ECONSTOR
Make Your Publications Visible.

A Service of
ZBW
Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Kolomak, Evgeniya

Conference Paper

Infrastructure Capital in Russia: Effects On Economic Growth

50th Congress of the European Regional Science Association: "Sustainable Regional Growth and Development in the Creative Knowledge Economy", 19-23 August 2010, Jönköping, Sweden

Provided in Cooperation with:
European Regional Science Association (ERSA)

Suggested Citation: Kolomak, Evgeniya (2010) : Infrastructure Capital in Russia: Effects On Economic Growth, 50th Congress of the European Regional Science Association: "Sustainable Regional Growth and Development in the Creative Knowledge Economy", 19-23 August 2010, Jönköping, Sweden, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:
https://hdl.handle.net/10419/118888

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

WWW.ECONSTOR.EU

Mitglied der Leibniz-Gemeinschaft

Infrastructure Capital in Russia: Effects On Economic Growth

Evgeniya Kolomak

Introduction

Infrastructure capital is one of important determinants of economic performance, productivity growth, and standards of life. There are many studies where this fact is confirmed empirically and theoretically. However Russia still lags behind many of developed countries in physical and institutional infrastructure elements, infrastructure remains underdeveloped in Russia (Annex, Tables 1 – 3) especially in terms of quality.

Decisions on infrastructure investment usually involve comparison of all costs and benefits of the projects. One of the major problems of the approach is benefit externalities, which have essential spatial dimension in the case of infrastructure. Quality of assessment of infrastructure shortage depends on correct estimates of infrastructure benefit including generated spillovers.

Due to public properties and to high cost infrastructure projects are very often initiated by a government. Identification of shortage of infrastructure and of size of infrastructure investments is usually political decision of governments. Russia is a federal state and the government is decentralized, it consists of several levels (national, sub-federal and local) and they provide different public goods and services and have different scope for making decision how different types of infrastructure to be financed. Optimal institutional structure is one where internalization of the interregional spillovers is the most.

Objectives of the paper are to estimate contributions of different categories of infrastructure into economic performance, distinguishing between internal effects and spatial spillovers. Tested hypotheses are as follows:

Hypothesis 1. Infrastructure is an important factor of productivity growth in Russia.

Hypothesis 2. Infrastructure generates spatial spillovers across regions.

Review of literature

There is a widespread recognition that physical and institutional infrastructure reduces transaction costs (communication, transportation and information) and increases growth, average productivity and efficiency in the economy. A number of studies have established this link. Aushauer (1989) found that transport infrastructure had significant positive effects on the aggregate factor productivity in the United States. Norton (1992) showed that cross-country differences in the growth of GDP per capita are related to the telecommunication infrastructure. Nadiri and Mamuneas (1994) and Morrison and Schwartz (1996) confirmed that infrastructure capital provided significant return to manufacturing firms and augments productivity growth in the U.S. Aghion and Schankerman (1999) showed that infrastructure contributes to a better functioning of markets, improving selection of efficient firms and changing incentives for restructuring. Holtz-Eakin and Lovely have not found direct effects of public infrastructure on output, but have got evidence to suggest a positive impact of public capital on manufacturing variety. Martin and Rogers (1995) and Rietveld (1995) concluded that certain infrastructure endowment may increase regional disparities. However some authors (Straub, Vellutini, and Warlters, 2008) failed to find a significant link between infrastructure, productivity and growth in East Asia.

Regional models relating to infrastructure productivity at national and sub-national levels produced different results of econometric estimations. This fact led several researchers (Holtz-Eakin and Schwartz 1995; Kelejian and Robinson 1997; and Boarnet 1998) to the conclusion that there are spillover effects resulting in underestimating (or overestimating in a case of negative externalities) the benefits generated by public infrastructure when regional data is used, due to the benefits are not confined to the regional boundaries. These authors have found that the infrastructure spillovers across states are negative or insignificant. Moreno and Lopez-Bazo (2007) tested dependence of spillovers and effects of infrastructure on the type of public capital: local and transportation. They revealed, firstly, that returns to local public capital have been higher than those to transport infrastructure and, secondly, that spillover effects of transport infrastructure is negative while externalities of local infrastructure are insignificant. Owyong and Thangavely (2001) tested spillover effects of public capital across two countries, the estimations has shown positive spillovers from United States capital to Canadian productivity. Cohen and Monaco (2008) assess contribution of transportation infrastructure in production, costs and employment in the manufacturing sector of the USA, the authors have found that investments in ports infrastructure decreases manufacturing costs of local producers, however in the neighboring states manufacturing firms experiences higher costs.

The paper relies on the main findings of the previous studies. We estimate contribution of public infrastructure to productivity in Russian region and pay special attention to spatial impact of the infrastructure. We assume that effects and spatial spillovers of the infrastructure depend on type of public capital. Different categories of infrastructure may have different impact on productivity, since their purposes are different and their relationships with territory are not similar. To confirm the assumption we, firstly, consider functionally different categories of infrastructure and, secondly, estimate spatial spillovers across Russian regions.

Model specification

Theoretical model

The basic idea of econometric estimates of public capital impact on productivity is to expand a production function $Q = AF(K, L)$ including infrastructure capital stock $Q = AF(K, L, G)$. Where A is total factor productivity, F – stock of private capital, L – labor force and G – stock of public capital. We examine k different categories of public capital and the production function is written as $Q = AF(K, L, G_1, G_2, \dots, G_k)$. Using the log-linear Cobb-Douglas form gives empirical model as follows:

$$lnQ = lnA + alnK + blnL + \sum_{s=1}^{k} c_s lnG_s + \varepsilon,\ \ \varepsilon \sim N(0, \sigma^2 I)$$

We assume existence of spatial spillovers of the infrastructure elements. The dependence of regional productivity on public capital of neighboring regions expands the model:

$$lnQ = lnA + alnK + blnL + \sum_{s=1}^{k} c_s lnG_s + \sum_{s=1}^{k} \rho_s W \cdot lnG_s + \varepsilon$$

W is spatial weights matrix and $\rho_s W \cdot lnG_s$ is a spatial lag component.

Spatial weights matrix (W) is determined exogenously. The elements of the matrix are commonly reflecting measure of distance between units of observations typically based on geographic criteria. The most common weights matrix is the binary contiguity matrix, where the individual elements w_{ij} are set equal to unity if observations i and j ($i \neq j$) share a common border and are set to zero otherwise. This specification assumes that all neighboring regions have equal influence and there are no spatial correlations beyond common-border neighbors. Another approach is to determine w_{ij} as follows:

$$w_{ij}(q) = \begin{cases} 0 & if \quad i = j \\ 1/d_{ij} & if \quad i \neq j \end{cases}$$

Where d_{ij} – distance between regional centers. Elements of spatial weights matrix are analogies of gravitation coefficients.

The first hypothesis of the project implies that $c_s>0$. Confirmation of the second hypothesis means statistical significance of ρ_s (positive or negative). If is positive ρ_s than effects of interregional cooperation dominate, if ρ_s is negative it means that effects of interregional competition prevail.

Data

There are several approaches to the definition and measures of infrastructure capital in literature. One of them is estimation of natural monopolies capital: transportation and communication facilities; most of these systems are owned publicly however allow private ownership. Another approach is to include capital stock of public sector only. The broader definition includes human capital investments and R&D capital.

In the paper we measure stock of the traditional infrastructure sectors: railways, paved roads and communication. List of the suggested elements, units of measure, source of data and covered period are shown in the table below.

Table 1. Data

Category	Measures	Source of data	Covered period
Railways	Kilometers	Federal state statistics service	1995 - 2008
Paved roads	Kilometers	Federal state statistics service	1995 – 2008
Communication: terminals of mobile communication Number of computers having access to Internet	 Number Number	Federal state statistics service	 1999 - 2008 2003 – 2008

Estimation results and conclusions

Estimation

Infrastructure capital is a public good however its effects can be distributed uneven among different sectors of economic activity. To take this fact into account the estimations can be done for alternative production functions focusing on gross regional product or on manufacturing and mining sector only.

Another problem is exogenous determination of the spatial weights matrix. The guidance in the choice of the spatial weights is that the spatial weights matrix should reflect the suspected spatial correlation structure of the data. To identify the suitable one Moran’s I statistic were estimated for two spatial weights matrix: the binary contiguity matrix and the distance matrix. The testing showed that the binary contiguity matrix corresponds to the spatial dependence pattern better (Appendix 2).

Apart from the spatial dimension there is problem of endogeneity, absence of progress in infrastructure capital can reduce economic growth, however growth of output determine the demand for infrastructure. The endogeneity poses question of instrumental variables; one of the recommendation on the selection of the instruments is to use lagged variables.

The strategy of the estimates was to run set of regressions including different formulation of dependent variable: gross regional product and industrial and mining sector. The results of the estimates are following (Table 2). While the communication infrastructure contributes to the productivity growth, the transport infrastructure does not have significant positive effect on the economic activity. Evidence on the spatial externalities of the infrastructure are limited to effect of Internet on manufacturing sector only.

Table 2. Estimates of the model

Variable	Coefficient	P-value	Coefficient	P-value
	Gross regional product per capita		Labor productivity in the manufacturing and mining sector	
Private capital per capita	**0,686**	**0,000**	**0,476**	**0,000**
Paved roads per capita	0,009	0,867	0,041	0,592
Railways per capita	-0,066	0,725	-0,162	0,392
Mobile phones per capita	**0,087**	**0,000**	**0,082**	**0,000**
Computers and Internet per capita	**0,126**	**0,000**	**0,240**	**0,000**
Spatial spillovers of paved roads	0,038	0,071	-0,053	0,104
Spatial spillovers of railways	-0,058	0,489	-0,117	0,166
Spatial spillovers of mobile communication	0,006	0,098	0,004	0,440
Spatial spillovers of Internet	0,008	0,518	**0,040**	**0,010**

Transport infrastructure is a sector where government decision-making and regulation are dominated, decisions are based on political influence (lobbing and coalition agreements) and may lead to distortions in infrastructure provision. Other explanations of the insignificant link between transport infrastructure and productivity are low level of management, unreliability and quality of service. To test these arguments natural measures of transport infrastructure usage were added into regression instead of available paved roads and railways. The estimates (Table 3) confirm the suggested reasons, the new variables are positive and statistically significant for the productivity.

Table 3. Estimates of the modified model with variable of transport infrastructure usage

Variable	Coefficient	P-value	Coefficient	P-value
	Gross regional product per capita		Labor productivity in the manufacturing and mining sector	
Private capital per capita	**0,701**	**0,000**	**0,524**	**0,000**
Turnover of automobile transport	**0,081**	**0,001**	**0,081**	**0,045**
Goods delivered by railways	**0,175**	**0,012**	**0,204**	**0,040**
Mobile phones per capita	**0,077**	**0,000**	**0,072**	**0,001**
Computers and Internet per capita	**0,144**	**0,000**	**0,249**	**0,000**
Spatial spillovers of paved roads	0,015	0,203	-0,02	0,900
Spatial spillovers of railways	0,020	0,574	0,025	0,602
Spatial spillovers of mobile communication	0,003	0,534	0,002	0,794
Spatial spillovers of Internet	0,014	0,193	0,023	0,112

Conclusion

Our estimates indicate that that transport infrastructure does not contribute to productivity growth in Russia. The proposed explanations are quality of management, state regulation and governance. Impact of communication infrastructure on economic growth is positive and significant, probably due to more active technological innovations, more efficient work organization in the sector and less involvement of government.

Absence of the spatial spillovers shows that decision-making and corresponding financial resources dealing with the considered infrastructure elements can be transferred from the federal level to the sub-federal one. However we observe the opposite tendency in Russia (Appendix 3).

Bibliography

Aghion P., and M. Schankerman (1999) Competition, Entry and the Social Returns to Infrastructure in Transition Economies. *The Economics of Transition*, 7, pp. 79 – 101.

Anselin, L. (1988) *Spatial econometrics: Methods and models*. Dordrecht, the Netherlands: Kluwer Academic Publishers

Aushauer D. (1989) Is Public Expenditure Productive? *Journal of Money, Credit and Banking*, 23, pp. 177 – 200.

Cohen J., and K. Monaco (2008) Ports and Highways Infrastructure. An Analysis of Intra- and Interstate Spillovers. *International Regional Science Review*, 31, pp. 257 – 274.

Holtz-Eakin H, and M. E. Lovely (1996) Scale Economies, Returns to Variety, and the Productivity of Public Infrastructure. Regional Science and Urban Economics, 26, pp. 105 – 123.

Martin P., and C.A.Rogers (1995) Industrial Location and Public Infrastructure, *Journal of International Economics*, 39, pp. 335 - 351

Moreno R, and E. Lopez-Bazo (2007) Returns to Local and Transport Infrastructure under Regional Spillovers, *International Regional Science Review*, 30, pp. 47 – 71.

Morrison C.J., and A.E.Schwartz (1996) State Infrastructure and Productive Performance. *American Economic Review*, 86, pp. 1095 – 1111

Norton S. (1992) Transaction costs, Telecommunications and the Microeconomics of Macroeconomic Growth. *Economic Development and Cultural Change*, 40, pp.175 – 196.

Nadiri I, and T. Mamuneas (1994) The Effects of Public Infrastructure and R&D Capital on the Cost Structure and Performance of U.S. Manufacturing Industries. *The Review of Economics and Statistics*, LXXVI, pp. 189 - 198

Owyong D.T., and S.M.Thangavely (2001) An Empirical Study on Public Capital Spillovers from the USA to Canada, *Applied Economics*, 33, 1493 – 1499.

Rietveld P. (1995) Infrastructure and Spatial Economic Development, *Annals of Regional Science*, 29, 117 – 119

Straub S., Vellutini C., and M.Warlters (2008) Infrastructure and Economic Growth in East Asia, *The World Bank*. Policy Research Working Paper N 4589.

Appendix 1

Table 1. *Transport infrastructure*

	Railway infrastructure		Highway infrastructure	
	Year	Density of railways, km per 1000 km^2 of territory	Year	Density of highways, km per 1000 km^2 of territory
Russia	***2007***	***5,0***	***2007***	***36,5***
Europe				
Austria	2006	69,3	2005	1276
Belgium	2006	115,0	2005	4986
Germany	2006	95,6	2004	1805
Denmark	2006	46,8	2005	1677
Ireland	2006	27,4	2005	1321
Spain	2005	28,5	2004	326,4
Italy	2006	54,6	2002	2219
Netherlands	2006	67,7	2005	3232
Norway	2006	12,5	2005	287,7
Finland	2006	17,4	2003	956,7
France	2006	53,5	2005	1824
Switzerland	2006	81,2	2005	1727
Sweden	2006	22,1	2005	945,4
Asia				
China	2006	6,6	2003	188,5
Republic Korea	2006	34,3	2003	977,8
Turkey	2006	11,2	2005	450,9
Japan	2006	53,0	2005	3157
America				
Canada	2005	5,8	1999	90,5
Mexico	2004	13,6	2002	172,2
USA	2004	24,0	2003	676,6

Table 2. *Communication infrastructure, 2007*

	Number of telephone apparatus of common use per 100 people	Number of mobile phone users per 1000 people	Number of Internet servers per 100 people
Russia	***31,8***	***1206***	***0,6***
Europe			
Austria	40,4	1168	15,7
Belgium	45,2	926	2,3
Germany	65,1	1176	3,7
Denmark	51,9	1147	25,8
Ireland	49,1	1149	4,2
Spain	42,0	1102	2,2
Italy	*46,3*	1351	2,8
Netherlands	44,7	1059	33,3
Norway	44,3	1162	19,0
Finland	33,0	1152	22,2
France	55,8	898	3,9
Switzerland	66,8	1082	10,3
Sweden	59,5	1059	14,7
Asia			
China	*27,5*	412	*0,01*
Republic Korea	48,3	902	11,3
Turkey	24,6	828	0,7
Japan	*35,8*	786	12,9
America			
Canada	64,5	576	11,1
Mexico	18,5	641	1,5
USA	57,2	835	66,5

Table 3. *Public utilities*

	Year	Percentage of houses equipped by central		
		water supply	sewerage system	heating system
Russia	***2007***	***76***	***72***	***81***
Europe				
Austria	2003	99,9	99,2	89,8
Belgium	1991	99,6	91,9	60,1
Germany	1998	…	…	86,9
Denmark	2003	…	98,2	98,6
Ireland	2002	97,0	96,0	59,0
Spain	1991	99,3	97,2	…
Italy	1991	99,0	98,8	26,4
Netherlands	1998	…	…	86,3
Finland	2004	98,4	96,0	92,6
France	1999			82,8
Sweden	2004	100	100	100
Asia				
Japan	2003	…	…	88,4
America				
USA	2003	99,2	99,7	88,9

Appendix 2

Table 1. Binary contiguity matrix, Moran's I statistic.

Year	Gross regional product				Manufacturing and mining sector			
	I	E(I)	z	p-value	I	E(I)	z	p-value
1995	0.152	-0.013	2.763	0.003	0.251	-0.013	4.163	0.000
1996	0.422	-0.013	6.427	0.000	0.267	-0.013	4.117	0.000
1997	0.432	-0.013	6.521	0.000	0.278	-0.013	4.647	0.000
1998	0.408	-0.013	6.107	0.000	0.286	-0.013	4.537	0.000
1999	0.333	-0.013	4.983	0.000	0.281	-0.013	4.398	0.000
2000	0.162	-0.013	2.639	0.004	0.275	-0.013	4.327	0.000
2001	0.175	-0.013	2.833	0.002	0.267	-0.013	4.116	0.000
2002	0.154	-0.013	2.523	0.006	0.255	-0.013	3.954	0.000
2003	0.138	-0.013	2.284	0.011	0.218	-0.013	3.431	0.000
2004	0.133	-0.013	2.243	0.012	0.180	-0.013	2.952	0.002
2005	0.133	-0.013	2.284	0.011	0.263	-0.013	4.630	0.000
2006	0.147	-0.013	2.478	0.007	0.255	-0.013	4.445	0.000
2007	0.154	-0.013	2.522	0.006	0.192	-0.013	3.126	0.001

Table 2. Distance matrix, Moran's I statistic.

Year	Gross regional product				Manufacturing and mining sector			
	I	E(I)	z	p-value	I	E(I)	z	p-value
1995	0.183	-0.013	1.000	0.159	0.281	-0.013	1.413	0.079
1996	0.312	-0.013	1.475	0.070	0.296	-0.013	1.420	0.078
1997	0.217	-0.013	1.032	0.151	0.373	-0.013	1.890	0.029
1998	0.249	-0.013	1.161	0.123	0.229	-0.013	1.119	0.132
1999	0.202	-0.013	0.940	0.174	0.158	-0.013	0.777	0.218
2000	0.101	-0.013	0.520	0.302	0.109	-0.013	0.556	0.289
2001	0.129	-0.013	0.655	0.256	0.187	-0.013	0.888	0.187
2002	0.180	-0.013	0.902	0.184	0.232	-0.013	1.097	0.136
2003	0.184	-0.013	0.926	0.177	0.242	-0.013	1.147	0.126
2004	0.162	-0.013	0.818	0.207	0.225	-0.013	1.103	0.135
2005	0.178	-0.013	0.904	0.183	0.245	-0.013	1.306	0.096
2006	0.232	-0.013	1.155	0.124	0.233	-0.013	1.231	0.109
2007	0.181	-0.013	0.900	0.181	0.295	-0.013	1.420	0.078

Appendix 3

Distribution of budget expenditures

	Federal Budget	Consolidated Sub-federal Budgets
	2005	
Transport	16,8	83,2
Communication and IT	31,2	68,8
Public utilities	1,5	98,5
	2006	
Transport	32,1	67,9
Communication and IT	30,0	70,0
Public utilities	8,3	91,7
	2007	
Transport	29,7	70,3
Communication and IT	38,3	61,7
Public utilities	26,7	73,3