the largest single investor in Russia, accounting for about a third of FDI between 1995 and

regions published by the Moscow Expert Institute; it was not generally significant.

1999, the majority of Russian FDI originates in Europe.[34] Distance to Europe may therefore be important, but as it is highly correlated (0.96) with distance to Moscow, and since many foreign investors in Russia maintain Moscow headquarters, KM is used in the FDI regression as well.

Lastly, foreign investors in Russia are likely to face different challenges from their domestic competitors, notably informational disadvantages with regard to regional business climate and opportunities. Broadman and Recanatini (2001) control for this effect by including domestic private investment as an explanatory variable in their FDI regressions, positing that domestic investment signals to foreign investors about the level of regional capital returns. While this may be the case, the model presented in the previous section suggests that both private and foreign investment are driven by the same regional factors determining local investment returns, so that including domestic investment in the FDI regression would produce simultaneity bias. To control for informational asymmetries affecting foreign investors, I therefore include the number of existing joint ventures in each region (JV), based on the premise that the more foreign investment there has been in a region, the greater will be foreign knowledge of local business conditions, and the more likely foreigners will identify new investment opportunities.[35] It is also likely

[34]Data are from Goskomstat website, www.gks.ru.

[35]Following the convention in the FDI literature, I also controlled for the ratio of regional exports to income as a measure of openness. However, the variable was never significant and was therefore omitted.

that foreign partners in regional joint ventures periodically inject additional funds into existing projects.

The two previous studies of aggregate regional FDI in Russia find significant effects for some of these factors. Brock (1998) analyzes the determinants of average regional FDI and per capita FDI during 1993-1995, and finds it relates positively to regional per capita GRP and education, and negatively to regional crime and political risk. Broadman and Recanatini (2001) analyze the determinants of aggregate regional FDI for 1995-1999, and find that it relates positively to regional GRP, infrastructure, domestic investment, and domestic investment's interaction with a regional policy environment index.

Descriptive statistics of the regression variables and their correlation coefficients are reported in Tables 15 and 16. Panel data covering 73 of the 89 Russian regions[36] for the years 1995-1999 are used to estimate the effects of the above variables on regional investment by domestic firms (DOM) and FDI (FDI)[37]. Year fixed effects were also included

[36]Regions included in the full sample are the Republics of Adgeya, Bashkortostan, Buryatia, Chuvashia, Dagestan, Gorno-Altai, Kabardino-Balkaria, Karachaevo-Cherkessia, Karelia, Khakasia, Komi, Marii-El, Sakha-Yakutia, Tatarstan, and Udmurtia; the Amur, Arkangel, Astrakhan, Belgorod, Bryansk, Chelyabinsk, Chita, Irkutsk, Ivanovo, Kaliningrad, Kamchatka, Kemerovo, Kirov, Kaluga, Kostromo, Kurgan, Kursk, Leningrad, Lipetsk, Magadan, Moscow, Murmansk, Nizhny Novgorod, Novgorod, Novosibirsk, Omsk, Orenburg, Orlov, Perm, Penza, Pskov, Rostov, Ryazan, Sakhalin, Samara, Saratov, Smolensk, Sverdlovsk, Tambov, Tomsk, Tula, Tver, Tyumen, Ulyanovsk, Volgagrad, Vologda, Vladimir, Voronezh, and Yaroslavl oblasts; the Altai, Khabarovsk, Krasnodarsk, Krasnoyarsk, Primorskii, and Stavropol krais; the Jewish autonomous oblast, and the cities of Moscow and St. Petersburg.

[37]Goskomstat defines foreign direct investment as equity investment in firms with at least 10 percent foreign ownership. Domestic investment is private investment net of investments by companies containing at least 10 percent foreign capital, which may have access to extraregional capital sources not enjoyed by Russian firms.

to control for annual changes in macroeconomic conditions. The full regression models were estimated both with and without observations on Moscow and St. Petersburg. The two federal cities, which during the period under study accounted for an annual average of about one quarter of total Russian FDI (but less than one tenth of domestic investment), are conventionally dropped from regional regression samples due to their distorting effects. In particular, investment by both domestic and foreign firms that maintain Moscow headquarters but operate outside the capital is frequently misregistered as investment in Moscow (Freinkman, et al., 1999).

Use of panel data permits estimation of regional intercepts using fixed- or random effects, which reduces estimation bias from unobserved regional characteristics relegated to the error terms that are correlated with the regressors. The presence of time-invariant regional regressors CLIMATE, NATURAL, KM, PRIVATE and PLIB limits this study to the use of random effects, which specifies an error term of the form, $w_{it} = u_i + e_{it}$. Hausman tests (Hausman, 1978) for the existence of systematic differences between the random- and fixed-effects coefficients (estimated by dropping time-invariant regressors) fail to reject the null hypothesis that the u_i's are uncorrelated with the regressors for both the domestic and foreign investment models. The Breusch-Pagan Lagrange multiplier test (Breusch and Pagan, 1980) of the null hypothesis that the variance of the u_i's is zero was rejected at a less than one percent level of confidence in all models tested, indicating the presence of significant regional heterogeneity. Thus, although I present the results of OLS estimations with robust standard errors (White, 1990) in Tables 22 and 23, I concentrate my analysis on the random effects regressions because they are more efficient and control better for the effects of regional heterogeneity.

Since section four of Appendix A shows that two of the regressors, regional wages and GRP, are affected by regional capital inflows, current-period wages and GRP are endogenous to regional investment. Because investment in joint ventures is included in FDI, using the number of current or end-of-period joint ventures could also introduce simultaneity bias. I therefore use lagged or beginning-of-period values of WAGE, GRP and JV. Provided that there is no autocorrelation, use of lagged endogenous variables avoids simultaneity bias. Regression of the time- and region-specific component of the random effects error term, e_{it}, on its lagged values returns insignificant coefficient estimates for both the domestic and foreign investment models, indicating that use of lagged endogenous variables is an acceptable solution to the simultaneity problem. Using lagged values of WAGE and GRP moreover accords with the reality that investment projects take time, so that current-period investment reflects decisions made in response to market conditions prevailing in previous periods. As noted above, the number of preexisting joint ventures may also increase FDI if foreign investors inject more funds into existing projects; without more disaggregated data, it is however not possible to distinguish this effect from the informational effect of the stock of local joint ventures on regional FDI flows.

The full regression models are therefore:

$FDI_{it} = \alpha_0+\alpha_t+\alpha_1 GRP_{i,t-1}+\alpha_2 WAGE_{i,t-1}+\alpha_2 INDUST_{it}+\alpha_3 NATURE_i+ \alpha_4 ROAD_{it} + \alpha_5 TELECOM_{it} + \alpha_6 EDUC_{it} + \alpha_7 RISK_{it} + \alpha_8 PRIVATE_i + \alpha_9 PLIB_i + \alpha_{10} CLIMATE_i + \alpha_{11} KM_i + \alpha_{12} JV_{i,t-1} + u_i + e_{it}$

and

$DOM_{it} = \beta_0+\beta_t+\beta_1 GRP_{i,t-1}+\beta_2 WAGE_{i,t-1}+\beta_2 INDUST_{it}+\beta_3 NATURE_i+ \beta_4 ROAD_{it} + \beta_5 TELECOM_{it} + \beta_6 EDUC_{it} + \beta_7 RISK_{it} + \beta_8 PRIVATE_i + \beta_9 PLIB_i + \beta_{10} CLIMATE_i + \beta_{11} KM_i + v_i + \varepsilon_{it}$

The signs of GRP, INDUST, NATURE, ROAD, TELECOM, EDUC, PRIVATE, CLIMATE, and JV are expected to be positive; the signs of WAGE, KM and RISK are expected to be negative, and the expected sign on PLIB is indeterminate. Following convention, the significance levels reported in Tables 17-20 are for two-tailed tests; however, in interpreting the regression results, one-tailed tests are used to judge the significance of coefficients with definite predicted signs. Non-nested tests for model specification, specifically Davidson and MacKinnon's P_E test described in Greene (1993), indicate that a partial log-linear specification is appropriate for both investment models. Logs of FDI, DOM, GRP and WAGE are therefore used, so that coefficients on WAGE and GRP are elasticity estimates.

The results of the full-sample random effects regressions of regional-level domestic and foreign direct investment are reported in Tables 17 and 18, respectively. Because the high degree of collinearity among some regression variables produced cross-effects among their coefficients, particularly in the FDI regression, sensitivity analysis was conducted by estimating the model stepwise. In the first column of each table, the two investment measures are regressed on GRP and year dummies alone to gauge the comparative closeness of the relationship between local market size and domestic vs. "footloose" foreign investment. As can be seen, there is a marked difference: whereas GRP accounts for one quarter of the variation in FDI, it accounts for 90 percent of the variation in domestic investment. Comparison with regional investment-to-income ratios in other countries would furnish a useful basis for judging whether or not this high correlation is remarkable.

A basic model including only those variables specified in the Borts-Stein model was also estimated in the second column of both tables. Adding the wage, regional economic structure, and public policy variables to GRP accounts for an additional 17 percent of the variation in FDI vs. two percent of the variation in domestic investment. Confirming the relation between capital returns, education and infrastructure posited in Proposition 6, both education and telecommunications connectivity are positively related to foreign investment. Foreign investors moreover avoid political risk and invest more in regions whose governments have promoted privatization, as predicted. By contrast, in the corresponding model only natural resource endowments affect domestic investment; local public policy variables have no significant influence on domestic investment patterns.[38] Together with the high correlation between GRP and domestic investment, these results suggest a strong home bias on the part of Russian investors. They are also consistent with the existence of significant regional capital market segmentation, which lowers domestic investment's elasticity to regional policies affecting local capital productivity.

In the random effects regressions, regional level price liberalization does not exert a significant influence over either domestic or foreign investment, possibly due to its cost effects offsetting its market environment effects. The OLS regressions in Tables 22 and 23, however, show a marginally significant positive effect of PLIB on domestic investment, particularly during the years 1995-1997. Conversely, it has a significant negative effect on foreign investment during the post-devaluation period. These signs are generally preserved in the random-effects regressions, although the variable does not reach significance. These results suggest that price liberalization may effect the profitability of domestic and foreign investment asymmetrically, possibly due to differences in the sector and scale of enterprises involved in each category. Analysis of more dis-

[38]When geographic variables are added in column 4 of Table 12, the coefficient on risk threatens to become significantly positive. It is unlikely that Russian investors are peculiarly risk-loving; the slope and significance of the variable rises with inclusion of KM because risk levels tend to be higher in the east, which is also the richest in natural resources. However, given their superior knowledge of local institutions, Russians may be better able than foreigners to insulate themselves from political risk.

aggregated data would help clarify the cause of this discrepancy.

The third columns of Tables 17 and 18 include the geographic variables, CLIMATE and KM, predicted to impact business costs. While January temperature has the expected sign and is significant in the FDI regression, it has no significant impact on domestic investment. Distance to Moscow (KM) has a significant negative effect on domestic investment, as predicted, whereas in the FDI regressions its coefficient is significantly positive. Aside from Moscow and St. Petersburg, the Russian Far East received more FDI than any other region due largely to its mineral and marine resources; the size and significance of NATURE decline in the FDI regression once the geographical variables are included, as do those of PRIVATE.

As expected, columns 4 and 5 of Table 18 show that FDI flowed most strongly into regions with more existing joint ventures: JV is positive and highly significant in all FDI models. Because the number of joint ventures is highly correlated with the size of the regional economy (0.6), JV sharply reduces the size and significance of the coefficient on GRP. It also reduces the significance of CLIMATE and KM as well as TELECOM, since the bulk of Russia's joint ventures are located in Russian's central and northwestern regions, which have higher connectivity rates. Inclusion of JV also restores the significance of the privatization variable in the full-sample regressions.[39]

[39]In the split-sample regressions in columns 6-9, exclusion of JV (not shown) has no

The estimations shown in Tables 19 and 20 address Broadman and Recanatini's discovery of a structural shift in the pattern of Russian regional investment following the 1998 financial crisis. Their cross-sectional regressions of regional FDI show that during 1998 and 1999, the signs of GRP, road density and a climate dummy flip from positive to negative, while the sign of regional wages does the reverse. To investigate these relationships, I split the data into two subsamples covering 1995-1997 and 1998-1999 and ran random effects regressions with year dummies to test for the effect of the devaluation on FDI as well as domestic investment.

The results support the existence of a structural change in investment patterns following 1997 not only among foreign investors in Russia, but among domestic investors as well. The first result of note, captured in the year dummies, is that the 1998 ruble devaluation had opposite effects on the volumes of domestic and foreign investment in Russia. Because the sharp drop in the ruble occurred in the second half of 1998, its effects show up most clearly in the 1999 data. Whereas the coefficient on the 1999 year dummy in Table 17 shows a drop in domestic investment following the devaluation (the split samples do not adequately capture the shift from 1997 to 1998-9), the coefficient on the 1999 dummy in the split-sample foreign investment regressions (Table 20) is sharply positive. The ruble's steep decline in 1998 slashed domestic real income,

effect on the significance of PRIVATE, which remains insignificant in the 1995-1997 sample and significant in the 1998-1999 sample.

putting downward pressure on investment; however, it also made Russian assets far cheaper to external investors, stimulating an increase in foreign capital inflows.

The ruble devaluation also occasioned a shift in the spatial distribution of domestic and foreign regional investment. Table 21 shows the shares of domestic and foreign investment accruing to the two federal cities during each year between 1995 and 1999. As can be seen, Moscow and St. Petersburg's share of foreign investment dipped from an average of one fifth during 1995-1997 to less than one tenth by 1999; concomitantly, the two cities' share of domestic investment rose from an average of less than five percent during the earlier period to almost eight percent in 1999. While the latter effect is likely due to the effect of higher income levels in the federal cities supporting the marginal propensity to invest in the face of a general cut in purchasing power, the causes of the spatial diversification in foreign investment as well as its durability require further investigation.

Another notable effect of the ruble devaluation is the shift of significance between the two periods from NATURE to INDUST: for 1995-1997, Tables 19 and 20 show that the sign on NATURE (or, for FDI, that on KM, which captures foreign investment in Russia's resource-rich east) was positive and significant. In the subsequent period, however, NATURE and KM lose significance, while INDUST gains it. This shift may indicate that the relative price shock caused by the 1998 ruble devaluation, which reenergized Russia's beleaguered manufacturing sector, may have switched investors' focus from natural resource extraction to investment in industry. This finding corroborates Proposition 5, which posits that regions which sustain a positive price shock to their major industries will reap a capital inflow.

There also appears to have been a shift in the structure of foreign investment between the mid- and late 1990's concerning its relation to the Russian workforce and regional business environment. Whereas during 1995-1997, FDI flowed into regions with lower wages and better educated workers (as predicted by Propositions 6 and 7), in the next two years these factors - as well as regional income - lost significance, and regions with better infrastructure became favored. Additionally, foreign investors appear to have become less sensitive to political risk (having perhaps learned enough about local institutions to insulate themselves from it as well), and invested more in regions with higher privatization rates.

Finally, domestic investors' sensitivity toward the regional policy environment appears to have increased somewhat toward the end of the decade, as indicated by PRIVATE's significance in columns 3 and 4 of Table 19. Concomitantly, the tight connection between regional income and investment loosened slightly: The R-squared of a univariate regression of DOM on income (not shown) dropped from 0.92 during 1995-1997 to 0.86 during 1998-1999. Coupled with the increased significance of privatization this change may presage an increase in domestic capital's elasticity to regional investment conditions as regional capital markets became more integrated over time. The second half of the 1990s witnessed increasing penetration of provincial banking markets by the Moscow banks, a process likely to reduce regional capital market fragmentation (Johnson, 2000).

In contrast two the previous studies of Russian regional FDI, whose results proved highly sensitive to the exclusion of Moscow and St. Petersburg, this study's results are relatively robust to sample specification. Tables 17-20 exhibit a general consistency of results between models estimated with and without observations on Russia's "twin capitals".

3.4 Conclusions

In contrast to the assumption conventionally found in the literature, Russia appears to enjoy better international than interregional capital mobility. Foreign direct investment in the Russian regions is distributed largely in accordance with standard models of capital allocation: it is positively related not only to regional economic characteristics such as market size and factor endowments, but also to policy inputs including infrastructure, workforce education, political risk and government market-orientation. By contrast, domestic investment in Russia remains largely determined by regional income and economic structure; there is little evidence that domestic capital flows respond to public inputs such as infrastructure, education and economic liberalization. This finding contributes to the evidence of interregional capital market fragmentation, which prevents efficient reallocation of capital among regions.

In light of these facts, it seems at least as important to advance the integration and reform of Russia's domestic financial system as to increase its intake of foreign capital. Although since 1998 there has been substantial growth in both the level and share of foreign investment in Russia, domestic private investment still accounts for almost two thirds of total fixed capital investment and more than three quarters of all private investment, as shown in Figure 3 (Goskomstat, 2000). It is therefore important not only for Russia's productive potential but also for its political environment that its internal capital markets improve. The theory that regional governments have poor incentives to promote market-based growth because they cannot thereby attract sufficient foreign investment appears misfocused: this study finds that while foreign capital responds to regional policies, domestic capital is considerably less elastic. Given their relative magnitudes, it is therefore more likely the difficulty of attracting domestic investment, coupled with the facility of restricting local capital flows, that creates poor incentives for regional governments to promote local factor productivity.

4 Appendix A

4.1 The Borts-Stein Model with Variations in Regional Capital and Labor Productivity

This section adapts the model of regional factor allocation presented in Borts and Stein (1964) to reflect the role of government inputs (education and public infrastructure) affecting labor and capital productivity, respectively. Following the original, each region's economy has both a tradeable goods sector, identified with manufacturing, and a non-tradeable goods sector. The tradeable sector comprises an export good, X_1, some of which may also be consumed in the home region, and an import good, X_3, which is consumed but not produced. Production of the non–traded good, X_2, is assumed to be labor intensive relative to the export good. I initially assume zero capital or labor mobility in order to gauge the effect on factor returns of variation in tradeable goods prices and regional levels of education and infrastructure. The resulting variance in regional factor returns predicts the direction of interregional labor and capital flows from low- to high-return regions. I then examine the feedback effect on factor returns of those flows.

The difference between the standard HOS model and the modified Borts-Stein model is the inclusion of a non-traded good whose price, P_2, is endogenously determined by general equilibrium in the regional economy. To the standard set of eight equations describing production in a two-sector HOS economy (BPS, 1998),

(1) $L = a_{L1}X_1 + a_{L2}X_2$

(2) $K = a_{K1}X_1 + a_{K2}X_2$

(3, 4) $P_i = c^i(w, r)$

(5, 6) $c^i_w = a_{Li}$

(7, 8) $c^i_r = a_{Ki}$

in which (1) and (2) are the labor and capital resource constraints, (3) and (4) the minimum average cost pricing conditions, and (5)-(8) the envelope properties of firms' optimal selection of optimal factor intensities a_{Li} and a_{Ki} given their production functions and factor prices w and r, one must therefore add the following equations describing regional demand:

(9, 10) $Y = P_1X_1 + P_2X_2 = P_1C_1 + P_2C_2 + P_3C_3$

(11) $X_2 = C_2$

(12) $X_1 = C_1 + Z$

(13) $P_1Z = P_3C_3$

(14 – 16) $C_i = C_i(P, Y) = \gamma_i \frac{Y}{P_i}$

Equations (9) and (10) stipulate that income, Y, equals both total factor revenues, $\Sigma_i P_i X_i$, and total consumption, $\Sigma_i P_i C_i$. Equation (11) notes that production and consumption of the non-traded good are equal. Equation (12) divides production of the export good into home consumption, C_1, and exports, Z. Equation (13) describes the regional current account balance when capital is assumed to be interregionally immobile. Finally, $C_i(.)$ is the Walrasian demand function for good i, which depends on the regional price vector P and income Y. For simplification purposes, a Cobb-Douglas form of utility is assumed so that consumption of each good depends only on its own price and income, where γ_i represents good i's budget share.

This system of 16 equations contains 14 unknowns - Y, P_2, X_1, X_2, Z, C_1, C_2, C_3, a_{K1}, a_{K2}, a_{L1}, a_{L2}, w and r.

Prior to converting the system into the "hat algebra" terms of percentage changes, I introduce the following modifications adopted from Bhagwati, Panagariya and Srinivasan (1998): regional education and infrastructure levels, denoted by μ_L and μ_K, increase the productivity levels of the regional labor force and capital stock, respectively, in both the traded and non-traded goods sectors, such that $X_i = F(\mu_L L_i, \mu_K K_i)$. In unit terms, therefore, assuming that the production function is homogenous of degree one, $1 = F(\mu_L a_{Li}, \mu_K a_{Ki}) = F(\tilde{a}_{Li}, \tilde{a}_{Ki})$. Minimizing the unit cost function, $c^i = w a_{Li} + r a_{Ki} = \tilde{w}\tilde{a}_{Li} + \tilde{r}\tilde{a}_{Ki}$, where $\tilde{w} = \frac{w}{\mu_L}$ and $\tilde{r} = \frac{r}{\mu_K}$, subject to the constraint of the production function, produces optimal values of $\tilde{a}_{Li}$ and $\tilde{a}_{Ki}$, permitting equations (3)-(6) to be rewritten as

$$(3', 4') \qquad P_i = c^i(\tilde{w}, \tilde{r})$$

$$(5', 6') \qquad c^i_w(\tilde{w}, \tilde{r}) = \tilde{a}_{Li}$$

Converting the modified system to percentage changes yields the following set of sixteen equations in fourteen unknowns:

(1″) $\hat{L} = \lambda_1(\hat{a}_{L1} + \hat{X}_1) + \lambda_2(\hat{a}_{L2} + \hat{X}_2)$, where $\lambda_i = \frac{L_i}{L}$

(2″) $\hat{K} = \kappa_1(\hat{a}_{K1} + \hat{X}_1) + \kappa_2(\hat{a}_{K2} + \hat{X}_2)$, where $\kappa_i = \frac{K_i}{K}$

(3″,4″) $\hat{P}_i = \Theta_{Li}(\hat{w} - \hat{\mu}_L) + \Theta_{Ki}(\hat{r} - \hat{\mu}_K)$, where $\Theta_{Li} = \frac{wL_i}{P_iX_i}$ and $\Theta_{Ki} = \frac{rK_i}{P_iX_i}$

(5″,6″) $\hat{a}_{Li} = -\Theta_{Ki}\sigma_i[(\hat{w} - \hat{\mu}_L) - (\hat{r} - \hat{\mu}_K)] - \mu_L$, where $\sigma_i = \frac{c^i_{rw}c^i}{c^i_r c^i_w}$, the elasticity of substitution in sector i.

(7″,8″) $\hat{a}_{Ki} = \Theta_{Li}\sigma_i[(\hat{w} - \hat{\mu}_L) - (\hat{r} - \hat{\mu}_K)] - \mu_K$

(9″) $\hat{Y} = \rho_1(\hat{X}_1 + \hat{P}_1) + \rho_2(\hat{X}_2 + \hat{P}_2)$, where $\rho_i = \frac{P_iX_i}{Y}$

(10″) $\hat{Y} = \gamma_1(\hat{C}_1 + \hat{P}_1) + \gamma_2(\hat{C}_2 + \hat{P}_2) + \gamma_3(\hat{C}_3 + \hat{P}_3)$, where $\gamma_i = \frac{P_iC_i}{Y}$

(11″) $\hat{X}_2 = \hat{C}_2$

(12″) $\hat{X}_1 = \delta\hat{C}_1 + (1-\delta)\hat{Z}$, where $\delta = \frac{C_1}{X_1}$

(13″) $(\rho_1 - \gamma_1)(\hat{P}_1 + \hat{Z}) = \gamma_3(\hat{P}_3 + \hat{C}_3)$

(14″ − 16″) $\hat{C}_i = \hat{Y} - \hat{P}_i$

Since there are 16 equations in only 14 endogenous variables, equations 10 and 15 will be dropped. The price of the imported good is taken as numeraire, so that $\hat{P}_3 = 0$. I first solve equations (9")-(16") for $\hat{P}_2$ in terms of $\hat{P}_1$, $\hat{X}_1$ and $\hat{X}_2$; the resulting equation can then be used to close the system in nine unknowns described in (1")-(8"). Solving (12") and (13") for $\hat{Z}$, setting the results equal to each other, and substituting in for $\hat{C}_1$ and $\hat{C}_3$ from (14") and (16") yields

$$\hat{Z} = (\frac{\gamma_3}{\rho_1 - \gamma_1})\hat{Y} - \hat{P}_1 = \frac{\hat{X}_1}{1-\delta} - \frac{\delta}{1-\delta}(\hat{Y} - \hat{P}_1)$$

Note that since $\Sigma^2_{i=1}\rho_i = \Sigma^3_{i=1}\gamma_i = 1$ and, from (11"), $\rho_2 = \gamma_2$, the coefficient on the left-hand $\hat{Y}$ simply equals one. Multiplying through by $(1 - \delta)$, solving for $\hat{Y}$, and setting the result equal to the right-hand side of (9") yields

$$\hat{Y} = \rho_1(\hat{X}_1 + \hat{P}_1) + \rho_2(\hat{X}_2 + \hat{P}_2) = \hat{X}_1 + \hat{P}_1$$

and solving this expression for $\hat{P}_2$ produces

$$\hat{P}_2 = \hat{X}_1 + \hat{P}_1 - \hat{X}_2 \tag{17}$$

The change in price of the non-traded good is a positive function of the price and output changes of the traded good, and a negative function of its own output.[40] Equation (17) can now be used to solve the production side of the system expressed in equations (1)-(8).

4.2 The Effect of a Terms of Trade Shock

I will first solve for the impact of a price shock in the traded goods sector, $\hat{P}_1$, on regional wages and interest rates, holding $\hat{P}_3 = \hat{L} = \hat{K} = \hat{\mu}_L = \hat{\mu}_K = 0$. Substituting eqs. (5") and (6") into (1"), and eqs. (7") and (8") into (2") and solving for $\hat{X}_1$ and $\hat{X}_2$ in terms of $\hat{r}$ and $\hat{w}$ yields

$$\hat{X}_1 = \frac{\sigma_1(\lambda\Theta_{L1} + \kappa\Theta_{K1}) + \lambda\kappa\sigma_2}{\kappa - \lambda}(\hat{w} - \hat{r}) = \psi_1(\hat{w} - \hat{r}) \tag{18}$$

$$\hat{X}_2 = \frac{\sigma_1 + \sigma_2(\kappa\Theta_{L2} + \lambda\Theta_{K2})}{\lambda - \kappa}(\hat{w} - \hat{r}) = \psi_2(\hat{w} - \hat{r}) \tag{19}$$

where $\lambda = \frac{L_2}{L_1}$ and $\kappa = \frac{K_2}{K_1}$. Equations (18) and (19) can be substituted into (17) an rearranged to yield

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[40] More generally, it can be shown that

$$\hat{P}_2 = \hat{X}_1\frac{\Phi_2}{\Phi_1} + \hat{P}_1\frac{\Phi_3}{\Phi_1} - \hat{X}_2\frac{\Phi_4}{\gamma_2\Phi_1}$$

where $\Phi_1 = -(\eta_{22}+\gamma_2\eta_{2Y})$, $\Phi_2 = (1-\gamma_2)\eta_{2Y}$, $\Phi_3 = 1-[\gamma_2(1-\eta_{21})+(1-\gamma_2)(1-\gamma_2\eta_{2Y})]$, and $\Phi_4 = 1 - \gamma_2\eta_{2Y}$, and where η_{2i} equals the price elasticity of demand for X_2 with respect to price i and η_{2Y} equals the income elasticity of demand for X_2. This more general formulation proves extremely cumbersome when solving the production side of the system, however, so the simpler Cobb-Douglas formulae are used.

(20) $\hat{P}_2 = \hat{P}_1 + (\psi_1 - \psi_2)\hat{w} + (\psi_2 - \psi_1)\hat{r}.$

Substituting out for $\hat{P}_2$ and $\hat{P}_1$ from equations (3") and (4") and solving for $\hat{w}$ in terms of $\hat{r}$ then produces

$$\hat{w} = \frac{\Theta_{K2} - \Theta_{K1} + \psi_1 - \psi_2}{\Theta_{L1} - \Theta_{L2} + \psi_1 - \psi_2}\hat{r}$$

Because $\Theta_{L1} + \Theta_{K1} = \Theta_{L2} + \Theta_{K2} = 1$, the coefficient on $\hat{r}$ is equal to unity, and $\hat{w} = \hat{r}$. Substituting this back into equation (3") shows that the elasticity of regional wages and interest rates with respect to changes in the export good price is positive and, given the Cobb-Douglas utility assumed here, is simply equal to one: $\frac{\hat{w}}{\hat{P}_1} = \frac{\hat{r}}{\hat{P}_1} = 1$. The equality of $\hat{w}$ and $\hat{r}$ also collapses equation (20) to an identity, $\hat{P}_2 = \hat{P}_1$, so that the non-traded goods price also shows unit elasticity with respect to the export good price, and there is no change in outputs, as shown by equations (18) and (19): $\hat{X}_1 = \hat{X}_2 = 0$. Total regional income, as shown by equation (9"), therefore also rises by the same percentage as $\hat{P}_1$. Real wages rise, assuming that imports are non-zero, since $\hat{w}$ has risen by the same percentage as $\hat{P}_1$ and $\hat{P}_2$ and by more than $\hat{P}_3 = 0$.

These results demonstrate that a positive relative price shock to the traded goods sector would raise regional (real) wages and interest rates, and therefore cause an incipient inflow of both labor and capital. Capital would therefore flow not into low-wage regions, but rather into high-wage regions.

4.3 The Effect of Changes in Labor and Capital Productivity

This section discusses the impact of changes in the labor and capital productivity parameters, μ_L and μ_K, on wages, rents, prices, and outputs. In contrast to the effect of changes in the export good price, the effect of factor productivity changes differs considerably between the Borts-Stein model and the basic HOS model due to the endogeneity of non-traded goods prices.

Setting $\hat{P}_1 = \hat{L} = \hat{K} = 0$, I will first solve for the effect of a change in the capital productivity parameter, $\hat{\mu}_K$, holding $\hat{\mu}_L$ equal to zero. Solving (3") for $\hat{w}$ in terms of $(\hat{r} - \hat{\mu}_K)$ yields

$$(3a) \qquad \hat{w} = -\frac{\Theta_{K1}}{\Theta_{L1}}(\hat{r} - \hat{\mu}_K)$$

and substituting this into (4"-8") yields:

$$(4a) \qquad \hat{P}_2 = -\frac{\Theta}{\Theta_{L1}}(\hat{r} - \hat{\mu}_K), \text{ where } \Theta = \Theta_{K1}\Theta_{L2} - \Theta_{K2}\Theta_{L1} > 0, \text{ by}$$

virtue of sector one's relative capital intensity.

$$(5a, 6a) \qquad \hat{a}_{Li} = \frac{\Theta_{Ki}}{\Theta_{L1}}\sigma_i(\hat{r} - \hat{\mu}_K)$$

$$(7a, 8a) \qquad \hat{a}_{Ki} = -\frac{\Theta_{Li}}{\Theta_{L1}}\sigma_i(\hat{r} - \hat{\mu}_K) - \hat{\mu}_K$$

By (17), equation (4a) also equals $\hat{X}_1 - \hat{X}_2$. Substituting (5a-8a) into (1") and (2") and solving for $\hat{X}_1$ and $\hat{X}_2$ yields

$$\hat{X}_1 = -\frac{1}{\lambda - \kappa}\{[\sigma_1(\lambda + \kappa\frac{\Theta_{K1}}{\Theta_{L1}}) + \sigma_2\frac{\kappa\lambda}{\Theta_{L1}}](\hat{r} - \hat{\mu}_K) + (\lambda + \lambda\kappa)\hat{\mu}_K\}$$

$$\hat{X}_2 = \frac{1}{\lambda - \kappa}\{[\frac{\sigma_1}{\Theta_{L1}} + \sigma_2(\lambda\frac{\Theta_{K2}}{\Theta_{L1}} + \kappa\frac{\Theta_{L2}}{\Theta_{L1}})](\hat{r} - \hat{\mu}_K) + (1 + \kappa)\hat{\mu}_K\}$$

Taking the difference of these terms and setting it equal to (4a) produces

(21) $$\hat{X}_1 - \hat{X}_2 = \frac{1}{\lambda - \kappa}[\frac{\xi_1}{\Theta_{L1}}(\hat{r} - \hat{\mu}_K) + \xi_2\hat{\mu}_K] = -\frac{\Theta}{\Theta_{L1}}(\hat{r} - \hat{\mu}_K)$$

where $\xi_1 = [\sigma_1(1 + \lambda\Theta_{L1} + \kappa\Theta_{K1})] + \sigma_2(\kappa\lambda + \kappa\Theta_{L2} + \lambda\Theta_{K2})\} > 0$ and $\xi_2 = 1 + \kappa + \lambda + \kappa\lambda > 0$. Solving this expression for the elasticity of capital rents with respect to changes in capital productivity yields

(22) $$\frac{\hat{r}}{\hat{\mu}_K} = 1 - \frac{\Theta_{L1}\xi_2}{\Theta(\lambda - \kappa) + \xi_1}$$

Because the second term on the right-hand side is positive but of indeterminate magnitude, the elasticity cannot be readily signed, but it is clearly less than unity: capital owners do not capture the full benefit of increases in capital productivity; and it is even possible that rents fall in response to such an increase. It is therefore unsurprising to discover that wages rise unequivocally in response to higher capital productivity. Substituting from (3a) into (21) and solving for the elasticity of wages with respect to μ_K produces

(23) $$\frac{\hat{w}}{\hat{\mu}_K} = \frac{\Theta_{K1}\xi_2}{\Theta(\lambda - \kappa) + \xi_1} > 0$$

and substituting (4a) into (21) produces

(24) $$\frac{\hat{P}_2}{\hat{\mu}_K} = \frac{\hat{X}_1 - \hat{X}_2}{\hat{\mu}_K} = \frac{\Theta\xi_2}{\Theta(\lambda - \kappa) + \xi_1} > 0$$

Prices of non-traded goods rise, but output in the capital-intensive traded goods sector rises by more than the output of non-traded goods. Again, since $\Theta_{K1} > \Theta$, nominal wages rise by more than prices so that real wages also rise.

Derivation of the impact of changes in labor productivity, $\hat{\mu}_L$, is entirely symmetrical, so I present only the end results. The expression analogous to (21) is

(25) $$\hat{X}_1 - \hat{X}_2 = \frac{1}{\lambda - \kappa}[\frac{\xi_1}{\Theta_{K1}}(\hat{w} - \hat{\mu}_L) + \xi_2\hat{\mu}_L] = -\frac{\Theta}{\Theta_{K1}}(\hat{w} - \hat{\mu}_L)$$

Solving for the elasticity of wages, rents, prices and relative outputs with respect to changes in labor productivity yields

(26) $$\frac{\hat{w}}{\hat{\mu}_L} = 1 - \frac{\Theta_{K1}\xi_2}{\Theta(\lambda - \kappa) + \xi_1} < 1$$

(27) $$\frac{\hat{r}}{\hat{\mu}_L} = \frac{\Theta_{L1}\xi_2}{\Theta(\lambda - \kappa) + \xi_1} > 0$$

(28) $$\frac{\hat{P}_2}{\hat{\mu}_L} = \frac{\hat{X}_1 - \hat{X}_2}{\hat{\mu}_L} = -\frac{\Theta\xi_2}{\Theta(\lambda - \kappa) + \xi_1} < 0$$

Again, the elasticity of returns to the factor whose productivity has risen is less than unity (and possibly even negative), while the return to the other factor rises. An increase in labor productivity lowers the cost of output in the labor-intensive sector, P_2, and causes output in this sector to rise by more than output in the capital-intensive sector. Since $\Theta_{K1} > \Theta$, the effect on real wages is ambiguous.

These results differ significantly from those of the basic HOS model, in which, assuming both goods prices are constant, equations (3) and (4) can be solved to show that $\frac{\hat{w}}{\hat{\mu}_L} = \frac{\hat{r}}{\hat{\mu}_K} = 1$ and $\frac{\hat{w}}{\hat{\mu}_K} = \frac{\hat{r}}{\hat{\mu}_L} = 0$.[41] In other words, the full gain from any rise in a factor's productivity accrues entirely to the owners of that factor. In the Borts-Stein model, the endogeneity of P_2 redistributes some of the gains from increased productivity between factors: a rise in labor (capital) productivity causes a fall (rise) in the price of the non-traded good as the output of the labor- (capital-) intensive sector expands relative to the other sector.

The implications of these dynamics for interregional factor flows are

[41]See Bhagwati, Panagariya, and Srinivasan, p. 152 for discussion.

as follows: increased labor productivity raises rents and therefore attracts capital, while increased capital productivity raises wages and therefore attracts labor. Infrastructure investment may also raise interest rates and attract capital, but the model's results are inconclusive.

4.4 The Effect of Changes in the Labor and Capital Stocks

The following section explores the feedback effect of labor and capital flows on factor returns, which in the Borts-Stein model do not differ substantially from those of the basic HOS model, although the endogeneity of P_2 moderates the fall in the real wage in response to a labor inflow as well as the rise in the real wage in response to a capital inflow.

Setting $\hat{P}_1 = \hat{P}_3 = \hat{\mu}_L = \hat{\mu}_K = 0$ and solving equation (3") for $\hat{w}$ in terms of $\hat{r}$ yields

(3b) $\hat{w} = -\frac{\Theta_{K1}}{\Theta_{L1}}\hat{r}.$

which can be further substituted into equations (4")-(8") to produce:

(4b) $\hat{P}_2 = -\frac{\Theta}{\Theta_{L1}}\hat{r}$

(5b, 6b) $\hat{a}_{Li} = \frac{\Theta_{Ki}}{\Theta_{L1}}\sigma_i\hat{r}$

(7b, 8b) $\hat{a}_{Ki} = -\frac{\Theta_{Li}}{\Theta_{L1}}\sigma_i\hat{r}$

By (17), $\hat{P}_2 = \hat{X}_1 - \hat{X}_2$, so that $\hat{r} = \frac{\Theta_{Li}}{\Theta}(\hat{X}_2 - \hat{X}_1)$, which can be substituted into equations (5a)-(8a) and then into equations (1") and (2") to produce

(1b) $$\hat{L} = \hat{X}_1[\lambda_1(1-\sigma_1\frac{\Theta_{K1}}{\Theta})-\lambda_2\sigma_2\frac{\Theta_{K2}}{\Theta}]+\hat{X}_2[\lambda_1\sigma_1\frac{\Theta_{K1}}{\Theta}+\lambda_2(1+\sigma_2\frac{\Theta_{K2}}{\Theta})]$$
$$= \hat{X}_1\phi_{11} + \hat{X}_2\phi_{12}$$

(2b) $\hat{K} = \hat{X}_1[\kappa_1(1+\sigma_1\frac{\Theta_{L1}}{\Theta}) + \kappa_2\sigma_2\frac{\Theta_{L2}}{\Theta}] + \hat{X}_2[-\kappa_1\sigma_1\frac{\Theta_{L1}}{\Theta} + \kappa_2(1 - \sigma_2\frac{\Theta_{L2}}{\Theta})]$

$$= \hat{X}_1\phi_{21} + \hat{X}_2\phi_{22}$$

In the above equations, ϕ_{12} and ϕ_{21} are unambiguously positive since all their terms are positive; while ϕ_{11} and ϕ_{22} cannot be definitely signed. Setting first $\hat{K}$ and then $\hat{L}$ equal to zero, one can solve (1b) and (2b) for changes in outputs in response to capital stock changes using Cramer's rule. The determinant of the matrix of coefficients, $\phi = \phi_{11}\phi_{22} - \phi_{21}\phi_{12} = \lambda_1\kappa_2 - \kappa_1\lambda_2 - \frac{\sigma_1(\kappa_1\Theta_{L1} + \lambda_1\Theta_{K1}) + \sigma_2(\kappa_2\Theta_{L2} + \lambda_2\Theta_{K2})}{\Theta}$ is negative assuming that sector two is labor-intensive. Therefore,

(29) $\frac{\hat{X}_1}{\hat{K}} = \frac{-\phi_{12}}{\phi} > 0$

(30) $\frac{\hat{X}_2}{\hat{K}} = \frac{\phi_{11}}{\phi}$

(31) $\frac{\hat{X}_1}{\hat{L}} = \frac{\phi_{22}}{\phi}$

(32) $\frac{\hat{X}_2}{\hat{L}} = \frac{-\phi_{21}}{\phi} > 0$

As in the basic HOS model, the capital-intensive sector expands unambiguously in response to an increase in the capital stock, while the labor-intensive sector may either expand or contract, and conversely for an increase in the labor stock. To gauge the effects of capital stock changes on non-traded goods prices, I substitute (29)-(32) back into equation (17) to obtain

$$\frac{\hat{P}_2}{\hat{K}} = -\frac{\phi_{12} + \phi_{11}}{\phi} = -\frac{1}{\phi} > 0$$

$$\frac{\hat{P}_2}{\hat{L}} = \frac{\phi_{22} + \phi_{21}}{\phi} = \frac{1}{\phi} < 0$$

An inflow of capital increases the price of the traded good, while an inflow of labor lowers it. Substituting back into (3b) and (4b) and solving for changes in $\hat{w}$ and $\hat{r}$ in response to $\hat{K}$ and $\hat{L}$ produces:

$$\frac{\hat{r}}{\hat{K}} = \frac{\Theta_{L1}}{\phi\Theta} < 0; \qquad \frac{\hat{r}}{\hat{L}} = -\frac{\Theta_{L1}}{\phi\Theta} > 0;$$
$$\frac{\hat{w}}{\hat{K}} = -\frac{\Theta_{K1}}{\phi\Theta} > 0; \qquad \frac{\hat{w}}{\hat{L}} = \frac{\Theta_{K1}}{\phi\Theta} < 0.$$

As in the HOS model, a rise in the labor stock lowers wages and raises rents, while a rise in the capital stock does the reverse; therefore, factor returns are endogenous to changes in factor endowments. Since $\Theta_{K1} > \Theta$, the nominal wage rises by more than P_2 in response to a capital inflow, and falls by more than P_2 in response to a labor influx, so that real and nominal wages move in the same direction in response to factor stock changes.

5 Appendix B: Description of the Data

The measure of public investment is annual regional government investment in fixed capital for the years 1994-1997, as reported by Goskomstat (1998). PIPC is total regional public investment in rubles deflated by the regional minimum subsistence wage and divided by regional population; PISHARE is the ratio of total annual regional investment spending to total annual regional budget expenditure in percentage terms. Foreign direct investment (FDI) is quoted in thousands of US dollars. Domestic investment (DOM) is total non-budgetary investment in fixed capital net of investment by joint ventures, quoted in millions of post-devaluation rubles and deflated using the regional minimum subsistence wage. These data are from Goskomstat (1998, 1999).

Gross regional product (GRP) is quoted in millions of post-devaluation rubles. Nominal GRP per capita (GRPPC) is quoted in post-devaluation rubles. WAGE is the total regional wage bill divided by the number of active workers quoted in thousands of post-devaluation rubles per year. All three series are deflated using the regional minimum subsistence wage and are from Goskomstat (2000).

The index of regional industrial structure, INDUST, is an industrial share-weighted index of sectoral performance measures: $INDUST_{it} = \Sigma_j w_{ij,t-2} IP_{jt-1}$, where i is region, j is industrial sector, w_{ijt} is the output share of sector j in region i for year t, and IP_{jt} is the national-level industrial sector output index for year t where $IP_{t-1} = 100$. Regional governments planning investment expenditure in year $t-1$ for year t are thus assumed to take regional industrial composition as given, and to know the current performance of each sector for the nation as a whole. Data are from Goskomstat (1998-2000) as well as various years of the Russian Statistical Yearbook. The regional index of natural resource potential (NATURE) is compiled by the Expert Institute (1998), and comprises measures of each region's endowment of productive geological assets, including renewable and non-renewable raw materials (e.g., fossil fuels, minerals, and forests), climate, soil quality, and water. Regional capital stock (KSTOCK) is the 1991 book value of total regional capital annually increased by total regional investment in fixed capital deflated by the regional producer price indices, and depreciated at a rate of 10 percent per annum.

Indices of regional transport (ROAD) and telecommunications (TELECOM) infrastructure are decile rankings of regions on the basis of paved road density and urban household connectivity (Goskomstat, 2000). The regional infrastructure index (INFRA) is the arithmetic mean of the two measures. The percentage of regional population with higher education and specialized secondary education (EDUC) is calculated from the 1989 Soviet census and Goskomstat (2000). POVERTY, the percentage of regional households with below-minimum subsistence incomes, and UNEMP, the standard unemployment rate, are from Goskomstat (1998).

The measure of the federal taxation rate, TAX, is the ratio of annual regional tax remittances to the federal government to annual total regional revenue collections; the measure of the federal subsidization rate, SUB, is the ratio of federal transfers and budget loans to total regional government budget expenditure; and the measure of regional fiscal devolution, MUNI, is the average share of consolidated regional revenues (net of federal collections) accruing to municipal governments during 1994-1996. These data are from Freinkman, et al. (1999).

The index of regional investment risk (RISK), compiled by Bank Austria (1995, 1998), is a weighted average of 13 different measures of the regional policy environment, including: external and internal threats to stability, characteristics of administrative leaders and their attitudes toward foreign investment, government ownership of economic entities and intervention in the economy, legislative stability of market reforms, legal guarantees for foreign investment, nationalization risk, political polarization and heterogeneity, share of votes for reform parties, and independence of mass media. Data on regional small privatization (PRIVATE) and goods and service price liberalization (PLIB) are from Lavrov (1997).

FINDEV is based on the sum of each region's ranking in four categories during the years 1993-1995: number of registered banks, number of banking affiliates, total chartered capital and number of banks with currency licences. The index classifies Russian regions on a scale of 1 to 6, with 1 being the least developed financially and 6 the most. FINOPEN is a 1-to-4 ranking of regions based on the share of their financial institutions headquartered outside the region (mostly in Moscow), with 4 reflecting the highest degree of openness. Both measures are from Klimanov (1995).

Regional climate (CLIMATE) is measured by mean January temperature (Goskomstat, 1996). Distance to Moscow (KM) is the arc length between regional and national capitals calculated using their longitude and latitude. Data on the number of joint ventures (JV) are from Goskomstat (1998-2000) and Russian Statistical Yearbooks.

Table 1
Summary Statistics of Regression Variables

Variable	Mean	Std. Dev.	Min	Max
PISHARE	7.88	5.19	0.30	47.68
PIPC	4.89	4.47	0.15	42.19
PISHARE*	-2.67	0.76	-5.80	-0.09
Log PIPC	1.27	0.82	-1.92	3.74
GRPPC	5.57	0.37	4.29	6.85
POP	14.20	0.75	12.20	15.99
KSTOCK	2.62	0.76	1.19	5.70
SECTOR	86.51	7.53	61.59	103.82
NATURE	100.62	53.36	0.00	274.00
INFRA	5.79	2.05	1.50	10.00
UNEMP	10.61	3.71	3.68	30.27
POVERTY	28.19	11.65	11.50	74.70
TAX	34.01	8.45	0.00	67.30
SUB	22.79	17.43	0.00	113.50
MUNI	61.58	14.63	0.00	92.22
REPUB	0.24	0.43	0.00	1.00
FINDEV	2.86	1.29	1.00	6.00
FINOPEN	2.72	0.92	1.00	4.00

PISHARE = Public investment as a percentage of regional govt. expenditures
PIPC = Ratio of public investment per capita to regional minimum subsistence wage (RMSW)
PISHARE* = Logistic transformation of PISHARE
GRPPC = Log of ratio of gross regional product per capita to RMSW
POP = Log of beginning-of-period regional population
KSTOCK = Log of beg. of period capital stock per capita, thous. 1991 rubles
SECTOR = Index of regional industrial strength (see Appendix B).
NATURE = Index of regional nat. resource potential (Expert Institute, 1998)
INFRA = Beg. of period avg. regional decile ranking for road density and urban household connectivity
UNEMP = Beg. of period standard unemployment rate
POVERTY = Beg. of period percentage of households with below minimum subsistence income
TAX = Percentage of total regional tax collections allocated to federal govt.
SUB = Federal subsidies as a percentage of total regional govt. expenditures
MUNI = Percentage of regional consolidated tax collections left with municip governments (Freinkman, et al., 1999)
REPUB = Dummy variable taking on value of 1 if region is a republic.
FINDEV = Index of regional financial development (Klimanov, 1995)
FINOPEN = Index of regional financial openness (Klimanov, 1995)

Table 2
Correlation Coefficients of Public Investment Regression Variables

	PISHARE	PIPC	GRPPC	KSTOCK	SECTOR
PISHARE	1.00				
PIPC	0.93	1.00			
GRPPC	0.45	0.58	1.00		
KSTOCK	-0.17	-0.06	0.13	1.00	
INDUST	0.12	0.09	-0.04	0.05	1.00
INFRA	0.05	0.03	-0.03	-0.07	-0.14
POP	0.46	0.44	0.52	-0.24	0.02
POVERTY	-0.23	-0.35	-0.71	-0.18	-0.12
UNEMP	-0.36	-0.40	-0.68	-0.06	0.00
TAX	0.08	0.07	0.12	0.04	-0.13
SUB	-0.36	-0.38	-0.57	0.03	-0.10
MUNI	-0.38	-0.43	-0.54	0.05	0.02
REPUB	0.04	0.05	-0.39	-0.16	-0.03
FINDEV	0.37	0.43	0.45	-0.15	0.05
FINOPEN	-0.21	-0.18	-0.18	0.04	-0.16

	INFRA	POP	POVERTY	UNEMP	TAX
INFRA	1.00				
POP	0.03	1.00			
POVERTY	-0.15	-0.35	1.00		
UNEMP	-0.03	-0.40	0.52	1.00	
TAX	0.28	0.23	-0.10	-0.11	1.00
SUB	0.05	-0.51	0.55	0.48	-0.13
MUNI	-0.30	-0.51	0.47	0.49	-0.09
REPUB	0.08	-0.41	0.44	0.41	-0.22
FINDEV	-0.06	0.69	-0.31	-0.31	0.18
FINOPEN	0.30	-0.28	0.07	0.02	0.11

	SUB	MUNI	REPUB	FINDEV	FINOPEN
SUB	1.00				
MUNI	0.49	1.00			
REPUB	0.45	0.16	1.00		
FINDEV	-0.47	-0.43	-0.14	1.00	
FINOPEN	0.33	0.03	0.06	-0.48	1.00

Table 3
Random Effects Regressions of PISHARE - Full Sample

Variable	PISHARE			
	1	2	3	4
GRPPC	-	0.627***	-	0.734***
		0.183		*0.182*
KSTOCK	-0.049	-	-0.001	-
	0.084		*0.078*	
INDUST	0.009	-	0.012	-
	0.010		*0.010*	
NATURE	0.003**	-	0.001	-
	0.001		*0.001*	
INFRA	0.061*	-	0.017	-
	0.035		*0.035*	
POVERTY	0.006	-	0.003	-
	0.005		*0.005*	
UNEMP	-0.031**	-	-0.036**	-
	0.015		*0.015*	
POP	0.318***	0.280***	0.390***	0.380***
	0.096	*0.106*	*0.104*	*0.103*
TAX	0.000	-0.010*	0.003	-0.006
	0.005	*0.006*	*0.005*	*0.006*
SUB	-0.006*	-0.005	-0.008**	-0.009**
	0.003	*0.004*	*0.003*	*0.004*
MUNI	-	-	-0.004	0.001
			0.005	*0.005*
REPUB	-	-	0.569***	0.709***
			0.169	*0.162*
1995	-0.36***	-	-0.34***	-
	0.10		*0.10*	
1996	-0.43***	0.17**	-0.45***	0.19***
	0.14	*0.07*	*0.13*	*0.07*
1997	-0.46***	0.009	-0.47***	0.03
	0.13	*0.076*	*0.12*	*0.08*
Constant	-7.85	-9.85	-8.68	-12.17
No. Obs.	296	224	296	224
R-squared	0.33	0.28	0.41	0.40

* Significant at a 10 percent level
** Significant at a 5 percent level
*** Significant at a 1 percent level
Standard errors in italics.

Table 4
Random Effects Regressions of PIPC - Full Sample

Variable	PIPC			
	1	2	3	4
GRPPC	-	1.061***	-	1.173***
		0.180		*0.175*
KSTOCK	0.014	-	0.069	-
	0.091		*0.081*	
INDUST	0.006	-	0.010	-
	0.010		*0.010*	
NATURE	0.004**	-	0.002	-
	0.002		*0.001*	
INFRA	0.071*	-	0.012	-
	0.038		*0.035*	
POVERTY	-0.005	-	-0.008*	-
	0.005		*0.005*	
UNEMP	-0.034**	-	-0.040***	-
	0.015		*0.015*	
POP	0.287***	0.191*	0.365***	0.292***
	0.104	*0.107*	*0.107*	*0.100*
TAX	-0.001	-0.006	0.003	-0.002
	0.005	*0.006*	*0.005*	*0.005*
SUB	-0.004	-0.003	-0.006*	-0.007*
	0.003	*0.004*	*0.003*	*0.004*
MUNI	-	-	-0.006	-0.000
			0.005	*0.005*
REPUB	-	-	0.703***	0.800***
			0.173	*0.157*
1995	-0.33***	-	-0.30***	-
	0.10		*0.10*	
1996	-0.53***	0.08	-0.56***	0.10
	0.14	*0.07*	*0.13*	*0.07*
1997	-0.40***	0.12*	-0.41***	0.12*
	0.13	*0.07*	*0.12*	*0.07*
Constant	-3.25	-7.27	-4.04	-9.57
No. Obs.	296	224	296	224
R-squared	0.34	0.37	0.46	0.50

* Significant at a 10 percent level
** Significant at a 5 percent level
*** Significant at a 1 percent level
Standard errors in italics.

Table 5
Random Effects Regressions of PISHARE - Restricted Samples

Variable	Sample 1		Sample 2	
	1	2	3	4
GRPPC	-	0.766***	-	0.768***
		0.192		*0.181*
KSTOCK	-0.008	-	-0.014	-
	0.080		*0.073*	
INDUST	0.013	-	0.010	-
	0.010		*0.009*	
NATURE	0.001	-	0.002	-
	0.001		*0.001*	
INFRA	0.018	-	0.030	-
	0.034		*0.034*	
POVERTY	0.004	-	0.003	-
	0.005		*0.004*	
UNEMP	-0.035**	-	-0.033**	-
	0.015		*0.016*	
POP	0.387***	0.373***	0.301***	0.299***
	0.105	*0.105*	*0.102*	*0.104*
TAX	0.003	-0.007	0.008	0.005
	0.005	*0.006*	*0.005*	*0.005*
SUB	-0.007**	-0.009**	-0.005*	-0.007*
	0.003	*0.004*	*0.003*	*0.004*
MUNI	-0.007	0.003	-0.007	-0.001
	0.007	*0.008*	*0.005*	*0.005*
REPUB	0.549***	0.712***	0.526***	0.612***
	0.173	*0.165*	*0.161*	*0.164*
1995	-0.34***	-	-0.39***	-
	0.1		*0.09*	
1996	-0.48***	0.19**	-0.49***	0.19**
	0.14	*0.08*	*0.13*	*0.07*
1997	-0.48***	0.05	-0.52***	0.04
	0.13	*0.08*	*0.12*	*0.07*
Constant	-8.52	-12.35	-7.36	-11.47
No. Obs.	288	218	274	206
R-squared	0.39	0.38	0.45	0.44

Sample 1: Ex-Moscow and St. Petersburg.
Sample 2: Ex-Sakha and North Caucasian Republics
* Significant at a 10 percent level. ** Significant at a 5 percent level.
*** Significant at a 1 percent level. Standard errors in italics.

Table 6
Random Effects Regressions of PIPC - Restricted Samples

Variable	Sample 1		Sample 2	
	1	2	3	4
GRPPC	-	1.227***	-	1.232***
		0.184		*0.171*
KSTOCK	0.074	-	0.057	-
	0.082		*0.075*	
INDUST	0.012	-	0.012	-
	0.010		*0.009*	
NATURE	0.002	-	0.003*	-
	0.002		*0.001*	
INFRA	0.014	-	0.035	-
	0.035		*0.035*	
POVERTY	-0.008	-	-0.009*	-
	0.005		*0.004*	
UNEMP	-0.042***	-	-0.038**	-
	0.015		*0.017*	
POP	0.357***	0.282***	0.245***	0.178*
	0.109	*0.101*	*0.106*	*0.096*
TAX	0.003	-0.004	0.006	0.004
	0.005	*0.006*	*0.005*	*0.005*
SUB	-0.006*	-0.007**	-0.003	-0.006*
	0.003	*0.004*	*0.003*	*0.003*
MUNI	-0.004	0.004	-0.011**	-0.004
	0.007	*0.007*	*0.005*	*0.005*
REPUB	0.703***	0.809***	0.656***	0.712***
	0.177	*0.159*	*0.166*	*0.152*
1995	-0.28***	-	-0.28***	-
	0.10		*0.09*	
1996	-0.58***	0.10	-0.62***	0.07
	0.14	*0.07*	*0.13*	*0.07*
1997	-0.40***	0.16**	-0.47***	0.12*
	0.13	*0.07*	*0.12*	*0.07*
Constant	-4.18	-9.93	-2.49	-8.27
No. Obs.	288	218	274	206
R-squared	0.44	0.49	0.49	0.59

Sample 1: Ex-Moscow and St. Petersburg.
Sample 2: Ex-Sakha and North Caucasian Republics
* Significant at a 10 percent level. ** Significant at a 5 percent level.
*** Significant at a 1 percent level. Standard errors in italics.

Table 7
Random Effects Regressions of PISHARE: Rich vs. Poor

Variable	Full		Sample 2	
	1	2	3	4
GRPPC	-	0.707***	-	0.717***
		0.205		*0.207*
KSTOCK	-0.003	-	-0.023	-
	0.79		*0.073*	
INDUST	0.010	-	0.007	-
	0.010		*0.009*	
NATURE	0.001	-	0.002	-
	0.001		*0.001*	
INFRA	0.014	-	0.028	-
	0.034		*0.034*	
POVERTY	0.004	-	0.004	-
	0.005		*0.004*	
UNEMP	-0.031**	-	-0.024*	-
	0.015		*0.017*	
POP	0.354***	0.369***	0.248**	0.288***
	0.107	*0.107*	*0.106*	*0.107*
RICHTAX	0.007	-0.005	0.015***	0.006
	0.005	*0.006*	*0.005*	*0.006*
POORTAX	-0.000	-0.008	0.004	0.003
	0.005	*0.006*	*0.005*	*0.006*
RICHSUB	-0.011*	-0.011	-0.011**	-0.009
	0.006	*0.007*	*0.005*	*0.006*
POORSUB	-0.006*	-0.008*	-0.002	-0.006
	0.004	*0.004*	*0.003*	*0.004*
MUNI	-0.003	0.002	-0.006	-0.001
	0.005	*0.005*	*0.005*	*0.005*
REPUB	0.550***	0.696***	0.482***	0.600***
	0.174	*0.170*	*0.166*	*0.173*
1995	-0.37***	-	-0.44***	-
	0.10		*0.09*	
1996	-0.44***	0.19**	-0.48***	0.19***
	0.13	*0.08*	*0.12*	*0.07*
1997	-0.48***	0.03	-0.54***	0.04
	0.12	*0.08*	*0.12*	*0.07*
Constant	-8.13	-11.88	-6.57	-11.05
No. Obs.	296	224	274	206
R-squared	0.42	0.40	0.46	0.44

Sample 1: Ex-Moscow and St. Petersburg.
Sample 2: Ex-Sakha and North Caucasian Republics
* Significant at a 10 percent level. ** Significant at a 5 percent level.
*** Significant at a 1 percent level. Standard errors in italics.

Table 8
Random Effects Regressions of PIPC: Rich vs. Poor

Variable	Full		Sample 2	
	1	2	3	4
GRPPC	-	1.082***	-	1.159***
		0.196		*0.196*
KSTOCK	0.063	-	0.044	-
	0.080		*0.074*	
INDUST	0.008	-	0.009	-
	0.010		*0.009*	
NATURE	0.002	-	0.003**	-
	0.001		*0.001*	
INFRA	0.006	-	0.032	-
	0.035		*0.034*	
POVERTY	-0.006	-	-0.007	-
	0.005		*0.004*	
UNEMP	-0.032**	-	-0.026	-
	0.015		*0.017*	
POP	0.298***	0.279***	0.169*	0.172*
	0.108	*0.103*	*0.106*	*0.100*
RICHTAX	0.011**	-0.000	0.015***	0.006
	0.005	*0.006*	*0.005*	*0.006*
POORTAX	-0.003	-0.005	-0.001	0.002
	0.005	*0.006*	*0.005*	*0.006*
RICHSUB	-0.011**	-0.007	-0.011**	-0.006
	0.006	*0.007*	*0.005*	*0.006*
POORSUB	-0.003	-0.006	0.001	-0.005
	0.004	*0.004*	*0.003*	*0.004*
MUNI	-0.005	0.000	-0.010*	-0.004
	0.005	*0.005*	*0.005*	*0.005*
REPUB	0.675***	0.802***	0.601***	0.716**
	0.174	*0.163*	*0.167*	*0.161*
1995	-0.35***	-	-0.35***	-
	0.10		*0.09*	
1996	-0.54***	0.09	-0.62***	0.063
	0.13	*0.07*	*0.12*	*0.068*
1997	-0.42***	0.13*	-0.51***	0.112
	0.12	*0.07*	*0.12*	*0.071*
Constant	-3.05	-8.9	-1.37	-7.79
No. Obs.	296	224	274	206
R-squared	0.49	0.51	0.52	0.57

Sample 1: Ex-Moscow and St. Petersburg.
Sample 2: Ex-Sakha and North Caucasian Republics
* Significant at a 10 percent level. ** Significant at a 5 percent level.
*** Significant at a 1 percent level. Standard errors in italics.

Table 9
Random Effects Regressions of PISHARE: Republic vs. Non-Republic

Variable	Full		Sample 2	
	1	2	3	4
GRPPC	-	0.723***	-	0.751***
		0.181		*0.181*
KSTOCK	0.005	-	-0.018	-
	0.078		*0.073*	
INDUST	0.012	-	0.009	-
	0.010		*0.009*	
NATURE	0.001	-	0.002	-
	0.001		*0.001*	
INFRA	0.015	-	0.035	-
	0.034		*0.034*	
POVERTY	0.002	-	0.001	-
	0.005		*0.004*	
UNEMP	-0.032**	-	-0.029*	-
	0.014		*0.016*	
POP	0.364***	0.326***	0.267***	0.286***
	0.104	*0.105*	*0.103*	*0.106*
REPTAX	-0.001	-0.021**	0.008	0.003
	0.006	*0.008*	*0.007*	*0.009*
OBLTAX	0.009	0.005	0.009	0.003
	0.007	*0.008*	*0.006*	*0.008*
REPSUB	-0.005	-0.003	0.002	0.000
	0.004	*0.005*	*0.004*	*0.005*
OBLSUB	-0.012***	-0.016***	-0.014***	-0.015***
	0.004	*0.005*	*0.004*	*0.005*
MUNI	-0.003	0.002	-0.007	-0.002
	0.005	*0.005*	*0.005*	*0.005*
REPUB	0.685*	1.212	0.144	0.203
	0.387	*0.453*	*0.379*	*0.459*
1995	-0.36***	-	-0.43***	-
	0.10		*0.09*	
1996	-0.46***	0.23**	-0.50***	0.21
	0.13	*0.07*	*0.13*	*0.07*
1997	-0.48***	0.09	-0.55***	0.05
	0.12	*0.08*	*0.12*	*0.07*
Constant	-8.48	-11.74	-6.71	-10.97
No. Obs.	296	224	274	206
R-squared	0.41	0.41	0.46	0.45

Sample 2: Ex-Sakha and North Caucasian Republics
* Significant at a 10 percent level. ** Significant at a 5 percent level.
*** Significant at a 1 percent level. Standard errors in italics.

Table 10
Random Effects Regressions of PIPC: Republic vs. Non-Republic

Variable	Full		Sample 2	
	1	2	3	4
GRPPC	-	1.163***	-	1.219***
		0.176		*0.171*
KSTOCK	0.073	-	0.053	-
	0.080		*0.074*	
INDUST	0.010	-	0.011	-
	0.010		*0.009*	
NATURE	0.002	-	0.003**	-
	0.001		*0.001*	
INFRA	0.011	-	0.040	-
	0.035		*0.034*	
POVERTY	-0.009*	-	-0.011**	-
	0.005		*0.004*	
UNEMP	-0.037**	-	-0.035**	-
	0.015		*0.016*	
POP	0.340***	0.257**	0.209**	0.172*
	0.106	*0.103*	*0.105*	*0.099*
REPTAX	0.000	-0.011	0.005	0.004
	0.006	*0.008*	*0.007*	*0.008*
OBLTAX	0.007	0.004	0.007	0.002
	0.007	*0.008*	*0.007*	*0.007*
REPSUB	-0.001	-0.002	0.004	-0.001
	0.004	*0.005*	*0.004*	*0.004*
OBLSUB	-0.011**	-0.013**	-0.012***	-0.012**
	0.005	*0.005*	*0.004*	*0.004*
MUNI	-0.006	0.000	-0.011**	-0.004
	0.005	*0.005*	*0.005*	*0.005*
REPUB	0.643*	1.037***	0.241	0.372
	0.387	*0.438*	*0.383*	*0.437*
1995	-0.33***	-	-0.33**	-
	0.10		*0.09*	
1996	-0.57***	0.12*	-0.64**	0.08
	0.13	*0.07*	*0.13*	*0.07*
1997	-0.42***	0.18**	-0.51**	0.12*
	0.12	*0.08*	*0.12*	*0.07*
Constant	-3.73	-9.21	-1.80	-7.92
No. Obs.	296	224	274	206
R-squared	0.46	0.50	0.51	0.57

Sample 2: Ex-Sakha and North Caucasian Republics
* Significant at a 10 percent level. ** Significant at a 5 percent level.
*** Significant at a 1 percent level. Standard errors in italics.

Table 11
Volatility of Transfer Income vs. Own Income: Coefficients of Variation

Sample	No. Obs.	Own Income	Transfer Income
All Regions	74	0.20	0.80
Above-median income	37	0.17	0.93
Below-median income	37	0.22	0.67
Non-Republic	56	0.19	0.86
Republic	18	0.21	0.62

Table 12
Random Effects Regressions of PISHARE Including Financial Indices

Variable	1	2	3	4
GRPPC	-	0.760***	-	0.721***
		0.183		*0.185*
KSTOCK	-0.000	-	-0.002	-
	0.079		*0.080*	
INDUST	0.012	-	0.010	-
	0.010		*0.010*	
NATURE	0.001	-	0.001	-
	0.001		*0.001*	
INFRA	0.016	-	0.017	-
	0.034		*0.035*	
POVERTY	0.003	-	0.003	-
	0.005		*0.005*	
UNEMP	-0.035**	-	-0.036**	-
	0.015		*0.014*	
POP	0.434**	0.470***	0.375***	0.377***
	0.123	*0.126*	*0.109*	*0.109*
TAX	0.004	-0.006	0.003	-0.007
	0.005	*0.006*	*0.005*	*0.006*
SUB	-0.008**	-0.010**	-0.008**	-0.009**
	0.003	*0.004*	*0.003*	*0.004*
MUNI	-0.004	0.001	-0.004	0.001
	0.005	*0.005*	*0.005*	*0.005*
REPUB	0.591***	0.765***	0.559***	0.702***
	0.173	*0.167*	*0.173*	*0.166*
FINDEV	-0.043	-0.083	-	-
	0.063	*0.067*		
FINOPEN	-	-	-0.034	0.001
			0.070	*0.073*
1995	-0.34***	-	-0.34***	-
	0.10		*0.1*	
1996	-0.46***	0.20***	-0.43***	0.20***
	0.13	*0.07*	*0.14*	*0.07*
1997	-0.48***	0.04	-0.45***	0.04
	0.12	*0.08*	*0.13*	*0.08*
Constant	-9.16	-13.36	-8.26	-12.04
No. Obs.	296	224	292	221
R-squared	0.41	0.41	0.40	0.40

* Significant at a 10 percent level. ** Significant at a 5 percent level.
*** Significant at a 1 percent level
Standard errors in italics.

Table 13
Random Effects Regressions of PIPC Including Financial Indices

Variable	1	2	3	4
GRPPC	-	1.176***	-	1.167***
		0.177		*0.178*
KSTOCK	0.069	-	0.068	-
	0.081		*0.082*	
INDUST	0.010	-	0.009	-
	0.010		*0.010*	
NATURE	0.002	-	0.002	-
	0.002		*0.002*	
INFRA	0.013	-	0.010	-
	0.036		*0.036*	
POVERTY	-0.009*	-	-0.008*	-
	0.005		*0.005*	
UNEMP	-0.040***	-	-0.040***	-
	0.015		*0.015*	
POP	0.334***	0.300**	0.400***	0.293***
	0.127	*0.124*	*0.112*	*0.106*
TAX	0.003	-0.002	0.003	-0.002
	0.005	*0.005*	*0.005*	*0.005*
SUB	-0.005	-0.007*	-0.005	-0.007*
	0.003	*0.004*	*0.003*	*0.004*
MUNI	-0.006	-0.000	-0.006	-0.000
	0.005	*0.005*	*0.005*	*0.005*
REPUB	0.686***	0.804***	0.700***	0.797***
	0.178	*0.164*	*0.177*	*0.162*
FINDEV	0.030	-0.007	-	-
	0.065	*0.065*		
FINOPEN	-	-	-0.011	0.009
			0.072	*0.071*
1995	-0.34***	-	-0.30***	-
	0.10		*0.10*	
1996	-0.42***	0.10	-0.54***	0.10
	0.14	*0.07*	*0.14*	*0.07*
1997	-0.45***	0.14**	-0.39***	0.15**
	0.13	*0.07*	*0.13*	*0.07*
Constant	-8.23	-9.67	-3.82	-9.56
No. Obs.	296	224	292	221
R-squared	0.40	0.50	0.45	0.50

* Significant at a 10 percent level. ** Significant at a 5 percent level.
*** Significant at a 1 percent level
Standard errors in italics.

Table 14
OLS Regressions of PIPC and PISHARE - Robust Standard Errors

Variable	PISHARE		PIPC	
	1	2	3	4
GRPPC	-	0.698***	-	1.189***
		0.176		*0.226*
KSTOCK	-0.024	-	0.038	-
	0.067		*0.077*	
INDUST	0.021*	-	0.023*	-
	0.012		*0.013*	
NATURE	0.000	-	0.001	-
	0.001		*0.001*	
INFRA	-0.010	-	-0.025	-
	0.043		*0.041*	
POVERTY	-0.001	-	-0.011	-
	0.006		*0.007*	
UNEMP	-0.050*	-	-0.060**	-
	0.027		*0.028*	
POP	0.381***	0.383***	0.351***	0.293**
	0.129	*0.124*	*0.124*	*0.114*
TAX	0.008	0.001	0.011*	0.003
	0.006	*0.008*	*0.005*	*0.006*
SUB	-0.007	-0.007	-0.004	-0.006
	0.005	*0.006*	*0.005*	*0.006*
MUNI	-0.002	0.001	-0.005	0.000
	0.004	*0.004*	*0.005*	*0.004*
REPUB	0.677***	0.719***	0.830***	0.824***
	0.163	*0.168*	*0.156*	*0.140*
1995	-0.23*	-	-0.17	-
	0.13		*0.11*	
1996	-0.50**	0.18**	-0.64***	0.09
	0.15	*0.07*	*0.17*	*0.07*
1997	-0.45**	0.05	-0.39**	0.17*
	0.18	*0.10*	*0.19*	*0.09*
Constant	-9.06	-12.26	-4.56	-9.91
No. Obs.	296	224	296	224
R-squared	0.42	0.40	0.47	0.50

* Significant at a 10 percent level
** Significant at a 5 percent level
*** Significant at a 1 percent level
Standard errors in italics.

Table 15
Summary Statistics of Private Investment Regression Variables

Variable	Mean	Std. Dev.	Min	Max
DOM	13.1	1.03	8.62	15.85
FDI	8.3	2.5	0	15.23
GRP	15.28	0.92	12.55	17.74
WAGE	5.32	0.24	4.37	6.1
INDUST	90.98	8.09	61.59	103.82
NATURE	102.27	53.66	0	274
ROAD	5.98	2.64	1	10
TELECOM	5.52	2.65	1	10
EDUC	31.94	7.64	6.09	77.56
RISK	0.95	0.4	0	2.21
PRIVATE	81.29	15.8	20.31	100
PLIB	84.41	8.69	30.88	96.14
CLIMATE	-10.4	6.29	-31.9	1.1
KM	2.25	2.76	0	11.88
JV	4.19	1.08	0.69	9

DOM - Log of domestic private investment in mns. rubles deflated by regional minimum subsistence wage (RMSW)
FDI - Log of foreign direct investment in thousands of US dollars
GRP - Log of gross regional product in mns of rubles deflated by RMSW
WAGE - Log of ratio of regional avg. nominal wage to RMSW
INDUST - Index of regional industrial strength (See Appendix B)
NATURE - Index of regional natural resource potential (Expert Institute, 1998
ROAD - Decile ranking of paved road density
TELECOM - Decile ranking of urban household connectivity
EDUC - Percentage of regional population with specialized secondary or higher education
RISK - Normalized index of regional political risk (Bank Austria, 1995, 1998)
PRIVATE - Percentage of trade and catering enterprises that are privately owned (Lavrov, 1997)
PLIB - Percentage of goods and service prices that are deregulated (Lavrov, 1997)
CLIMATE - Average January temperature, celsius
KM - Kilometers from Moscow (thousands)
JV - Log of the beginning-of-period number of regional joint ventures

Table 16
Correlation Coefficients of Private Investment Regression Variables

	DOM	FDI	GRP	WAGE	INDUST
DOM	1.00				
FDI	0.48	1.00			
GRP	0.94	0.50	1.00		
WAGE	0.41	0.26	0.43	1.00	
INDUST	0.05	0.14	0.01	-0.02	1.00
NATURE	0.21	0.05	0.14	0.38	0.16
ROAD	0.08	0.05	0.13	-0.31	-0.15
TELECOM	-0.04	0.26	-0.05	0.02	0.02
EDUC	0.01	0.29	0.01	0.17	0.06
RISK	-0.17	-0.36	-0.23	-0.15	0.00
PRIVATE	0.04	0.15	0.05	-0.09	-0.05
PLIB	0.02	-0.03	0.00	0.08	-0.02
CLIMATE	0.05	0.07	0.09	-0.26	-0.11
KM	-0.33	-0.03	-0.35	0.15	0.08
JV	0.55	0.61	0.60	0.23	0.02

	NATURE	ROAD	TELECOM	EDUC	RISK
NATURE	1.00				
ROAD	-0.65	1.00			
TELECOM	-0.24	0.14	1.00		
EDUC	-0.05	-0.16	0.33	1.00	
RISK	0.21	-0.10	-0.26	-0.35	1.00
PRIVATE	-0.31	0.12	-0.05	0.10	-0.13
PLIB	-0.01	-0.13	0.00	0.11	-0.12
CLIMATE	-0.49	0.69	0.20	-0.27	-0.15
KM	0.49	-0.67	-0.09	0.21	0.18
JV	-0.05	0.10	0.21	0.27	-0.29

	PRIVATE	PLIB	CLIMATE	KM	JV
PRIVATE	1.00				
PLIB	0.14	1.00			
CLIMATE	0.08	-0.02	1.00		
KM	-0.01	0.07	-0.71	1.00	
JV	0.11	0.03	0.13	-0.06	1.00

Table 17
Random Effects Results for Domestic Private Investment: 1995-1999

Variable	1	2	3	4
Sample	*Full*	*Full*	*Full*	*Ex-City*
GRP	1.04***	1.04***	0.99***	1.01***
	35.15	*30.44*	*26.78*	*23.78*
WAGE	-	-0.009	0.01	0.004
		0.07	*0.07*	*0.03*
INDUST	-	0.005	0.005	0.004
		0.99	*0.91*	*0.71*
NATURE	-	0.002**	0.002***	0.002**
		2.11	*2.91*	*2.49*
ROAD	-	0.006	-0.003	-0.002
		0.41	*0.19*	*0.11*
TELECOM	-	0.011	0.013	0.014
		1.11	*1.30*	*1.39*
EDUC	-	0.001	0.002	0.004
		0.13	*0.40*	*0.81*
RISK	-	0.083	0.089*	0.100*
		1.59	*1.73*	*1.89*
PRIVATE	-	0.001	0.003	0.002
		0.79	*1.41*	*1.39*
PLIB	-	0.004	0.004	0.003
		1.12	*1.18*	*1.20*
CLIMATE	-	-	-0.007	-0.006
			1.09	*-0.91*
KM	-	-	-0.046***	-0.04***
			2.78	*-2.40*
1996	0.15***	0.61	0.07	0.09
	3.4	*0.57*	*0.64*	*0.79*
1997	0.31***	0.62	0.06	0.08
	2.97	*0.73*	*0.77*	*0.98*
1998	0.20	-0.09	-0.08	-0.06
	0.45	*0.72*	*0.67*	*0.49*
1999	-0.8*	-0.16*	-0.16*	-0.15
	1.73	*1.67*	*1.70*	*1.51*
Constant	-2.88	-3.93	-3.44	-3.69
No. Obs.	343	343	343	333
R-squared	0.89	0.91	0.91	0.91

* Significant at a 10 percent level; ** Significant at a five percent level;
*** Significant at a one percent level.
T-statistics in italics.

Table 18

Random Effects Results for Foreign Direct Investment, 1995-1999

Variable	1	2	3	4	5
Sample	*Full*	*Full*	*Full*	*Full*	*Ex-City*
GRP	1.37***	1.24***	1.54***	0.85***	0.97***
	6.39	*5.45*	*6.47*	*2.90*	*3.21*
WAGE	-	-0.25	-0.28	-0.16	-0.31
		0.29	*0.34*	*0.21*	*0.38*
INDUST	-	0.009	0.016	0.018	0.017
		0.29	*0.54*	*0.64*	*0.58*
NATURE	-	0.007	0.003	0.007	0.005
		1.35	*0.60*	*1.40*	*0.99*
ROAD	-	0.037	0.038	0.056	0.078
		0.37	*0.36*	*0.56*	*0.77*
TELECOM	-	0.13**	0.11*	0.09	0.10
		2.04	*1.72*	*1.53*	*1.61*
EDUC	-	0.065**	0.067**	0.05*	0.06**
		2.53	*2.66*	*1.88*	*2.37*
RISK	-	-0.96***	-0.97***	-0.95***	-0.98***
		-3.22	*3.28*	*-3.28*	*3.29*
PRIVATE	-	0.024*	0.016	0.019*	0.018*
		1.92	*1.39*	*1.72*	*1.68*
PLIB	-	-0.026	-0.029	-0.027	-0.25
		1.18	*1.43*	*1.39*	*1.30*
CLIMATE	-	-	0.109**	0.060	0.064
			2.45	*0.37*	*1.46*
KM	-	-	0.334***	0.174	0.204*
			3.08	*1.57*	*1.82*
JV	-	-	-	0.706***	0.798***
				3.59	*3.84*
1996	0.43*	0.07	-0.15	-0.13	0.02
	1.73	*0.11*	*0.25*	*0.22*	*0.04*
1997	0.60**	0.37	0.11	0.14	0.32
	2.42	*0.77*	*0.23*	*0.29*	*0.65*
1998	0.67***	0.37	0.14	0.13	0.32
	2.73	*0.55*	*0.22*	*0.20*	*0.46*
1999	0.81***	0.53	0.54	0.53	0.49
	3.22	*0.96*	*1.02*	*0.99*	*0.87*
Constant	-10.49	-13.15	-7.26	-9.83	-11.73
No. Obs.	343	343	343	343	333
R-squared	0.25	0.42	0.47	0.51	0.46

* Significant at a 10 percent level; ** Significant at a five percent level;
*** Significant at a one percent level.
T-statistics in italics.

Table 19
Random Effects Results for Domestic Private Investment: Split Sample

Variable	1	2	3	4
Sample	*Full*	*Ex-City*	*Full*	*Ex-City*
Period	*95-97*	*95-97*	*98-99*	*98-99*
GRP	0.98***	1.00***	1.01***	1.041**
	24.56	*21.64*	*16.29*	*13.86*
WAGE	0.09	0.076	0.077	0.040
	0.66	*0.54*	*0.28*	*0.14*
INDUST	0.002	0.002	0.025*	0.023
	0.43	*0.38*	*1.65*	*1.47*
NATURE	0.002***	0.002**	0.002	0.002
	2.95	*2.56*	*1.41*	*1.13*
ROAD	0.015	0.016	-0.021	-0.019
	0.83	*0.87*	*0.79*	*0.72*
TELECOM	0.10	0.010	0.012	0.015
	0.81	*0.87*	*0.72*	*0.81*
EDUC	-0.00	0.002	0.005	0.008
	0.07	*0.34*	*0.82*	*1.03*
RISK	0.093	0.109	0.162	0.165
	0.92	*1.05*	*1.56*	*1.57*
PRIVATE	0.001	0.001	0.006**	0.006*
	0.36	*0.36*	*2.03*	*1.94*
PLIB	0.004	0.004	0.004	0.004
	1.1	*1.10*	*0.82*	*0.82*
CLIMATE	-0.008	-0.007	-0.003	-0.002
	1.12	*0.95*	*0.31*	*0.20*
KM	-0.035**	-0.031*	-0.061**	-0.056**
	-1.99	*1.67*	*2.32*	*2.00*
1996	0.13	0.13	-	-
	1.41	*1.40*		
1997	0.10	0.11	-	-
	1.42	*1.50*		
1999	-	-	0.04	0.02
			0.39	*0.26*
Constant	-3.38	-3.64	-6.52	-6.58
No. Obs.	207	201	136	132
R-squared	0.94	0.93	0.88	0.87

* Significant at a 10 percent level
** Significant at a 5 percent level
*** Significant at a 1 percent level
T-statistics in italics.

Table 20
Random Effects Results for Foreign Direct Investment, Split Sample

Variable	1	2	3	4
Sample	*Full*	*Ex-City*	*Full*	*Ex-City*
Period	*95-97*	*95-97*	*98-99*	*98-99*
GRP	1.27***	1.302***	0.26	0.408
	3.84	*3.81*	*0.60*	*0.94*
WAGE	-1.69*	-1.73*	1.92	1.61
	-1.95	*1.92*	*1.49*	*1.25*
INDUST	0.021	0.020	0.183**	0.171**
	0.78	*0.70*	*2.51*	*2.30*
NATURE	0.005	0.004	0.010	0.007
	0.84	*0.70*	*1.60*	*1.11*
ROAD	0.043	0.047	0.202	0.233*
	0.37	*0.40*	*1.62*	*1.89*
TELECOM	0.07	0.07	0.17**	0.18**
	0.96	*0.98*	*2.01*	*2.17*
EDUC	0.54*	0.061*	0.032	0.060*
	1.82	*1.80*	*1.02*	*1.74*
RISK	-1.55**	-1.485**	-0.725	-0.711
	2.33	*2.14*	*1.47*	*1.46*
PRIVATE	0.010	0.010	0.035**	0.033**
	0.81	*0.81*	*2.49*	*2.37*
PLIB	-0.019	-0.019	-0.036	-0.033
	0.88	*0.86*	*1.53*	*1.43*
CLIMATE	0.057	0.059	0.051	0.051
	1.16	*1.18*	*0.88*	*0.89*
KM	0.268**	0.276**	0.104	0.135
	2.09	*2.12*	*0.73*	*0.96*
JV	0.470**	0.502**	0.885***	1.107**
	2.12	*2.11*	*2.95*	*3.48*
1996	-0.50	-0.47	-	-
	0.97	*0.78*		
1997	0.09	0.12	-	-
	0.20	*0.26*		
1999	-	-	1.34**	1.35***
			2.96	*2.92*
Constant	-6.65	-7.28	-30.7	-31.97
No. Obs.	207	201	136	132
R-squared	0.54	0.47	0.56	0.54

* Significant at a 10 percent level; ** Significant at a five percent level;
*** Significant at a one percent level.
T-statistics in italics.

Table 21
Percentage Share of Total Domestic and Foreign Private Investment Received by the Cities of Moscow and St. Petersburg

Year	Domestic	FDI
1995	4.6	19.3
1996	4.5	15.6
1997	5.3	26.7
1998	7.6	10.5
1999	7.9	8.3

Table 22
OLS Results for Private Investment, Robust Standard Errors

Variable	1	2	3	4
Sample	Full	Ex-City	Full	Full
Years	1995-99	1995-99	1995-97	1998-99
GRP	0.955***	1.015***	0.991***	1.007***
	28.59	*25.00*	*26.32*	*15.06*
WAGE	0.082	0.078	0.143	0.009
	0.58	*0.53*	*1.02*	*0.04*
INDUST	0.012*	0.010*	0.010	0.023*
	1.95	*1.68*	*1.62*	*1.75*
NATURE	0.002**	0.002**	0.002***	0.002*
	2.57	*2.15*	*2.77*	*1.83*
ROAD	0.000	0.001	0.013	-0.017
	0.005	*0.071*	*0.66*	*0.59*
TELECOM	0.014	0.015	0.013	0.016
	1.38	*1.48*	*1.27*	*1.12*
EDUC	0.001	0.003	-0.002	0.004
	0.27	*0.004*	*0.50*	*0.76*
RISK	0.116*	0.129*	0.105	0.126
	1.88	*1.97*	*1.19*	*1.22*
PRIVATE	0.003	0.003	0.001	0.006*
	1.48	*1.43*	*0.60*	*1.99*
PLIB	0.004*	0.004*	0.004*	0.004
	1.79	*1.79*	*1.95*	*1.17*
CLIMATE	-0.007	-0.005	-0.007	-0.007
	0.97	*0.79*	*0.91*	*0.066*
KM	-0.043***	-0.038***	-0.032**	-0.060**
	3.19	*2.77*	*2.55*	*2.27*
1996	-0.03	-0.01	0.02	-
	0.28	*0.07*	*0.22*	
1997	-0.03	-0.00	0.01	-
	0.30	*0.04*	*0.08*	
1998	-0.23*	-0.21	-	-
	1.77	*1.52*		
1999	-0.28**	-0.26**	-	0.01
	2.46	*2.23*		*0.06*
Constant	-4.44	-4.69	-4.42	-5.77
No. Obs.	343	333	207	136
R-squared	0.91	0.91	0.94	0.88

* Significant at a 10 percent level
** Significant at a 5 percent level
*** Significant at a 1 percent level
T-statistics in italics.

Table 23

OLS Results for Foreign Direct Investment, Robust Standard Errors

Variable	1	2	3	4
Sample	Full	Ex-City	Full	Full
Years	1995-99	1995-99	1995-97	1998-99
GRP	0.733**	0.838***	1.099***	0.139
	2.32	*2.68*	*3.07*	*0.36*
WAGE	-0.223	-0.361	-1.310	1.959
	0.29	*0.46*	*1.51*	*1.52*
INDUST	0.069**	0.058*	0.031	0.267***
	2.36	*1.92*	*1.09*	*4.78*
NATURE	0.007	0.005	0.005	0.010*
	1.41	*1.03*	*0.086*	*1.72*
ROAD	0.110	0.129	0.065	0.224*
	1.03	*1.21*	*0.55*	*1.80*
TELECOM	0.141**	0.148**	0.119*	0.158*
	2.25	*2.38*	*1.72*	*1.82*
EDUC	0.030	0.051	0.032	0.025
	0.93	*1.48*	*1.06*	*0.74*
RISK	-1.041***	-0.972***	-1.512***	-0.813**
	3.28	*2.95*	*2.66*	*2.07*
PRIVATE	0.018**	0.018**	0.009	0.036***
	2.20	*2.09*	*0.87*	*3.20*
PLIB	-0.021	-0.019	-0.014	-0.034***
	1.02	*0.86*	*0.46*	*2.70*
CLIMATE	0.040	0.042	0.042	0.041
	0.91	*0.91*	*0.87*	*0.68*
KM	0.163	0.184	0.236*	0.098
	1.10	*1.17*	*1.70*	*0.58*
JV	0.784***	0.923***	0.620***	0.996***
	3.68	*4.18*	*2.66*	*3.71*
1996	-1.04*	-0.90	-0.66	-
	1.85	*1.55*	*1.19*	
1997	-0.62	-0.50	-0.13	-
	1.31	*1.03*	*0.29*	
1998	-0.98	-0.72	-	-
	1.37	*0.98*		
1999	-0.33	-0.08	-	1.78***
	0.57	*0.14*		*4.83*
Constant	-12.52	-13.87		-37.87
No. Obs.	343	333	207	136
R-squared	0.52	0.47	0.55	0.57

* Significant at a 10 percent level; ** Significant at a five percent level;
*** Significant at a one percent level.
T-statistics in italics.

Figure 1
Capital Investment and GDP in Russia, 1990-1999

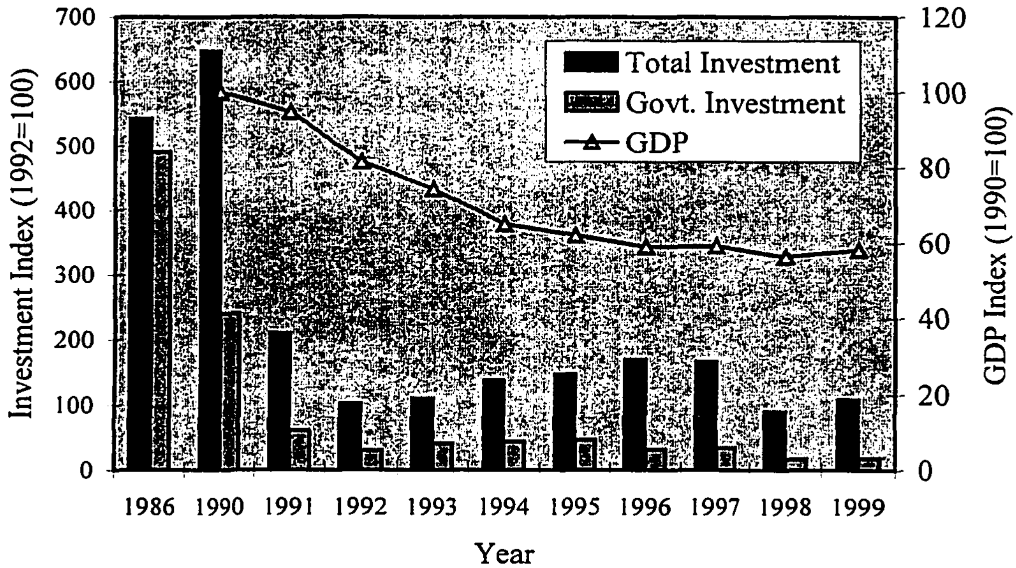


Figure 2
Russian Consumer Prices and Ruble/Dollar Rate

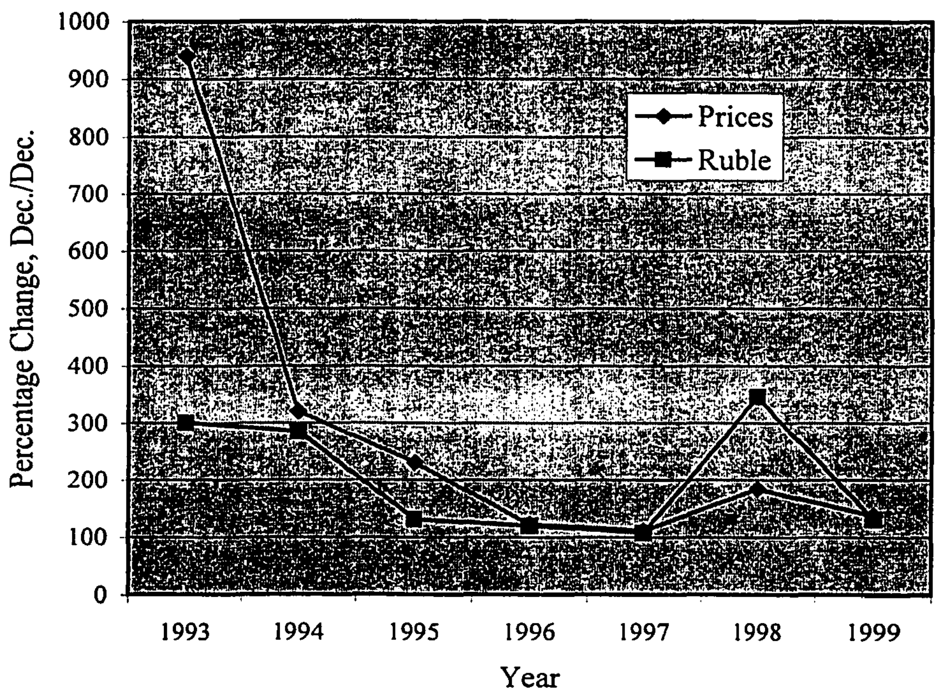
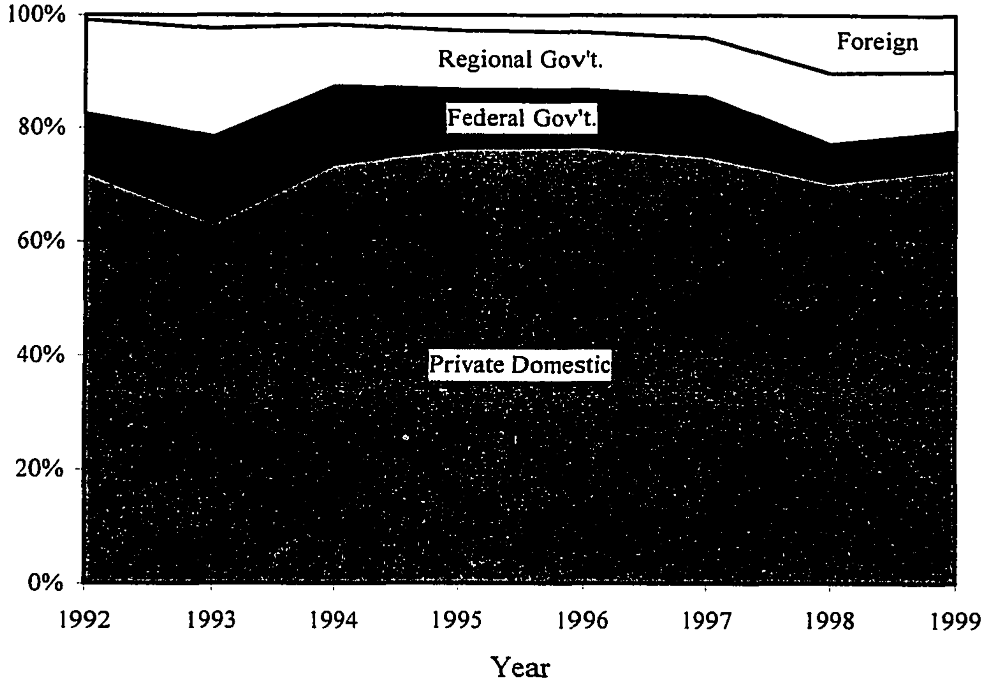


Figure 3
Shares of Total Investment in Fixed Capital, 1992-1999



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