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# Benevolent regional government

## Who does benefit from it?

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What agglomeration factors have influence on the spatial structure of investment in Russia? What role does federal and local governments play in that? Whether does the government promote engaging the investments and, first of all, private investments, in the Russian regions? Except for the direct government investment in the economy of regions the government can influence the other agglomeration factors, capable to change an investment situation. The government can improve an investment climate in region, to generate positive expectations and to make region more attractive to the private investors. What levers is for that used? In the research we attempt to give the answers to these problems.

**Keywords.** Russia, capital, investment, agglomeration, expectations, production concentration, regions.

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# CONTENTS

## NON-TECHNICAL SUMMARY

Both regional, and the federal government have a wide spectrum of measures capable to attract the investment in the economy of regions. Except for the direct investment in the economy of region, the government can to change an investment situation influencing on the agglomeration factors.

The basic purpose is to investigate the impact of the regulating factors of regional policy on distribution of investment over regions under spatial concentration of production in view of expectations of investors.

For realization of the said object we have developed the econometric model pattern of joint dynamics of expected profitability and investments, and have modified the theoretical agglomeration model for the analysis of spatial distribution of the capital. A role of an infrastructure, regional expenditures on public account and expectations of the investors in attracting the investments are tested; the sentences in the field of forming policy of development of regions under concentration are developed.

The agglomeration theory of new economic geography is the theoretical base for the analysis. The following hypotheses were checked: whether interregional economic and investment policy of government does connected to using of the agglomeration mechanisms? What the agglomeration factors does affect on the spatial concentration process and forming of a favorable investment climate in region?

The effects of benevolent regional government on structure of market equilibrium states have been analyzed within the framework of modification of the footloose capital model proposed by the author. In particular, it has been found that under decreasing of transport costs the boundary of internal equilibrium stability, as well as the boundaries of upper and lower overlapping, from which the core-periphery outcomes are accessible, are narrows. On the contrary, the development of infrastructure in region extends boundaries of interior equilibrium stability and overlapping.

The regional government must to attract the capital in region for deriving the rent. The appeal of region to the investor will depend on magnitude of external economies, which is defined by 1) external economies originating from development of an infrastructure in region and 2) rate of the rent, which the regional government appropriates, diminishing thereby income on the capital. The regional government interested in deriving of the income, will not only try to increase the rental rate, but also to attract the capital for job in region through development of infrastructure and magnification of external economies on the capital. The mentioned about infrastructure is both industrial, and social, which ensures increase of external economies. Under weakly developed infrastructure even the benevolent government cannot keep the capital. If the region is highly advanced also magnitude of exterior economies rather high, at average or even at high magnitude of the regional rent rate the concentration of production and investment in region is possible under non-benevolence government. The uniform distribution of investment over regions is possible at average level of infrastruc-

ture development under condition that non-benevolent regional government, and, hence the rate of the rent, does not exceed some critical value.

The hypotheses, which we have checked in the econometric part, concerned the impact of expected yield on arrangement of investment over regions of Russian Federation; effects of territorial concentration of production; the industrial and social infrastructure providing exterior economies; the role of government in development of regions and other.

The author has offered the econometric model founded on estimation of investment in region depending on expected yield and the agglomeration factors. The model reflects joint dynamics of investment and expected yield. The models of total investment and investment of a different pattern of ownership (state, municipal, private and mixed), investment in a fixed capital of organizations including the foreign capital and investment in branch of the economy (industry; transport; agriculture; construction; connection; trade, public catering and wholesale by production of technological assigning; education and public health services) are estimated. The model is tested on the Russian data. The econometric estimation of the model has allowed to investigate the effects of federal and regional governments policy on volumes of attracted investment in regions of Russia. It is found that the agglomeration factors and the processes of concentration essentially influence spatial structure of investment in Russian Federation. Therefore, they are necessary for taking into account under formation of interregional socio-economic and investment policy. The significant instruments of influence of government on spatial investment structure are detected. So the forming of home market and development of investment and social infrastructure promotes a growth return on investment and external economies. So, it was found that conducting interregional investment policy and using accessible instruments, the state could influence growth of investment appeal and inflow of the investments in regions.

# 1. INTRODUCTION

## 1.1. Political context of study

Both regional, and the federal governments have a wide spectrum of measures, capable to attract the investments in the economy of regions. Among of the accessible tools there are both direct, and indirect measures inducing investment. Besides government can realize investment itself. Promoting development of the Russian regions, it attracts the additional investment and, first of all, capital of private investors. Except for the direct investment in the economy of region, the government can use the agglomeration factors to change an investment situation.

The investigations of agglomeration process in the Russian Federation display that the process of concentration and expectation of owners of production factors essentially influence the location (Лапо, 2004б, в; 2005). The specificity of process of spatial concentration in the Russian Federation is those, that the leading role in this process belongs to moving of capital, while the owners of the capital, as well as working population, remain immobile (Лапо, 2003). The theoretical analysis of the agglomeration process displays that the government, improving an investment climate in region, can create the positive expectations, make region more attractive to the private investors (Лапо 2004б, 2005).

## 1.2. Statement of the research problem

The theoretical base of analysis is the agglomeration theory of new economic geography (NEG). Among the basic advantages of spatial concentration of production it are considered, as a rule: external economies, growth of the intra-regional markets, the agglomeration effects. The appearance of agglomerations is connected with the advantage of infrastructure development, with the higher level of the public goods allotment, with higher living standards.

The government can attract the investment in regions, using mechanisms of agglomeration and production concentration, developing infrastructure, transportation network, conditions promoting to growth of the economy, forming positive expectations concerning yield on investment located in region and growth of production concentration. In that studies the influence of economic and investment policy of the federal and regional governments on processes of spatial concentration of production in Russia is tested. The hypothesis, which has been verified, is whether the interregional economic and investment policy of government connected to using of agglomeration tools? Which the agglomeration factor affect process of spatial concentration and form the favorable investment climate in region?

The future of the Russian economy in many respects depends on the tendencies of spatial concentration, which have developed during transformation. Agglomeration gives the rent to the participants of production, which retains the factors on the territory of region (Baldwin, Krugman, 2002). If the spatial concentration of production has taken place, and its advantages were already exhibited,

then effort on modification of territorial disproportions and attempts to help to depressive and underdeveloped regions can be rather expensive or ineffective Therefore, measures on adjusting territorial structure of the economy necessary to realize already now. The perspective interregional economic and investment policy should be developed with accounting for agglomeration process.

### 1.3. Objectives of the study

The basic purpose is to investigate influence of the factors of regional regulating policy on spatial distribution of investment over regions under spatial concentration of production.

The author has proposed the econometric model and modification of the agglomeration theoretical model in order to analyze the spatial distribution of investment in frameworks of the agglomeration approach. The role of infrastructure, regional budgetary expenditures and the investor's expectations in regional investment policy are tested; the sentences in the field of regional development policy under concentration are developed.

## 2. THE THEORETICAL BASIS OF RESEARCH

### 2.1. Review of literature

There are a lot of papers devoted to the problem of industrial agglomeration: Krugman (1991a, b, c), Matsuyama (1991), Venables (1996), Fujita, Krugman, Venables (1998), Krugman, Venables (1995, 1996), Puga (1998), Martin, Ottaviano (1996, 1998), Baldwin (1998), Baldwin *et al*. (2003), Markusen, Venables (1997) *etc*. The most closed to the Russian reality is the scheme of capital relocation between regions offered in (Martin, Rodgers, 1995). In the model the labour is spatially immobile as well as owners of the capital. Capital is only mobile. The post-tax capital income is repatriated from regions and spent on markets of the other regions. Therefore the owner accepts the solution about the location of the capital basing on comparison of the nominal post-tax income.

Unlike the Martin–Rodgers model, in the model of Lapo (Лапо, 2004a, 2005) the inter- and intra-regional trade costs are equal. In jobs of Lapo (Лапо, 2004a, 2005) the analyses is extended by the expense of research of infrastructure, which ensures external economies in region. The factor of infrastructure essentially influences a system of equilibrium outcomes and changes a picture of possible equilibrium state in a long-term solution.

The impact of expectations is investigated in (Krugman, 1991b, c), (Matsuyama, 1991), (Baldwin, 1999). It was proved that under certain conditions the expectations could create self-fulfilling agglomeration process and lead the economy to a new local equilibrium.

Concerning a role of expectations of economic agents in agglomeration processes, it is necessary to say the following. Still Marshall has shown that the resources move in a direction been determined by gap in current return. The speed of resources moving is defined by costs of relocation. If not only

current profitability is significant, but also the expected one, then it is connected to solutions of other individuals about location, and to their expectations of the future return. If the expectations of different individuals coincide, there is a new sort of externalities and, therefore, at least a potentially exists a possibility of self-fulfilling expectations.

The expectation influence has been accounted under development of the agglomeration model. Examining a role of benevolent government in forming of spatial structure of investment in country, we have attempted to determine by econometrics, which tools are used by the federal and the regional government to engage the investment in regions. One of problems is to find, whether the government creates a condition for converging positive expectations of majority of investors concerning the economy of regions. The methodology of expectations research in the greater degree have based on the approach offered by the author and described in (Лапо, 2004б).

### 2.2. Theoretical model

**Description of the model**. The footloose-capital model (FC-model) of Martin and Rodgers (1995), and Baldwin *et al*. (2003) and its modification proposed by author and described in Lapo (2004a, 2005) have been used as basis of development of the model. Let's expose the last modification briefly.

In contrary to Martin and Rodgers (1995), which studied a problem of infrastructure influence through the transport costs and their differentiation in intra-regional and interregional trade, the following basic modifications proposed in (Lapo 2004a, 2005) are realized: the transport costs are identical both at intra-regional and at interregional transportation; the external economies arise not in transporting, but in production of goods; the external economies influence not the transport costs, but the return on the capital; the appearance of external economies is connected to development of public infrastructure in region.

Capital is considered in the model as the mobile production factor. For the goods of monopolistic competition the transport costs of transition between regions are specified. The advantages of infrastructure development, such as the external economies and growth of return on capital, are received by its owners, which immobile.

The modeling of infrastructure and its influence on profitability of invested capital is the new moment in the model. The basic outcomes demonstrate the analysis of agglomeration effects as interaction of transport costs and external economies originating from the infrastructure.

The model includes two regions: east (region 1) and western (region 2); two factors of production — labor $L$ and capital $K$, which volume in country is limited; two sectors — industrial producing the goods with increasing return $M$, and sector with a constant return producing the public goods $Z$. The infrastructure is a public good. A labor is mobile between sectors, but immobile over regions. The capital is unique spatially mobile factor of production, while the owners of the capital remain immobile. However income on the capital is repatriated in regions, where the residents — owners of the capital live.

The regions in the model are symmetric respectively tastes and production technologies. The industry is a sector of monopolistic competition of Dixit–Stiglitz type. The industrial sector made the goods, which can be sold in the markets of both regions, the transport costs are assumed of iceberg type.

All tax incomes are putted in regions. The infrastructure gives the public benefit and is a free resource for owners of capital, thereby it increases return on capital and is a source of external economies. The investors of industrial sector consider the public good as the given magnitude, which is not depending on their will and solutions. The technology in industry is presented by the following function, ensuring increasing return to scale:

$$\pi_j F + w_L a_M x_j = \pi_j f\left(K_j\right) f\left(z_j\right) + w_L a_M x_j, \qquad j = 1, 2, \tag{2.1}$$

where $a_M$ is an amount of labour units per unit of the output, it is equal for both regions, $f(K)$ is the required volume of the capital, $f(z)$ is the function, which determines the size of external economies, $j$ — index of region. We normalize the level of infrastructure development in region 2 (West), let $f\left(z_2\right) \equiv 1$ then $f\left(z_1\right) / f\left(z_2\right) = f\left(z\right)$ is the relative level of infrastructure development in East, $\pi_j$ is the rate of income on the capital; $w_L$ is rate of wages; $x_j$ is volume of issue of manufactured goods (variations), $x_j$ defines a size of firm under condition that one firm produces one type of goods. Including $f\left(z\right)$ in function (2.1) means that the capital obtains advantages of external economies from development of infrastructure in region, therefore the real return rate to the capital with account of infrastructure development in region is equal: $\pi_1 f\left(z\right) = \overline{\pi}_1$, $\pi_2 = \overline{\pi}_2$.

The share of variations produced in East is equal to $d_n = \left(K_1 f\left(z\right)\right) \Big/ \left(K_1 f\left(z\right) + K_2\right)$, and in West is $1 - d_n = K_2 \Big/ \left(K_1 f\left(z\right) + K_2\right)$. The share of the capital determines the spatial structure of industrial production therefore basic our attention is directed on problems of the spatial arrangement of the capital.

The following suggestions of model are concern of public goods production. The public good $Z$ makes with a constant return, the $a_Z$ units of labour are required to produce one unit of infrastructure: $Z = a_Z w_L x_Z$, here $w_L$ is rate of wages. The public good can be removed between regions without costs. The state put the orders in region with the minimum costs, therefore the rate of wages levels between regions and sectors/, and is identical to both regions. Due to this the rate of wages in industrial sector also is equal $w_L$.

The migration condition of the mobile factor is

$$\dot{d}_k = \left(\overline{\pi}_1 - \overline{\pi}_2\right)\left(1 - d_k\right) d_k, \tag{2.2}$$

it means that the capital follow to the best nominal rate of the return, $d_k$ is the share of the capital employed in East.

The parameters of infrastructure development are external for the investors and do not depend on them. Consequently distribution of capital over regions is equilibrium of Nash.

Criterion function of a customer. The representative customer in each region has preferences given by function

$$U_j = C_j, \qquad C_j = \left( \int_{i=0}^{n} c_i^{1-1/\sigma} di \right)^{1/(1-1/\sigma)}, \qquad j = 1, 2, \tag{2.3}$$

where $c_j$ is the consumption of a manufactured goods composition; $n$ is number or mass of manufactured goods accessible in the market; $\sigma$ is the constant elasticity of substitution between any two goods. The indirect utility function has a form

$$V_j = \frac{\overline{E}_j}{P}; \qquad P = \left( \int_{i=0}^{n} p_i^{1-\sigma} di \right)^{1/(1-\sigma)}, \qquad j = 1, 2, \tag{2.4}$$

where $\overline{E}_j$ is expenditures in region $j$; $P$ is "perfect" regional price index; $p_i$ is price of an industrial variation $i$ for a customer. Let $a = 1/(1-\sigma)$ and

$$\Delta_j = \left( \int_{i=0}^{n} p_i^{1-\sigma} di \right),$$

then,

$$P_j = \Delta_j^a, \qquad j = 1, 2. \tag{2.5}$$

As the assumption about monopolistic competition of Dixit–Stiglitz type presumes a free and continuous entrance on the market, the net profit cuts up to zero. Therefore $\overline{E}$ includes only corrected incomes on the factors. Besides the monopolistic competition of Dixit–Stiglitz type result in the producer's prices are optimum for industrial firms, so ratio of the goods prices of East in their local and export markets $p_i$ is equal $\tau$: $p_2/p_1 = \tau$. Similarly is for West. At last, according to the Dixit–Stiglitz conception a competition of infinite number of atomistic competitors has a place, the producer's prices in equilibrium do not depend on a type of a competition (under Cournot or Bertrand) and are equal over regions. Hence, the consumer costs in the local and export markets of east region, accordingly, are equal

$$p_1 = \frac{w_l a_M}{1-1/\sigma} \quad \text{and} \quad p_2 = \frac{\tau w_l a_M}{1-1/\sigma}. \tag{2.6}$$

And similarly is for the local and export markets of West. Using demand function and producer's price the income on the capital in shot-run equilibrium can be expressed as

$$\overline{\pi}_1 = bB_1 \frac{\overline{E}}{n} f(z); \qquad \overline{\pi}_2 = bB_2 \frac{\overline{E}}{n}, \tag{2.7}$$

where

$$b = 1/\sigma; \quad B_1 = \frac{d_{\bar{E}}}{\Delta_1} + \phi\frac{1-d_{\bar{E}}}{\Delta_2}; \quad B_2 = \phi\frac{d_{\bar{E}}}{\Delta_1} + \frac{1-d_{\bar{E}}}{\Delta_2};$$

$$\Delta_1 = d_n + \phi(1-d_n); \quad \Delta_2 = \phi d_n + (1-d_n);$$

$d_{\bar{E}}$ and $1-d_{\bar{E}}$ is shares of the eastern and western regions in expenditures; $\Delta_1$ and $\Delta_2$ is denominator of demand function for East and West accordingly; $\phi = \tau^{-\sigma}$ is parameter describing the transport costs; $0 \le \phi \le 1$; then lower $\phi$, then more the transport costs.

The share of industry depends on share of capital working in region and infrastructure, therefore share of eastern $d_n$ and western $(1-d_n)$ regions are possible to define as

$$d_n = \frac{d_k f(z)}{d_k f(z) + (1-d_k)} \quad \text{and} \quad (1-d_n) = \frac{1-d_k}{d_k f(z) + (1-d_k)}, \tag{2.8}$$

accordingly, and then the expressions for $\Delta_1$ and $\Delta_2$ takes a form

$$\Delta_1 = \frac{d_k f(z) + \phi(1-d_k)}{d_k f(z) + (1-d_k)} \quad \text{and} \quad \Delta_2 = \frac{\phi d_k f(z) + (1-d_k)}{d_k f(z) + (1-d_k)}. \tag{2.9}$$

The share of the post-tax incomes in east region will be

$$d_{\bar{E}} = d_L(1-b) + bs_k, \tag{2.10}$$

where $d_L = L_1/L$ is a share of employed in east region, $s_k$ is a share of capital owned to the residents of east zone.

The capital is mobile in a long-term equilibrium. The equation (2.2) is a formal condition for stability of equilibrium state. It is visible, there are possible two types of long-term equilibrium in a system: 1) internal, when capital takes identical return in regions ($\bar{\pi}_1$ and $\bar{\pi}_2$ are given through (2.8)):

$$\bar{\pi}_1 = \bar{\pi}_2, \text{ when } 0 < d_k < 1; \tag{2.11}$$

2) core-periphery outcome, when $d_k = 0$ or $d_k = 1$.

The condition (2.11) allows to find the closed form of solution for $d_k$:

$$d_k = \frac{d_{\bar{E}}(A+\phi) - \phi}{f(z) - \phi}, \quad \text{where} \quad A = \frac{f(z) - \phi}{1 - f(z)\phi}. \tag{2.12}$$

The admissible boundaries of parameters values are $0 \le \phi \le 1$ and $0 \le f(z)$. Boundaries, in which the internal long-term equilibrium is stable, are $\phi < f(z) < 1/\phi$; they determine sectors marked as 6,

2, 3 and 5 in a Fig. 1. If $f(z) \le \phi$ (area 1), the internal equilibrium is unstable, and core displaced on West. If $f(z) \ge 1/\phi$ (area 4), the internal equilibrium is unstable, core displaced on East.

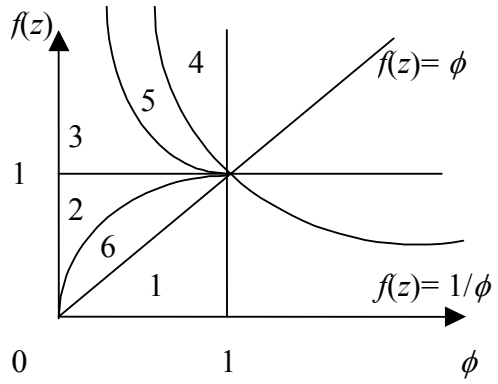


**Fig. 1.** The diagram with overlapping, symmetric case

In the model with the identical regional markets a break passes on curves

$$f(z) = \phi \quad \text{and} \quad f(z) = 1/\phi .$$

If

$$f(z) > \left(1+\phi^2\right)/2\phi ,$$

then the outcome with the core in East will be stable. The curve

$$f(z) = \left(1+\phi^2\right)/2\phi$$

is same analog of a singular point. However, as against to Martin and Rodgers model, here we have not a point, but the curve. The comparison displays, that

$$\left(1+\phi^2\right)/2\phi \; < 1/\phi ,$$

and consequently there is a range of values of parameters (area 5), in which there are bifurcations of system and from which any of two stable equilibrium outcomes are accessible: internal and core-periphery with the core in East. It is area of overlapping

Similarly the equilibrium with the core in West is becomes stable, when

$$f(z) < 2\phi/\left(1+\phi^2\right).$$

Therefore, there is a second overlapping (area 6), in which two outcomes: the internal equilibrium and the stable concentration of the capital in West are accessible. Under $\phi = 1$ any equilibrium is stable.

If to split the territory of the Russian Federation on two parts: west and east, and to include the Far East, Siberian, and Ural Federal districts in the East part, then for the Russian economy $d_{\bar{E}} = 1/3$. Under conservation of the stability conditions of internal equilibrium the boundary of a stability of

the core-periphery outcome are displaced. The upper bound with the stable core in East passes along a curve $f(z) = \left(2 + \phi^2\right)/3\phi$, and with the core in West do $f(z) = 3\phi/\left(1 + 2\phi^2\right)$. We see, that the boundaries are displaced upwards of rather symmetric case (Fig. 2).

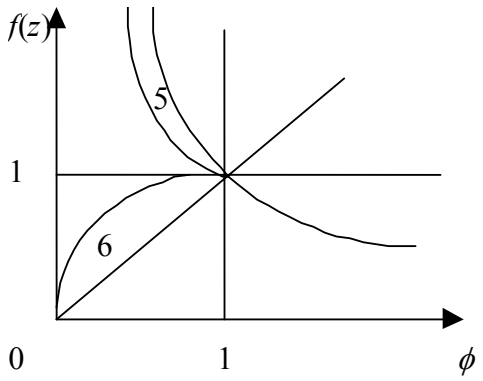


**Fig. 2.** The diagram with overlapping, asymmetric case

The obtained outcome concerning the form of overlapping and long-term dynamics principally distinguishes the considered model from the Martin and Rodgers model, and from the other agglomeration models.

**Analysis of government benevolence influence on structure of market equilibrium states.** We shall turn to a problem of regional government benevolence. We shall consider, how the intents of regional government, concerning collecting of the regional rent from the capital working in region, influence structure of equilibriums in model.

We shall assume that the benevolence government works in the west region; it does not collect the regional rent from capital. We review in more detail the government of east region, which can be both benevolence and non-benevolence. We determine the $f(z)$ as

$$f(z) = (1 - \delta)\, z, \tag{2.13}$$

where $\delta$ is rate of rent from the capital income, which collect the east regional government, $z$ is relative level of infrastructure development providing external economies in east region. The size of external economies, and consequently magnitude of the real income on the capital will be defined not only development of infrastructure in region, but also by the benevolence of regional government. At $\delta = 1$ we have non-benevolent government (Leviathan), which accepts the all income on the capital. The magnitude $\delta = 0$ means benevolent regional government. Intermediate government we have at $0 < \delta < 1$.

In long-term equilibrium a solution will be still defined by condition (2.2), where $\bar{\pi}_1 = \pi_1(1-\delta)z$, $\bar{\pi}_2 = \pi_2$. The boundaries of stable equilibrium outcomes will depend on magnitude of external economies that is from a relation between benevolence of regional government and development of infrastructure in region. For $d_E = 1/2$ the conditions $f(z) > \phi$, and $f(z) < 1/\phi$ delimiting stabilities

of an internal equilibrium, give:

$$\frac{\phi}{(1-\delta)} < z < \frac{1}{\phi(1-\delta)}. \tag{2.14}$$

From the inequality $f(z) > (1+\phi^2)/2\phi$ follows the condition, under which the outcome with core in East will be stable:

$$z > \frac{1+\phi^2}{2\phi(1-\delta)}. \tag{2.15}$$

The equilibrium with the core in West is similar becomes stable under $f(z) < 2\phi/(1+\phi^2)$ that is when:

$$z < \frac{2\phi}{(1+\phi^2)(1-\delta)}. \tag{2.16}$$

At $d_E$ =1/3 two last conditions (2.15) and (2.16) have the following form:

$$z > \frac{2+\phi^2}{3\phi(1-\delta)}, \tag{2.17}$$

$$z < \frac{3\phi}{(1+2\phi^2)(1-\delta)} \tag{2.18}$$

accordingly.

The diagram demonstrating a general type of boundaries defining stability of equilibrium outcomes (2.14)–(2.18) is pictured in Fig. 3.

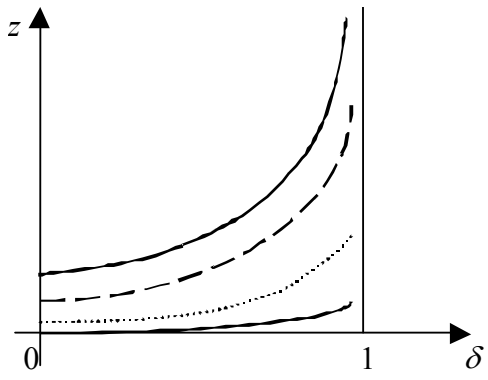


**Fig. 3.** Boundaries of equilibrium states of the economy

Thick solid lines figure curves delimiting stability of internal equilibrium (2.14). A long dotted line plotted boundary of stability of solution with the core in East in (2.15) at $d_E$ = 1/2 or in (2.17) at $d_E$ = 1/3 accordingly. Boundary in (2.16) at $d_E$ = 1/2 or in (2.18) at $d_E$ = 1/3 defining stability of core in West is figured by points.

The required magnitude of infrastructure development at some values of benevolence of regional government and transport costs providing stability of equilibrium states of the economy are shown in Appendix A1, Table A1.1–A1.6. From the data in tables we see, that under decreasing in transport costs both the boundaries of internal stabile equilibrium and the boundaries of the upper and lower overlap constrict.

To obtain the rent it is necessary for regional government to attract the capital, which stays and works in region. The appeal of region to the investor depends on magnitude of external economies $f(z)$, which is defined by two factors: 1) by external economies originating from development of infrastructure in region and 2) rate of the rent, which the regional government collect diminishing thereby the income on the capital. The regional government interested in deriving of the income will not only try to increase the rental rate, but also to attract the capital for job in region through development of infrastructure and magnification of external economies on the capital. Under poorly developed infrastructure even the benevolent government cannot keep the capital in region. If region is highly advanced, and magnitude of external economies is rather high, than at average or even at high magnitude $\delta$ the concentration of production and investment in region is possible under non-benevolent government. At the average level of infrastructure development it is possible uniform distribution of investments over regions under condition that non-benevolence of regional government, and consequently rate of the rent, does not exceed some critical value. Thus, both benevolent, and non- benevolent government are interested in regional infrastructure development and forming external economies to the capital. The question is about any infrastructure, both industrial, and social, which ensures appearance of external economies.

## 3. THE ECONOMETRIC MODEL SPECIFICATION AND THE ESTIMATION RESULTS

### 3.1. Model specification

We shall consider dynamics of investment depending on expected yield. In its turn, a value of expected profitability in regions also depends on a line of regional characteristics. The offered econometric model forms a recursive set of equations and includes the equations for investment and expected profitability. The system describes two jointly related variables: $I_{it}$ is investment in region $i$ in year $t$, and $\pi_{it}^{e}$ is the expected magnitude of profitability. Besides, there is autocorrelation of the first order for investment and profitability dependent variables will be taken into account in the model.

The expectations concerning profitability of investment in the current year depend on profitability obtained in preceding year and other current regional characteristics. Under rational expectations depending on the information at the moment $t$

$$E[\pi_{it}^{e} - (\alpha_{10} + \alpha_{11}\pi_{it-1} + \alpha_{1}X_{1it-1} + \mu_{1i} + \gamma_{1t})|\Im_{t}]=0, \quad (3.1)$$

where $\pi_{it-1}$ is magnitude of profitability in preceding year; $X_{1it-1}$ are the regional characteristics, which have been taken into account in the model; $\mu_{1i}$ is a regional specific fixed effects; $\gamma_{1t}$ is time-specific effects; $\alpha_{10}$, $\alpha_{11}$ are unknown parameters; $\alpha_1$ is a vector of unknown parameters, $i$ is index of region, $i = 1, \ldots, N$; $t$ is index of year, $t = 3, \ldots, T$. From the taken preposition the expected profitability equation can be written as

$$\pi_{it}^{e} = \alpha_{10} + \alpha_{11}\pi_{it-1} + \alpha_1 X_{1it-1} + \mu_{1i} + \gamma_{1t} + \nu_{1it}, \tag{3.2}$$

where $\nu_{1it}$ — stochastic disturbances, $\nu_{1it} \sim IID(0, \sigma_1^2)$ and do not depend on a predicted error of expected profitability and random disturbance of investment.

The investment equation depending on the expected profitability and lagged investment takes a form

$$I_{it} = \beta_{20} + \beta_{21}\pi_{it}^{e} + \beta_{22} I_{it-1} + \beta_2 X_{2it-1} + \mu_{2i} + \gamma_{2t} + \nu_{2it}, \tag{3.3}$$

where $\nu_{2it}$ — stochastic disturbances, $\nu_{2it} \sim IID(0, \sigma_2^2)$ and do not depend on a predicted error and random disturbance of expected profitability; $\beta_{20}$, $\beta_{21}$, $\beta_{22}$ — are unknown parameters; $\beta_2$ is a vector of unknown parameters; $X_{2it-1}$ are the current regional characteristics accounted in the model, which influence investment location in region; $\mu_{2i}$ — unobservable regional specific effects; $\gamma_{2t}$ — time-specific effects.

Profitability $\pi_{it}$ obtained in current year $t$, is equal

$$\pi_{it} = \pi_{it}^{e} + e_{it}, \tag{3.4}$$

where $e_{it}$ is the prediction error of profitability, which has the conditional mean equals zero under rational expectations conditioned by the information $\Im_t$ at the moment $t$

$$E(e_{it}|\Im_t) = 0,$$

and the constant variance $\sigma_e^2$. Expected profitability at the moment $t$ does not depend on prediction error $e_{it}$, and, besides, does not depends on $\nu_{1it}$ and $\nu_{2it}$. Expressing the expected profitability $\pi_{it}^{e}$ through observable $\pi_{it}$

$$\pi_{it}^{e} = \pi_{it} - e_{it}, \tag{3.5}$$

and substituting it in the equation (3.2) and (3.3), we obtain

$$\pi_{it} = \alpha_{10} + \alpha_{11}\pi_{it-1} + \alpha_1 X_{1it-1} + \mu_{1i} + \gamma_{1t} + \varepsilon_{1it}, \tag{3.6}$$

where

$$\varepsilon_{1it} = \nu_{1it} + e_{it}, \tag{3.7}$$

$$E(\varepsilon_{1it}|\Im_t) = 0, \quad \text{var}(\varepsilon_{1it}|\Im_t) = \sigma_1^2 + \sigma_e^2, \quad i = 1, \ldots, N, \quad t = 3, \ldots, T; \tag{3.8}$$

and

$$I_{it} = \beta_{20} + \beta_{21}\pi_{it} + \beta_{22}\, I_{it-1} + \beta_2\, X_{2i\,t-1} + \mu_{2i} + \varepsilon_{2it}, \tag{3.9}$$

$$\varepsilon_{2it} = \nu_{2it} - \beta_{21} e_{it}, \tag{3.10}$$

$$E(\varepsilon_{2it}\,|\Im_t) = 0, \quad \text{var}(\varepsilon_{2it}\,|\Im_t) = \sigma_2^2 + \beta_{21}^2\,\sigma_e^2, \quad i = 1, \ldots, N, \quad t = 3, \ldots, T. \tag{3.11}$$

Under coincides of the macroeconomic expectations concerning of the different regions development, taking into account that we consider rational expectation, the prediction errors in different regions are correlated with each other

$$\text{cov}(e_{1it}, e_{1jt}\,|\Im_t) = \sigma_{ee}, \quad i, j = 1, \ldots, N, \quad t = 3, \ldots, T,$$

consequently

$$\text{cov}(\varepsilon_{1it}, \varepsilon_{1jt}\,|\Im_t) = \sigma_{ee}, \quad i \neq j, \quad i, j = 1, \ldots, N, \quad t = 3, \ldots, T. \tag{3.12}$$

The disturbances of different regions in the investment regression correlate between each other

$$\text{cov}(\varepsilon_{2it}, \varepsilon_{2jt}\,|\Im_t) = \beta_{21}^2\,\sigma_{ee}, \quad i \neq j, \quad i, j = 1, \ldots, N, \quad t = 3, \ldots, T. \tag{3.13}$$

However the errors relating to different time intervals do not correlate each other.

As the disturbances of both equations of the system $\varepsilon_{1it}$ and $\varepsilon_{2it}$ depends on the prediction errors of profitability, so their covariance differs from zero

$$\text{cov}(\varepsilon_{1it}, \varepsilon_{2it}\,|\Im_t) = -\beta_{21}\,\sigma_e^2, \quad i = 1, \ldots, N, \quad t = 3, \ldots, T. \tag{3.14}$$

Besides, there is non-zero covariance of the different regions disturbances in the profitability and investment equations

$$\text{cov}(\varepsilon_{1it}, \varepsilon_{2jt}\,|\Im_t) = -\beta_{21}\sigma_{ee}, \quad i \neq j, \quad i, j = 1, \ldots, N, t = 3, \ldots, T. \tag{3.15}$$

The rest covariance is equal to zero.

Taking into account the accepted hypotheses the covariance matrix of the system equations disturbances $\Omega$ have complex bloc structure

$$\Omega = \begin{pmatrix} \Omega_{11} & \Omega_{12} \\ \Omega_{21} & \Omega_{22} \end{pmatrix}, \tag{3.16}$$

where $\Omega_{11}$ and $\Omega_{22}$ are the covariance matrixes of disturbances of profitability and investment equations respectively, $\Omega_{12}$ and $\Omega_{21}$ — the covariance matrixes of disturbance of both equations.

The blocks of a covariance matrix have the following form. The covariance matrix of the expected profitability equation disturbances is

$$\Omega_{11} = \begin{pmatrix} G_i & G_{ij} & \cdots & G_{ij} \\ G_{ij} & G_i & \cdots & G_{ij} \\ \cdots & \cdots & \cdots & \cdots \\ G_{ij} & G_{ij} & \cdots & G_i \end{pmatrix}, \tag{3.17}$$

where

$$G_i = \begin{pmatrix} \sigma_1^2 + \sigma_e^2 & 0 & \cdots & 0 \\ 0 & \sigma_1^2 + \sigma_e^2 & \cdots & 0 \\ \cdots & \cdots & \ddots & \cdots \\ 0 & 0 & \cdots & \sigma_1^2 + \sigma_e^2 \end{pmatrix}, \qquad G_{ij} = \begin{pmatrix} \sigma_{ee} & 0 & \cdots & 0 \\ 0 & \sigma_{ee} & \cdots & 0 \\ \cdots & \cdots & \ddots & \cdots \\ 0 & 0 & \cdots & \sigma_{ee} \end{pmatrix}.$$

The covariance matrix of the investment equation disturbances takes a form

$$\Omega_{22} = \begin{pmatrix} F_i & F_{ij} & \cdots & F_{ij} \\ F_{ij} & F_i & \cdots & F_{ij} \\ \cdots & \cdots & \cdots & \cdots \\ F_{ij} & F_{ij} & \cdots & F_i \end{pmatrix}, \tag{3.18}$$

where

$$F_i = \begin{pmatrix} \sigma_2^2 + \beta_{21}^2\sigma_e^2 & 0 & \cdots & 0 \\ 0 & \sigma_2^2 + \beta_{21}^2\sigma_e^2 & \cdots & 0 \\ \cdots & \cdots & \ddots & \cdots \\ 0 & 0 & \cdots & \sigma_2^2 + \beta_{21}^2\sigma_e^2 \end{pmatrix}$$

and

$$F_{ij} = \begin{pmatrix} \beta_{21}^2\sigma_{ee} & 0 & \cdots & 0 \\ 0 & \beta_{21}^2\sigma_{ee} & \cdots & 0 \\ \cdots & \cdots & \ddots & \cdots \\ 0 & 0 & \cdots & \beta_{21}^2\sigma_{ee} \end{pmatrix}.$$

The disturbances covariance matrixes of the expected profitability and investment equations $\Omega_{12}$ and $\Omega_{21}$ are symmetric, and besides they are symmetric respective to mine diagonal, therefore

$$\Omega_{12} = \Omega_{21} = \begin{pmatrix} H_i & H_{ij} & \cdots & H_{ij} \\ H_{ij} & H_i & \cdots & H_{ij} \\ \cdots & \cdots & \cdots & \cdots \\ H_{ij} & H_{ij} & \cdots & H_i \end{pmatrix}, \tag{3.19}$$

there

$$H_i = \begin{pmatrix} -\beta_{21}\sigma_e^2 & 0 & \cdots & 0 \\ 0 & -\beta_{21}\sigma_e^2 & \cdots & 0 \\ \cdots & \cdots & \ddots & \cdots \\ 0 & 0 & \cdots & -\beta_{21}\sigma_e^2 \end{pmatrix}$$

and

$$H_{ij} = \begin{pmatrix} -\beta_{21}\sigma_{ee} & 0 & \cdots & 0 \\ 0 & -\beta_{21}\sigma_{ee} & \cdots & 0 \\ \cdots & \cdots & \ddots & \cdots \\ 0 & 0 & \cdots & -\beta_{21}\sigma_{ee} \end{pmatrix}.$$

The problems of model estimator are discussed in Appendix A2.

### 3.2. Variables, hypothesis and information

We evaluate, what variables affect the acceptance of investment solutions in regions. The list of all variables can be found in Appendix A3.

At the first stage the regression of gross investment (variable *inv*) on the investment factors was estimates. The basic attention was given to that explaining variable, which the state can control.

On the following analysis stage the estimation of the investment equations of different ownership pattern have been conducted: state (*inv_gos*), municipal (*inv_mun*), private (*inv_priv*) and mixed (*inv_mix*). Besides the equation of the foreign investment (*inv_foring*) is estimated.

The influence of variables defining location of the state and municipal investment in regions was analyzed. The estimation of regressions has allowed to establish characteristics of regions, which the state takes into account at acceptance of investment solution. The particular features of problem regions, which the state investment policy are aimed to correct, and same indexes of investment climate, what government aims to improve, were detected. The special attention in the system of equations for the state investments is given to investment in a social sphere, which provides development of a social infrastructure and quality of the human capital.

Under estimation of mixed investment we check the hypothesis about whether the factors vary at acceptance of investment solutions of private business, if private business participates in the investment projects jointly with the state.

The third analysis stage have proposed estimation of system of regression equations for investment in different branches of the economy: *inv_prom* in industry; *inv_tran* in transport; *inv_agri* in agriculture; *inv_build* in building; *inv_conn* in connection; *inv_trad* in trade; *inv_edu* in education; *inv_heal* in public health services. Among enumerated sectors there are branches, in which the private business is advanced mainly, and there are branches, where the public sector predominates. Therefore comparative analysis of the estimation outcomes for branchs equations systems also has significant means for the purposes of analysis. All indexes of investment were evaluated in terms of money and were cleared of inflation. It is necessary to mark, that GMM as the method of estimation allows to decide a problem of heteroscedasticity, therefore necessity of a normalization or taking the logarithm of the investment variable did not arise.

The variables of the lagged investment in the appropriate equations reflect the tendencies of concentration of investment in regions. In agglomeration models two types of dynamics are investigated:

monotone and cyclical. Under monotone dynamics the historical tendencies of concentration are saved, and the expectations of yield on investment are connected to regions, where the concentration already has place. In case of cyclical dynamics the expectations connected to change the region of investment location can be generated. Therefore, the positive sign of estimates of lagged investment means conservation of the historically usual tendencies in spatial structure of investment and conservation of expectations concerning profitability of investment in regions.

The negative sign at the lagged variable of investment demonstrates change of the historical tendencies of investment location, and as a corollary, modification of investment expectations concerning profitability of investment in regions.

The expected profitability of investment is approximated by a variable of profitability assets (*return*). The significance of variable *return* in the equation of investment demonstrates impact of expected yield on acceptance of investment solutions, not specifying, whether the historical tendencies in the arrangement of investment have saved or varied. It is necessary to underline, that in the agglomeration models the expected rate of income to capital is the basic criterion of the capital migration. It levers due to migration of capital and is identical to all enterprises of region. Therefore, the variable of expected profitability of assets (*return*) in the econometric model is uniform for all systems of equations. In system of equations we vary only second jointly dependent variable appropriate to investment of different pattern of ownership or different branches of the economy.

The influence of agglomeration processes is fixed by the following variables. The internal regional market consolidates both retail turnover, and turnover intra- and inter-branch of trade. Accordingly two variables are used to exposit the influence of the market: a retail turnover on soul of the population (*exp_peo*), and number of enterprises and organizations registered in the region (*plants*). The index of retail turnover reflects impact of the retail trade market.

The number of enterprises operating in region plays in agglomeration models one of basic roles and is, for example, the alternative to the working capital. That variable reflects a degree of concentration in region. Therefore, we used it as a variable approximating influence of concentration of enterprises in the econometric model. At once this variable allows to approximate effect of the market connected with intra- and inter-branch turnover of goods.

Variables reflecting effect of external economies in region are connected to development of infrastructure (Лапо, 2004а, б; 2005). Among infrastructure variables we used an amount of room telephones (*telephone*). The connection is most dynamically developed branch forming infrastructure. The development power-engineering branch is necessary for operation of a line of industries in region, therefore variable of the electric power production in regions also have been included in the regression equations. The variable *stu_emp* reflects dynamics of a social infrastructure intended for training of personnel and shaping human capital in region. The variable *stu_emp* is defined as the ratio of students of higher school education to the employed population. The variable *t_price* is an index of the transport tariffs; it is oriented to take into account influence of transport costs.

Among explaining variables defining policy of government the index of budgetary security of regions (*bud_peo*) are considered; it is calculated as the ratio of expenditures on public account of the Russian Federation subjects to population.

Besides, the singularities of branch structure were controlled in the regression equations. From the point of view of investment activity in region it was important to inspect influence of branches connected to oil extracting. Therefore, the variable of specific weight of a fuel industry *(fuel*) has been included in the regression. The share of chemical and petrochemical industry (*chemical*) is supplemented also. Influence of macroeconomic shocks connected with denomination, default and rise in prices on petroleum were taken into account by fixed annual effects of 1997, 1998 and 2002.

We tested the following hypotheses.

*Hypothesis* 1. The expected yield is the essential factor for the location of investment over regions.

*Hypothesis* 2. The process of production concentration in regions strongly affect on location of investment.

*Hypothesis* 3. The infrastructure development in region ensures external economies and by that attracts the additional investment.

*Hypothesis* 4. The growth of home market attracts the new investment in regions.

*Hypothesis* 5. A high skill level of employed population (quality of the human capital) attracts the investment on territory of region.

*Hypothesis* 6. The regional government maintaining development of a social infrastructure and growth of the human capital on territory of region promotes inflow of investment.

*Hypothesis* 7. Increasing budgetary security of region the government reduces regional risks and raises the investment appeal of territory.

*Hypothesis* 8. Participating in the joint investment projects the government of a different level (federal, regional and municipal) reduces regional risks of investors and ensures inflow of investment in region.

*Hypothesis* 9. The transport costs are the essential factor in the arrangement of investment. However, depending on a degree of production concentration and depending on level of costs, their influence is exhibited differently: the transport costs can promote both process concentration of investment in regions, and process of dispersion of production over territory of country, therefore estimates of parameters can have both positive, and negative sign.

The empirical analysis has based on sample enveloping all regions of Russia and metropolis Moscow and St.-Petersburg (total 79 regions). The Chechnya republic is considered together with Ingushetiya. The autonomous territories are jointed in a composition of regions and areas. The observable horizon for the total investment envelops 1992–2003 years, for the state and private investments is 1993–2003, for investments in branches of the economy is 1994–2003. The represented information is a panel data. The basic recourse of information is statistical collection "Re-

gions of Russia" for 1996–2004 years issued by Goscomstat. All data are reduced in a comparable form. The price deflators eliminated effects of inflation.

### 3.3. Outcomes of estimation

**The total investment in regions of the Russian Federation**. The outcomes of estimation are presented in Appendix A4, Table A4.1.

At the beginning we shall stay on the equation of assets profitability. The unstable state of the economy in transition period has found reflecting in oscillations of yield of assets in regions, therefore the negative sign of parameter estimate of lagged magnitude of yield (–0.1757) testifies. Among explaining variables the positive influence to yield render the infrastructure variables: development in region of electric power industry (4.0741), parameter is significant at a level 1%. The ratio number of students to the employed population equals to 95.6419 and expresses the influence of a social infrastructure.

By results of estimation the negative effects of expenditures on public account to 1 inhabitant of region and number of enterprises on expected profitability of assets is detected. The first outcome can be stipulated by budgetary policy correcting non-uniformity of regional development of territories of Russia. The second established fact probably is connected to singularities of account on private enterprises, which are concentrated in economically developed regions, where, it is possible, the accounted indexes of profitability are underestimated a little.

The significant positive estimates of variable of electric power development prove essential influence of industrial infrastructure on the expected yield of assets.

There is an ambiguous interpretation of outcomes concerning influence of variable describing a variation of the transport costs. One of the explanations can probably consist in the following. The positive influence of the transport costs growth rates on expected yield and on the investment in the appropriate equations can be one of regularities of the agglomeration processes. It is proved by the agglomeration model that the magnification of the transport costs conducts to amplification of non-uniformity of regional development, appearance of agglomerations, and forming of core-periphery structure of the economy.

By results of analysis of correlation matrixes in the regression equation of expected yield the minor correlation of residuals with some explaining variables is found: with *t_price* (–0.4922), *plants* (0.1909), and *energy* (–0.2585). The correlation has given us the foundation to estimate this system using instead of variable in the first differences *t_price*, *plants*, *energy* their lagged value in levels: *dt_price*, *dplants*, *denergy* for construction of GMM-instruments. However the parameters estimates in system in the second variant differ only un-significantly. Therefore, the second variant of regression we not demonstrate. The signs of coefficients have not varied, as the significance level has not varied also. It is necessary to make conclusion that the first variant of regression and using of variables *t_price*, *plants*, and *energy* in the first differences for construction of GMM-instruments are acceptable.

Certainly, the basic interest for the analysis has the equation of investment. Particularly, the positive estimate (0.2554) for the lagged variable of investment is significant at 1% level and testifies to an amplification of process of investment concentration in regions for analyzable period. It is found that the investors largely react to expected yield of assets; the parameter estimate of expected yield is equal to 0.0052 at one-percentage significance level. It is necessary to state that arrangement of total investment over regions of the Russian Federation follows to a direction of expected yield under conservation of the usual tendencies of spatial concentration of investment. The following hypotheses implying from the agglomeration model have found the confirmation: the growth of investment concentration conducts to their further concentration, and also hypothesis that investment moves in a direction of expected yield. The determined positive response on expected yield allows to conclude that expectation of investors in Russia influence on the territorial structure of investment.

The effect of the market connected to a retail turnover was estimated by variable *exp_peo*. The estimation is equal –0.4680; the sign of parameter estimate is negative. The negative influence of the inhabitant's expenditures in region to the total investment can have, apparently, some reasons.

1. The fact of negative influence of the population expenditures on investment in region is connected to the theoretically justified and investigated dilemma between the savings and consumption of population. The growth of consumption in Russia in analyzable phase has leaded in a drop of saving and investment at the expense of resources of population.

2. Decrease of the real incomes of population. Variable *exp_peo* reflects real population expenditures on soul in region.

Therefore, the market effect founded in the agglomeration model and connected to growth of income of population, which theoretically should conduct to an amplification of concentration processes in region, has not found confirmation in econometrics.

The market effect been attribute for the agglomeration model in the Russian Federation apparently is connected to growth of intra- and inter-branch trade between enterprises of region.

**Features of spatial investment concentration under different patterns of ownership**. The factors influencing on spatial arrangement of state, municipal, private, mixed and foreign investments were estimated (Table A4.2). First of all, we shall mark outcomes obtained in the equations of expected yield of assets. The significant correlation of expected yield with the lagged actual indexes of yield is found. The influence of the lagged value of yield on expected one reaches 0.0507 and is significant on 1% level in the system of equations for state pattern of ownership. In the system of equations for other patterns of ownership the following estimates of factors are obtained: 0.0302 in the equation for the municipal property (factor is significant at 5%), 0.0303 and 0.0337 accordingly for the private and mixed pattern of ownership, the significance of two last factors is fixed at 5 and 1%. Indicated factor is equal 0.0275 in the system of equations for the foreign investment. Thus, the separation of investment by patterns of ownership has allowed to establish positive significant effects, which in the analysis of the gross investment were not found. In particularly, the presence of

positive expectations concerning yield of assets in the Russian economy, which is determined by the reached level of yield, is established.

All equations of profitability demonstrate negative correlation with expenses of retail turnover on 1 inhabitant of region; the significance level of estimates of parameters reaches 1–5%. The established fact, in common, contradicts theoretical conception, however it can be quite explained a) by discrepancies in yield of the large and average enterprises and b) by singularities of accounting. The enterprises working in an sphere of the wholesale flows of intra- and inter-branch trade, on the one hand, ensure higher yield, and, on the other hand, the accounting in the large companies is organized much more exact than in sphere of a retail turnover in small organizations catering the population. In this light the sign of estimates quite can achieve negative values or demonstrate lack of connection with yield.

The quality of human capital has positive correlation with yield of assets in system of equations of state and municipal investments. Thus, the policy of government directed on development of the human capital, can indirectly influence the attraction of investment in regions through magnification of their yield and growth of appeal of regions for investment.

After separation of investment by patterns of ownership the effects of expected yield become more explicit and precise. The level of budgetary security essentially influences the expected yield in system of equations of the state, municipal and private investment: 5.3047, 5.8174, and 4.2278 accordingly; the parameters are significant at 5–10%. We see, that the budgetary security of region is significant factor for engaging of investment and its effect is determined through the growth of expected yield. The development of social infrastructure influences on expected yield significantly in the system of equations for state and municipal patterns of ownership.

There was the variable of share of fuel industry, which significantly effects, in all equations of expected yield; factor varies from 0.2447 up to 0.2508 and is significant at 5%.

Let's return to the equations of investment and consider, what factors affect magnitude of state, municipal, mixed, private and foreign investment in regions.

So the positive correlation with the lagged investment is found in the equations of the state, municipal and private investment. All enumerated estimates of parameters are significant at 1% level. They get the highest values in equations for municipal (0.3248) and private investment (0.3063). While in the equation of the state investment the estimate is equal to 0.0821. For the mixed investment such feature is not determined.

Thus, both private, and government investor continue to invest in those regions, where before realized the investment; in the most part of regions the historical tendencies of investment location are saved. This tendency is stronger exhibited for the municipal investment: the estimate of parameter for the lagged municipal investment more than twice exceeds a similar estimate for the state investment. The founded outcome demonstrates that participation of municipal administration in investment process in regions more intensively than federal. The municipal territories conduct long-term investment policy.

The positive sign of variable of lagged private investment in the appropriate regression equation confirms the hypothesis about amplification of spatial concentration of investment. The obtained estimate testifies to a dominance of positive investment expectations concerning regions, where the investment located earlier. There are the external economies and the agglomeration rent is formed with growth of production concentration in regions. The positive expectations concerning yield on investment in regions in proceeding phases confirms growth of actual yield of assets and hereinafter attract the new investment in region. Thus, we have discovered confirmation to cyclical process of concentration growth of investment in regions by econometrics.

The common effect of expected yield on investment are estimated by variable yield on assets (*return*). So the estimate of the yield effect is equal 0.0092 in the equation of the state investment and is significant at 1%. For the municipal investment the appropriate coefficient reaches 0.0006.

The outcomes of estimation demonstrate the following. The inflow of the state investment positively answers on growth of expected yield on investment. In common case investors benefit from engaging of the state investment, as the average yield on assets in region will increase.

The comparison of the coefficients estimates of yield influence in the equations of the state and municipal investments allows to make an inference that the state investments in the greater degree than municipal react to growth of yield. One of the basic reasons, as it seems, is that the state investment are more oriented on a realization of the large infrastructure projects, what largely ensure formation of external economies and fast growth of yield on assets.

The municipal investment is aimed in the greater degree at realization of socially significant projects, which ensures return through growth of quality of the human capital not at once, and much later. The private business does not undertake realization of such project, but they are necessary for development of territory. In the total sum the municipal investment also allow to increase appeal of region to the private investors.

Coefficient reflecting effects of expected yield on magnitude of the mixed investment attracted in region in the regression equation of the mixed investment equal 0.0039. Thus, the mixed investment is oriented on expected yield. A role of federal and regional government in the joint project is to correct migration of private investment to a direction of less attractive regions. In this case the state participation in the mixed investment projects allows to increase attraction of private investment in regions by decreasing regional investment hazards.

Coming back to the equation of private investment, we see, that effect of expected yield on private investment is not significant. The apparent inconsistency with the theoretical postulates of the agglomeration models is explained, how we think, by following. On state, municipal, and also joint enterprises the book keeping conducts much stricter, it is not aimed at concealment of the profit. On private enterprises the launder schemes of money withdrawal are applied more often. Therefore, in the equations of the state, municipal and mixed investments the appropriate significant factors are found. In the greater degree the distortions of accountability take place at the enterprises of the private pattern of ownership. That is why there is an imaginary picture that the private investors are

not oriented on profit. However private investors are interested to obtain the profit and they are guided in making decision by expected yield of investment. This phenomenon has found evidence in the regression equation of the private investment through estimate of the lagged investment coefficient. The effect of the last private investment is significant at a level 1% and equal 0.3063. Proceeding from the hypotheses that the lagged investment reflects expectations of private investors concerning yield under conservation of historical tendencies in distribution of investment, it is possible to make conclusion, that the private investment follows to expected yield, and the historical tendencies of spatial concentration predominate in spatial distribution of private investment.

Let's consider effects of other variables.

The budgetary security of region introduced through a variable *bud_peo*, significantly influences on state (0.1597), municipal (0.0341), and mixed (0.1626) investment. The growth of budgetary security, on the one hand, augments the investment possibilities of regions, and, with the other hand, it serves as the factor of growth of investment appeal of territory in the investment projects. The effect magnitude of variable "budgetary security of territory" in engaging the mixed investment is stronger, than its influence on the exclusive state or municipal investment. At the same time the budgetary security influence the distribution of private investment through growth of expected yield in region.

The growth of infrastructure development in region measured through growth of telephones numbers positively influence engaging of the private (1.8418) and foreign (0.7159) investment, and it allows to decrease the fix costs for private business by the joint exploitation of infrastructure and formation of external economies. The other variable of infrastructure development connected with energy in region is significant in equation of state (0.0092) and mixed (0.0237) investment. The advantages of the human capital are emerging to the Russian business only indirect through growth of expected yield. And, apparently, it did not become determinative under taken a solution about direction and location of investment yet.

The insignificant estimates of coefficients of the infrastructure variable in the equations of state and municipal investments and negative one in the equations of the mixed investment demonstrate a role of the state in regulating process of spatial concentration. The state investment directs to regions less provided with an infrastructure to promote their development hereafter.

The same conclusion should be made concerning influence of the transport costs. The state and municipal investments locates in regions with the high transport costs. The appropriate significant coefficients are equal to 0.0166 for the state investment, and 0.0059 for municipal. The obtained estimates prove that central and local governments direct investment to regions with the higher transport costs; state takes this function in the greater degree.

Analyzing the obtained equations, we see, both the federal and regional governments incur the support function to develop regions, which are less attractive for investor, with the high transport costs and less developed infrastructure. Thereby the government promotes development of region, growth of its home market, infrastructure, which forms favorable investment climate for the private invest-

ment, the government decrease investment hazards of the private investors participating in the investment projects.

The effects of enterprises number (variable *plants*) on the private and foreign investments in regions are quite expected and coordinated with theoretical position of the agglomeration theory. Estimates of parameters are equal 0.0049 and 0.0046 accordingly and are significant at 1%. Obtained coefficients demonstrate direct influence of the agglomeration effects on the private and foreign investments.

The number of the enterprises been registered in region significantly influences volume of municipal investment. The estimate of parameter is equal 0.0003, and, as it seems, demonstrates the following regularity. When more enterprises enter into agglomeration, then budgetary possibilities of regional jurisdictions are wider for a realization of investment.

**The investment in branches of the economy.** The outcomes of the equations systems estimation are shown in Table A4.3 in Appendix A4.

As well as in systems of equations for investment of different pattern of ownership, in systems of equations for investment in branch of the economy the expected yield on assets is essentially positively influenced by budgetary security of regions, and the share of branches of a fuel industry, and it is negatively influenced by the expenditures of a retail turnover on one inhabitant. At the same time there are differences. The effect of lagged indexes of yield has a negative sign.

The analysis of the investment equations has shown the following.

The industry is the sector of the economy, in which privatization basically is completed. Consequently regularities of the spatial arrangement of investment in industry are defined mainly by market factors. In the equation of investment in industry the following significant variables are found. The last year's indexes of investment essentially influence volume of investment in industry of regions; the estimate equal 0.1027, and is significant at a level 1%.

The positive effects of the lagged investment are established in the other branches of the economy for investment in agriculture (0.0525) and connection (0.1363). It is possible to make inference that the process of spatial concentration of investment in industry, agriculture, and connection amplifies; the expectations determined by the historical tendencies of concentration play the essential role.

The expected profitability of assets positively influences investment in transport branch and education. Factors are equal 0.0163 and 0.0009 accordingly. Thus, the hypothesis about interrelation of expected profitability and decisions of investors on location of investment over regions of the Russian Federation have found confirmation.

The most part of branches of the economy, among which are transport (0.0054), building (0.0019), connection (0.0021), trade (0.0018), education (0.0002) demonstrate a strong direct correlation between investment in the regional economy and number of enterprises registered on its territory. The coefficients are significant at a level 1–5%. The founded correlation allows to make conclusion that the investors tend to invest in regions with higher concentration of enterprises, which guarantees the

large home market and high external economies. The infrastructure variables influence the spatial arrangement of investment in some branches of the economy. For example, the electric power generation in region essentially influences engaging of investment in agriculture (0.0010). The development of social infrastructure is the factor attracting investment in agriculture and education.

Let's analyze in more details equations for branches, where the position of the federation and municipalities are strong. To such branches it is necessary to refer education and public health services, which, behind some elimination, are on state financing; an agriculture, which receives state support from the budgets of a different level (for example, credits for fuel-lubricant materials); the building, where exist building permit. In these branches (except for education) the negative response of investors on expected yield is detected. So, the estimates of parameters of expected yield on assets in construction, agriculture and public health services are equal accordingly –0.0040, –0.0003 and –0.0014 and are significant at a level 1–5%. The following values of coefficients of the lagged investment influence in construction and public health services are obtained: –0.6680 and –0.2921 accordingly, the estimates also are significant at a level 1%.

Thus, the governing role of government with the purpose to correct investment streams in the enumerated branches is enough precisely traced. The investment direct to regions less attractive to private investors, therefore in the econometric analysis we have negative estimates of parameters.

Thereby, we see, that the government is interested in development not only perspective regions, but also in development of regions, which economy requires support at the present moment. The purpose of government spends correcting interregional investment policy is a solution of problems of socio economic development of regions, forming of investment appeal of territories, creating of a favorable investment climate.

In this connection it is necessary to mark the other significant correlations, which have been determined in the equations of investment in agriculture and education. The quality of the human capital of region significantly influences investment in agriculture, the estimate of parameter equals 0.0861 and is significant at a level 5%. The competent and qualified population of region ensures higher yield and can attract more investment in branch. Other essential factor for investment in agriculture is the budgetary security of region, which estimate is equal 0.0122. Both estimates are significant at a level 5%.

As to education, the quality of human capital, and number of enterprises registered in region contribute in growth of investment in the regional system of education. All estimates of parameters for the enumerated variables are significant and positive. At the same time the state compensates a shortage of infrastructure in regions, promoting development of system of education. So we see, that coefficient at variable of infrastructure is significant at a level 1 % and is negative (–0.1634).

Let's see once again, how the state investment in regions correlated with the investment in socially significant branches of the economy (Table A4.4). We have additionally estimated the systems of equations for the state investment, in which we had included the variable of investment in such branches of economy as education, public health services as explanatory variables in investment equations. Investment in construction was controlled.

The parameters estimates of investment in education and public health services in the equations 2, 3 and 4 in Table A4.4 are significant and positive. The investment in education gives estimate 1.5327, which is significant at a level 1%. The investment in public health services influences at a level of 0.7751 under significance 5%. The estimate of investment in building is not significant. Thereby we have found evidence of social directedness of public expenditures oriented on development of social infrastructure in the field of education and public health services of regions.

The comparison of estimation outcomes of systems of equations 2–4 for state investment with the first variant, in which the investment in branches of the economy were not taken into account, displays the following. The parameters estimates of common explanatory variables (lagged state investment, expected yield, budgetary security of regions, generation of electric power, influence of transport rates) practically not vary and remain significant. Hence, it is possible to conclude that the obtained outcomes are stable.

Thus, it is established by results of estimation that the governments of different levels (federal, regional and local) positively affect development of regions eliminating the failures of market. Under growth of production concentration in separate regions and intensive formation of spatial agglomeration, which are precisely exhibited in regularities of the spatial location of commercial branches, such support is necessary. Let's remark, that such branches, as education and public health services, are one of the key factors in formation of the human capital; they define the future scientific and technical development of regions and country as a whole, form a social infrastructure of regions. In particularly, the government support expresses in that, what the state attracts investment in regions, which are less favorable for the private investors, in regions, where the expected yield of assets is lower then required, where the streams of investment are unstable, where the amenity provision is inadequate, where the concentration of enterprises is less and accordingly magnitude of external economies is lower.

## 4. CONCLUSION

The modification of the theoretical agglomeration model, which is taking into account external economies on the capital from development of infrastructure in region and the rent to regional government, is developed in research. The rental rate allows to take into account a degree of government benevolence. The necessary operations of government (both benevolence and non-benevolence) on development of infrastructure and on forming of external economies in order to attract the investment in region are analyzed in the model.

In that research we offer the econometric model, which estimates the investment in region depending on expected yield and on the agglomeration factors. The model of total investment, investment of different pattern of ownership (state, municipal, private and mixed), investment in a fixed capital of organizations including the foreign capital and investment in branch of the economy (industry; transport; agriculture; construction; connection; trade, public catering and wholesale by production of technological assigning; education and public health services) are estimated. The models are tes-

tified on the Russian data. The estimation of the models has allowed to investigate influence of policy of the federal and regional governments on volumes of investment attracted in regions of Russia. It was evidenced that the agglomeration factors and the process of concentration essentially influence spatial structure of investment in the Russian Federation. Consequently, those factors are necessary taken into account under formation of the inter-regional socio-economic and investment policy. The significant instruments of influencing on spatial structure of investment by government were determined by results of estimation. The formation of a home market and development of the investment and social infrastructure promote appearing of increasing return on investment and external economies. It was found, that the policy of government directed on location of investment in regions including the regions less developed and less attractive for private investment. Making interregional investment policy and using accessible instruments, the state promotes growth of investment appeal and migration of investment in regions.

# APPENDICES

## A1. Relation between values of infrastructure development parameters in region and benevolence of regional government delimiting the boundaries of steady states in the economy

**Table A1.1.** Necessary level of infrastructure development depending on benevolence of regional government at the high transport costs, $d_E = 1/2$, $\phi = 0.2$

| $\delta$ | Boundary of internal equilibrium stability | | Boundary of stability of core in East | Boundary of stability of core in West |
|---|---|---|---|---|
| 0 | 0.2 | 5 | 2.6 | 0.3846 |
| 0.1 | 0.2222 | 5.5555 | 2.8889 | 0.427 |
| 0.2 | 0.25 | 6.25 | 3.25 | 0.4807 |
| 0.3 | 0.2857 | 7.1428 | 3.7143 | 0.5494 |
| 0.4 | 0.3333 | 8.3333 | 4.3333 | 0.6410 |
| 0.5 | 0.4 | 10 | 5.2 | 0.7692 |
| 0.6 | 0.5 | 12.5 | 6.5 | 0.9615 |
| 0.7 | 0.6667 | 16.6667 | 8.6667 | 1.2820 |
| 0.8 | 1 | 25 | 13 | 1.9230 |
| 0.9 | 2 | 50 | 26 | 3.8461 |

**Table A1.2.** Necessary level of infrastructure development depending on benevolence of regional government at the high transport costs, $d_E = 1/3$, $\phi = 0.2$

| $\delta$ | Boundary of internal equilibrium stability | | Boundary of stability of core in East | Boundary of stability of core in West |
|---|---|---|---|---|
| 0 | 0.2 | 5 | 3.4 | 0.5555 |
| 0.1 | 0.2222 | 5.5555 | 3.7778 | 0.6173 |
| 0.2 | 0.25 | 6.25 | 4.25 | 0.6944 |
| 0.3 | 0.2857 | 7.1428 | 4.8571 | 0.7936 |
| 0.4 | 0.3333 | 8.3333 | 5.6667 | 0.9259 |
| 0.5 | 0.4 | 10 | 6.8 | 1.1111 |
| 0.6 | 0.5 | 12.5 | 8.5 | 1.3889 |
| 0.7 | 0.6667 | 16.667 | 11.333 | 1.8518 |
| 0.8 | 1 | 25 | 17 | 2.7778 |
| 0.9 | 2 | 50 | 34 | 5.5556 |

**Table A1.3.** Necessary level of infrastructure development depending on benevolence of regional government at the average transport costs, $d_E = 1/2$, $\phi = 0.5$

| $\delta$ | Boundary of internal equilibrium stability | | Boundary of stability of core in East | Boundary of stability of core in West |
|---|---|---|---|---|
| 0 | 0.5 | 2 | 1.25 | 0.8 |
| 0.1 | 0.5556 | 2.2222 | 1.3889 | 0.8889 |
| 0.2 | 0.625 | 2.5 | 1.5625 | 1 |
| 0.3 | 0.7143 | 2.8571 | 1.7857 | 1.1428 |
| 0.4 | 0.8333 | 3.3333 | 2.0833 | 1.3333 |
| 0.5 | 1 | 4 | 2.5 | 1.6 |
| 0.6 | 1.25 | 5 | 3.125 | 2 |
| 0.7 | 1.6667 | 6.6667 | 4.1667 | 2.6667 |
| 0.8 | 2.5 | 10 | 6.25 | 4 |
| 0.9 | 5 | 20 | 12.5 | 8 |

**Table A1.4.** Necessary level of infrastructure development depending on benevolence of regional government at the average transport costs, $d_E = 1/3$, $\phi = 0.5$

| $\delta$ | Boundary of internal equilibrium stability | | Boundary of stability of core in East | Boundary of stability of core in West |
|---|---|---|---|---|
| 0 | 0.5 | 2 | 1.5 | 1 |
| 0.1 | 0.5556 | 2.2222 | 1.6667 | 1.1111 |
| 0.2 | 0.625 | 2.5 | 1.875 | 1.25 |
| 0.3 | 0.7143 | 2.8571 | 2.1428 | 1.4285 |
| 0.4 | 0.8333 | 3.3333 | 2.5 | 1.6667 |
| 0.5 | 1 | 4 | 3 | 2 |
| 0.6 | 1.25 | 5 | 3.75 | 2.5 |
| 0.7 | 1.6667 | 6.6667 | 5 | 3.3333 |
| 0.8 | 2.5 | 10 | 7.5 | 5 |
| 0.9 | 5 | 20 | 15 | 10 |

**Table A1.5.** Necessary level of infrastructure development depending on benevolence of regional government at the low transport costs, $d_E = 1/2$, $\phi = 0.8$

| $\delta$ | Boundary of internal equilibrium stability | | Boundary of stability of core in East | Boundary of stability of core in West |
|---|---|---|---|---|
| 0 | 0.8 | 1.25 | 1.025 | 0.9756 |
| 0.1 | 0.8889 | 1.3889 | 1.1389 | 1.0840 |
| 0.2 | 1 | 1.5625 | 1.2812 | 1.2195 |
| 0.3 | 1.1428 | 1.7857 | 1.4643 | 1.3937 |
| 0.4 | 1.3333 | 2.0833 | 1.7083 | 1.6260 |
| 0.5 | 1.6 | 2.5 | 2.05 | 1.9512 |
| 0.6 | 2 | 3.125 | 2.5625 | 2.4390 |
| 0.7 | 2.6667 | 4.1667 | 3.4167 | 3.2520 |
| 0.8 | 4 | 6.25 | 5.125 | 4.8780 |
| 0.9 | 8 | 12.5 | 10.25 | 9.7561 |

**Table A1.6.** Necessary level of infrastructure development depending on benevolence of regional government at the low transport costs, $d_E = 1/3$, $\phi = 0.8$

| $\delta$ | Boundary of internal equilibrium stability | | Boundary of stability of core in East | Boundary of stability of core in West |
|---|---|---|---|---|
| 0 | 0.8 | 1.25 | 1.1 | 1.0526 |
| 0.1 | 0.8889 | 1.3889 | 1.2222 | 1.1696 |
| 0.2 | 1 | 1.5625 | 1.375 | 1.3158 |
| 0.3 | 1.1428 | 1.7857 | 1.5714 | 1.5037 |
| 0.4 | 1.3333 | 2.0833 | 1.8333 | 1.7544 |
| 0.5 | 1.6 | 2.5 | 2.2 | 2.10526 |
| 0.6 | 2 | 3.125 | 2.75 | 2.6316 |
| 0.7 | 2.6667 | 4.1667 | 3.6667 | 3.5087 |
| 0.8 | 4 | 6.25 | 5.5 | 5.2633 |
| 0.9 | 8 | 12.5 | 11 | 10.5263 |

### A2. Description of estimator methodology of the econometric model

Model (3.6)–(3.11) under condition of cov($\varepsilon$) = Ω, where Ω is defined as (3.16)–(3.19) represents a recursive system of the simultaneous equations with the correlated errors. As the errors of the equations of system correlate among themselves, the joint estimator of the equations is necessary. In this case the step-by-step procedures, which usually apply to recursive systems, do not approach for estimator. Besides, whereas the equations of system are defined as a dynamic panel regression, the generalized method of least squares applied to a set of equations at the presence of covariance of disturbances does not approach for estimator. It is necessary to use the generalized method of moment.

Introduce the notations.

$\tilde{Y} = \begin{bmatrix} \pi \\ I \end{bmatrix}$ is vector of observations of $(2N(T-2))\times 1$ joining all simultaneously depended variables, $\pi$ is the profitability observation vector, $I$ is the investment observation vector.

$\tilde{X} = \begin{bmatrix} \tilde{X}_1 & 0 \\ 0 & \tilde{X}_2 \end{bmatrix}$ is the bloc-diagonal matrix of $(2N(T-2))\times(p_1 + p_2)$, combined the observations of right-hand-side explanatory variables in both equations of the system, $\tilde{X}_1$ — the matrix of observations of explanatory variables for the equation of expected profitability, $\tilde{X}_2$ — the observations matrix of explanatory variables for the investment equation, $p_1$ and $p_2$ are the quantity of the estimating parameters in the first and in the second equations respectively.

$\tilde{\beta} = \begin{bmatrix} \tilde{\beta}_1 \\ \tilde{\beta}_2 \end{bmatrix}$ is vector united the parameters both equations of dimension $(p_1 + p_2)\times 1$, there $\tilde{\beta}_1 = (\alpha_{10}, \alpha_{11}, \alpha_1^{\mathrm{T}})^{\mathrm{T}}$, $\tilde{\beta}_2 = (\beta_{20}, \beta_{21}, \beta_{22}, \beta_2^{\mathrm{T}})^{\mathrm{T}}$. The appropriated them vector of parameters estimates we denote as $\tilde{B}$.

$\tilde{E} = \begin{bmatrix} E_1 \\ E_2 \end{bmatrix}$ — the combined vector of disturbances of profitability and investment equations of dimension $(2N(T-2))\times 1$.

Rewrite the system (3.6)–(3.11), (3.16) as

$$\tilde{Y} = \tilde{X}\tilde{\beta} + \tilde{E}, \tag{A.1}$$

$$E(\tilde{E} \mid \Im_t) = 0, \operatorname{cov}(\tilde{E} \mid \Im_t) = \Omega. \tag{A.2}$$

The objects including in the sample cover all regions (regions, territories, republics) of Russia excepting Chechnya. The autonomous formations are taken into account in composition of territories. Thus the sampling regions can consider as population. It allows to specify the estimated regressions equations in the system as fixed effects regression. The model with the fixed effects takes into ac-

count the specific features of each region. The years' fixed effects reflect influence of macroeconomic shocks.

The estimated equations are the dynamic panel regressions. The presence of the profitability prediction error determines the correlation of disturbances and the correlation between errors and explanatory variables. The application of OLS and GLS gives inconsistent estimates (Verbeek, 2000; Baltagi, 1995). Therefore the generalized method of moments (GMM) in the first differences has been used for estimation. For proposed model specification it guarantee the effective parameters estimation at large $T$ (Blundell, Bond, Windmeijer, 2000). The first differences allow to remove unobservable fixed effects $\mu_i$.

A line of instrumental variables for model in first differences is defined from orthogonal conditions of lagged values of variables and disturbances (Baltagi, 1995). Variables are instruments themselves for strictly exogenous explanatory variables, including the fixed effects.

As the lagged values of depended variables $Y_{is}$ (investment and expected profitability) do not correlate with disturbances of equations in first differences, under the suppositions for system of equations, we take the lagged value of endogenous variables as instruments. Strictly exogenous explanatory variables $X_{is}$ are the instruments for themselves. The GMM moment conditions for both equations of system can be written in the following form:

$$E(\Delta\varepsilon_{kit}\, Y_{kis}) = 0, \quad s = 2, \ldots, t-1; \quad t = 3, \ldots, T, \tag{A.3}$$

$k = 1$ corresponds to expected profitability equation, $k = 2$ specifies the investment equation. We use the lagged value of investment and profitability as instruments for endogenous variables in the investment equation. Condition defining the instruments for expected yield in the equation of investment is possible to note as

$$E(\Delta\varepsilon_{2it}\, \pi_{is}) = 0, \quad s = 2, \ldots, t-1; \quad t = 3, \ldots, T. \tag{A.4}$$

The matrix of instruments has the bloc-diagonal form:

$$\tilde{Z} = \begin{bmatrix} \tilde{Z}_1 & 0 \\ 0 & \tilde{Z}_2 \end{bmatrix}.$$

The number of the moment conditions exceeds the number of the estimated parameters; therefore the estimator of the generalized method of moments will be based on minimization of a quadratic form of corresponding sampling moments:

$$\min_{\tilde{B}} \left(\Delta\tilde{E}^{\mathrm{T}}\tilde{Z}\right) W_N \left(\tilde{Z}^{\mathrm{T}}\Delta\tilde{E}\right), \tag{A.5}$$

where $W_N$ is some weight matrix; $\tilde{Z}^{\mathrm{T}}$ is a matrix of dimension $m \times 2N(T-2)$, $m$ is the number of validity instruments. Then the GMM-estimates of parameters are

$$\tilde{B} = \left(\Delta\tilde{X}^{\mathrm{T}}\tilde{Z}W_N\tilde{Z}^{\mathrm{T}}\Delta\tilde{X}\right)^{-1}\Delta\tilde{X}^{\mathrm{T}}\tilde{Z}W_N\tilde{Z}^{\mathrm{T}}\Delta\tilde{Y}, \tag{A.6}$$

where $W_N$ is a matrix of weigh coefficients. The estimator of the covariance matrix of the parameters estimates is equal (see. Baltagi, 1995)

$$\hat{\text{cov}}(\tilde{B}) = \left(\Delta\tilde{X}^{\text{T}}\tilde{Z}W_N\tilde{Z}^{\text{T}}\Delta\tilde{X}\right)^{-1}. \quad \text{(A.7)}$$

Taking into account the covariance of errors the GMM-estimation to be conducted in two stages. On the first step some initial weight matrixes $W_N$ can be selected, particularly it is possible to take the identity matrix as weight one:

$$W_N = I_N,$$

that allows to obtain the optimum estimator of $W_N^{\text{opt}}$.

On the second step $W_N^{\text{opt}}$ is determined as

$$W_N^{\text{opt}} = \left(\tilde{Z}^{\text{T}}W\tilde{Z}\right)^{-1}, \quad \text{(A.8)}$$

where $W$ is the estimate of covariance matrix, obtained on the first step; the dimension of $W$ is equal to $2N(T-2)\times 2N(T-2)$. Definition $I_N$ as $W_N$ on the first step allows to computer $W$ as the consistent estimate of the covariance matrix of errors. The estimation of elements of matrix $W$ was conducted with use of regression residuals $\Delta\hat{\tilde{E}}$ obtained on the first step.

The estimates obtained on the first stage are consistent for large $N$ and finite $T$. Using $W_N^{\text{opt}}$ on the second step allows to obtain estimates, which in the absence of the additional information are asymptotically effective in the class of estimator founded on the linear moment conditions.

The matrix $W_N^{\text{opt}}$ corresponds to a general case of GMM and does not require *IID* or normal distribution of disturbances $v_{it}$ or $e_{it}$. It guarantees the asymptotically normal estimator of parameters.

To test the validity of the moment conditions used in GMM, the Sargan-test of overidentifying restriction (Blundell, Bond, Windmeijer, 2000) was applied. For the model in first differences the test statistic is obtained as

$$Sar_d = \Delta\hat{\tilde{E}}^{\text{T}}\tilde{Z}W_N\tilde{Z}^{\text{T}}\Delta\hat{\tilde{E}}, \quad \text{(A.9)}$$

where $\Delta\hat{\tilde{E}}$ are the two step residuals of regression; $W_N$ is the optimum weight matrix $W_N^{\text{opt}}$.

If the null hypothesis supposing validity of the moment conditions is correct, $Sar_d$ is asymptotically $\chi^2$ distributed with $(m-p)$ degrees of freedom.

The residuals of regression were tested on availability of autocorrelation by autocorrelation coefficients of the first and second order ($r_A(1)$ and $r_A(2)$). Because the estimation was conducted in the first differences, the first order autocorrelation is admissible.

The check of multicollinearity and endogenity of explaining variables was spent by coefficients of correlation of explaining variables among themselves and with residuals of the equations. These coefficients we do not show in the report, they would take too much places. However at once we shall note, that the correlation is not detected.

## A3. List of variables

### Dependent variables

*return* — the assets profitability of organizations in industry (in percentage);

*inv* — investment in a fixed capital;

*inv_prom, inv_tran, inv_agri, inv_build, inv_conn, inv_trad, inv_edu, inv_heal* — investment in industry; transport; agriculture; construction; connection; trade, public eating and wholesale by production of technological assigning; education and public health services accordingly;

*inv_gos, inv_mun, inv_priv, inv_mix* — state, municipal, private and mixed investment in the fixed capital accordingly;

*inv_foring* — investment in a fixed capital of organizations including the foreign capital;

### Explanatory variable

*lreturn*, *linv*, *linv_prom*, *linv_tran*, *linv_agri*, *linv_build*, *linv_conn*, *linv_trad*, *linv_edu*, *linv_heal*, *linv_gos*, *linv_mun*, *linv_priv*, *linv_mix*, *linv_foring* — the lagged value of the appropriate variables;

*exp_peo* — ratio of retail turnover to population of region;

*bud_peo* — budgetary security of region calculated as the ratio of budgetary expenditure of the Russian Federation subjects to a population;

*t_price* — indexes of the tariffs on freight traffic;

*telephone* — availability of room telephones of a common use web on 1000 persons of an urban population;

*stu_emp* — ratio of number of the higher education students in regions of the Russian Federation to a volume of employment in the economy of region;

*plants* — number of enterprises and organizations;

*energy* — generation of electric power (billions kilowatt-hours);

*fuel, chemical* — specific share of the fuel and chemical industry in the branch structure of industry of region;

*god*97, *god*98, *god*02 — fixed annual effects 1997, 1998 and 2002 years accordingly.

### Instruments

For endogenous variables the GMM-instruments were constructed on the basis of the following lagged values of variable in levels:

*dinv*, *dreturn*, *dinv_prom*, *dinv_tran*, *dinv_agri*, *dinv_build*, *dinv_conn*, *dinv_trad*, *dinv_heal*, *dinv_edu*, *dinv_gos*, *dinv_mun*, *dinv_priv*, *dinv_mix*, *dinv_fdi*, *dt_price*, *dplants*, *denergy*.

For construction of GMM-instruments of exogenous variables the variables themselves were applied.

## A4. Outcomes of econometrics

**Table A4.1.** The parameters estimates of the regression equations system for expected profitability and investment[1)]

| Explanatory variables | Inv[2)] |
|---|---|
| 1 | 2 |
| Return | |
| *lreturn* | –0.1757* |
| *exp_peo* | 12.1274 |
| *bud_peo* | –21.7866* |
| *t_price* | 3.8903* |
| *telephone* | –88.2533 |
| *stu_emp* | 95.6419*** |
| *plants* | –0.5780* |
| *fuel* | 0.4376 |
| *energy* | 4.0741* |
| *chemical* | –0.1595 |
| Investment | |
| *linv* | 0.2554* |
| *return* | 0.0052* |
| *exp_peo* | –0.4680*** |
| *bud_peo* | 0.1790 |
| *stu_emp* | 0.6268 |
| *telephone* | –1.3856 |
| *t_price* | 0.0154*** |
| *plants* | 0.0004 |
| *fuel* | 0.0023 |
| *energy* | 0.0002 |
| *chemical* | 0.0135 |
| | |
| p-level Sar | 1 |
| $r_A(1)$ | 0.0822* |
| $r_A(2)$ | 0.0338 |

[1)] * — 1 %, ** — 5 %, *** — 10%. The estimates of the fixed regional and annual effects are not shown. The annual effects 1997, 1998 and 2002 were valued.

[2)] Instruments in the equation of expected profitability of assets are the following: *dreturn, exp_peo, bud_peo, t_price, telephone, stu_emp, plants, fuel, energy, chemical, god*07, *god*08, *god*02. Instruments in the equation of investment: *dinv, dreturn, exp_peo, bud_peo, stu_emp, telephone, t_price, plants, fuel, energy, chemical, god*07, *god*08, *god*02.

**Table A4.2.** The parameters estimates of the regression equations system for expected profitability and investment of different patterns of ownerships[1)]

| Explanatory variables | Gos | Mun | Priv | Mix | Foring |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| Return[3)] | | | | | |
| *lreturn* | 0.0507* | 0.0302** | 0.0303** | 0.0337* | 0.0275** |
| *exp_peo* | –7.9491* | –8.0790* | –7.7730* | –7.2789** | –7.4572* |
| *bud_peo* | 5.3047*** | 5.8174** | 4.2278*** | 4.0031 | 3.9743 |
| *t_price* | 0.6445** | 0.7201** | 0.5880*** | 0.5246*** | 0.5214*** |
| *telephone* | –4.6912 | –10.0002 | –8.9391 | –5.6179 | –13.0337 |
| *stu_emp* | 32.7555*** | 33.2000*** | 25.8199 | 26.5093 | 25.2144 |
| *plants* | –0.0028 | –0.0068 | –0.0071 | –0.0070 | –0.0087 |
| *fuel* | 0.2495** | 0.2447** | 0.2479** | 0.2481** | 0.2508** |
| *energy* | 0.1232 | 0.1227 | 0.0539 | 0.0837 | 0.0708 |
| *chemical* | 0.1163 | 0.1188 | 0.1027 | 0.0987 | 0.1010 |
| Investment[4)] | | | | | |
| *linv_j*[2)] | 0.0821* | 0.3248* | 0.3063* | 0.0265 | –0.1182** |
| *return* | 0.0092* | 0.0006** | 0.0007 | 0.0039*** | –0.0015 |
| *exp_peo* | –0.0171 | 0.0070 | –0.1791 | –0.2160** | 0.0261 |
| *bud_peo* | 0.1597* | 0.0341* | 0.0620 | 0.1626*** | –0.0522 |
| *stu_emp* | 0.2213 | 0.1151 | 0.0496 | 0.0225 | 0.0983 |
| *telephone* | –0.5554 | –0.0819 | 1.8418*** | –1.4675*** | 0.7159*** |
| *t_price* | 0.0166* | 0.0059* | –0.0123 | 0.0100 | 0.0036 |
| *plants* | 0.0000 | 0.0003 | 0.0049* | 0.0004 | 0.0046* |
| *fuel* | –0.0018 | –0.0000 | –0.0006 | –0.0037 | 0.0004 |
| *energy* | 0.0092*** | –0.0002 | –0.0071 | 0.0237** | –0.0020 |
| *chemical* | –0.0005 | 0.0009 | –0.0080 | 0.0042 | –0.0044 |
| | | | | | |
| p-level Sar | 1 | 1 | 1 | 1 | 1 |
| $r_A(1)$ | –0.2240* | –0.1912* | –0.1883* | –0.1921* | –0.1806* |
| $r_A(2)$ | –0.0720* | –0.0824* | –0.0878* | –0.0895* | –0.0931* |

[1)] * — 1 %, ** — 5 %, *** — 10%. The estimates of the fixed regional and annual effects are not shown. The annual effects 1997, 1998 and 2002 were valued.

[2)] The effect of lagged state (*linv_gos*), municipal (*linv_mun*), private (*linv_priv*), mixed (*linv_mix*) and foreign (*linv_foring*) investment accordingly was evaluated in the equations.

[3)] Instruments: *dreturn, exp_peo, bud_peo, t_price, telephone, stu_emp, plants, fuel, energy, chemical, god*07, *god*08, *god*02.

[4)] Instruments: *dinv_gos, dinv_mun, dinv_priv, dinv_mix, dinv_foring* in the appropriate equations of regressions, and also: *dreturn, exp_peo, bud_peo, stu_emp, telephone, t_price, plants, fuel, energy, chemical, god*07, *god*08, *god*02.

**Table A4.3.** The parameters estimates of the regression equations system for expected profitability and investments in branches of the economy[1)]

| Explanatory variables | Prom[3)] | Tran[3)] | Agri[3)] | Build[3)] |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Return | | | | |
| *lreturn* | –0.1397* | –0.1178** | –0.1476* | –0.1297** |
| *exp_peo* | –4.8349** | –4.9869** | –4.8203** | –4.8974** |
| *bud_peo* | 3.4791*** | 3.3337*** | 3.7501*** | 3.4183*** |
| *t_price* | –0.1512 | –0.1352 | –0.0751 | –0.1445 |
| *telephone* | 2.4064 | 0.2097 | 6.3555 | 1.0496 |
| *stu_emp* | 10.0298 | 9.4750 | 12.0989 | 9.9242 |
| *plants* | 0.0008 | 0.0008 | 0.0004 | 0.0007 |
| *fuel* | 0.2385* | 0.2372* | 0.2357* | 0.2387* |
| *energy* | 0.0697 | 0.0612 | 0.0795 | 0.0675 |
| *chemical* | –0.0541 | –0.0537 | –0.0509 | –0.0522 |
| Investment | | | | |
| *linv_j*[2)] | 0.1027* | –0.2086** | 0.0525*** | –0.6680* |
| *return* | –0.0019 | 0.0163* | –0.0003** | –0.0040* |
| *exp_peo* | –0.0589 | 0.1206 | –0.0069 | –0.0983** |
| *bud_peo* | 0.0715 | 0.0477 | 0.0122** | 0.0248 |
| *stu_emp* | 0.4790 | –0.1316 | 0.0861** | 0.1766 |
| *telephone* | 0.7863 | –0.1704 | –0.0359 | 0.0472 |
| *t_price* | 0.0057 | –0.0074 | 0.0006 | –0.0008 |
| *plants* | –0.0001 | 0.0054* | –0.0000 | 0.0019* |
| *fuel* | 0.0011 | –0.0036 | –0.0001 | 0.0013 |
| *energy* | 0.0028 | 0.0156 | 0.0010*** | –0.0001 |
| *chemical* | 0.0005 | 0.0044 | 0.0000 | –0.0023 |
| | | | | |
| p-level Sar | 1 | 1 | 1 | 1 |
| $r_A(1)$ | –0.0666** | –0.0807* | –0.0614** | –0.0733* |
| $r_A(2)$ | –0.1513* | –0.1481* | –0.1501* | –0.1502* |

| Explanatory variables | Conn[4)] | Trad[4)] | Edu[4)] | Heal[4)] |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 6 |
| Return | | | | |
| *lreturn* | 0.1217** | –0.1294* | –0.1010*** | –0.1415* |
| *exp_peo* | –5.1414* | –4.8627** | –4.8102** | –4.8927** |
| *bud_peo* | 3.5672*** | 3.5539*** | 3.2814*** | 3.5128*** |
| *t_price* | –0.0871 | –0.1316 | –0.1654 | –0.1463 |
| *telephone* | 2.7471 | 3.7917 | 2.7462 | 1.2936 |
| *stu_emp* | 11.1700 | 10.9730 | 10.1244 | 10.0405 |
| *plants* | 0.0010 | 0.0011 | 0.0016 | 0.0006 |
| *fuel* | 0.2377* | 0.2380* | 0.2367* | 0.2392* |
| *energy* | 0.0707 | 0.0741 | 0.0651 | 0.0707 |
| *chemical* | –0.0500 | –0.0544 | –0.0528 | –0.0542 |
| Investment | | | | |
| *linv_j*[2)] | 0.1363** | –0.3849* | –0.0112 | –0.2921* |
| *return* | –0.0032* | –0.0042* | 0.0009* | –0.0014* |
| *exp_peo* | –0.0323** | –0.0321*** | 0.0021 | –0.0167 |
| *bud_peo* | 0.0273*** | 0.0261 | 0.0083 | 0.0188 |
| *stu_emp* | 0.1369 | –0.1458 | 0.4642* | 0.1198 |
| *telephone* | –0.0392 | –0.0683 | –0.1634*** | 0.0779 |
| *t_price* | 0.0005 | 0.011 | 0.0005 | 0.0009 |
| *plants* | 0.0021* | 0.0018* | 0.0002** | 0.0002 |
| *fuel* | 0.0002 | 0.0005 | 0.0000 | 0.0005 |
| *energy* | 0.0000 | –0.0007 | –0.0001 | –0.0003 |
| *chemical* | 0.0005 | 0.0003 | –0.0001 | –0.0003 |
| | | | | |
| p-level Sar | 1 | 1 | 1 | 1 |
| $r_A(1)$ | –0.0783* | –0.0724* | –0.0891* | –0.0662** |
| $r_A(2)$ | –0.1470* | –0.1488* | –0.1455* | –0.1519* |

[1)] * — 1 %, ** — 5 %, *** — 10%. The estimates of the fixed regional and annual effects are not shown. The annual effects 1997, 1998 and 2002 were valued.

[2)] The effect of lagged investment in industry (*linv_prom*), transport (*linv_tran*), agriculture (*linv_agri*), construction (*linv_build*), connection (*linv_conn*), trade (*linv_trad*), education (*linv_edu*), public health services (*linv_heal*) accordingly was evaluated in the appropriate equations.

[3)] Instruments in the equation of expected profitability of assets: *dreturn, exp_peo, bud_peo, t_price, telephone, stu_emp, plants, fuel, energy, chemical, god*07, *god*08, *god*02. Instruments in the appropriate equation of investment: *dinv_prom, dinv_tran, dinv_agri*, *dinv_dild,*and also *dreturn, exp_peo, bud_peo, stu_emp, telephone, t_price, plants, fuel, energy, chemical, god*07, *god*08, *god*02.

[4)] Instruments in the equation of expected profitability of assets: *dreturn, exp_peo, bud_peo, t_price, telephone, stu_emp, plants, fuel, energy, chemical, god*07, *god*08, *dog*02. Instruments in the appropriate equation of investment: *dinv_conn, dinv_trade, dinv_edu, dinv_heal*, and also *dreturn, exp_peo, bud_peo, stu_emp, telephone, t_price, plants, fuel, energy, chemical, god*07, *god*08, *dog*02.

**Table A4.4.** The parameters estimates of the regression equations system for expected profitability and state investment[1)]

| Explanatory variables | Variant 1 | Variant 2 | Variant 3 | Variant 4 |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Return[2)] | | | | |
| *lreturn* | 0.0507* | 0.0463* | 0.0398* | 0.0417* |
| *exp_peo* | –7.9491* | –7.9042* | –7.5652* | –7.6345* |
| *bud_peo* | 5.3047*** | 5.1105*** | 4.4967*** | 4.5746*** |
| *t_price* | 0.6445** | 0.5871*** | 0.5367*** | 0.5338*** |
| *telephone* | –4.6912 | –4.9417 | –5.2614 | –4.6941 |
| *stu_emp* | 32.7555*** | 30.8374*** | 27.5663*** | 27.8410*** |
| *plants* | –0.0028 | –0.0028 | –0.0047 | –0.0039 |
| *fuel* | 0.2495** | 0.2499** | 0.2462** | 0.2466** |
| *energy* | 0.1232 | 0.1026 | 0.0766 | 0.07595 |
| *chemical* | 0.1163 | 0.1109 | 0.0986 | 0.1009 |
| Investment[3)] | | | | |
| *linv_gos* | 0.0821* | 0.0731* | 0.0946* | 0.0951* |
| *return* | 0.0092* | 0.0113* | 0.0067* | 0.0075* |
| *inv_edu*[4)] | – | 1.5926* | 1.5316* | 1.5327* |
| *inv_heal*[5)] | – | – | 0.7871** | 0.7751** |
| *inv_bild*[6)] | – | – | – | 0.0287 |
| *exp_peo* | –0.0171 | 0.0084 | 0.0112 | 0.0140 |
| *bud_peo* | 0.1597* | 0.1488** | 0.1548* | 0.1585* |
| *stu_emp* | 0.2213 | –0.3856 | –0.2810 | –0.2651 |
| *telephone* | –0.5554 | –0.3186 | –0.5329 | –0.5378 |
| *t_price* | 0.0166* | 0.0136** | 0.0137** | 0.0138** |
| *plants* | 0.0000 | 0.0001 | –0.0000 | –0.0000 |
| *fuel* | –0.0018 | –0.0028 | –0.0019 | –0.0021 |
| *energy* | 0.0092*** | 0.0095*** | 0.0119*** | 0.0122** |
| *chemical* | –0.0005 | –0.0002 | –0.0006 | –0.0004 |
| | | | | |
| p-level Sar | 1 | 1 | 1 | 1 |
| $r_A(1)$ | –0.2240* | –0.2153* | –0.2036* | –0.2067* |
| $r_A(2)$ | –0.0720* | –0.0775* | –0.0846* | –0.0833* |

[1)] * — 1 %, ** — 5 %, *** — 10%. The estimates of the fixed regional and annual effects are not shown. The annual effects 1997, 1998 and 2002 were valued.

[2)] Instruments: *dreturn, exp_peo, bud_peo, t_price, telephone, stu_emp, plants, fuel, energy, chemical, god*07, *god*08, *god*02.

[3)] Instruments: *dinv_gos, dreturn, exp_peo, bud_peo, stu_emp, telephone, t_price, plants, fuel, energy, chemical, god*07, *god*08, *god*02.

[4)] Additional instrument: *dinv_edu*.

[5)] Additional instruments: *dinv_edu*, *dinv_heal*.

[6)] Additional instruments: *dinv_edu*, *dinv_heal*, *dinv_bild*.

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