КОНСОРЦИУМ ЭКОНОМИЧЕСКИХ ИССЛЕДОВАНИЙ И ОБРАЗОВАНИЯ - РОССИЯ И СНГ
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Spatial distribution of investment in Russia: the effect of agglomeration

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When and where will there be an increase in investment activity? During transition the tendency has been for investment to concentrate in just a few regions. Is the agglomeration of production responsible for this tendency in the regional distribution of investment in Russian Federation? Do investment expectations influence production concentration and investment? Is it possible to alter the spatial concentration of investment that has developed during transition? These questions will be investigated within a macroeconomic model of the agglomeration process that includes investment expectations and the interregional mobility of investment. The author will test the agglomeration theory on Russian data, and empirically identify the influence of expectations on the spatial distributions of investment. The results will be used to develop proposals for regional investment policy.

Keywords: investment, agglomeration, expectation, concentration of production, regions

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Non-technical summary

It is important to use all opportunities involving the investment in the regional economy in order to counteract the investment recession in Russia. In Russia it is possible to select some of the large industrial agglomerations, including, the industrial agglomeration of the central part cities of Russia concentrating around Moscow, the agglomeration of Povolgie cities, the industrial agglomeration of Ural, the agglomeration of Siberia cities located along the Trans-Siberian trunk-line and others. So a role of Povolgie, Ural and Northwest Federal Districts noticeably increases in the regional structure of the industrial output. The Central and Southern Districts appreciably lose their positions. However the Central Federal District still receives the most part of the investment basically owing to Moscow. Analyzing the Russian economic dynamics for the transition period it is possible to select at least two different processes: the rise and fall of industrial concentration. Empirical analysis of agglomeration factors has shown that two types of industrial concentration: absolute and relative should be taken into account.

Thus, the fundamental goal of our research is to establish if the tendencies of spatial distribution of investment in the Russian regions could be explained within the theory of new economic geography and be determined by agglomeration process of production in the regions. Our main hypothesis is the following. The economic perspectives of regions find the reflection in positive or negative expectations of investors; it attracts the investment in regions and creates the circular causality of the further production growth and the investment concentration. The following research objectives were presented as basic ones. To develop the macroeconomic agglomeration model of the investment process taking into consideration the investment mobility and the investor expectations and to check up how concentration in the falling economy, which was observed during the transitional period in the Russian Federation, is explained theoretically. Whether the mechanism of concentration in the falling economy differs from the mechanisms of concentration in the growing economy.

We have considered the agglomeration model with positive external economies of the investment concentration in one region. It was established that the investors' behavior and role of expectations in many respects are determined by parameters of the economy. From the point of view of the economic policy it is important to note that the concentration depend on such parameters as the speed of adjustment, external economies, interest rate, which can be used as the instruments of regulation of the agglomeration process. It is established that some different variants of economic development are possible. First variant is that the development is completely determined by the historical tendencies. Second, it is possible to change dynamics of economic development by influencing of expectations of the most part of investors.

Use of the accelerator model in framework of the agglomeration model is the new moment in research of agglomeration and allows simulating not only growing, but also falling dynamics of the economy. It was discovered, that concentration is possible not only in conditions of economic growth, but also in conditions of decreasing dynamics of production and investment. It was proved, that the mechanism of the agglomeration processes in case of the decreasing economy is the same, as in case of the growing economy and one is conditioned by such parameters as force of external economies, rate of return and speed of adjustment of investment. It is proved that the concentration process in case of the falling economy is connected to migration of production in regions with a dominance of extractive industries and raw specialization of the economy, as it had occurred in the Russian Federation in the transition period.

It was found that there are the trajectories of an economical dynamics, when the most part of investment is reallocated for region with increasing return, and it is possible providing development of manufacturing industries and appearing of the effect of external economies. At the same time, certain part of investment remains in regions with constant return. Both regions develop successfully, and this pathway, seems to be most favorable for the country providing more stable growth of the economy, investment and national income. The full production concentration in region with constant return and formation of completely raw economy can be as alternative. The production concentration in raw sector gives the lowest parameters of dynamics of investment and national income on all trajectory of the development. The path leading to production concentration in region with increasing return are connected with change of technologies, management, organization of production, structural rearrangement of economy, updating of the manufacturing equipment that demands considerable costs before it is possible to receive the investment yield. But this variant of the economic policy guarantees higher return than raw specialization.

The goal of the econometric research is to establish types and features of the industrial concentration processes in the Russian Federation and in the separate industries, and to evaluate whether the investor expectations influence the investment process in the regions, or not

The basis for construction and estimation of the econometric model is the sample from 78 subjects of the Russian Federation: 6 territories, 70 areas, and two cities - Moscow and St.-Petersburg. The analyzed period covers 1993 – 1999 years.

The sample represents the panel data distinguished by a plenty of objects and a short time interval. To estimate of the equations the production data in industries and investment are utilized. The indexes are cleared from the inflation and are expressed in price of 1990. The main part of the used information was submitted in the statistical collection «Регионы России» for 1996- 2000 years and «Российский статистический ежегодник» for 1994, 1998, 1999 years published by Goscomstat.

The outcomes of empirical research have shown the following. Testing of two types of agglomeration of industrial production: absolute and relative prove the hypotheses concerning influencing of concentration on a spatial distribution of investment in the economy of regions in transitional Russia.

Testing of regression with different variants of territorial structure of the Russian Federation was performed. The regression for all regions of Russia and regression with differentiation of conditions by groups of regions were estimated. The regions groups include: regions with predominance of manufacturing industries, regions with predominance of extractive industries and northern group of regions, in which also the leading role belongs to raw industries. Testing of variants of regression with different territorial structure has confirmed positive relationship between investment and production concentration in industries. It was demonstrated that in Russia during transition the concentration of production and investment in separate regions occurred being under the influencing of investors' expectations.

Insertion of the conditions of regimes switching of positive and negative investors expectations in the estimated models have allowed to find the essential relationship between expectations and concentration of investments and production. The significant outcomes are obtained both for positive and for negative expectations, and the nature of this relationship is determined by a regime of expectations of the investors. It is discovered that positive expectations of the investors concerning the production concentration growth of industries in regions increase the investment in these regions, and stimulate further concentration of industries. When the negative expectations dominate, the reduction of investment in the economy of regions and decrease in a concentration level occur. Moreover, it is empirically demonstrated that influencing of expectations: positive and negative ones are essentially differed by the regions groups depending on branch specialization and specific characteristics of separate groups of regions.

Section 1. Introduction

One of the basic goals of the Russian economy is the investment activity increasing. The distinctive features of spatial organization of production in Russia are a large territory, essential non-uniformity of regional economic development, the significant transport costs. Many regions have the narrow industrial specialization. For Russia the high labor migration is not typical in a transition period. The pre-computations have shown that the Herfindal-Hirshman concentration index, counted by the data of employment in the economy, remained stable during all transition period except 1999 while the index of the investment concentration has grown more than twice (fig. 1.1). It is possible to find both the period of stabilization and the period of growth of the investment and production concentration in the Russian economy during transition. The tendency to the rising of the production concentration and especially the investment concentration was observed during the stabilization of the exchange rate of the dollar (the currency corridor 1995 - 1997) and the decreasing of the interest rates. In the period of the high inflation unto 1995 and after the financial crisis of 1998 the interest rates have grown significantly, but the indexes of the investment and production concentration have been stabilized and even decreased a little.

The concentration is an operation result some economic mechanisms and can be observed not only in case of the economic growth but also in case of the negative dynamics. During transition in Russia the concentration was substantially connected with the industrial production and investment falling (fig. 1.2).

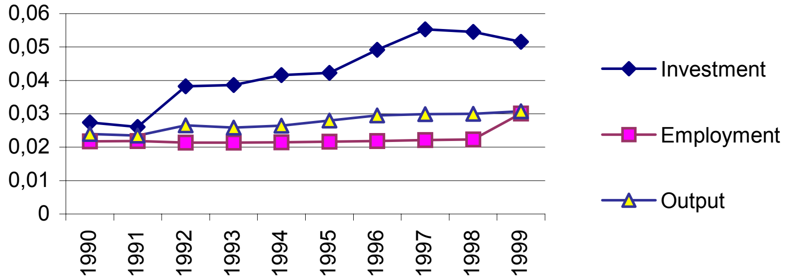

Fig. 1.1. Dynamic of the investment and production concentration. The Herfindal-Hirshman concentration index[1]

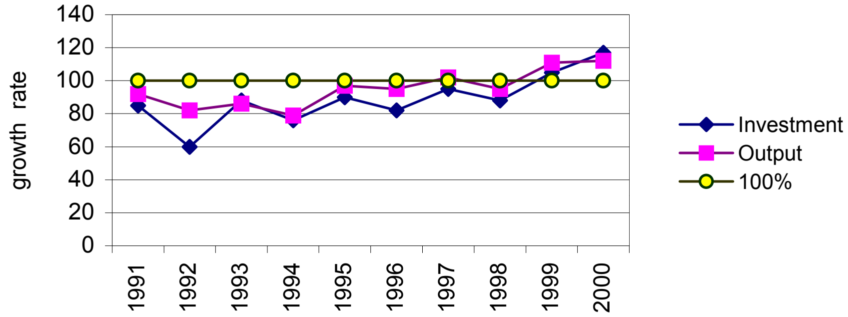

Fig. 1.2. Indexes of industrial production and investment in theRussian Federation during transition (in the comparable prices, in percentage by the previous year) [2]

In Russia it is possible to select some of the large industrial agglomerations, including, the industrial agglomeration of the central part cities of Russia concentrating around Moscow, the agglomeration of Povolgie cities, the industrial agglomeration of Ural, the agglomeration of Siberia cities located along the Trans-Siberian trunk-line and others. Some representation about the development tendencies of the mentioned agglomerations during the period of reforms could be obtained using the data on structure of industrial production in districts of the Russian Federation (fig. 1.3, 1.4). So a role of Povolgie, Ural and Northwest Federal Districts noticeably increases in the regional structure of the industrial output. The Central and Southern Districts appreciably lose their positions. However the Central Federal District still receives the most part of the investment basically owing to Moscow. Ural and Povolgie, in which the petroleum and gas extraction are concentrated, takes the

[1] Calculated by «Регионы России», М: Госкомстат, 1996 – 2000 гг.

second and third positions in a share of the investment in 2000-th year. The share of investment has considerably fallen in the Siberian and Far East federal districts.

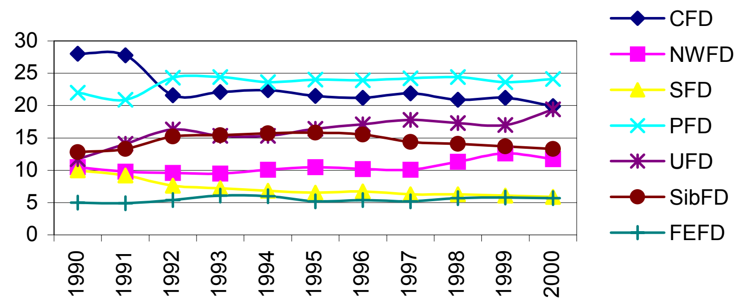

Fig. 1.3. Densities of the federal districts in industrial production of the Russian Federation, %[3]

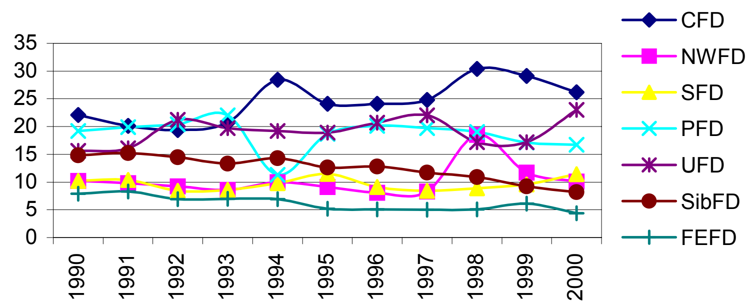

Fig. 1.4. Densities of the federal districts in the investment in the Russian Federation, %[4]

It is important to use all opportunities involving the investment in the regional economy in order to counteract the investment recession. Therefore, the spatial analysis is important for the Russian economy. It is necessary to conduct the researches explaining the spatial distribution of investment, including one explained by concentration.

Changes of spatial distribution of investment, as a rule, are closely coordinated with changes of production. We want to pay attention to those parameters, which explain the spatial distribution of production and investment in framework of the agglomeration theory of new economic geography (NEG). We can select two basic

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[2] Регионы России 2001. М: Госкомстат, 2001, – стр. 374 – 375 , 762 – 763.
[3] Calculated by «Регионы России 2001», М: Госкомстат, 2001
[4] Calculated by «Регионы России 2001», М: Госкомстат, 2001

groups of factors for the analysis. The first group includes the observable indicators of industrial production: prices, tariffs, and the second group accumulates the indicators which are not observable directly but influencing the investment decisions. Externalities and increasing returns also are important in the agglomeration process.

Thus**, the fundamental goal of our research** is to establish if the tendencies of spatial distribution of investment in the Russian regions could be explained within the theory of new economic geography and be determined by agglomeration process of production in the regions.

Our main hypothesis is the following. The economic perspectives of regions find the reflection in positive or negative expectations of investors; it attracts the investment in regions and creates the circular causality of the further production growth and the investment concentration. Besides the expectations the spatial distribution of investment is influenced by the basic parameters of the regional economy: a current production concentration in the regions, size of a home market, costs of production factors, transport costs, which determine the efficiency of industrial localization in one region and define the process of the production and investment concentration.

Analyzing the Russian economic dynamics for the transition period it is possible to select at least two different processes: the rise and fall of industrial concentration. Empirical analysis of agglomeration factors has shown that two types of industrial concentration: absolute and relative should be taken into account. Therefore, the absolute and relative industrial concentration is investigated. Besides, we are going to check whether the investors' behavior differs in both types of the agglomeration dynamic.

The following research objectives were presented as basic ones.

1. To develop the macroeconomic agglomeration model of the investment process taking into consideration the investment mobility and the investor expectations. To find in which of the equilibrium points are the Russian economy at the present time.
2. To check up how concentration in the falling economy, which was observed during the transitional period in the Russian Federation, is explained theoretically. Whether the mechanism of concentration in the falling economy differs from the mechanisms of concentration in the growing economy.
3. To establish types and features of the industrial concentration processes in the Russian Federation and in the separate industries.
4. To evaluate whether the investor expectations influence the investment process in the regions, or not.

The **theoretical significance** of the researches is the following. The conducted researches develop the economic theory of agglomeration taking into account the influence of investor expectations on the spatial distribution of economic activity and investment; it is given the empirical check of adequacy of the Russian data to the new economic geography theory; it is allowed to evaluate the key agglomeration parameters for Russia; it is allowed to test the influence of investor expectation on the spatial distribution of investment.

The **practical significance** of the researches is the following. On the basis of the obtained results it is proposed the recommendations to use the tools of regional industrial and investment policy in individual branches of industry and regions groups such us regions with the predominance of extractive industry, the manufacturing industry group and the northern group of regions. Measures decreased the adjustment costs of investment and transport costs, measure created the conditions to form positive expectations of the majority of investors and measures formed the domestic regional market can be used as the economic policy tools.

Section 2. Literature review

Theoretical researches. Explanation of spatial distribution of investment using such theories, as the theory of investment risk, ignoring the analysis of the arrangement of output, does not give sufficiently complete explanation of the investigated phenomenon. The indexes of risk do not allow to explain distribution of investment over the regions, do not give the answer, why investment arrives more in those regions, in which the risk is higher, why shares of investment differ some times in regions closed to a risk level (fig. 2.1). So, for example, the risk level in Adigeya, Sverdlovsk and Belgorod areas, according to agency "The Expert ", is 0,872, 0896 and 0,898 accordingly, and the share of investment of these regions from all investments in the Russian Federation is equal to 0,08 %, 3,47% and 0,96 % respectively. Let's take regions, for which the risk level is higher: Altai, Leningrad area and Tatarstan. For the second group of regions the values of risk index are equal 1,139, 1,141 and 1,145 correspondently, and the share in the investment equals 0,04 %, 1,16 % and 3,47 % accordingly. The theory of investment risk, fixing a present condition of a various aspects of risk in region, in common, does not explain, why there was a modern production structure, as it will change. The spatial arrangement of investment in the real sector of the economy is necessary to consider in correlation with the spatial arrangement of output. The processes of production and investment are indissolubly interconnected, and the long-term processes of the spatial arrangement of investment can be explained only within the framework of model explaining the spatial distribution of production.

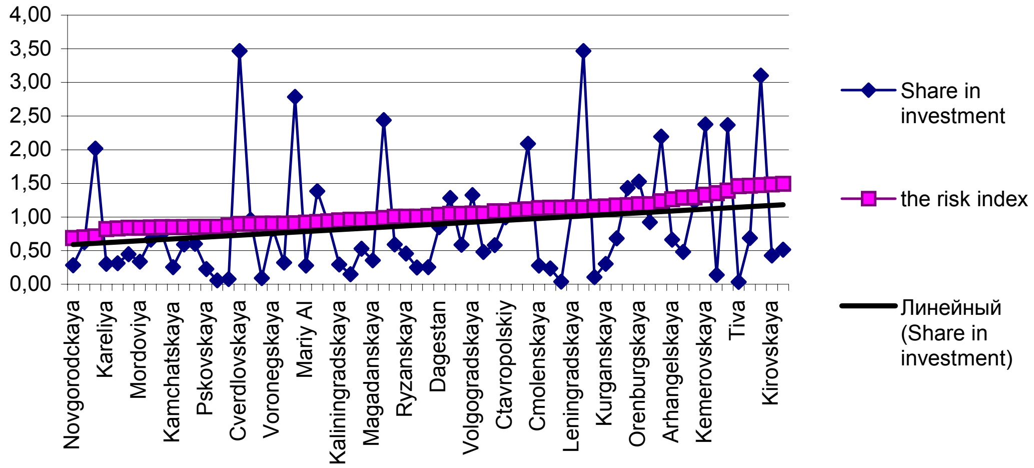

Fig. 2.1. A share of some regions in volume of investment in the Russian Federation and indexes of investment risk[5]

Models of spatial distribution of production, in particular, in frameworks of Neo-classical theory, have traditionally explained the spatial differentiation of regions through the differences in stores of natural resources, endowments by the factors of production, technological differences; for example, these determinants traditionally appear in the Heckscher-Ohlin model. The enumerated factors exogenously determine an inequality of regions. In structure of territories non-uniformly endowed by the factors of production, economic integration leads to specialization of regions according to their comparative advantages. Therefore in Neo-classical theory the dominating location pattern is the inter-industry specialization of regions. There is a unique long-term equilibrium (comparative survey of works of the Neo-classical theory is possible to find in Breulhart M. (1998)). Absence of significant distinctions between regions in a combination with a constant returns to scale, zero costs of adjustment and perfect competition predict that the production will be evenly distributed across territory of the country. However such explanation fails, when the primary similar regions develop unequally forming different industrial structure, the explanation to rough growth of the separate countries is not given. Comparative advantages, as well as the factors of risk, are relative and also give a little in an explanation of spatial concentration of economic activity, when the regions which are highly similar by the factors of production, have very different industrial structure.

The models of the new trade theory, considering imperfect competition, take into account intra-industry differentiation of products and increasing return. They try to explain, why the countries without essential comparative advantages regarding each other can create different technological structures on the basis of distinctions in their access to the market (review of works of the new trade theory see in Breulhart M. (1998), Ottaviano G., Puga D. (1998)). There are generally no distinctions in comparative advantages in traditional sense as endowments by natural resources in models of the new trade theory. There are distinctions connected to access to the market, however size of the market is limited. The attempt was undertaken to explain spatial structure of manufacture through effect of a home market (Davis, D.R. And D.E.Weinstein (1996), (1998)). However in models of the new trade theory the distribution of economic activity is given exogenously, the size of the market is limited and there is still a unique equilibrium.

And only in models of new economic geography the spatial distribution of production becomes completely endogenous, producers and factors of production are mobile. Even the sizes of the market are explained within the model. It was obtained the explanation of equilibrium set existence. The volume of investment is defined by the requirements of production development. The theoretical models of new economic

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[5] The data is taken from «Regions of Russia 2001», М: Госкомстат, 2001, and «Expert», site http://

geography (NEG) introduce a substantial contribution to an explanation of non-uniformity of spatial distribution of economic activity. There are a lot of papers devoted to the problem of industrial agglomeration: Krugman P. (1991a, b, c), Matsuyama K. (1991), Venables A. (1996), Fujita M., Krugman P. Venables A. (1998), Krugman P. Venables A. (1995, 1996), Puga D. (1998), Martin P. Ottaviano G.I. (1996, 1998), Baldwin R.E. (1998), Markusen J.R., Venables A.J. (1997) etc. They formally explain the appearance of agglomeration and describe the agglomeration as a process by increasing return to scale (IRS), imperfect competition (MC) and non-zero trade costs.

The migration of labor forces is considered by (Krugman P., 1991a, b) as production concentration mechanism in separate regions, which is typical in a greater degree for the USA economy. Besides, vertically-integrate links between industries related to IRS-MC (Venables, 1996), (Krugman P., Venables, 1995), inter-temporal links of an input - output (Martin, Ottaviano, 1996), intermediate costs (Krugman P., 1991b) - last mechanisms are more appropriate for countries of the European Union, technological spillovers and R&D (Krugman P., 1991b), (Martin P., Ottaviano G., I., 1996), local technological externalities as the factors of accumulation (Martin P., Ottaviano G., I., 1998), allocation in the centers of the transport networks (Krugman P., 1993), (Fujita M., Mori T., 1997) are considered.

It is attended dynamics and location of production in the models, but the problems of spatial distribution of investment are not considered at all. A lot of theoretical works are devoted to researching of foreign direct investment (FDI) and feedback links with it (Markusen, Venables T., 1997), (Baldwin R.E., Ottaviano G.I., 1998). Baldwin R.E. (1998) has investigated the problem of endogenous nature of the

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capital. The paper of Forslid K. (1999) is devoted to analysis of influencing of the capital as a set of knowledge.

Distinctive feature of all these models is the growth of the market size and appearance of various externalities concerned with it. For Russia the most famous example of influencing of the pecuniary externality is Moscow, and technological externality is the aluminium complex of Siberia. Externalities determine the nature of the agglomeration process. Presence of pecuniary or technological externalities, the increasing return, costs of adjustment in a combination with an incomplete competition give self-reinforcing agglomeration process. Any disturbance to initial distribution of economic activity will lead the economy to a trajectory directed to new long-term equilibrium. Reaching of any equilibrium depends on the initial location of production, parameters of the economy, performance of the industries. The final agglomeration outcome is only one of the possible variants. The agglomeration process can have not only monotone, but also the cyclic character because of costs of adjustment, it cannot have connection with economic integration, and the economy becomes more polarized in space. Possibility of several equilibriums makes the difficulties for the empirical check of NEG. Reaching of some equilibrium point depends on a combination of the agglomeration factors, initial conditions and counteracting factors. Among the basic parameters, which determine a possibility of agglomeration, the transport costs are considered (Krugman P., 1991a, b). The agglomeration process then arises when the transport costs correspond to some average level. In other cases there is a dispersion of the industries over the regions. Only existence of externalities allows to explain the agglomeration as a process.

In the model of Markusen, Venables T. (1997) foreign direct investment in a final product is considered. It creates feedbacks between the surplus of the intermediate goods and technological externalities. The main conclusion is FDI replaces the import. Baldwin R.E., Ottaviano G.I. (1998) have shown that trade and FDI can substitute each other when the part of varieties is produced abroad. It creates a trade effect in the form of the re-import in addition to the usual trade displacing effects. Baldwin R.E. (1998) considers the building activity as the sector making non-tradable goods. The author has shown that, if the owners of the capital are not mobile, even if the capital is mobile, then the shift in the expenditures does not arise and, therefore, there is no circular causality. Therefore mobility of the capital is considered a stabilizing force.

In the papers of Krugman P. (1991b, c), Matsuyama K. (1991), Baldwin R.E. (1999) influencing of expectations is investigated and demonstrated that, under certain conditions, expectations can result the economy in a new local equilibrium. Analyzing a role of expectations, Krugman P. (1991b, c) and Matsuyama K. (1991) connect them with technological externalities. Ottaviano G.I. (1996) studies the problem within the framework of pecuniary externalities. Expectations can change history if the discounted value of the future incomes is essential to cover adjustment costs and the people are patient. Ottaviano G.I. (1996) has demonstrated the great significance of such factors, as trade costs and scale economies for expectations. We assume, that these factors can play an essential role for Russia too.

However, any research in the field of agglomeration touching on the investment do not consider regularity of spatial distribution of home investment and do not consider investment in a context of investors expectations.

Empirical researches. The effect of external economies is difficult to measure directly. Hanson G. H. (2000) emphasizes the following identification problems: the existence of unobserved regional characteristics, simultaneity in the regional data and multiplicity of externalities sources. Moreover the empirical check is hindered by set of equilibrium points, including those, which can be explained in the frames of the other theories, and the presence of the immobile factors which counteract the agglomeration.

The greatest part of the empirical researches in the field of agglomeration is devoted to find the evidence of existence of scale economy, the increasing returns and the effect of agglomeration. Dumais G., Ellison G., Glaeser E. (1997), Kim (1995) have conducted the researches in USA. In the first investigation the indexes of industrial concentration and co-agglomeration were estimated, and it was found the considerable evidence that there is the localization connected with the labor market. In the second one, the indicators of regional localization and specialization were used; the existence of long-run trend in a specialization and scale economies were confirmed. Hanson G. H. (1997, 1998) has considered the increasing return and the agglomeration in Mexico using the data on wages. The researches over the European Union can be found in the articles of Bruelhart M., Trionfetti F. (1999); Bruelhart M. (2000); Davis D.R., Weinstain (1998) etc. The researches conducted by Antweiler W., Trefler D. (2000) have covered more than 70 countries. The most part of investigations depend on the data of the international trade, the added value or the industrial employment. The hypothesis that the foreign firms are placed where there is a local concentration of the foreign firms was confirmed by the Japanese firms location in USA (Head et al., 1995). Influencing of the transport costs on the agglomeration process have been demonstrated by Hanson G. H. (1997, 1998) and Haaland J.I. et al. (1999). Davis D.R. and Weinstain (1998) have found the evidence of increasing return in connection with the comparative advantages. To prove it the authors have used the specially constructed variable of idiosyncratic demand

(IDIODEM). It has been later used by Bruelhart M. and Trionfetti F. (1999) in the gravity models with variable of bias.

The researches of FDI determinants basically predominate among the empirical investment researches. Particularly the research of Wheeler and Mody (1992) are dedicated to FDI of the American trans-national corporations and also confirms the tendency to agglomeration. Driffeld and Munday (2000) have conducted research in UK and established that FDI promote the growth of industrial agglomeration and technological spillover. The authors have controlled the influencing of the industrial capital, intra-industry investment and non-tariff barriers.

Bevan A.A. and Estrin S. (2000) have estimated the determinants of FDI in the transition economy according to the data of the Central and East Europe countries. Among the major factors the authors have evaluated a country's risk, which one includes the macroeconomic, institutional and political stability, expected profitability, labor costs concerned with a manpower, the size of the home market and the gravity factors. The main conclusion is the following: the essential influencing on FDI is rendered by the membership in the EU. The researches of inter-relationship between FDI, R& D and technological spillover in the industry of Czechia are reported in Kinoshita's (2000) work. However, the benefit of technological spillover of foreign firms was not found. The macroeconomic analysis of the internal investment in Slovenia was conducted in Prasnikar J., Svejnar J. (2000). It was demonstrated that the investment behavior of firms is more consistency under conditions of the imperfect capital market. The firms demonstrate strong negative links between internal investment and wage.

Brawn J.D., Earle J.E. (2000), Ahrend R. (2000), Kozlov K. et.al. (2000), Popov V. (2000), Михеева Н.Н. (2000) have dedicated the determinants researches of the development of the Russian economy. Волчкова Н.А. (2000) have studied investment in FPG. Tax stimulation of investment is investigated by Аркин В. etc. (1999), Коломак Е. (2000).

Brawn J.D. and Earle J.E. (2000) explain monopolistic power of the enterprises by the geographic factors underlining the importance of the country size and the dispersion of firms. On the other hand, the transport infrastructure, privatization and the economic reforms, in general, enhance a competition. It was used the Herfindal-Hirshman index as index of the market concentration calculated to 1992. It is established, that the concentration significantly influences the value added. However the dynamics of concentration and the dynamic aspects of the concentration influencing were not considered. Михеева Н.Н. (2000) and Ahrend R. (2000) have conducted researches of distinctions of the regional growth rates accordingly to the regional data. Ahrend R. (2000) concludes that the distinctions in the economic reforms explain much less in an economic situation of the regions than primary structure and competitiveness of industries, natural resources and labor skill. It is not found influencing of the political factors, including political orientation of the regional leaders on the regional growth. Moreover the essential influencing of FDI on the real incomes and industrial production it is not revealed. Popov V. (2000) has established that resource endowment, the force of institutes significantly influence the output and investment, but the evidence of influencing of regional reforms such as deregulation of the prices, small privatization, is not revealed. Therefore, in our research we did not use the political risks and the progress of reforms in the regional economy, considering these factors concerned the whole economy and determined the development of all economical country space.

Section 3. The theoretical model of the industrial agglomeration

As a basis of research the P.Krugman's (1991c) model is used. We offer the model with two regions. In contrast to Krugman's model we should consider the investment as a mobile factor determined the production concentration taking into consideration intensive processes of the investment concentration (fig. 1.1) during the transition period. The proposed variant of the model gives the most interesting interpretation of investment concentration for the Russian economy in view of its regional structure.

We shall consider the agglomeration model with positive external economies of the investment concentration in one region. The agglomeration models with external economies generally have some different equilibrium points. The achievement of steady states can be determined both the historical tendencies and the effect of expectations, or, so-called, self-fulfilling prophesies. Krugman P. (1991c) has demonstrated with the simple model of trade, that both the historical tendencies and expectations of the future depending on the parameters of economy can determine the selection of equilibrium. We shall consider a model, in where both history and expectation also play the essential role in the spatial distribution of investment. The role of investors' expectations to achieve the steady states will depend on the parameters of the economy: the strength of external economies, the speed of investment adjustment, and the interest rate. Feature of proposed model is: the self-fulfilling prophecies occur, when the determined dynamic system demonstrates the oscillatory behavior.

We offer two versions of the model. The first variant, which is the most simple, allows a constant volume of investment in the economy. It illustrates all main features of the model, in which the essential role to achieve the equilibrium, depending on the parameters of economy, can play both the historical tendencies in the spatial distribution of investment and the investors expectations. The second version of the model includes the possibility to change the total volume of investment in the economy by the way of the mechanism of the accelerator, which allows connecting the dynamics of the investment change and the national output.

The investment, as a rule, comes to those regions in which the yield is higher. Nevertheless, the spatial structure of investment varies step-by-step, because of their adjustment costs including, for example: building of objects, creation of the infrastructure, training of the staff and etc. The investment migration between regions has gradual pattern; the effect of increasing returns comes not at once. Therefore the investors will be interested not only in current investment yield but also expected yield in future. Existence of future externalities depends on the current solutions in the disposition of investment by other investors, which also depend on the expected investment yield. If the most of the investors should think that the historical tendency of investment distribution is saved, then the history should play a leading role. However if the most of the investors should expect, that the economy come to other equilibrium, then, at least, potentially, there is a possibility of self-fulfilling prophesies, and the expectations in the greater degree than history should determine a spatial pattern of the investment. Thus, we want to show, that in the dynamic aspect the history and the expectations both can be as determinants of the spatial investment distribution.

The agglomeration model with external economies and constant volume of investment in the economy

Let's consider the economy with two completely identical regions: X and A (the notes of all variables and parameters of the theoretical model are shown in appendix 1). The industries with the constant return to scale, for example, extractive industry concentrate in the region A. The industries, which demand more resources but provide increasing return to scale due to the external economies, for example, manufacturing industries, develop in region X; they consequently are object of externalities. Investment is only factor determining the volumes of production; they are allocated and depreciated for one year. It is supposed, the economy is capable to sell everything that is produced in both regions at fixed prices on world markets. The concentration of production in the region X allows putting up return of investment.

Let's mark the investment return in the region i through π_i:

$$\pi_i = \pi_i(I_i), \ \ i = X, A. \qquad (3.1)$$

Selecting the units of the output and the investment, we can normalize them so that one unit of investment in the region A allows producing one unit of goods in the extractive industries and value of that unit also will be equal to one. Therefore we shall accept the investment return in the region A equal unity: $\pi_A = 1$.

In the region X the investment return depends on a level of the investment concentration in the region. Since the scale economies are external each investor accepts it as a value, given at each moment, and consequently for each investor the investment return will be equal to average return:

$$\pi_x = \pi_x(I_x).$$

We shall consider π as the relative rate of the investment return in the region X setting $\pi = \pi_x / \pi_A$. Besides in case of full concentration of the investment in one of regions we have the following: $\pi(0) < 1$ and $\pi(I) > 1$, where I is the total volume of investment in the economy.

Thus, full concentration of investment in one region is the equilibrium points. So in case of the production concentration in A, if someone of investor will plan to move the production to X, his yield will be lower than yield in the region A, and, consequently, concentration in A is an equilibrium point; no investor leaves it. If all production is concentrated in X, the investing in the region A of one investor will mean a decrease of a level of his yield; therefore the point X also is equilibrium. Let, there is a point I_x^*, in which the investment yield in both regions is equal one. Intuitively it is obvious, that this point also is an equilibrium point, where $\pi\left(I_x^*\right) = 1$.

Let's make the dynamic formation of the model. Consider costs of reallocating investment are a quadratic function of the rate at which the investment is moved to the region X. Thus, the income, which the investors will receive in both regions at the moment t, is

$$R = \pi(I_x)I_x + (I - I_x) - \frac{1}{2\gamma}\left(\dot{I}_x\right)^2, \qquad (3.2)$$

where γ is an inverse index of the adjustment costs there for $1/\gamma$ characterizes the speed of the investment adjustment. Due to the costs of adjustment the investment solution will depend not only on differences in yield taking into account a modern spatial pattern of production, but also from the expected investment yield under conditions of the shift of spatial production pattern. The future investment yield depends not only on one investor, but also the solution of other investors. If it is expected, that the most part of the investors will put in X then the production moving from A to X will result in the increase of attractiveness of the region X even if there is no the immediate effect on the investment yield. Thus, we have dynamics in distribution of investment in regions, which will be largely connected to expectations.

Let investment moves between regions with rate m

$$\dot{I}_x = m\,. \tag{3.3}$$

We shall suppose, that the investors can lend or borrow credits without limitation on world markets at the given world interest rate r. The investor objective is to maximizes the present value of the income

$$H = \int_0^{\infty} Re^{-rt} dt \to \max\,. \tag{3.4}$$

As the economies are external and do not depend on the separate individual, the investors accept π as given value at the moment t. The solution of the optimization problem of (3.2) - (3.4) are the following two equations (see appendix 1):

$$\dot{I}_x = \gamma q\,; \tag{3.5}$$

$$\dot{q} = rq - (\pi - 1), \tag{3.6}$$

where q is the shadow price of the investment in X with respect to A, $\dot{q}$ is the rate of gain of the shadow price. The shadow price reflects the differences in the values between unit of investment in regions X and A, and is determined as

$$q(t) = \int_t^{\infty} (\pi - 1) e^{-r(\tau - t)} d\tau\,, \tag{3.7}$$

Thus, the rate of moving of investment between regions depends on costs of adjustment and shadow price of investment. If the volume of investment in the economy is stable, then the equations (3.5) and (3.6) determine dynamics of development of a system in space I_x and q.

The system behavior is depicted in a fig. 3.1. The arrows on the figure indicate the path of the system moving (3.5) - (3.6). The economy moves to full concentration of the production in *A* or in *X* depending on the sign of the shadow price of the investment. If q is positive, there is a tendency to concentration in *X*, and, if the shadow price of investment is negative, the production moves to agglomeration in *A*. The line *AX* intercepts an abscissa axis in a point $q = 0$ and $I_x = I_x^*$. On that line the value q is equal to present value of gain of the investment income in the region *X* in comparison with the region *A* providing that the investment return is a constant value:

$$q = \frac{\pi - 1}{r}.$$

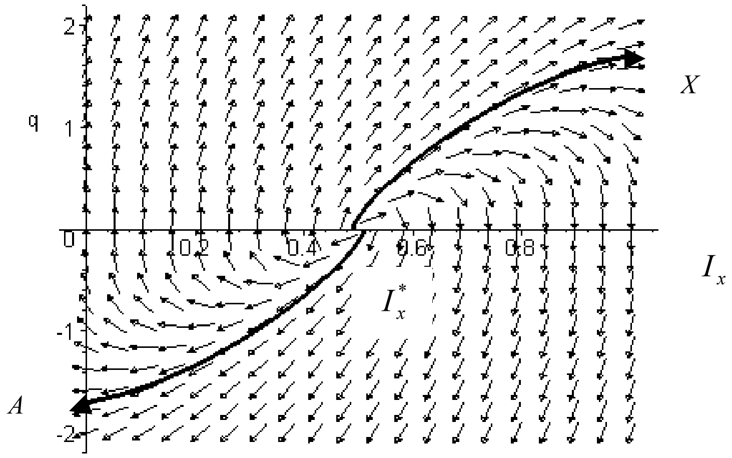

Fig. 3.1. Monotonic dynamic of the system behavior

Two long-term equilibriums with a full agglomeration of the production in one of the regions are possible in the points *A* and *X*. The shadow price q in each of equilibrium points demonstrates a difference between present value of the real investment income and present value of that income which the investors could receive if the production was concentrated in the other region for a indefinitely long time.

Let relation of external economies from volumes of investment is

$$\pi = 1 + \beta\left(I_x - I_x^*\right), \tag{3.8}$$

Inserting π into expression (3.6), we have

$$\dot{q} = rq - \beta\left(I_x - I_x^*\right). \tag{3.9}$$

Solving a system (3.5), (3.9) we shall receive two roots

$$\rho_{1,2} = \frac{r \pm \sqrt{r^2 - 4\beta\gamma}}{2}. \tag{3.10}$$

Depending on combinations of parameters we have two real positive roots, including a case of the multiple roots, or two complex roots with positive real parts and consequently two different paths are possible. In a point $I_x = I_x^*$, $q = 0$ we have unstable equilibrium.

For $r^2 > 4\beta\gamma$ we have two real roots. The system is unstable and moves away from a point $I_x = I_x^*$, $q = 0$ (see fig. 3.1). The path connecting the equilibrium point *A* and *X,* has a form of a S-curve. Let's assume, we know the spatial structure of investment. Then the shadow price in the initial state will determine the final point, to which we shall come on a S-curve. If initially $I_x > I_x^*$ and $q > (\pi - 1)/r$, the economy step-by-step will come to full concentration of investment in *X* and full agglomeration of the production in the region with the manufacturing industries. If initially $I_x < I_x^*$ and $q < (\pi - 1)/r$, the economy, moving according to law of dynamics, will come to full raw specialization of industrial production in *A*. Thus the dynamics of a system depicted in a fig. 3.1 completely corresponds to the theoretical rules of location stating that the resources and investment are displaced in a direction of higher yield; therefore, in case of the S-curve the leading role in the definition of trajectory of a system belongs to the historical tendencies.

However this path of the territorial structure changing is not only possible. For $r^2 < 4\beta\gamma$ we have two complex roots with a positive real part. In this case the system is also unstable and diverges from I_x^* with oscillations (fig. 3.2). Therefore, the other possible path to long-term equilibrium is the spiral one.

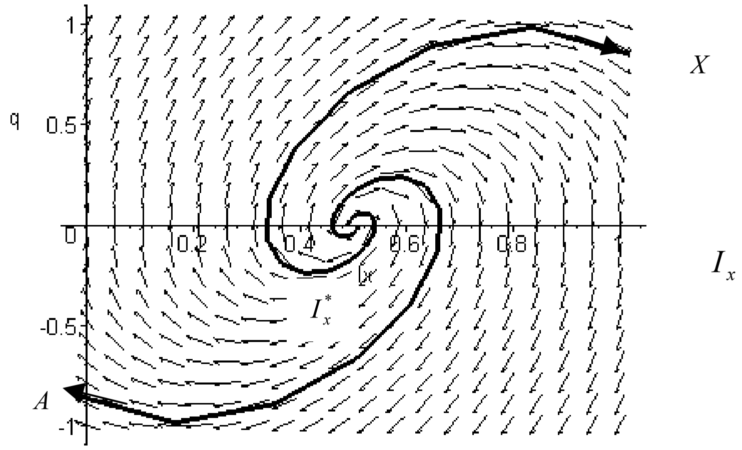

Fig. 3.2. The oscillatory behavior of the system

In case of the complex roots, the equilibrium path represents two interlocking spirals that diverge from the center in a direction of full concentration of the production in one or in the other region. These two spirals are not intercepted anywhere; therefore from any point there is alone path, which conducts to one in two equilibriums. Any small shift in territorial structure of investment from equilibrium point $I_x = I_x^*$, q =0 after limited number of oscillations will move a system to either of the steady equilibrium states.

In case of spiral movement of the system there is a range, in which either equilibrium can be reached. P. Krugman (1991c) has called a range with oscillations in the form of a two interlocking spiral as *overlap*. Hereinafter we shall use the same terminology. After restricted number of oscillations the path leaves the range of the overlap and monotonically moves to either long-run stable state. Let's point out, that the main characteristic of the solution with overlap is an existence of range from which either long-term equilibrium can be reached. In the range of overlap the leading role in definition of a path belongs to expectations.

It is possible to show that in model the optimization of the income of the investor and the optimization of a consumption of the investor gives the identical agglomeration mechanism. Let investor maximizes a level of the consumption $(R - I)$:

$$\int_0^\infty \left((\pi - 1) I_x - \frac{1}{2\gamma} \left(\dot{I}_x \right)^2 \right) e^{-rt} dt \rightarrow \max \qquad (3.2a)$$

subject to (3.3). As we can see, the solution of the problem (3.2a) - (3.3) are equivalent to the solution (3.2) - (3.4), and consequently all conclusions concerning influence of concentration are kept. Let's mark, that the optimization problem (3.2a) - (3.3) do not depend on the volume of the investment in the economy.

The discussion and economic interpretation of the agglomeration model with external economies and constant volume of investment in the economy

There is a capability for expectations to change trajectory of the development of the system within overlap. The form of a spiral determines a range of values I_x from which both equilibriums are available. There are very close to each other trajectories inside the overlap, which leads to the different long-term equilibriums; therefore capability to achieve one of the equilibriums in any initial position inside the overlap will largely depend on the investor expectations. Influencing of expectations in case of dynamics with the overlap is connected to a capability of jumping on the close arranged orbits of a spiral. If there are close arranged orbits of a spirals coming from I_x^*, then the capability of jump from one path to the other leading the system to different equilibrium is not eliminated. These jumps can have random nature or can be conditioned by expectations, and can influence the solutions of the investors. The probability of a jump will be determined by a capability of the growth of shadow price, which will cover the yield decreasing at the first time. Thus, expectations of the investors can change history and result a system in any long-term equilibrium.

Let's suspect, the investors expect that the economy will develop in the direction of agglomeration of production in *X*, then for any values I_x in the rang of overlap there will be a spiral path which will lead to *X*. In the contrast of the real roots there is more then one initial position inside the overlap, which result the economy in the different equilibrium. In the range of overlap closed to I_x^* there be an indefinitely large number of possible paths leading the system to all directions, and consequently any variant of dynamics is possible. The aims outside the overlap determine only simple paths. Therefore in case of the complex roots (fig. 3.2) expectations of the investors in the greater degree than the historical tendencies are decisive to achieve the equilibrium. If overlap is absence, everything is determined by the history, if there is an overlap and the initial value I_x belongs to overlap, the achievement of any stable equilibrium is possible. If I_x is outside of overlap, the dynamics and the spatial distribution of investment is determined by history.

There is a question, how do the parameters of the economy influence the system development? Apparently, the circumstances here will play a role such as proximity to I_x^*. In addition, a role of history and the expectations to accept the investment decisions will determine three parameters: *r* - interest rate, β - force of external agglomeration economies, and $1/\gamma$ - speed of the investment adjustment. A condition of the overlap existence is $r^2 < 4\beta\gamma$.

Parameter r shows a general level of hazards in the economy. If the interest rates r is rather large, the future income is discounted according the high rate. The availability of high discount of the future income means a decrease of a role of external concentration economies in the income. Here the economical sense the following; in a long-lived outlook the future income never will reach the level of the income, which the investor has in the present spatial structure of production and investment. All operations are directed on a maximization of the current income; therefore the investors will not have interest in the future joint actions of other individuals. If external economies of movement of investment activity in X are insufficiently high, there are no the expectations, and so the effect of self-fulfilling expectations is eliminated. Investment will be placed in the regions corresponding to their current yield.

If γ is small enough, and so the costs of adjustment are high, for example: there is no modern infrastructure, the capital stock is worn or morally depreciated, then the region economy will adapt slowly. Obtaining of the investment yield is removed in a long-term future. Expectations of the investors still will not influence their solutions. Production and investment will follow current yield, and everyone will be determined by the historical tendencies of production. If the cost of investment adjustment are quite small, for example, there are good infrastructure, the modern communication facilities, the reserves of powers which can easily be put into production, skilled labor, then there is a capability to change of the historical tendencies, and the leading role can play expectations.

On the basis of the results of econometric model (sections 4, 5) were calculated values of parameters r, γ and β corresponding to a modern condition of the Russian economy. The point estimations of parameters are supplemented by their interval estimation. The 95% confidence intervals were constructed by using the delta-method (Greene (1997), p. 124). Besides, to establish in what equilibrium, complex or real roots there the Russian economy is, a value and a confidence interval for a radicand $(r^2 - 4\gamma\beta)$ in (3.10) were calculated. The values of parameters and the confidence boundaries are shown in tab. 3.1. The negative values of the radicand $(r^2 - 4\gamma\beta)$ and its confidence boundaries testify, that we have got a case of the complex roots with 95 % of probability.

Table 3.1

The concentration parameters values and their confidence intervals

(confidence probability 95 %)

Parameter	Value	Lower confidence boundary	Upper confidence boundary
r	0,3128	0,2991	0,3265
γ	0,7191	0,6577	0,7805
β	0,2573	0,2265	0,2884
$(r^2 - 4\gamma\beta)$	-0,6423	-0,7733	-0,5112

In addition, the numerical modeling purposing to define the influence of r, β and γ on the value of the overlap was conducted. In the series of the experiments the value of the parameter γ was varied from 0 up to 0,7191. The upper level of parameter γ was determined by its estimation obtained in the econometric part of the research. To compare there was carried out a second series of experiments of the parameters values $r = 0,2$ and $\beta = 0,6$. The value β equaling 0,6 corresponds to higher level of the external economies and the increasing investment return in case of the production agglomeration. The outcomes of calculations of the overlap size are shown on fig. 3.3. The overlap slowly reduced on an interval of values γ from 0,8 to 0,1. Let's mark, that overlap, and consequently also capability of the investors' expectations to influence a spatial distribution of investment, disappears for γ equalling 0,1. For the alternate set of parameters r and β the overlap disappears for γ equalling 0,023. *As we see, in the modern Russian economy where: r = 0,3125, β = 0,2573 and γ = 0,7191 the expectations play a leading role eliminating any role for history.*

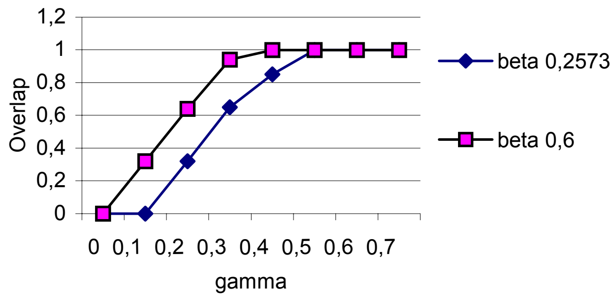

Fig. 3.3. The inter-relationship between the value of overlap and the speed of the investment adjustment $\left(1/\gamma \right)$

The agglomeration model with external economies and variable volume of investment in the economy

It is interesting to investigate the influence of the concentration on the dynamic of investment in the economy. In order to make such analyses we solve the problem (3.2) – (3.4) including the conditions connecting the change of the macro indexes such as the national income and investment with the variables and parameters defining the agglomeration process in the model. As the basic equation connecting the volume of investment in economy and dynamics of the national income, we use the model of flexible accelerator of (Koyck, 1954).

For investment at the moment t the model of the accelerator can be recorded as

$$I_t = \mu \lambda Y_t - (1 - \delta) \mu \lambda Y_{t-1} + (1 - \lambda) I_{t-1}, \quad (3.11)$$

where t is the index of the year, I_t and $I_{t\text{-}1}$ are investments in current and preceding year accordingly; Y_t and $Y_{t\text{-}1}$ are the output of current and preceding year accordingly; the parameters: δ is the declining factor (the analog of the discounted rite); μ is the fixed capital/output ratio; λ is the constant speed of adjustment of the desirable and actual capital stock (the proof of the equation (3.11) can be found in (E.R.Berndt, 1991, p. 233 - 235)). After small transformations the equation (3.11) takes a form

$$Y_t - (1\text{-}\delta)\ Y_{t\text{-}1} = (1/\mu\lambda)(I_t - (1\text{-}\lambda)\ I_{t\text{--}1})$$

or

$$\Delta Y_t + \delta\ Y_{t\text{-}1} = (1/\mu\lambda)(\Delta I_t + \lambda\ I_{t\text{--}1}). \qquad (3.12)$$

Directing $\Delta t \to 0$ we shall have

$$\dot{Y} + \delta Y = \frac{1}{\mu\lambda}\left(\dot{I} + \lambda I\right) \qquad (3.13)$$

the accelerator model in the continuous time. The equation (3.13) allows to link the dynamics of investment to dynamics of the national income and to analyze the influencing of the agglomeration process on the volume of investment in the economy.

Let's express investment in region A as a difference between total volume of investment in economy and investment in region X:

$$I_A = I - I_x. \qquad (3.14)$$

The national income Y is equal to the sum of gross regional products of two regions: Y_A and Y_x

$$Y = \pi I_x + \left(I - I_x\right). \qquad (3.15)$$

Then

$$\dot{Y} = \left(\pi'\left(I_x\right)I_x + \pi - 1\right)\dot{I}_x + \dot{I} \qquad (3.16)$$

is the equation describing speed of change of the national income. As we can see in (3.16), dynamics of the national income depends on a gain of investment in the economy, external economies, and the increase of investment in region *X*.

The parameters of the fixed capital/output ratio (μ) and the adjustment coefficient (λ) significantly differ by the regions. Let's introduce new denotations. Let λ_i is the regional parameter of speed of adjustment of the desirable and actual capital, μ_i - regional level of the fixed capital/output ratio, where i = A, X. Then the accelerator model for the regions i can be written as

$$\dot{Y}_i + \delta Y_i = \frac{1}{\mu_i \lambda_i}\left(\dot{I}_i + \lambda_i I_i\right), \tag{3.17}$$

Summarizing the right and left-hand parts of (3.17) for i = A, X taking into consideration (3.16) and designating $\mu_A \lambda_A = a\mu_x \lambda_x$ and $\lambda_A = b\lambda_x$, we shall have the accelerator model differentiated by two regions:

$$\left(\pi'(I_x)I_x + \pi\right)\dot{I}_x + \dot{I} - \dot{I}_x + \delta\left(\pi I_x + I - I_x\right) = \frac{1}{\mu_x \lambda_x}\left(\dot{I}_x + \lambda_x I_x\right) + \frac{1}{a\mu_x \lambda_x}\left(\dot{I} - \dot{I}_x + b\lambda_x\left(I - I_x\right)\right) \tag{3.18}$$

Executing some transformations and substituting (3.5), we shall receive a differential equation in a explicate form, which one defines the rate of investment change in the economy depending on a volume of investment (I), the investment in the region with increasing return (I_x), and the shadow price of investment q in region *X*:

$$\dot{I} = \eta\left\{\theta I - \left(\pi'(I_x)I_x + \pi - 1 - \frac{a-1}{a\mu_x \lambda_x}\right)\gamma q - \left(\delta(\pi - 1) - \frac{a-b}{a\mu_x}\right)I_x\right\}, \tag{3.19}$$

where

$$\eta = \frac{a\mu_x \lambda_x}{a\mu_x \lambda_x - 1} \text{ and } \theta = \frac{b - a\delta\mu_x}{a\mu_x}.$$

The equation (3.19) can be considered as the other record of the model of flexible accelerator taking into account the territorial structure of investment.

The parameters determining dynamics in the agglomeration model with the constant volume of investment can be expressed through the parameters of the model of flexible accelerator (3.19). Particularly, the force of external economies in region with increasing return β can be evaluated through the regional parameter of the fixed capital/output ratio of the region with increasing return μ_x as

$$\beta = \frac{1}{\mu_x}; \qquad (3.20)$$

the parameter γ can be compared with the parameter of adjustment speed of the desirable and actual capital in the region with increasing investment return λ_x, so that

$$\gamma = \lambda_x; \qquad (3.21)$$

the discounted rate

$$r = \delta \qquad (3.22)$$

is identical to both regions. Therefore the model of flexible accelerator can be used as the basis of the econometric analysis and be received the numerical evaluations of parameters determining the agglomeration process in the Russian Federation in the transition period. The formulas associated with the parameters of the theoretical and econometric models are shown in appendix 6. The calculated values of parameters were used to set-up the model at a phase of numerical modeling. We shall keep initial denotations of parameters in subsequent presentation of the model.

Let's consider the decentralized model of agglomeration process and its influencing the distribution of investment over the regions. The model integrates the center and the investor problems. We shall keep conditions (3.2) - (3.4) as a problem of the investor. The investors take the volume of investment as given value at each moment of the time. Therefore the solution of the investor problem coincides with the solution of the model with external economies and the constant volume of investment in the economy (3.5) - (3.6).

Objective function of center is the maximization of the national income. The national income includes consumption and investment. Taking into account the assumption, the problem of center can be written as: the center maximizes the present value of the national income

$$\int_0^\infty Ye^{-rt}dt\,, \tag{3.23}$$

where the national income is equal to (3.15). Dynamics and structure of the national income are determined by the equation of the flexible accelerator model (3.19). Limitation on I_x is

$$I - I_x \geq 0 \tag{3.24}$$

It means, that investment in the region *X* should not exceed the total value of investment in an economy.

The solution of a problem (3.15), (3.19), (3.23) - (3.24) is shown in appendix 2. It gives an equation (3.19), which describes the dynamics of investment in economy, and the equation (A.2.2), which simulates the changing rate of the shadow price of investment in the economy. Shadow price of investment *h* does not influence the change of the other variables in the model therefore it can be eliminated from the further analysis of a system dynamics. The complementary slackness conditions of (A.2.3) demonstrate that if $\left(I - I_x\right)$ > 0, the co-state variable *l* is equal to zero point; if *l* > 0, all investment goes to the region *X*: I_x =*I*.

After insertion of the term (3.8) into (3.19) updating the type of relation between external economies and investment in region *X*, we shall obtane

$$\dot{I} = \eta\left\{\theta I - \left(\beta I_x + \beta\left(I_x - I_x^*\right) - \frac{a-1}{a\mu_x\lambda_x}\right)\gamma q - \left(\delta\beta\left(I_x - I_x^*\right) - \frac{a-b}{a\mu_x}\right)I_x\right\}, \quad (3.25)$$

Thus, the system behavior as a whole is described by three equations: (3.5), (3.9) and (3.25). Variables of the model in the steady state are equal to $q = 0$, $I_x = I_x^*$ and $I^* = \frac{b-a}{b-a\delta\mu_x} I_x^*$. If the spatial distribution of investment between regions will be established so as to equalize the rate of the investment return between regions then the system is in a steady state. The equilibrium volume of investment in the economy is fixed at a constant level depending on I_x^* and is determined by the parameters of regional level of the fixed capital/output ratio and the speed of adjustment of investment in regions with constant and increasing return.

The equation (3.25) is non-linear. After decomposing (3.25) in a Taylor-series around the stationary point (see Appendix 3) the following three roots of a set of equations (3.5), (3.9) and (3.25) are obtained:

$$\rho_1 = \eta\theta,$$

and

$$\rho_{2,3} = \frac{r \pm \sqrt{r^2 - 4\gamma\beta}}{2}.$$

The first root is real. Thus, if $\rho_1 > 0$, the system diverges from a point of unstable equilibrium $I_x = I_x^*$, $q = 0$ and I^*. The calculations of values ρ_1 accomplished on the basis of estimations of the econometric part of research have given the following outcomes: $\rho_1 = 0{,}1173 > 0$. The nature of the system movement in space I_x and q is similar to trajectories with overlap (fig. 3.2) and without overlap (fig. 3.1) reflecting dynamics of the agglomeration model with constant volume of the investment and is determined by parameters r, γ and β in ρ_2 and ρ_3.

The system behavior in case of: $r^2 > 4\gamma\beta$ is shown in a fig. 3.4. For $r^2 < 4\gamma\beta$ the phase diagram of a system is illustrated in a fig. 3.5. The influencing of parameters r, γ and β on monotonic and oscillatory behavior of a system was already discussed. In case of the real roots the system still demonstrates absence of an oscillation, and the dynamic behavior of the system is completely determined by the historical tendencies in spatial distribution of investment, but these tendencies differ enough from those, which occurred in model with the constant volumes of investment. In case of the complex roots there are oscillations and overlap in dynamics of a system in which the expectations of the investors are decisive. Therefore, in farther analysis we shall stay more detail on those new features in dynamics, which is introduced by the accelerator model.

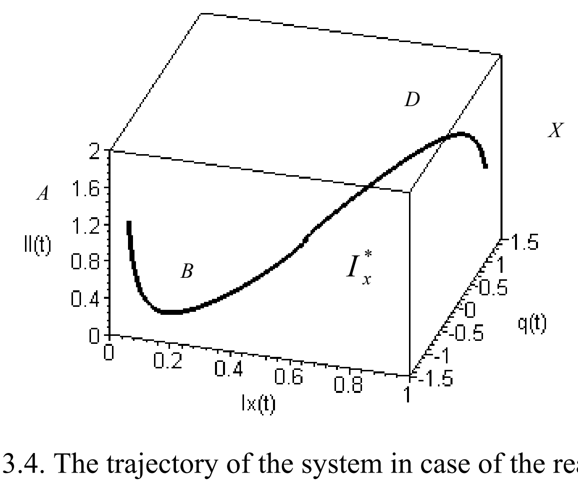

Fig. 3.4. The trajectory of the system in case of the real roots

Let's return once again to the problem of the center changing the objective function. Let C is consumption in the country, then

$$\begin{aligned} C &= Y - I \\ &= (\pi(I_x) - 1)I_x \end{aligned} \tag{3.15a}$$

Maximization of the discounted consumption

$$\int_0^\infty Ce^{-rt}dt, \tag{3.23a}$$

subject to (3.15a), (3.19) and (3.24) gives the only different formula of the shadow price of the investment and as before one does not depend on the any variables I_x and q. The behaviour of a system as well as in the previous problem is described by the equations (3.5), (3.9) and (3.25).

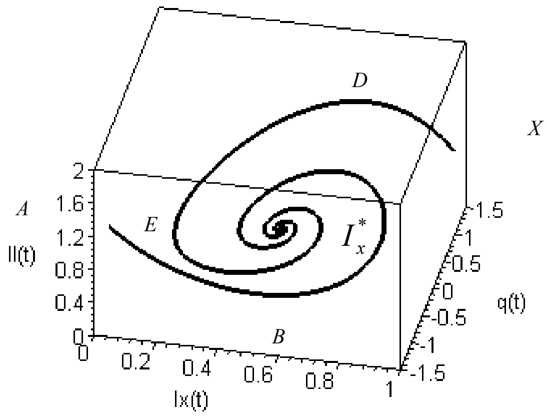

Fig. 3.5. The trajectory of the system in case of the complex roots

The discussion and economic interpretation of the agglomeration model with external economies and the variable volume of investment in the economy

After inserting of the flexible accelerator in the model, some new features in a system behavior appear. First, not only volume of investment in region with increasing return but also in a whole economy starts to change with the changing of the shadow price of investment in region *X*. Second, it is possible such pathways when the large part of investment is displaced to region *X* providing the effect of external economies, and at the same time the definite part of investment remains in region *A*. Both regions can normally develop. Third, the concentration of investment in *X*, as a rule, provides more favorable trajectories of the development of the economy, growth of both investment and the national income.

Let's consider more detail features of behavior of a system in a case of real roots: $r^2 > 4\gamma\beta$. Supposing that the investment are concentrated in region with constant return (point *A* on a fig. 3.4), then any attempt to shift a part of investment to the other region at first time will result in the sharp reduction of investment in the economy. The reduction of investment in the region with constant return will have continued up to the full investment stopping in the region (section *AB*). If to take into account, that on a segment from *A* up to I_x^* the yield in *X* is lower than one in *A*, it is clear that to leave the region *A* for anybody of the investors is not expedient, and consequently the concentration in A still remains a point of the stable equilibrium.

The point I_x^* remains the point of unstable equilibrium in which the investment yield levels in the regions. From I_x^* the system can move in both directions: in a direction of concentration in *X*, or in a direction of concentration in *A*. However the intermediate variants of dynamics are possible too.

There are new features of the investment moving to the region with constant return. It is necessary to call it as a process of the investment dropping in the economy. And this problem seems to be very similar with the process, which occurred in a transition period in a modern history of Russia. On the segment [I_x^*, B] moving of investment from *X* to *A* is accompanied by decline of total volume of the investment; the external economies are eliminated. Moreover, because of the reduction of investment at first time, there is reduction and then completely stopping of the investment in a region A. In spite of the fact that all investment is concentrated in region with increasing return, the tendency of the investment reduction is prolonged. The turning point in history comes at the point B when the investors attention switched over to the region with predominance of extractive industries, and the most part of investment moves to region *A*. The process of the concentration of production in the region with the constant return is accompanied by the sharp growth of investment in the economy and is continued up to the full concentration of production in *A* (see segment [A, B]). The economy becomes completely raw. However moving of investment from *X* to *A* all along the trajectory provides lower level of investment in economy and lower level of the national income.

If investment in *X* exceed I_x^*, then one monotonically increase up to the full concentration in the region with increasing return. However, the new features appear on this trajectory too. On a segment from I_x^* up to the point D the growth of investment both in the region with increasing return and in the region with constant return is observed. In the point D the volume of investment in the economy reaches the maximum, and on the last segment of a curve reduces a little. On the segment [D, X] the investment in *X* continues to increase, and the investment in A are reduced in the beginning and then stopped at all.

Besides in the line of the trajectory of investment concentration in *X* the variants of dynamics non-connected with the termination of investment in region with constant return are possible (see a fig. 3.6). On the figure 3.6 the pathways with growth of investment concentration in the region with the predominance of manufacturing industries (from 70 up to 97 %) are figured; they save from 3 up to 30 % of all volume of investment in region with the predominance of extractive industries. If the production in *A* in a definite volume are saved the cut of investment and the national income is not obligatory (see fig. 3.6).

Nevertheless, at high costs the best variants of development cannot be always accessible if the economy is in a left-hand-side position of a point I_x^* as everyone decides the historical tendencies of the economic development. The Fig. 3.4 and 3.6 illustrate, in what way the historical tendencies determine not only spatial pattern but also the dynamics of investment in the economy in condition of the high adjustment costs.

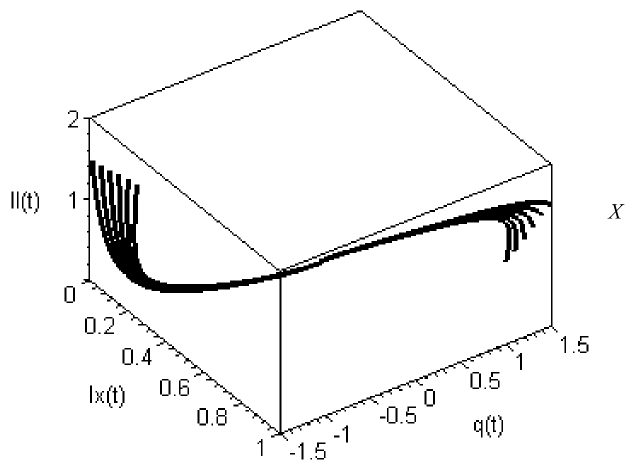

Fig. 3.6. Variants of monotonic dynamics

In case of the complex roots (fig. 3.5) there are cyclical pathways and area of overlap in dynamics of a system. The overlap in the model with the variable volume of investment in the economy has following features. First, inside the overlap the different versions of dynamics, which can result the system in agglomeration of production in either regions: in the raw region or in the region with manufacturing industries, are possible. Second, the development of the economy can be accompanied by the cut of the total volume of investment or, on to the contrary, by their growth. Thus, the expectation of investor can influence not only a spatial pattern of investment but also the growth of the investment volume in the economy at the low costs of adjustment. We consider that this outcome should be rather relevant.

If the system lies on one of the trajectories near the point I_x^*, it is possible by small adjusting to jump to the other pathway leading to concentration in *X*, which is not connected with the considerable drop of investment. Moreover, the switching to the other pathway guaranteeing the stability or growth of investment in an economy is possible. Consequently the significant role of expectations on this segment of the trajectory is saved.

The growth of investment in the economy on the cyclical pathways starts owing to the increase of investment in region *A*, but then the dynamics changed, and the growth of production in the region with increasing return *X* is starting that allows essentially to increase the volume of investment in economy and the volume of the national income.

Moreover, in case of the complex roots the variants of development associated with the concentration of investment in *X* but not requiring of full stopping of production in region with the constant return are possible (see fig. 3.7). Presented in the figure 3.7 variant of the investment concentration in region with predominance of manufacturing industries (area *X*) allow to keep in raw regions from 3 up to 30 % of investment volume.

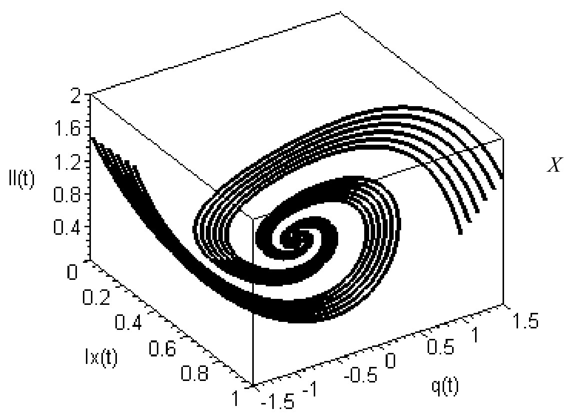

Fig. 3.7. Variants of cyclical dynamics

We should remark once again, that depending on the parameters of economy and the starting position of economy different variants of economic development: concentration of production in *A*, concentration of production in *X*, or intermediate trajectories are possible. The development of the economy through the concentration of production in *X* ensuring the development of manufacturing industries is represented more attractive. Those trajectories passing through the point D (see fig. 3.5) provide on the greater part of a pathway a higher level of investment in economy. At the same time it guarantees the higher level of the national income and consumption. While the trajectories of concentration in *A* turn the economy into completely raw economy and give the lowest volumes of investment, national income, and consumption over the whole of pathway. Therefore the most preferential variants of concentration are those, in which the main part of production concentrates in region with the predominance of manufacturing industries with the preservation of some part of production in the region with extractive industries.

In case of the complex roots the definition of a development pathway depends on the expectations and choice of the most of investors. The paths leading to the production concentration in *X* on a definite started segment of a path are connected with the reduction in investment and investment yield that apparently can be connected to change the technologies, the ways of production organization, the structural rearrangement of economy, the updating of the equipments, what demands the considerable costs before to receive the investment yield. But in any case this variant of development guarantees higher yield than the raw specialization. The choice of specialization in *X* depends on the solution, which will be accepted by the most of investors. If the most part of investors are going to move to *X*, the system in the field of overlap can jump on a pathway leading to *X*. Therefore inside of overlap the expectations of the investors still decide everything concerning the future investment yield in conditions of a changing spatial pattern of production.

Thus inside the overlap the capability of any variants of dynamics to be saved, and, consequently, a leading role to select a pathway of economic development belongs to expectations. The change of pathway inside the overlap is connected to a capability of a jump from one to the other closely arranged orbits of a spiral in area near to I_x^*. The probability of a jump is more than the expected growth of the shadow investment price is more in region *X*. If the roots are real, everything is determined by history in the model with variable volume of investment as well as in the model with constant volume of investment. If the overlap exists, and the system is inside of overlap, the transition of a system to any pathway of development is possible. If the overlap exists, and a system is outside of overlap, the dynamics of a system is completely determined by history.

Section 4. The empirical tests of hypotheses.

Methodology of econometric analysis

The basic econometric model

To test empirically the agglomeration theory and hypotheses of expectations we have connected expected investment with the expected volume of production. To describe the inter-relationship of production and investment, the model of flexible accelerator was used, in which we have included the expectations. The proof of the accelerator model with expectations is shown in Appendix 4. The base equation, which was obtained, is the following:

$$Y_{t+1}^{e} = (1-\delta)Y_t + \frac{1}{\lambda\mu} I_{t+1}^{e} - \frac{(1-\lambda)}{\lambda\mu} I_t . \quad (4.1)$$

The offered modification allows evaluating parameters of the theoretical accelerator model λ, μ and δ.

The Y_{t+1}^{e} and Y_t are an expected and current level of agglomeration of production accordingly measured through the conforming indexes. If to accept Y as the index of concentration of industrial production calculated on the data of output, then the expected level of agglomeration will be determined by the current production concentration, expected and current investment.

If to denote i - index of region; t - index of year and to designate

$$\beta_1 = (1-\delta); \quad \alpha_1 = 1/\lambda\mu; \quad \beta_2 = -(1-\lambda)/\mu\lambda, \quad (4.2)$$

then the equation (4.1) takes a form

$$Y^{e}_{it+1} = \beta_1 Y_{it} + \alpha_1 I^{e}_{it+1} + \beta_2 I_{it}. + \mu_i , \quad (4.3)$$

where μ_i is the regional specific effects.

Under rational expectations conditioned by the information at the moment t,

$$\mathrm{E}\,[Y_{it+1} - \beta_1 Y_{it} - \alpha_1 I^{e}_{it+1} - \beta_2 I_{it} - \mu_i \mid \Im_t] = 0,$$

where Y_{it+1} is the actual level of production agglomeration at the moment t+1, $\Im_t$ denotes the information at the moment t. Then

$$Y_{it+1} = \beta_1 Y_{it} + \alpha_1 I^{e}_{it+1} + \beta_2 I_{it} + \mu_i + v_{it+1} , \quad (4.4)$$

where v_{it+1} is the random disturbance, which characterizes a prediction error of the output.

Realized at the moment $t + 1$ investments I_{it+1} are equal to

$$I_{it+1} = I_{it+1}^{e} + \mathrm{e}_{it+1},$$

where e_{it+1} is the prediction error, which has the conditional mean equals zero under rational expectations conditioned by the information $\Im_t$ at the moment t

$$E[e_{it+1} \mid \Im_t] = 0,$$

and the constant variance σ_e^2. Expected at the moment t+1 investment I_{it+1}^e does not depend on a prediction error e_{it+1} and besides does not depend from v_{it+1}.

Expressing the expected investment I_{it+1}^e through observed, and substituting it in the equation (4.4) we obtain

$$Y_{it+1} = \beta_1 Y_{it} + \alpha_1 I_{it+1} + \beta_2 I_{it} + \mu_i + \varepsilon_{it+1}, \tag{4.5}$$

where

$$\varepsilon_{it+1} = v_{it+1} - \alpha_1 e_{it+1}. \tag{4.6}$$

Thus the error in prediction of investment e_{it+1} correlates with the actual investment at the moment $t + 1$ as right-hand-side variable in equation of regression, that is

$$\operatorname{cov}\left(I_{it+1}, \varepsilon_{it+1} \middle| \Im_t\right) = \operatorname{cov}\left(I_{it+1}, e_{it+1} \middle| \Im_t\right) = \sigma_e^2.$$

Equations (4.5) - (4.6) we shall consider as a base of further development of empirical model. If we consider μ_i as an unknown fixed parameters covering the influence of variables, which are typical for the i-st individual and constant over the time, then the model (4.5) – (4.6) are the fixed effects model. Let's to specify the hypotheses concerning the random component ε_{it+1} of the model (4.5) - (4.6).

$v_{it+1}$are the random disturbances describing a prediction error of the output

$$E\,(v_{it+1} \mid \Im_t) = 0, \; \operatorname{var}\,(v_{it+1} \mid \Im_t) = \sigma_v^2.$$

v_{it+1} does not correlate with the right-hand-side explanatory variables in (4.5); the prediction errors of the output are correlated in the groups of identical regions due to proximity of separate regions to each other. In the structure of regions we select three groups. First group includes the regions with high share, equaling more then fifty per cent in the regional industrial production of the manufacturing industries such as mechanical engineering, industry of building materials, glass industry, light industry, food-processing industry, flour-milling industry. Hereinafter we shall call this group as the manufacturing group of regions. The remaining regions, which have a high quota of power engineering industry, fuel industry, ferrous and non-ferrous metals, chemical and wood industry, were parted into two groups: the group of regions with a high quota extractive industries and the northern group of regions. The regions having polar territory were referred to northern group of regions. In order to share the sample, we used the data on industrial structure of production in regions in 1993. The list of all groups of regions is shown in Appendix 5, tab. A5.

Let's denote through σ_{kk} a covariance of prediction errors of the output for regions from k-st group

$$\operatorname{cov}\left(v_{i_k t+1}, v_{j_k t+1} \middle| \Im_t\right) = \sigma_{kk},$$

where i_k, j_k - correspond to the indexes for the regions from k-st group, k = 1, 2, 3.

The prediction errors of the output v_{it+1}, relating to different groups of regions or to different periods do not correlate with each other

$$\operatorname{cov}(v_{i_k t+1}, v_{j_l s} | \Im_t) = 0, \text{ if если } k \neq l \text{ and / or } t+1 \neq s.$$

e_{it+1} is the prediction error of investment. It has following distribution parameters:

$$E\,[e_{it+1} \mid \Im_t] = 0,\ \operatorname{var}(e_{it+1} \mid \Im_t) = \sigma_e^2.$$

The prediction error of investment e_{it+1} correlates with a prediction error of the output in the same region, so that

$$\operatorname{cov}(v_{it+1}, e_{it+1} | \Im_t) = \sigma_{ve}.$$

The prediction errors of the output and investment relating to the different regions or to the different periods do not correlate among themselves

$$\operatorname{cov}(v_{it+1}, e_{js} | \Im_t) = 0, \text{ if } i \neq j \text{ and / or } t+1 \neq s.$$

Let's consider structure of the covariance matrix of ε_{it+1}, $i=1,...,N,\quad t=2,...,T-1$ taking into account the accepted hypotheses. Let $i,\ j$ are the indexes of regions, N is the number of regions, $t,\ s$ are the indexes of year, T – is the monitoring period, N_k is the number of regions in k-st group, k = 1, 2, 3. Then

$$\operatorname{cov}\left(\varepsilon_{it+1},\varepsilon_{it+1}\middle|\ \Im_t\right)=\sigma_v^2+\alpha_1^2\sigma_e^2-2\alpha_1\sigma_{ve}\,,\ i=1,...,N\,,\ t=2,...,T-1\,.$$

$$\operatorname{cov}\left(\varepsilon_{i_k t+1},\varepsilon_{j_k t+1}\middle|\ \Im_t\right)=\sigma_{kk}\,,\ i_k\,,\ j_k\ =1,...,N_k\,,\ i_k\neq j_k\,,\ k=1,\,2,\,3,\ t=2,...,T-1\,.$$

$$\operatorname{cov}\left(\varepsilon_{i_k t+1},\varepsilon_{i_l s}\middle|\ \Im_t\right)=0\,,\ i_k\ =1,...,N_k\,,\ i_l\ =1,...,N_l\,,\ k,\ l=1,\,2,\,3,\quad k\neq l\,,$$

$$t+1,s=2,...,T-1\,.$$

Then the regional block of the covariance matrix G_{li} having a place over the main diagonal takes a form

$$\operatorname{cov}\left(\varepsilon_i\middle|\ \Im_t\right)=$$

$$=\begin{pmatrix} \sigma_v^2+\alpha_1^2\sigma_e^2-2\alpha_1\sigma_{ve} & 0 & \cdots & 0 \\ 0 & \sigma_v^2+\alpha_1^2\sigma_e^2-2\alpha_1\sigma_{ve} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \sigma_v^2+\alpha_1^2\sigma_e^2-2\alpha_1\sigma_{ve} \end{pmatrix} \quad (4.7)$$

$$=(\sigma_v^2+\alpha_1^2\sigma_e^2-2\alpha_1\sigma_{ve})I_{T-2}$$

$$=G_{li}=G_l.$$

Where $J_{T\text{-}2}$ is a square matrix of ones of dimension (T-2)× (T-2), $I_{T\text{-}2}$ is the identity matrix of dimension (T-2)× (T-2).

The block of the covariance matrix of errors for the regions from one group represents the diagonal matrix G_{lk}^*

$$\operatorname{cov}\left(\varepsilon_{i_k},\varepsilon_{j_k}\middle|\ \Im_t\right)=\begin{pmatrix} \sigma_{kk} & 0 & \cdots & 0 \\ 0 & \sigma_{kk} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \sigma_{kk} \end{pmatrix} \quad (4.8)$$

$$= \sigma_{kk} I_{T-2}$$

$$= G^*_{lk}, \quad k = 1, 2, 3, \quad i_k, j_k = 1,\dots, N_k.$$

Remaining block of the covariance matrix of errors cov(ε) equals zero. If the regions to arrange by the groups, then the covariance matrix cov(ε) for all sample takes the following block-diagonal form

$$\mathrm{cov}(\varepsilon \mid \Im_t) = \begin{pmatrix} \begin{matrix} G_l & G^*_{l1} & \dots & G^*_{l1} \\ G^*_{l1} & G_l & \dots & G^*_{l1} \\ \vdots & \vdots & \ddots & \vdots \\ G^*_{l1} & G^*_{l1} & \dots & G_l \end{matrix} & 0 & 0 \\ 0 & \begin{matrix} G_l & G^*_{l2} & \dots & G^*_{l2} \\ G^*_{l2} & G_l & \dots & G^*_{l2} \\ \vdots & \vdots & \ddots & \vdots \\ G^*_{l2} & G^*_{l2} & \dots & G_l \end{matrix} & 0 \\ 0 & 0 & \begin{matrix} G_l & G^*_{l3} & \dots & G^*_{l3} \\ G^*_{l3} & G_l & \dots & G^*_{l3} \\ \vdots & \vdots & \ddots & \vdots \\ G^*_{l3} & G^*_{l3} & \dots & G_l \end{matrix} \end{pmatrix} \quad (4.9)$$

$= \Omega_l$.

Methods of estimation

We shall designate an estimated equation in a matrix form as

$$Y = X\beta + \varepsilon, \quad (4.10)$$

$$\mathrm{E}(\varepsilon \mid \Im_t) = 0, \ \mathrm{cov}(\varepsilon \mid \Im_t) = \Omega_l,$$

where Y is the vector of the values of the dependent variables of dimension $N(T\text{-}2)$, X is the matrix of dimension $p \times N(T\text{-}2)$ including the observations on the explanatory variables and dummy variables to estimate the fixed effects, p is the number of independent variables, ε is the vector of the error of dimension $N(T\text{-}2)$, β is the vector of the parameters of dimension p.

The objects including in the sample cover almost all regions of Russia except those whose data are absent. Thus the sampling regions can consider as population. It allows to specify estimated regression equations as model with fixed effects. The model with the fixed effects takes into account the specific features of each region. The correlation of the explanatory variables with the errors of the model does not allow to use within-transformation; therefore, to estimate the regional fixed effects, the dummy variable were included in the equation.

The estimated equations are the dynamic panel regression, and there are some econometric problems of the estimation connected with it. First, the regional specific unobservable effects μ_i are correlated with the lagged dependent variable y_{it}, which represents to itself as an explanatory variable. For the typical panel, where N is large and T is fixed, the OLS and GLS estimations of the parameters will be biased and inconsistent.

Secondly, presence of the predictions error e_{it+1} results in a correlation between an error and the investment variable I_{it+1} at the moment $t + 1$. Because of a correlation of errors with explanatory variables the OLS and GLS estimators are inconsistent. These problems take place for any model specification: for fixed and for random effects. Some following alternate procedures connected with using of instrumental variables can be applied to estimate (4.10): the method of instrumental variables, generalized method of instrumental variables, generalized method of the moments (GMM). Among listed methods the generalized method of the moments is alone, which provides asymptotically effective estimation of parameters (Verbeek M., 2000; Baltagi B. H., 1995); therefore preference was given away to GMM.

To eliminate the regional unobservable specific effects μ_i for dynamic panels usually is used transformation in the form of the first differences (see: Verbeek M., 2000; Baltagi B. H., 1995). The transformation by the first differences, for example, in a procedure of Anderson and Hsiao (1981), and the subsequent application of instrumental variables eliminates regional effects μ_i and solves the problem of a correlation of explanatory variables with specific regional effects mentioned above. However if there are regime-switching conditions in the equation, then the transformation by first differences is impossible. Therefore we have settled to use GMM for equations in levels, which also provides the effective estimations. For the model in levels the instrumental variables are determined from an orthogonality condition of disturbances and lagged explanatory variables or their first differences (Baltagi, 1995). The strictly exogenous explanatory variables including the fixed effects can be the instruments themselves.

Generalized method of the moments. GMM for an equation in levels

The selection of instruments for variables depends on structure of correlation processes of explanatory variables x_{it+1} with process of an error ε_{it+1} particularly from a correlation with e_{it+1}, or v_{it+1} (Blundell R., Bond S. Windmeijer F.). If the first differences of a dependent variable ΔY_{it+1} do not correlate with unobservable specific effects μ_I, then in combination with the standard assumption of model (4.15), lagged values of the first differences of a dependent variable ΔY_{is} can be as instruments themselves. Additionally the dummy variables $dplus_{is}$, dummy variables for regional fixed effects multiplied by the dummy variable $dminus_{is}$, and the variable I_{is} were used as instruments (see the list of variables in the Appendix 8). The instruments for strictly exogenous explanatory variables X_{is} as instrumental variables can be explanatory variables themselves. Then the moment conditions for GMM-estimations can be written as:

$E(\varepsilon_{it+1}\ \Delta Y_{is}) = 0,\quad s = 2, \ldots, t;\ t = 2, \ldots, T-1.$

$E(\varepsilon_{it+1}\ dplus_{is}) = 0,\quad s = 1, \ldots, T;\ t = 2, \ldots, T-1.$

$E(\varepsilon_{it+1}\ dmin\_j_{is}) = 0,\quad s = 1, \ldots, t;\ t = 2, \ldots, T-1.$

$E(\varepsilon_{it+1}\ I_{is}) = 0,\quad s = 1, \ldots, t;\ t = 2, \ldots, T-1.$

$E(\varepsilon_{it+1}\ \widetilde{X}_{is}) = 0,\quad s = 1, \ldots, T;\ t = 2, \ldots, T-1.$

$\widetilde{X}$ means all remaining explanatory variables, including a constant.

Instead of $dplus_{is}$ and $dminus_{is}$ the variables $dpre_{is}$, $dmre_{is}$, $dpma_{is}$, $dmma_{is}$, $dpno_{is}$, $dmno_{is}$ are used as instruments in the moment conditions in regression with differentiation by the groups of regions.

The matrix of instruments Z'_{li} of dimension $(T-2) \times m$, where m is the number of validity instruments for an equation in levels is

$$Z_{li} = \begin{pmatrix} \left[\Delta Y_{i2}, dplus_{i1},\ldots, dplus_{iT}, dmin_{i1},\ldots, dmin_{iT}, I_{i1}, I_{i2}, \widetilde{X}_{i1},\ldots,\widetilde{X}_{iT}\right] & 0 & \ldots & 0 \\ 0 & * & \ldots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \ldots & ** \end{pmatrix},$$

in the matrix is marked by asterisk the following:

$$*\left[\Delta Y_{i2}, \Delta Y_{i3}, dplus_{i1},\ldots, dplus_{iT}, dmin_{i1},\ldots, dmin_{iT}, I_{i1}, I_{i2}, I_{i3}, \widetilde{X}_{i1},\ldots,\widetilde{X}_{iT}\right];$$
$$**\left[\Delta Y_{i2},\ldots,\Delta Y_{T-1} dplus_{i1},\ldots, dplus_{iT}, dmin_{i1},\ldots, dmin_{iT}, I_{i1},\ldots, I_{iT-1}, \widetilde{X}_{i1},\ldots,\widetilde{X}_{iT}\right].$$

The number of the moment conditions exceeds the number of the estimated parameters; therefore the estimator of a generalized method of the moments will be based on the minimization of a quadratic form of the corresponding sampling moments. Let $\hat{\beta}$ is a vector of the parameters estimations, then

$$\min_{\hat{\beta}}\left[\varepsilon' Z_l\right] W_N \left[Z_l^{'}\varepsilon\right], \qquad (4.11)$$

where W_N is some weight matrix; $Z_l^{'}$ is a matrix of dimension $m \times N(T-2)$

$$Z_l^{'} = \left(Z_{l1}^{'}, Z_{l2}^{'}, \ldots, Z_{lN}^{'}\right), \tag{4.12}$$

Then the estimates of parameters GMM in levels are (Baltagi B.H., 1995)

$$\hat{\beta}_l = \left(X^{'} Z_l W_N Z_l^{'} X\right)^{-1} X^{'} Z_l W_N Z_l^{'} Y, \tag{4.13}$$

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

$$\hat{\text{cov}}(\hat{\beta}_{GIV}) = \left(X' Z W_N Z' X\right)^{-1}. \tag{4.14}$$

Taking into account the structure of covariance matrix of errors a GMM-estimation for an equation in levels to be conducted in two stages. On a first step some initial weight matrixes W_N can be selected, particular an identity matrix:

$$W_N = I_N,$$

that allows to obtain an optimum estimator of W_N^{opt}.

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

$$W_N^{opt} = \left(Z' W Z\right)^{-1}, \tag{4.15}$$

where W is the estimate of covariance matrix Ω_l, obtained on a first step; the dimension of W is equal to $N(T$-2)$\times$ $N(T$-2). Using I_N as W_N on a first step allows to computer W as a consistent estimate of the matrix Ω_l. The estimation of elements of W was conducted using the residuals of regression $\hat{\varepsilon}_{it+1}$ obtained on a first step as following:

$$\hat{\sigma}_{\varepsilon}^2 = \frac{\sum_{i=1}^{N} \sum_{t=2}^{T-1} \left(\hat{\varepsilon}_{it+1}\right)^2}{N(T-2)}; \tag{4.16}$$

$$\hat{\sigma}_{kk}^2 = \frac{\sum_{t=2}^{T-1}\left[\sum_{i_k=1}^{N_k}\left(\sum_{j_k=1}^{N_k}\left(\hat{\varepsilon}_{i_k t+}\hat{\varepsilon}_{j_k t+1}\right)-\hat{\varepsilon}_{i_k t+1}^2\right)\right]}{N_k(N_k-1)(T-2)}, \quad k=1, 2, 3. \qquad (4.17)$$

The estimations obtained on the first stage are consistent for large N and finite T. Using W_N^{opt} on the second step allows to obtain estimations, 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^{opt} corresponds to a general case of GMM and does not require *IID* or normal distribution of disturbances v_{it+1} or e_{it+1}. 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 R, Bond S., Windmeijer F.) was applied. For the model in levels the test statistic is obtained as

$$Sar_l = \hat{\varepsilon}' Z W_N Z' \hat{\varepsilon},$$

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

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

Specification of variables and the information

We have conducted an estimation of regression equations for the following dependent variables.

As an indicator of the output the variable *prom* – per capita industrial production in a region is utilized. The regression of variable *prom* is necessary to estimate the parameters of the theoretical model, where two regions identical on a number of the inhabitants are considered.

Besides we allocate and consider two types of concentration: absolute and relative. The indexes of absolute concentration demonstrate a share of regions in the gross industrial production. The indexes of relative concentration show a degree in which industries are concentrated in relation to average volume of production by regions. The indexes of industrial concentration are estimated for both all industry of the Russian Federation and its separate industries.

To characterize the production agglomeration in some industries we have used the following indexes. The density of regional productions in the branch *j* (*otr_ j*) was considered as an *absolute* index of the production concentration in region:

$$otr\_j = \frac{\text{Volume of production of branch } j \text{ in region}}{\text{Volume of production of branch } j \text{ in the Russian Federation}}$$

The production localization coefficients in industries (*loc_ j*) characterizing a *relative* level of agglomeration of production are determined as

$$loc\_j = \frac{\text{(volume of production of branch } j \text{ in region) / (volume of production of branch } j \text{ in the Russian Federation)}}{\text{(volume of industrial production in region) / (volume of industrial production in the Russian Federation)}}$$

The coefficients of localization demonstrate, in what degree the weight of production of branch in a regional industrial production differs from the similar Russian mean index.

For industrial production the following variables were adopted. The ratio of a regional volume of production of industries having a share in the Russian Federation more then 2,6 % to the national industrial output (*scale2*) is accepted as *indexes of absolute concentration* in regions

$$scale2 = \frac{\text{Sum of volumes of production of industries in region (if a share of the regional output of branch is more or equal to 2.6 \% of industrial output in the Russian Federation)}}{\text{Volume of industrial output in the Russian Federation}}$$

The indicator demonstrates how much concentration in the region of the industries having a leading position in the national economy.

The *relative level of agglomeration of the production* in the country by region characterizes a coefficient of variation *agg* calculated by the coefficients of the industries localization in region

$$aggl = \frac{\sigma}{R},$$

where σ is the standard deviation of indexes of the industries localization in region, *R* is the mean value of factors of the industries localization in region. The similar index was utilized for the empirical analysis of the foreign direct investment conducted by Driffeld, Munday (2000). The high value of a coefficient of variation shows to considerable deviation of regional structure of industrial production from mean in Russia.

We take the following indexes as the explanatory variables. The variable of investment (*I*) is the per capita investment in region.

Apart from the accelerator model's variables the variables traditionally considered in the gravity models have come in regression. As variables is used, as a rule, the area of regions and the distance up to an administrative center of the country. However the proposed model has the features as contrasted with the conventional gravity models. We consider the gravity variables in combination with the transport costs variables. Therefore some variables characterize the transport costs: *transp* is the ratio of the transport tariff index to the industrial prices index; *area* is the natural logarithm of a radius of a circle equaling to the area of region. The similar to *area* indicator can be found in Bruelhart, Trionfetti (1999). In our research the variable *area* in combination with the transport tariff characterizes the costs on transportations inside the region; *dist* is the natural logarithm of the distance from center of region up to Moscow; the variable with the transport tariff approximates the costs of transportation between the regions.

The description and notation of all variables including the instrumental one is shown in Appendix 8.

The basis for construction and estimation of the model is the sample from 78 subjects of the Russian Federation: 6 territories, 70 areas, and two cities - Moscow and St.-Petersburg. The analyzed period covers 1993 – 1999 years for the parameters of an absolute and relative agglomeration of production. For the variable of the industrial output the equation was estimated on sample from 1990 to 1999 year. The sample represents the panel data distinguished by a plenty of objects and a short time interval.

To estimate of the equations the production data in industries and investment are utilized. The indexes are cleared from the inflation and are expressed in price of 1990 with the help of industrial production indexes and the consumer price indexes. Besides the transport tariff indexes are utilized. It allows eliminating a spurious correlation in time series. The spatial correlation of indexes can be conditioned by influencing of scales of the regions. To eliminate the scale effects from the data the variables have used as relative indexes or as ratio to one inhabitant of the region.

The main part of the used information was submitted in the statistical collection «Регионы России» for 1996- 2000 years and «Российский статистический ежегодник» for 1994, 1998, 1999 years published by Goscomstat.

The estimated model and hypotheses

The regime-switching model with expectations of the investors

Analyses of the theoretical model have shown the existence of multiple long-run equilibriums. The investor expectations play the significant role determining the long-run outcome. Pre-computations have confirmed that the volume of investment non-linearly depends on a level of production agglomeration in the regions. Taken as the hypotheses that this phenomenon is explained by the existence of multiple equilibriums and that the tendencies in production agglomeration in regions depend on the positive and negative expectations of the investors, we have included the operator separating the regimes of expectations of the investors in the model.

To use the endogenous conditions the regimes switching in the model, in which there are the endogenous explanatory variables correlated with errors, leads to the hard complicating and serious problems connected with the estimation. Moreover, there is a reflection problem or so-called «a circular causality» in inter-relationship of variables Y_{it+1} and I_{it+1} in the model. To avoid these problems the exogenous determined annual and regional conditions of the regimes switching were utilized. For these purposes the sample of observations S was parted in two subgroups S_1 and S_2: $S_1 \bigcup S_2$ = S. Increase or decrease of the actual level of industrial concentration in regions for the conforming years was used as the conditions of the separating of sample. The growth of the production concentration or the invariance of its level in region i in year $t + 1$: $\Delta y_{it+1} \geq 0$ corresponds to the positive expectations and the decrease of the concentration in the conforming region i in year $t + 1$: $\Delta y_{it+1} < 0$ appropriates the negative expectations of the investors. In the same time, the change of the realized level of concentration is the determined event. Thus, the first subgroup S_1 integrates the observations, where there is an increase of the concentration indexes, and therefore it corresponds to the positive expectations of the investors, and the second group – S_2 – includes the observations, when the concentration was reduced, that shows the availability of negative expectations. Thus, a condition of the regimes switching of expectations in an equation becomes a combination of the conforming indexes i and $t + 1$ of the variable I_{it+1}. In view of a hypothesis of rational expectations the entered exogenous conditions of regimes switching allow to solve a reflection problem or self-selection one of the investors (Manski, 1995). We assume, that the investors act rationally taken into account all the available information at the moment t, therefore in the case of positive expectations they increase the volume of the investment in region X. Threshold values of the concentration changing in this case equal to zero. Therefore for $\Delta y_{it+1} \geq 0$ the volume of investment in region should increase. In the case of negative expectations the level of concentration is decreased ($\Delta y_{it+1} < 0$), and consequently the rational investors reduce the volume of investment in region. The deviations from the behavior model are only explained by the error of prediction (Manski, 1995). Thus, if the expectations are rational, both cases: the case of positive expectations and the case of negative expectations of the investors are identified. Let's introduce the conditional operator L_1, such that

$L_1[(i, t+1) \in S_1]=1$ if $(i, t+1) \in S_1$ and is equal to zero point otherwise and

$L_1[(i, t+1)\in S_2]=1$ if $(i, t+1)\in S_2$ and is equal to zero point otherwise.

The operator L_1 allows to differ a slope for I_{it+1} depending on the expectations of the investors, which actually occurred. So the switching of the expectations regimes inside the model can be resolved by the dummy variables.

With the conditional operators the empirical model takes a form:

$$\begin{aligned} Y_{it+1} &= \beta_1 Y_{it} + I_{it+1}\begin{cases}\alpha_1^{(+)}L_1(i,t+1\in S_1)\\ \alpha_1^{(-)}L_1(i,t+1\in S_1)\end{cases} + \beta_2 I_{it} + \\ &+ transp_{it}(\beta_3+\beta_4 area_i+\beta_5 dist_i)\begin{cases}\alpha_2^{(+)}L_2(transp_{it}<1)\\ \alpha_2^{(-)}L_2(transp_{it}\geq 1)\end{cases} + \mu_i + \varepsilon_{it+1}. \end{aligned} \tag{4.18}$$

There is another conditional operator in the model (4.18). The operator L_2 is intended to establish, whether there are different regimes of influencing of the transport costs on production agglomeration, or not. The operator L_2 also is the exogenous condition of the regimes switching; $L_2(transp_{it}<1)$ is equal to one, if $transp_{it}<1$, and is equal to zero otherwise that corresponds to the conditions of a decrease in the ratio of the transport costs index to the industrial price index, and $L_2(transp_{it}\geq 1)$=1 if $transp_{it}\geq 1$ and zero point otherwise that reflects relative increase in transport costs.

Hereinafter, referring to the equation (4.18), we shall call it as regression with the regimes switching of expectations.

Under rational expectations the equation (4.18) allows to identify the parameters, corresponds to the positive and negative expectations of the investors $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$. So the probability of the investment growth in region in case of positive expectations equals to

$$P\left(I_{it+1}^{(+)}\middle|\Delta Y_{it+1}\right) = P\left(I_{it+1}^{(+)}\middle|\Delta Y_{it+1}>0\right)P(\Delta Y_{it+1}>0) + P\left(I_{it+1}^{(+)}\middle|\Delta Y_{it+1}<0\right)P(\Delta Y_{it+1}<0),$$

and it is similar for $P\left(I_{it+1}^{(-)} \middle| \Delta Y_{it+1}\right)$. The probability $P(\Delta Y_{it+1} = 0)$ equals to zero (Manski, 1995). All elements except $P\left(I_{it+1}^{(+)} \middle| \Delta Y_{it+1} < 0\right)$ are identified (Manski, 1995). Under the rational expectations $P\left(I_{it+1}^{(+)} \middle| \Delta Y_{it+1} < 0\right) = 0$ and $P\left(I_{it+1}^{(-)} \middle| \Delta Y_{it+1} > 0\right) = 0$, therefore both cases of positive and negative expectations are identified.

Value of $\alpha_1^{(+)}$ shows that in separate regions the positive expectations of the investors predominate, ensuring the growth of investment in region. The significance of parameter $\alpha_1^{(-)}$ pointed out the intensive correlation between negative expectations of the investors and decreasing of investment in region.

The equation (4.12) allows to test following **hypotheses**:

1. *In Russia in a transition period the processes of the production concentration occur. The geographic concentration of industrial production in regions creates the effect of agglomeration and provides rise in return of scale economies.* Therefore we assume that concentration of production leads to further concentration, and expect that β_1 should be more than zero point.

2. *The spatial distribution of investment in Russia can be explained by the agglomeration theory of new economic geography.* Therefore coefficients of the variables determining main parameters of agglomeration processes β_1, $\alpha_1^{(+)}$, $\alpha_1^{(-)}$, and β_2 should be significant. Following from conditions (4.2), parameter β_2 should be negative.

3. *If the most of the investors share the expectations concerning the growth of production concentration in regions, then the expectations influencing for investment processes will considerable and it can be suppose availability of significant inter-relationship between change of the expected concentration level and rise in investment volumes in regions.* Both tendencies directed to growth of production

concentration and the tendency to dispersion of production depending on combination of the key economic parameters occur in transition Russia in different industries. Therefore we can assume that parameters $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$ should be significant. The estimates of $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$ will probably have different signs. The distinctions in values of parameters $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$ indicate that the investors differently react to dynamics of production concentration in case of concentration growth and in case of decreasing. The positive expectations of the majority of the investors concerning of growth in production concentration stimulate attraction of investment in region. With growth of concentration of the investment volumes in the regional economy also increase; therefore it should be truth the inequality $\alpha_1^{(+)} > 0$. The negative investors expectations result in reduction of investment, therefore $\alpha_1^{(-)} < 0$

The expected signs of parameters are shown in tab. 4.1

Table 4.1

The expected singes of parameters estimations of the model

Expectations	Parameters		
	β_1	α_1	β_2
Positive	+	+	-
Negative	+	-	-

As to transport costs and gravity variables influencing on a level of concentration in industries according to the agglomeration theory it is necessary to test following hypotheses.

4. *Transport tariffs essentially influence the agglomeration of production and investment in Russia*. The growth of transport tariff results in diverging of production, therefore it is expected that $\alpha_2\beta_3 < 0$.

5. *The increase in the inter-regional and internal costs of transportation results in growth of production concentration in regions*. Therefore with increase of

the territory and the distance, the production concentration will go up: $\alpha_2\beta_4 > 0$, $\alpha_2\beta_5 > 0$.

The equation (4.18) can be recorded with dummy variables as

$$\begin{aligned} Y_{it+1} &= \beta_1 Y_{it} + \alpha_1^{(+)} I_{it+1} dplus_{it+1} + \alpha_1^{(-)} I_{it+1} dminus_{it+1} + \beta_2 I_{it} \\ &+ \beta_3 \alpha_2^{(+)} transptp_{it} + \beta_4 \alpha_2^{(+)} tareatp_{it} + \beta_5 \alpha_2^{(+)} tdisttp_{it} \\ &+ \beta_3 \alpha_2^{(-)} transptm_{it} + \beta_4 \alpha_2^{(-)} tareatm_{it} + \beta_5 \alpha_2^{(-)} tdisttm_{it} + \mu_i + \varepsilon_{it+1}. \end{aligned} \tag{4.19}$$

In (4.19) $dplus_{it+1}$, $dminus_{it+1}$ denote the dummy variables, which are equal to one if the growth of production concentration is fixed at the moment $t + 1$ that corresponds to positive expectations of the investors or the decrease of production concentration that corresponds to negative investors expectations and zero point otherwise. The variables $transptp_{it}$ and $transptm_{it}$ switch the transport tariff in a case of its relative decrease ($transptp_{it}$) or relative increase ($transptm_{it}$). The values of the variables of area and distance up to Moscow multiplied by values of the transport tariff depending on its decrease (*tareatp, tdisttp*) or increase (*tareatp, tdisttm*) is similarly switched.

We suppose, that all industries and all types of agglomeration processes are not possible to catch using one condition of regimes switching of investors expectations coved all regions by one condition. Apparently, for the different groups of regions the agglomeration processes should differ depending on an industrial specialization and characteristics of these regions. Therefore in the other variants of regression the condition of regime-switching were additionally differentiated according to groups of the regions: the group of regions with predominance of manufacturing industries, the group of regions with predominance of extractive industries and the northern group of regions. Thus one more modification of econometric model except the equation (4.19) was estimated.

Regression with the regime switching of expectations been differentiated by groups of regions

The equation allows to differentiate a slope for expectations by three groups of regions: for regions with predominance of extractive industries, regions with predominance of manufacturing industries and the group of northern regions.

$$\begin{aligned} Y_{it+1} &= \beta_1 Y_{it} + \alpha_{11}^{(+)} Idpre_{it+1} + \alpha_{11}^{(-)} Idmre_{it+1} + \alpha_{12}^{(+)} Idpma_{it+1} + \alpha_{12}^{(-)} Idmma_{it+1} \\ &+ \alpha_{13}^{(+)} Idpno_{it+1} + \alpha_{13}^{(-)} Idmno_{it+1} + \beta_2 I_{it} \\ &+ \beta_3 \alpha_2^{(+)} transptp_{it} + \beta_4 \alpha_2^{(+)} tareatp_{it} + \beta_5 \alpha_2^{(+)} tdisttp_{it} \\ &+ \beta_3 \alpha_2^{(-)} transptm_{it} + \beta_4 \alpha_2^{(-)} tareatm_{it} + \beta_5 \alpha_2^{(-)} tdisttm_{it} + \mu_i + \varepsilon_{it+1}. \end{aligned} \quad (4.20)$$

where *Idpre*, *Idpma*, and *Idpno* are the investment variables in regions with predominance extractive, manufacturing industries and in northern regions accordingly at the moment when the positive expectations of the investors dominate; *Idmre*, *Idmma*, and *Idmno* are the investment variables in the corresponding regions at the moment when expectations of the investors are negative. Differentiation by region groups allows taking into account the industrial structure and the climate of regions.

Concerning the statistical inference the equation (4.20) allows to test the following hypothesis.

6. *Influencing of expectations essentially differentiates by the groups of regions: the group of regions with predominance of manufacturing industries, the group of regions with predominance of extractive industries and the northern group of regions depending on industrial specialization and specific characteristics of the groups of regions*. Therefore, parameters $\alpha_{1k}^{(+)}$, $\alpha_{1k}^{(-)}$ for k = 1, 2, 3 should be essentially different with each other.

Section 5. Discussion and interpretation of the results

General characteristic of the results

The estimation of regression equations with the regime switching of expectations (4.19) and equations of regression with regime switching of expectations differentiated according to groups of regions (4.20) was carried out. Two macroeconomic indexes characterized absolute and relative concentration of an industrial output in Russia during transition and indexes of absolute and relative concentration of production in ten industries, there are only 22 dependent variables, were considered. The list of all dependent, explanatory, and instrument variables is shown in Appendix 8. The obtained estimations of regression equations are presented in tab. A7.1 - A7.10.

First of all, we were interested by slopes $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$ reflecting the influencing of positive or negative expectations of the investors for concentration of industrial production and investment. The information of availability of significant factors $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$ in equations of regression is shown in tab. 5.1 - 5.2.

The outcomes of calculations have shown the significant estimations of parameters for investors' expectations are obtained practically for all indexes of concentration. There are significant estimations of expectations parameters in regression of the aggregated concentration indexes of the industrial output and in equations of the branch indexes of concentration. The significant estimations of expectations influencing are determined for both: absolute concentration indexes and relative concentration indicators. At last, the significant parameters for positive expectations and for negative expectations of the investors are found. There are significant estimations of the parameters both in regression with expectations regimes switching and in regression with expectations regimes switching differentiated by groups of regions (see tab. 5.1 - 5.2).

Table 5.1

The sings of significant estimates $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$ of the investor expectation variables in the investor expectation regime-switching model [1]

Dependent variable	Positive expectations	Negative expectations
aggl		-
scale2		-
locto	+	-
locen		-
locch	+	
loccv		-
lochi		-
locma		
locls		-
locpsm	+	
locle	+	
locpi		-
otrto	+	
otren	+	
otrch		
otrcv		-
otrhi		-
otrma		-
otrls		-
otrpsm	+	
otrle	+	
otrpi	+	

[1] «+»means that the regression coefficient has the positive sign; «-» does negative sign

The common outcome for all indexes of concentration is the following. The positive expectations of the investors connected with the concentration growth stimulate the increase in volumes of investment in regions and further production concentration growth. The sign for all estimations of parameters $\alpha_1^{(+)}$ is positive irrespective of types of concentration, or branches. Vice-versa, the negative investors expectations result in reduction of investment in the region economy and decrease of a level of concentration; parameters estimations $\alpha_1^{(-)}$, as a rule, have the negative sign.

Table 5.2

The sings of significant estimates $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$ of the investor expectation variables in the investor expectation regime-switching model differentiated by groups of regions[1]

Dependent variable	Positive expectations			Negative expectations		
	Regions with predominance of extractive industries	Regions with predominance of manufacturing industries	Northern regions	Regions with predominance of extractive industries	Regions with predominance of manufacturing industries	Northern regions
aggl				-	-	-
scale2					-	-
locto	+					-
locen	+				-	
locch		+		-		-
loccv						
lochi	+					
locma					-	
locls					-	
locpsm		+				
locle		+				
locpi					-	
otrto			+			
otren	+	+	+	+		
otrch						
otrcv						-
otrhi	+				-	
otrma					-	
otrls	+				-	
otrpsm		+				
otrle		+				
otrpi		+	+			

[1] «+» means that the regression coefficient has the positive sign; «-» does negative sign

Among the variables of relative production concentration in separate industries the positive relationship is found for such industries as fuel and power engineering, ferrous metals, chemical, building materials, and light industry. For the indicators of absolute concentration the relationship is detected in industries of fuel and energy complex, chemical, wood, building materials, light, and food processing (see tab. 5.1).

The negative influencing of concentration and investment by expectations of the investors is revealed in equations for variables of industrial concentration: *aggl* and *scale*2. For relative indexes of concentration, practically, in all industries, except light and building materials, the negative estimates of $\alpha_1^{(-)}$ were found. The negative estimates of $\alpha_1^{(-)}$ are determined predominantly for indicators of absolute concentration in industries of non-ferrous metals, chemical, mechanical engineering, and wood.

For regression equations with differentiation of expectations regimes according to groups of regions is possible to emphasize the following characteristics. The significant parameters estimations $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$ are found predominantly in two of three groups of regions: in regions with predominance of extractive industries, in the group of regions with predominance of manufacturing industries and it is almost absent in northern group of regions.

For group of regions with predominance of *extractive* industries the greater number of significant estimations of parameters corresponds to positive expectations of investors. The intense positive expectations of investors concerning branches of a fuel and energy complex are detected. In these branches the estimations of parameters $\alpha_1^{(+)}$ are significant both for indexes of absolute concentration of output and for indexes of relative concentration. The similar situation of indexes of absolute and relative concentration of production is determined in chemical. In wood the positive expectations influence basically an absolute level of concentration.

In the group of regions with predominance of *manufacturing* industries a number of brunches also forms the basis for positive expectations of investors. Among such industries it is possible to mark out the light, food-processing, ferrous metals, power engineering and building materials. It is necessary to note, that in all listed industries, except ferrous metals, the positive expectations of the investors are connected to increase in absolute production concentration. The relationship between positive expectations and relative concentration of production is fixed only in industries of ferrous metals, building materials, and light industries.

In the *northern* group of regions positive expectations of the investors are connected to industries of the fuel and energy complex and food-processing industry.

In equations of regression with differentiation by groups of regions the picture is following.

Negative expectations in the greatest degree influence aggregative indexes of industrial production concentration. So for index of relative production concentration, which is presented by the variable *aggl*, the negative estimations of parameters $\alpha_{1k}^{(-)}$ are obtained in all three groups of regions. In the group of regions with predominance of manufacturing industries and in the northern group of regions the negative expectations of the investors essentially influence absolute concentration of industrial production (variable *scale*2).

Regions with predominance of manufacturing industries are considerably influenced by negative expectations. The significant relationship between negative expectations and concentrations of industrial production are found in half of industries in the mentioned group of regions. Relative concentration of production is decreased by the influencing of negative expectations of investors in such industries as: power engineering, light, wood, and mechanical engineering. Besides the level of absolute concentration in following industries: chemical, mechanical engineering, and wood are also decreased. In the northern group of regions the negative expectations have affected basically the ferrous and non-ferrous metals and fuel.

Thus, the hypothesis has found evidence that spatial distribution of investment in Russia can be explained in framework of the theory of new economical geography. The convincing evidence was found a hypothesis of the investors' expectations influencing on spatial distribution of investment at both levels of an industry as a whole and its separate industries. It is possible to assert, that if the most part of investors share expectations concerning the growth of production concentration in region, then the influence of expectations on investment process will essential and determine a concentration level and increase in volume of investment in region. We have obtained evidence that the positive expectations of the majority of the investors concerning production concentration growth in region promote attracting of investment in region; the negative expectations result in reduction of investment and decrease of production concentration in regions.

Moreover, the hypothesis that the influencing of expectations essentially differs by groups of regions: the regions with predominance of extractive industries, the regions with predominance of manufacturing industries, and the northern group of regions depending on branch specialization and specific characteristics of separate groups of regions has found evidence.

As to estimations of the parameters β_1, they are significant and positive practically in all equations of regression. Thus, we found absolute evidence at hypothesis that in transition Russia the processes of production concentration occurred that stimulated the agglomeration effect in spatial distribution of investment.

Let's consider in detail the outcomes of separate dependent variables.

The industrial concentration in the Russian Federation

The outcomes of regressions estimation with regimes switching of expectations are shown in tab. A7.1 and regression with regimes switching by groups of regions - in tab. A7.6

The estimation of regression of absolute and relative concentration of production have shown that for the northern group of regions the low level of the industrial output in response to investment at negative expectations of the investors results in a production concentration decrease. For both indexes of concentration the significant parameters of the negative expectations have the negative sign (tab. A7.1). The regression estimations of absolute production concentration (*scale*2) demonstrate that in regions in case of negative investors expectations the share of large specialization industries is decreased ($\hat{\alpha}_1^{(-)}$ = -0,7453, see tab. A7.1, equation 4). Simultaneously, as the regression estimations of relative production concentration (*aggl*) testify, in case of negative expectations with reduction of the share of specialization industries the branch structure of a regional industrial complex levels off. Last fact finds reflection in reduction at variation of localization indexes of industries in regions.

Differentiated by regions groups the coefficients $\alpha_1^{(-)}$ in equations of absolute and relative concentration of industrial production again confirm the obtained earlier conclusions that the resource regions are more sensitive to expectations of the investors. So, for dependent variable of relative concentration of industrial production in an equation of regression the estimates modulo of resource regions $\alpha_{1k}^{(-)}$ more than three times is higher than the appropriate parameter of the group of regions with predominance of manufacturing industries (fig. 5.1).

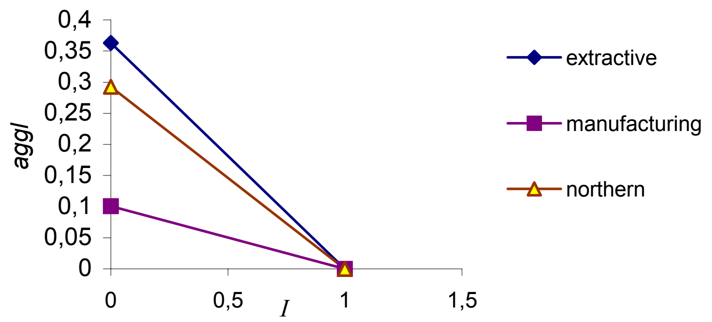

Fig. 5.1. Relation between relative concentration of industrial production and investment by regions groups for negative investors expectations

Differentiated by groups of regions the parameters estimates of absolute concentration of industrial production give a following result. The estimate of parameter $\alpha_{11}^{(-)}$ for group of regions with predominance of extractive industries not essentially differences from zero, and the parameters estimates for two other regions almost coincide (see tab. A7.6, equation 4):

$\hat{\alpha}_{12}^{(-)}$ (for regions with predominance of manufacturing industries) = -0,8598;

$\hat{\alpha}_{13}^{(-)}$ (for the northern group of regions) = -0,9691.

Thus, it is possible to make following conclusions. In case, when negative expectations dominate, relationship between investment and concentration of production is strong. If the large part of the investors shared negative expectations concerning production concentration in region, then the volumes of investment are reduced; the share of the specialization industries decreases both at a level of regions and at a national level. The process of production dispersion and leveling of branch structure of the regional industrial complexes occur. It is possible to make the conclusion that the investors expectations are connected not only to industrial complexes of regions as a whole but also to separate industries of specialization presented in regions. Let's point out again, that the regional industrial complexes with predominantly raw orientation: regions with predominance of extractive industries and regions of the northern group are most sensitive to investors' expectations. The latter specialize predominantly in fuel, non-ferrous metals and wood.

The feature of concentration in industries

In regression of indexes of absolute concentration for industries the significant positive estimates of parameters for positive expectations of the investors $\alpha_1^{(+)}$ are determined in industries of the fuel and energy complex, the industry of building material, the light and food-processing industry (tab. A7.4 - A7.5). After differentiation of regions by groups it was added the chemical and wood industry. The negative estimates for negative expectations of the investors $\alpha_1^{(-)}$ are obtained in the regression equation of absolute production concentration in non-ferrous metals, chemical, mechanical engineering, and wood.

From any two coefficients $\alpha_1^{(+)}$ and $\alpha_1^{(-)}$ in an regression equations with regimes switching of expectations or from the appropriate pair of coefficients $\alpha_{1k}^{(+)}$ and $\alpha_{1k}^{(-)}$, k = 1, 2, 3 for k-st of group of regions in regression with differentiation by groups of regions, as a rule, only one is significant. It can be the coefficients $\alpha_1^{(+)}$ conforming to positive expectations of the investors, and then it has the «plus» sign, or it can be a negative coefficient $\alpha_1^{(-)}$ for negative investors expectations. This circumstance indicates sensitivity of separate industries to certain types of investors expectations: positive or negative accordingly. Thus, we can assert, that, for example, light and food-processing industry, the industries of building materials, fuel and energy complex in the greater degree are inclined to react to positive investors expectations. And if the most part of the investors in region or in the group of regions shares positive expectations concerning perspectives of development of the above mentioned industries, it is necessary to expect an investment growth in regions and increase in production concentration, first of all, in these industries. On the other hand, a number of industries have demonstrated strong response to negative investors expectations. They unite, as we already remarked, mechanical engineering, chemical, wood, and non-ferrous metals. Under formation of negative expectations concerning development perspectives of former listed industries for the majority of the investors it is most probable that there will be reduction in investment in regions and decrease in production concentration first of all in these industries.

Nevertheless, it is necessary to mark a number of exceptions. So, for example, chemical and wood industries have demonstrated positive relationship between production concentration and investors expectations in one group of regions and negative in other, for example, for regions with predominance of a extractive industry factors $\hat{\alpha}_{11}^{(+)} > 0$, and for regions with predominance of manufacturing industries $\hat{\alpha}_{12}^{(-)} < 0$. In some groups of regions the significant parameters neither for negative expectations, nor for positive expectations of the investors is found. Therefore our conclusions concerning sensitivity of industries to investors' expectations are necessary to improve taking into account the specific characteristics of separate groups of regions.

Other interesting exception seems to be the power engineering. In an equation of regression estimated for this branch the significant estimates of parameters conforming to positive expectations of the investors in all three groups of regions are obtained. Moreover, the positive estimation $\alpha_{11}^{(-)}$ is found in the regions group with predominance of extractive industries. Comparison of estimates of positive and negative expectations in power engineering: $\hat{\alpha}_{11}^{(+)}$= 1,4131 and $\hat{\alpha}_{11}^{(-)}$ = 0,7261 demonstrates that the investment is attracted in power engineering in regions group with predominance of extractive industries both in case of positive and in case of negative expectations (see tab. A7.9, equation 3). There is an intensive process of production concentration of power industry in this group of regions. However in case of positive expectations the marginal gain of investment concentration is higher, also processes of concentration will be more intensive (fig. 5.2).

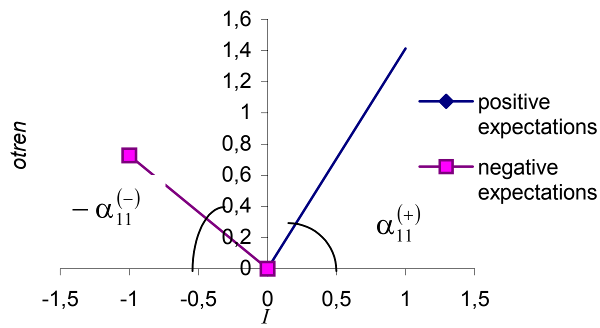

Fig. 5.2. Production concentration growth in power engineering industry in the regions group with predominance of extractive industries

The matching of concentration processes in power engineering by groups of regions also testifies in favor of the regions with predominance of extractive industries. The marginal concentration of investment production in case of predominance of positive investors expectations in this group more than twice is higher than in the group of northern regions and more than in 4 times is higher than in the group of regions with predominance of manufacturing industries (fig. 5.3).

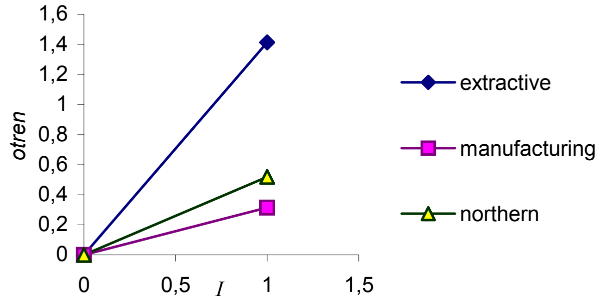

Fig. 5.3. Concentration growth in power engineering under positive investors expectations in regions groups

Thus, among specific features of concentration in industries we can emphasize the following. First, there is a sufficiently accurate polarization of industries according to their sensitivity to investors' expectations. Second, the positive expectations in the greater degree are connected with industries functioning for the ultimate consumer: light, food-processing. Third, the negative expectations of the investors in the greater degree dominate in regions, where concentration of manufacturing industries occurs and, first of all, branch of a military-industrial complex: engineering, chemical industry. Fourth, if the branch are connected with both positive and negative expectations, then marginal production concentration caused by the investment with dominance of positive expectations are higher than similar estimates with dominance of negative expectations.

The feature of relative concentration in industries

The indicator of relative production concentration defined by the industries localization factor allows to evaluate how the investor's expectations influence the densities of industries in the regional industrial structure in compare with the densities in the national industrial output.

The relative level of concentration of fuel, ferrous metals, building materials, and light is most sensitive to positive investors expectations (tab. A7.2 - A7.3). After differentiation of expectations by regions groups the list of industries inclined to increase of densities in regional industrial output at the positive expectations of the investors has increased up to six; power engineering and chemical additionally have been introduced in it (see tab. A7.7 - A7.8). Some industries: fuel, power engineering, ferrous and non-ferrous metals, mechanical engineering, wood, food-processing demonstrate the tendency to a decrease in a relative level of concentration in regions at negative expectations of the investors.

As we can see, for indexes of relative concentration of production there are no such exact limits, which have allowed conducting the classification of industries on a level of their localization in regions in reply to investors' expectation. The level of localization of industries changes both in case of positive expectations of the investors, and then the share of industries in a regional industrial complex increases in comparison with Russian one, and in case of negative expectations. In the second case, the densities of industries in comparison with Russian are reduced.

The comparison of regression equations with regimes switching of expectations and regression equations with regimes switching of expectations differentiated by groups of regions demonstrates that the expectations reaction determined in case of the aggregated estimation after differentiation of estimations by regions groups basically is kept. However there are also exceptions. After differentiation of parameters of investors' expectations regimes by regions groups follow-up there are significant estimations of parameters $\alpha_{1k}^{(+)}$ in power engineering, ferrous metals, mechanical engineering, and, on the contrary, the significant estimates for negative expectations in non-ferrous metals and chemical industry disappear.

These changes are connected, apparently, to specific features of separate regions groups.

There are common features determining influencing of investors' expectations on absolute and relative production concentration. As well as in case of absolute production concentration the most part of positive investors expectations in regions with predominance of extractive industries is connected with fuel, energy, and chemical industries, and in regions with predominance of a manufacturing industry connected with ferrous metals, building materials, and light industries. The essential difference in the analysis of relative concentration from absolute one is that the investors do not associate the positive expectations with localization in regions of a food-processing industry. Localization of a food-processing industry is influenced basically by negative expectations; under dominance of negative investors expectations the relative share of a food-processing industry in a regional industrial complex declines in comparison with Russian one.

The considerable influencing of negative expectations on the relative concentration of industries is found in the group of regions with predominance of manufacturing industries. The negative estimates of parameters are obtained for mechanical engineering, power engineering, wood, and food-processing industry. In the northern group of regions the negative expectations of the investors influence relative concentration in a fuel and ferrous metals, and in regions with predominance of an extractive industry do only in ferrous metals. The significant influencing of negative expectations in resource regions on a fuel industry and ferrous metals is a distinctive feature of processes of relative concentration of industrial production as contrasted to the process of absolute concentration.

The influencing of the transport costs on the industrial concentration

The information about the presence of significant estimates of parameters and tendency of its influencing is shown in tab. 5.3 and tab. 5.4. The regressions can be found in tab. A7.1 - A7.10.

Table 5.3

The sings of significant estimates of transport costs and gravity variables in the investor expectation regime-switching model [1]

Dependent variable	Decrease in transport costs			Increase in transport costs		
	transptp	*tareatp*	*tdisttp*	*transptm*	*tareatm*	*tdisttm*
aggl		-			-	
scale2	-		+	-		+
locto						
locen		-			-	+
locch						
loccv		+			+	
lochi						
locma						
locls						
locpsm						
locle						
locpi						
otrto						
otren	-		+			
otrch						
otrcv		+			+	
otrhi						
otrma	-	+		-	+	+
otrls						
otrpsm						
otrle						
otrpi		+		-	+	+

[1] «+» means that the regression coefficient has the positive sign; «-» does negative sign

In all regression equations, where the significant estimations of parameters were obtained, the increase in transport costs negatively influences a level of concentration. This outcome is found for variable of absolute concentration of industrial production and for indexes of concentration in such industries, as: power engineering, mechanical engineering and food-processing industry (see tab. 5.4). At a relative decrease in transport costs the production concentration in regions reduce more than at their relative increase. There is a divergence of production over regions of country. However both in case of relative increase and in case of a relative decrease the transport costs influence a decrease of production concentration.

Table 5.4

The sings of significant estimates of transport costs and gravity variables in the investor expectation regime-switching model differentiated by groups of regions [1]

Dependent variable	Decrease in transport costs			Increase in transport costs		
	transptp	*tareatp*	*tdisttp*	*transptm*	*tareatm*	*tdisttm*
aggl		-			-	
scale2	-			-		+
locto						
locen						
locch		+			+	
loccv						
lochi						
locma						
locls						
locpsm						
locle						
locpi						
otrto						
otren	-		+			
otrch						
otrcv		+			+	
otrhi						
otrma	-	+		-	+	+
otrls						
otrpsm		+	-			
otrle						
otrpi		+		-	+	

[1] «+» means that the regression coefficient has the positive sign; «-» does negative sign

Such variable as distance up to the center which also determines transport costs of region, particularly, inter-regional transportations cost positively influences the increase in concentration in an industry as a whole and in its industries such as: power engineering, non-ferrous metals, mechanical engineering, food-processing industry. These industries are most sensitive to transport costs. The remoteness of region from the center positively influences concentration of power engineering in case of a relative decrease in the transportation rates, but concentration of mechanical engineering and food-processing industry are influenced by the distance in case of relative increase of transport costs.

Conclusions about influencing of the area of region, which in combination with the transport tariff characterizes a internal transportation cost, are not such well-defined. In some equations we have estimates of parameters with negative sing, for example, in equations of relative concentration of industrial production, relative concentration of power engineering; in other cases estimates of the conforming parameters have the positive sign. The increase in the area stimulates the rise in absolute and relative concentration, for example, in non-ferrous metals, absolute concentration in mechanical engineering and food-processing industry.

Thus, the availability of significant estimates of parameters for an index of increase in the transport tariff and gravity variables confirms a hypothesis that the transport costs essentially influence the production agglomeration and spatial distribution of investment in Russia. We see, that according to estimation results the transport tariff in Russia are up to data, which leads to divergence of production over regions. The differentiation of increase and decrease in ratio transport costs/industrial prices index has not revealed any essential differences.

As we begin to take into account the distance of transportation together with the transport tariff in variables *tdisttm*, *tareatp*, *tareatm*, *tdisttp* the signs of parameters estimations start to vary. The transport tariff together with the distance, which characterize inter-regional transportations costs, positively influence the production concentration, and the transport costs with area, which accounts internal regional transportations costs, have either positive, or negative influence depending on specific features of branch and characteristics of regions.

Section 6. Conclusion

In the conducted research the different variants of agglomeration model are presented, which takes into account the effect of external economies, distribution of investment over the regions of country and influencing of expectations of the investors. The theoretical analysis of agglomeration models has allowed to reveal the following.

The investors' behavior and role of expectations in many respects are determined by parameters of the economy. From the point of view of the economic policy it is important to note that the concentration depend on such parameters as the speed of adjustment, external economies, interest rate, which can be used as the instruments of regulation of the agglomeration process. It is established that some different variants of economic development are possible. First variant is that the development is completely determined by the historical tendencies. Second, it is possible to change dynamics of economic development by influencing of expectations of the most part of investors. This outcome appeared to be in both in model with a constant volume of investment in the economy and in model with a variable one.

Opportunity to change dynamics of development of a system is in case, when in space of possible paths there is the area , which we following P. Krugman have named the overlap, and in which the economy during definite time moves with oscillations. Due to existence of the trajectory with cyclical dynamics there is a possibility to change a historical tendencies of development.

As one of factors, which can be decisive in choice of dynamics, are the expectations of the investors concerning perspectives of the regions development. If the most part of investors expects that other investors will also come in region, they will put up investment in this region; it provides production concentration growth. There is the agglomeration effect from external economies. The agglomeration effect provides scale economy and increasing return of investment, attracts new investors and leads to even greater concentration of production in region. In this process the essential role belongs to expectations of the investors whether investment in region will move or not. If the expectations of the most part of investors coincide, there is a possibility to change history and to create conditions of appearance of the agglomeration effect. Thus the formation of the positive expectations of the investor can be used as instrument of the economic policy.

Use of the accelerator model in framework of the agglomeration model is the new moment in research of agglomeration and allows simulating not only growing, but also falling dynamics of the economy. With the help of the model with variable volume of investment in the economy was discovered, that concentration is possible not only in conditions of economic growth, but also in conditions of decreasing dynamics of production and investment. It was proved, that the mechanism of the agglomeration processes in case of the decreasing economy is the same, as in case of the growing economy and one is conditioned by such parameters as force of external economies, rate of return and speed of adjustment of investment. It is proved that the concentration process in case of the falling economy is connected to migration of production in regions with a dominance of extractive industries and raw specialization of the economy, as it had occurred in the Russian Federation in the transition period.

The insertion of flexible accelerator into the agglomeration model allowed taking into account the influence of production concentration on the investment in regions with constant and increasing return. We consider predominantly resource regions as regions with constant return, and we consider regions with predominance of manufacturing industries as regions with increasing return.

After including the accelerator in model, it was found that there are the trajectories of an economical dynamics, when the most part of investment is reallocated for region with increasing return, and it is possible providing development of manufacturing industries and appearing of the effect of external economies. At the same time, certain part of investment remains in regions with constant return. Both regions develop successfully, and this pathway, seems to be most favorable for the country providing more stable growth of the economy, investment and national income. The full production concentration in region with constant return and formation of completely raw economy can be as alternative. The production concentration in raw sector gives the lowest parameters of dynamics of investment and national income on all trajectory of the development. The path leading to production concentration in region with increasing return are connected with change of technologies, management, organization of production, structural rearrangement of economy, updating of the manufacturing equipment that demands considerable costs before it is possible to receive the investment yield. But this variant of the economic policy guarantees higher return than raw specialization.

In the field of the overlap the possibility of any variants of dynamics is kept. If there is an overlap, the choice of a pathway of development in a direction of a specialization in region with predominance of manufacturing industries depends on the solution, which will be accepted by the majority of the investors. The change of a pathway in the field of overlap is connected with a possibility of a jumping on the closely arranged spirals. When the majority of the investor moves to region with increasing return, in the field of overlap the system can jump on a pathway leading to concentration of productions in this region. In the field of overlap still everything is decide by investors' expectations concerning the future investment yield in conditions of a varying spatial pattern of production. Probability of a jump is more than higher the expected increase of the shadow price of the investment in the region with increasing return.

If overlap is absent, in model with variable volume of investment as well as in model with constant volumes of investment everything is determined by history. If the overlap exists the system also is in the field of overlap, the transition of a system to any pathway is possible. If the overlap exists and the system is out of the overlap, then dynamics of a system is completely determined by the history.

The calculations of parameters of the agglomeration model have shown that in the modern Russian economy the leading role belongs to expectations, and realization of any pathway of development is potentially possible**.** The improvement of the modern economic dynamics in the Russian Federation is possible if to change from raw orientation of the economy to the development of a manufacturing industry.

The outcomes of empirical research have shown the following. Testing of two types of agglomeration of industrial production: absolute and relative for the aggregated and branch indexes prove the hypotheses concerning influencing of concentration on a spatial distribution of investment in the economy of regions in transitional Russia.

Testing of regression with different variants of territorial structure of the Russian Federation was performed. The regression for all regions of Russia and regression with differentiation of conditions by groups of regions were estimated. The regions groups include: regions with predominance of manufacturing industries, regions with predominance of extractive industries and northern group of regions, in which also the leading role belongs to raw industries. Testing of variants of regression with different territorial structure has confirmed positive relationship between investment and production concentration in industries. It was demonstrated that in Russia during transition the concentration of production and investment in separate regions occurred being under the influencing of investors' expectations.

Insertion of the conditions of regimes switching of positive and negative investors expectations in the estimated models have allowed to find the essential relationship between expectations and concentration of investments and production. The significant outcomes are obtained both for positive and for negative expectations, and the nature of this relationship is determined by a regime of expectations of the investors. It is discovered that positive expectations of the investors concerning the production concentration growth of industries in regions increase the investment in these regions, and stimulate further concentration of industries. When the negative expectations dominate, the reduction of investment in the economy of regions and decrease in a concentration level occur.

It is found by results of the analysis that in the *group of regions with predominance of an extractive industry* positive investors expectations dominate. The strong positive expectations concerning industries of the fuel and energy complex and the chemical industry are detected. In these industries influencing of positive expectations both on the level of absolute production concentration and on the level of relative one is considerable. Positive expectations influence basically an absolute level of concentration in wood industry.

In the *group of regions with predominance of manufacturing industries* a number of industries also gives the basis for **positive expectations** of the investors. Among such industries it is possible to mark out light and food-processing industry, ferrous metals, power engineering, industry of building materials. It is necessary to note, that in all listed industries, except ferrous metals, the positive investors expectations are connected with growth of absolute production concentration. The connection of positive expectations with relative concentration is found only in the industries of ferrous metals, building materials and light industry.

In the *northern group* of regions positive investors expectations are connected to industries of fuel and energy complex and food-processing industry.

Regions with predominance of manufacturing industries are most sensitive to **negative expectations**; the level of absolute concentration is reduced in the industries of chemical, mechanical engineering, woods. In the northern group of regions the negative expectations have affected basically the following branches: ferrous metals, non-ferrous metals, and fuel.

It is established, that the regional industrial complexes with predominantly raw orientation: the regions with predominance of extractive industries and the regions of the northern group are most sensitive to investors' expectations.

The sensitivity of industries differs by the types of investors' expectations: positive or negative. We can affirm that, for example, light, food processing, building materials, fuel and power engineering industries in the greater degree are inclined to respond to positive investors expectations. If the most part of investors in region, or in the group of regions is shared positive expectations concerning prospects for the development of the set of industries mentioned above, it is necessary to expect the increase in investment in regions and growth of production concentration, first of all, in these industries. On the other hand, a number of industries have demonstrated strong reacting to negative expectations of investors. In their number, as we already remarked, there are: engineering, chemical, wood, non-ferrous metals industries.

Therefore under negative expectations of the most part of investors concerning prospects for the development of four listed industries it is most possible that there will be a reduction of investment volume in regions and decrease in production concentration first of all in these industries.

The testing hypothesis has found evidence that spatial distribution of investment in Russia can be explained within the framework of the theory of new economical geography. The convincing evidence for hypothesis of investors' expectations influencing on spatial distribution of investment was obtained. Moreover, it is empirically demonstrated that influencing of expectations: positive and negative ones are essentially differed by the regions groups depending on branch specialization and specific characteristics of separate groups of regions.

It is empirically demonstrated that there is a rather accurate polarization of industries according to their sensitivity to investors' expectations. Second, it was shown that positive expectations in the greater degree are connected with industries working for the ultimate consumer: light and food processing. Third, negative expectations of the investors dominant in regions, where is concentrated manufacturing industries and, first of all, branch of a military-industrial complex: mechanical engineering, chemical industry. Fourth, if both positive and negative expectations are connected with some branches, then modulo of marginal production concentration are higher at dominance of positive expectations than similar parameter at dominance of negative expectations.

The comparison of regression equations with a different degree of territorial differentiation demonstrates that the reacting to expectations established in case of the aggregated estimation is basically preserved after differentiation of estimations by regions groups.

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Appendix 1

List of variables and parameters used in the theoretical model

Indexes:

X – index of the region with increasing return to scale;

A – index of the region with constant return to scale;

t – time.

Variables:

I – volume of investment in the economy;

I_X , I_A – volume of investment in regions *X* and *A* accordingly;

Y – national income;

Y_X, Y_A – gross regional product in regions *X* and *A* accordingly;

π –investment yield in the region *X* relative to the region *A*;

R – income of the investors;

m –rate of investment migration in the region *X*;

q – shadow price of investment in *X* in relation to *A*;

h – shadow price of investment in the economy.

Parameters:

r – interest rate in the world markets;

β – force of external economies from agglomeration;

I_X^* – volume of investments in *X*, at which the investment yield in *X* and in *A* are equal to one;

γ – an inverse index of costs of investment adjustment;

μ – capital/output ratio;

μ_x , μ_A – capital/output ratio in regions *X* and *A* accordingly;

λ – speed of adjustment of the desirable and actual capital;

λ_x, λ_A – speed of adjustment of desirable and actual capital in regions X and A accordingly;

δ – declining factor of the lagged links;

Appendix 2

The first-order conditions for the problem of the center

The equation describing the rate of change of investment in the economy is

$$\dot{I} = \eta\left\{\theta I - \left(\pi'(I_x)I_x + \pi - 1 - \frac{a-1}{a\mu_x\lambda_x}\right)\gamma q - \left(\delta(\pi-1) - \frac{a-b}{a\mu_x}\right)I_x\right\}, \quad \text{(A.2.1)}$$

the equation which gives the rate of change of the shadow price of investment in the economy is

$$\dot{h} = (r - \eta\theta)h - 1 - l, \quad \text{(A.2.2)}$$

the complementary slackness condition is

$$(I - I_x) \geq 0, \quad l \geq 0, \quad (I - I_x)\, l = 0, \quad \text{(A.2.3)}$$

transversality condition:

$$\lim_{t\to\infty} e^{-rt} hI = 0. \quad \text{(A.2.4)}$$

Appendix 3

The characteristic equation for the problem of the center

After the Taylor-series expansion around the stationary point the equation (3.25) has a form

$$\dot{I} = \eta\left\{\frac{b-a}{a\mu_x} - \delta\beta I_x^*\right\}(I_x - I_x^*) + \eta\gamma\left\{\frac{a-1}{a\mu_x\lambda_x} - \beta I_x^*\right\}q + \eta\theta\left(I - \frac{b-a}{b-a\delta\mu_x}I_x^*\right) \quad \text{(A.3.1)}$$

The characteristic equation of the system (3.5), (3.9), (A.3.1) is the following

$$\begin{vmatrix} -\rho & \gamma & 0 \\ -\beta & r-\rho & 0 \\ \eta\left(\dfrac{a-b}{a\mu_x}-\delta\beta I_x^*\right) & \eta\gamma\left(\dfrac{a-1}{a\mu_x\lambda_x}-\beta I_x^*\right) & \eta\theta-\rho \end{vmatrix} = 0, \qquad \text{(A.3.2)}$$

or

$$(\eta\theta-\rho)(\rho^2 - r\rho + \gamma\beta) = 0 \qquad \text{(A.3.3)}$$

Appendix 4

The proof of the flexible accelerator model with expectations of the investors

The expected net investment I_{t+1}^{*e} is determined by a gap of fixed capital $\left(K_{t+1}^{e} - K_t\right)$ and rate of adjustment of the capital λ

$$I_{t+1}^{*e} = \lambda\left(K_{t+1}^{e} - K_t\right), \qquad \text{(A.4.1)}$$

where K_{t+1}^{e} is the desirable or optimum capital. Substituting in (A.4.1) expression for the accelerator

$$K_{t+1}^{e} = \mu Y_{t+1}^{e}, \qquad \text{(A.4.2)}$$

where Y_{t+1}^{e} - the expected level of production, in (A.4.1), we receive

$$I_{t+1}^{*e} = \lambda\mu Y_{t+1}^{e} - \lambda K_t. \qquad \text{(A.4.3)}$$

Under rational expectations the net expected investment is equal to the real gain of the realized capital

$$I_{t+1}^{*e} = K_{t+1} - K_t, \qquad \text{(A.4.4)}$$

then

$$\lambda\mu Y_{t+1}^{e} - \lambda K_t = K_{t+1} - K_t. \qquad \text{(A.4.5)}$$

That allows to express realized level of the capital in the year t + 1 through the expected output

$$K_{t+1} = \lambda\mu Y^e_{t+1} + (1-\lambda)K_t\,. \tag{A.4.6}$$

Let δ - the constant rate of depreciation of the capital, then the equation of the gross expected investment I^e_{t+1} with accounting for (A.4.5) takes a form

$$\begin{aligned} I^e_{t+1} &= K_{t+1} - (1-\delta)K_t \\ &= \lambda\mu Y^e_{t+1} + (\delta-\lambda)K_t\,. \end{aligned} \tag{A.4.7}$$

It is possible to record the expression for the gross investment in year t

$$I_t = \lambda\mu Y_t + (\delta-\lambda)K_{t-1}, \tag{A.4.8}$$

where I_t and Y_t are the current investment and output.

Subtract (A.4.8) multiplying by (1- δ) from (A.4.7) and receive

$$I^e_{t+1} - (1-\delta)I_t = \lambda\mu Y^e_{t+1} + (\delta-\lambda)K_t - (1-\delta)\lambda\mu Y_t - (1-\delta)(\delta-\lambda)K_{t-1},$$

together with (A.4.8) this implies

$$I_t = \lambda\mu Y_t + (\delta-\lambda)K_{t-1}, \tag{A.4.8}$$

Expressing the expected output through current one and both expected and current investment, we shall receive:

$$Y^e_{t+1} = (1-\delta)Y_t + \frac{1}{\lambda\mu}I^e_{t+1} - \frac{(1-\lambda)}{\lambda\mu}I_t\,. \tag{A.4.10}$$

Appendix 5

Table A5

List of the regions groups

The extractive industry regions	The manufacturing industry regions		The north regions
Volgogradskaya	S-Petersburg	Penzenskaya	Kareliya
Leningradskaya	Novgorodckaya	Samarskaya	Komy
Ryzanskaya	Pskovskaya	Saratovskaya	Arhangelskaya
Tulskaya	Brynskaya	Ulianovskaya	Murmanskaya
Belgorodckaya	Vladimirskaya	Adigeya	Tumenskaya
Lipeckaya	Ivanovskaya	Dagestan	Krasnoyarskiy
Tatarstan	Kalugskaya	Kabardino-Balkariya	Saha
Vologodskaya	Kostromckaya	Karachaevo-Chercesskaya	Chukotskaya
Bashkortostan	Moscow	Severnaya Osetiya - Alaniya	
Orenburgskaya	Moskovskaya	Krasnodarskiy	
Permskaya	Orlovskaya	Ctavropolskiy	
Cverdlovskaya	Cmolenskaya	Rostovskaya	
Chelybinskaya	Tverskaya	Udmurtskaya	
Kemerovskaya	Jaroslavskaya	Kurganskaya	
Omskaya	Mariy Al	Altay	
Tomskaya	Mordoviya	Altayskiy	
Hacasiya	Chuvashskaya	Novosibirsaya	
Irkutskaya	Kirovskaya	Buriatiya	
Chitinskaya	Nigegorodskaya	Tuva	
Habarovskiy	Voronegskaya	Evreyskaya	
Amurskaya	Kurskaya	Primorskiy	
Magadanskaya	Tambovskaya	Kamchatskaya	
	Kalmikiya	Cahalinskaya	
	Astrahanskaya	Kaliningradskaya	

Appendix 6

The inter-relationship between parameters of the theoretical and econometric models

The parameters of the theoretical model were counted on the basis of estimations of parameters of the econometric model with regimes switching of expectations differentiated by groups of regions (4.20). With notations (4.2) the formulas of parameters calculation of the theoretical model take a following form.

The declining factor of the lagged links

$$\delta = 1 - \beta_1 . \qquad \text{(A6.1)}$$

Capital/output ratio in the region with constant return *X*

$$\mu_A = \frac{1}{\alpha_{1k}^{(+)} \lambda_A}, \qquad \text{(A6.2a)}$$

where k = 1, 3 in the econometric model corresponds to regions with predominance of extractive industries and the northern group of regions, in which the extractive industries prevail. The estimations for two mantioned groups of regions allow calculating parameters for the region with constant return to scale in the theoretical model;

capital/output ratio in the region with increasing return to scale is determined as

$$\mu_X = \frac{1}{\alpha_{1k}^{(+)} \lambda_X}, \qquad \text{(A6.2b)}$$

where k = 2 corresponds to the group of regions with predominance of manufacturing industries and evaluates parameters for region with increasing return.

The speed of adjustment of the desirable and actual capital can be computed as follows

$$\lambda_A = \frac{\beta_2}{\alpha_{1k}^{(+)}} + 1; \quad \text{(A6.3a)}$$

$$\lambda_X = \frac{\beta_2}{\alpha_{1k}^{(+)}} + 1, \quad \text{(A6.3b)}$$

where k = 1, 3 in (A6.3a) and k = 2 in (A6.3b) correspond to indexes of the regions group with predominance of extractive industries, the northern group of regions, and the group of regions with predominance of manufacturing industries accordingly.

Results of econometric analysis

Table A7.1

Regression of the industrial concentration indexes (the investor expectation regime-switching model) [1]

	prom[2]	*aggl*[2]	*scale2*[3]
1	2	3	4
yll	0,6916* (0,0926)	0,4873* (0,0606)	1,1658* (0,1133)
idplus	0,3868 (0,2684)	0,0379 (0,0371)	0,0565 (0,1743)
idminus	0,1245 (0,2510)	-0,1784* (0,0416)	-0,7453* (0,2604)
il	-0,0963 (0,1917)	0,0357 (0,0325)	-0,0785 (0,1512)
transptp	-0,0819 (0,8474)	0,3021 (0,2202)	-2,5339* (1,0198)
transptm	0,0216 (0,3816)	0,1767 (0,1601)	-2,1158* (0,7440)
tareatp	-0,0269 (0,3102)	-0,1008*** (0,0595)	0,2216 (0,2742)
tareatm	-0,0129 (0,1326)	-0,0708*** (0,0406)	0,2097 (0,1895)
tdisttp	0,0171 (0,1497)	-0,0200 (0,0331)	0,2525*** (0,1535)
tdisttm	-0,0000 (0,4283)	-0,0082 (0,0231)	0,2099** (0,1073)
p-lev Sar	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.

[2] Instruments *deltay, dplus, dmin13*

[3] Instruments *deltay, dplus, dmin2*

Table A7.2

Regression of the relative concentration indexes by industries (the investor expectation regime-switching model) [1]

	locto[2]	*locen*[2]	*locch*[2]	*loccv*[2]	*loch*[2]*i*
1	2	3	4	5	6
yl	0,8273* (0,0496)	0,3913* (0,0676)	0,6297* (0,0657)	0,2346* (0,0910)	0,3739* (0,0728)
idplus	0,1760* (0,0676)	0,0739 (0,0701)	0,1222** (0,0574)	-0,0852 (0,1710)	0,0750 (0,0959)
idminus	-0,1007*** (0,0597)	-0,1497** (0,0688)	-0,0469 (0,0506)	-0,3631** (0,1695)	-0,1959** (0,0994)
il	-0,0191 (0,0512)	0,0038 (0,0576)	-0,0961** (0,0443)	0,1548 (0,1416)	-0,0397 (0,0810)
transptp	-0,0478 (0,3521)	-0,3825 (0,3981)	-0,3841 (0,3003)	0,3454 (0,9700)	0,1055 (0,5571)
transptm	-0,0660 (0,2560)	-0,1111 (0,2884)	-0,2043 (0,2180)	0,1399 (0,7043)	0,0689 (0,4045)
tareatp	-0,0138 (0,0965)	-0,2040*** (0,1082)	-0,0710 (0,0775)	0,4171*** (0,2340)	-0,0660 (0,1553)
tareatm	0,0019 (0,0657)	-0,1353*** (0,0736)	-0,0249 (0,0525)	0,3316** (0,1585)	-0,0496 (0,1056)
tdisttp	0,0106 (0,0533)	0,1073*** (0,0598)	0,0658 (0,0448)	-0,1549 (0,1430)	-0,0108 (0,0843)
tdisttm	0,0075 (0,0371)	0,0511 (0,0417)	0,0304 (0,0312)	-0,0985 (0,0985)	-0,0082 (0,0587)
p-lev Sar	1	1	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.

[2] Instruments *deltay, dplus, dmin6*

Table A7.3

Regression of the relative concentration indexes by industries (the investor expectation regime-switching model) [1]

	locma[2]	*locls*[2]	*locpsm*[2]	*locle*[2]	*locpi*[2]
1	2	3	4	5	6
yl	0,2940* (0,1025)	0,1691** (0,0824)	0,5138* (0,1001)	0,6914* (0,0748)	0,5765* (0,0541)
idplus	0,0823 (0,0980)	0,1348 (0,2596)	0,4019*** (0,2327)	0,5414** (0,2288)	0,0639 (0,0717)
idminus	-0,0808 (0,1002)	-0,5193** (0,2561)	-0,0834 (0,2211)	0,1093 (0,2123)	-0,1913** (0,0799)
il	-0,0109 (0,0848)	0,1987 (0,2139)	-0,2288 (0,1894)	-0,4363** (0,1872)	0,1188*** (0,0646)
transptp	-0,4002 (0,5829)	0,7405 (1,4744)	0,1543 (1,3020)	0,3472 (1,2601)	-0,0213 (0,4277)
transptm	-0,2655 (0,4184)	0,3340 (1,0693)	0,0402 (0,9411)	0,4288 (0,9117)	-0,1807 (0,3115)
tareatp	0,0245 (0,1353)	-0,1504 (0,4090)	-0,3866 (0,3599)	-0,0057 (0,3429)	-0,1551 (0,1109)
tareatm	0,1178 (0,0910)	-0,1152 (0,2779)	-0,1214 (0,2434)	0,0323 (0,2335)	-0,0959 (0,0753)
tdisttp	0,0479 (0,0856)	-0,0783 (0,2232)	-0,0827 (0,1979)	-0,0328 (0,1901)	0,0394 (0,0640)
tdisttm	0,0330 (0,0583)	-0,0165 (0,1553)	0,0241 (0,1366)	-0,0552 (0,1321)	0,04978 (0,0447)
p-lev Sar	1	1	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.

[2] Instruments *deltay, dplus, dmin6*

Table A7.4

Regression of the absolute concentration indexes by industries (the investor expectation regime-switching model) [1]

	Otrto[2]	*otren*[2]	*otrch*[2]	*otrcv*[2]	*otrhi*[2]
1	2	3	4	5	6
yl	1,0961* (0,0457)	0,2197* (0,0611)	0,8403* (0,0788)	05262* (0,0588)	0,4575* (0,0677)
idplus	0,5110* (0,1736)	0,4263* (0,1405)	0,1900 (0,1624)	0,0810 (0,2411)	0,0854 (0,1521)
idminus	0,0708 (0,1579)	0,0336 (0,1380)	-0,0711 (0,1519)	-0,5627** 0,2575()	-0,3348** (0,1603)
il	-0,4175* (0,1373)	-0,1400 (0,1192)	-0,1613 (0,1357)	0,0329 (0,2084)	0,1342 (0,1311)
transptp	-0,1107 (0,9330)	-1,6838** (0,8213)	-0,8981 (0,8852)	-0,1452 (1,4181)	-0,3334 (0,8902)
transptm	-0,1877 (0,6775)	-0,3714 (0,5930)	-0,5976 (0,6402)	-0,0446 (1,0333)	-0,6223 (0,6480)
tareatp	0,2027 (0,2600)	-0,0188 (0,2198)	-0,0901 (0,2215)	1,2123* (0,3945)	0,0478 (0,2410)
tareatm	0,2032 (0,1762)	-0,0518 (0,1496)	-0,0112 (0,1495)	0,5388** (0,2706)	-0,0403 (0,1638)
tdisttp	0,0368 (0,1415)	0,2433** (0,1226)	0,1403 (0,1317)	-0,2194 (0,2141)	0,0339 (0,1342)
tdisttm	0,0272 (0,0984)	0,0662 (0,0852)	0,0790 (0,0910)	-0,0987 (0,1494)	0,0846 (0,0937)
p-lev Sar	1	1	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.

[2] Instruments *deltay, dplus, dmin6*

Table A7.5

Regression of the absolute concentration indexes by industries (the investor expectation regime-switching model) [1]

	otrma[2]	*otrls*[2]	*otrpsm*[2]	*otrle*[2]	*otrpi*[2]
1	2	3	4	5	6
yl	0,0434 (0,0864)	0,1490*** (0,0865)	0,5497* (0,0983)	0,5041* (0,0823)	0,5807* (0,0801)
idplus	0,0035 (0,1520)	0,0667 (0,2084)	0,4287** (0,1892)	0,4416** (0,1860)	0,2224** (0,1037)
idminus	-0,3429** (0,1693)	-0,4999** (0,2301)	-0,0936 (0,1897)	0,0315 (0,1770)	-0,0770 (0,1049)
il	0,1607 (0,1324)	0,1931 (0,1804)	-0,2013 (0,1610)	-0,3641** (0,1528)	-0,1090 (0,0903)
transptp	-2,8662* (0,8993)	0,5726 (1,2346)	0,9686 (1,1487)	0,7279 (1,0847)	-0,5374 (0,6114)
transptm	-2,2988* (0,6564)	0,5127 (0,8971)	-0,5594 (0,8100)	-0,5545 (0,7640)	-1,3327* (0,4446)
tareatp	0,6254* (0,2350)	-0,0134 (0,3411)	0,4286 (0,3007)	0,3609 (0,2878)	0,3779** (0,1645)
tareatm	0,3704** (0,1592)	0,1706 (0,2320)	0,1646 (0,2037)	0,1493 (0,1957)	0,2237** (0,1117)
tdisttp	0,1939 (0,1349)	-0,0832 (0,1865)	-0,2417 (0,1730)	-0,1917 (0,1628)	-0,0399 (0,0912)
tdisttm	0,1909** (0,0941)	-0,1018 (0,1302)	-0,0222 (0,1170)	0,0312 (0,1104)	0,1138*** (0,0637)
p-lev Sar	1	1	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.

[2] Instruments *deltay, dplus, dmin6*

Table A7.6

Regression of the industrial concentration indexes (the investor expectation regime-switching model differentiated by groups of regions) [1]

	prom[2]	*aggl*[2]	*scale2*[2]
1	2	3	4
yl	0,6872* (0,1747)	0,4682* (0,0619)	1,2191* (0,1088)
idpre	0,5306 (0,7490)	-0,0489 (0,1126)	0,4215 (0,5030)
idmre	0,2212 (0,5892)	-0,3711* (0,1197)	-0,2665 (0,5931)
idpma	0,3578 (0,4792)	0,0564 (0,0394)	0,0796 (0,1684)
idmma	0,1072 (0,4584)	-0,1038** (0,0470)	-0,8598* (0,3964)
idpno	0,3548 (0,7869)	0,0018 (0,1096)	-0,0011 (0,4183)
idmno	0,1120 (0,5684)	-0,2930* (0,0956)	-0,9691*** (0,5569)
il	-0,1005 (0,3350)	0,0214 (0,0321)	-0,1250 (0,1361)
transptp	-0,0815 (0,3839)	0,3013 (0,2168)	-2,1871** (0,9144)
transptm	0,0175 (0,6187)	0,1965 (0,1578)	-1,7915* (0,6649)
tareatp	-0,0279 (0,5041)	-0,1118*** (0,0592)	0,2602 (0,2609)
tareatm	-0,0147 (0,2154)	-0,0743*** (0,0400)	0,2396 (0,1754)
tdisttp	0,0176 (0,2435)	-0,0172 (0,3260)	0,2050 (0,1390)
tdisttm	0,0012 (0,1095)	-0,0102 (0,0233)	0,1655*** (0,0966)
p-lev Sar	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.

[2] Instruments *deltay, dpre, dmre, dpma, dmma, dpno, dmno*

Table A7.7

Regression of the relative concentration indexes by industries (the investor expectation regime-switching model differentiated by regions groups) [1]

	locto[2]	*locen*[2]	*locch*[2]	*loccv*[2]	*lochi*[2]
1	2	3	4	5	6
yl	0,8391* (0,0472)	0,4185* (0,0641)	0,6790* (0,0618)	0,2969* (0,0693)	0,4501* (0,0693)
idpre	0,3889** (0,1672)	0,3568*** (0,2034)	-0,0869 (0,1580)	0,0414 (0,3500)	1,0725* (0,3146)
idmre	-0,0617 (0,1805)	-0,0925 (0,1891)	-0,4504* (0,1401)	-0,5470 (0,3666)	0,1494 (0,2692)
idpma	0,0547 (0,0789)	0,0146 (0,0708)	0,1080*** (0,0599)	-0,0637 (0,1284)	0,0338 (0,0969)
idmma	-0,0340 (0,0620)	-0,2343* (0,0742)	0,0008 (0,0502)	-0,1737 (0,1323)	-0,1654 (0,1080)
idpno	0,0175 (0,1397)	0,2486 (0,1912)	-0,0734 (0,1107)	0,3852 (0,3002)	-0,0167 (0,2087)
idmno	-0,3202** (0,1320)	0,1479 (0,1608)	-0,2338** (0,1192)	-0,2814 (0,2889)	-0,0578 (0,2146)
il	-0,0351 (0,0485)	0,0051 (0,0543)	-0,0619 (0,0411)	0,1097 (0,0980)	-0,0239 (0,0773)
transptp	0,0174 (0,3292)	-0,3256 (0,3747)	-0,3215 (0,2734)	-0,0046 (0,6771)	0,0593 (0,5206)
transptm	-0,0120 (02396)	-0,0918 (0,2717)	-0,1889 (0,1982)	-0,1090 (0,4950)	0,0237 (0,3784)
tareatp	0,0014 (0,0920)	-0,1543 (0,1040)	-0,0812 (0,0770)	0,3398*** (0,1862)	-0,0660 (0,1479)
tareatm	0,0166 (0,0627)	-0,1073 (0,0702)	-0,0258 (0,0518)	0,2887** (0,1258)	-0,0387 (0,0996)
tdisttp	-0,0024 (0,0502)	0,0887 (0,0566)	0,0594 (0,0414)	-0,0887 (0,1021)	-0,0035 (0,0790)
tdisttm	-0,0023 (0,0349)	0,0423 (0,0393)	0,0291 (0,0287)	-0,0538 (0,0713)	-0,0034 (0,0549)
p-lev Sar	1	1	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.

[2] Instruments *deltay, dpre, dmre, dpma, dmma, dpno, dmno*

Table A7.8

Regression of the relative concentration indexes by industries (the investor expectation regime-switching model differentiated by regions groups) [1]

	locma[2]	*locls*[2]	*locpsm*[2]	*locle*[2]	*locpi*[2]
1	2	3	4	5	6
yl	0,3325* (0,0832)	0,1750*** (0,0915)	0,5141* (0,0803)	0,6998* (0,0604)	0,5723* (0,0554)
idpre	0,1337 (0,2796)	0,1199 (0,8737)	0,3929 (0,5608)	0,3441 (0,5559)	0,0265 0,2427()
idmre	-0,1961 (0,2767)	-0,6594 (0,8527)	-0,0341 (0,5500)	0,1194 (0,5115)	-0,2024 (0,2262)
idpma	0,1274 (0,0987)	0,1397 (0,3043)	0,3482*** (0,1993)	0,6540* (0,2028)	0,0798 (0,0813)
idmma	-0,2894* (0,1080)	-0,5955*** (0,3270)	-0,2418 (0,1984)	0,0430 (0,1885)	-0,2089** (0,0979)
idpno	-0,0195 (0,2070)	-0,0533 (0,7081)	0,6432 (0,6509)	0,4288 (0,4352)	0,0288 (0,1769)
idmno	-0,0568 (0,2157)	-0,4856 (0,6420)	0,3966 (0,4424)	0,2507 (0,4274)	-0,1700 (0,1962)
il	0,0924 (0,0788)	0,2379 (0,2396)	-0,2506*** (0,1526)	-0,4682* (0,1537)	0,1386** (0,0704)
transptp	-0,5157 (0,5242)	0,7073 (1,6173)	0,0754 (1,0398)	0,2135 (1,0148)	-0,1345 (0,4431)
transptm	-0,1722 (0,3800)	0,2782 (1,1736)	-0,0160 (0,7516)	0,4138 (0,7333)	-0,2619 (0,3219)
tareatp	0,0108 (0,1482)	-0,1475 (0,4559)	-0,3106 (0,2924)	-0,0243 (0,2811)	-0,1670 (0,1248)
tareatm	-0,0282 (0,0997)	-0,1072 (0,3071)	-0,0957 (0,1969)	-0,0029 (0,1907)	-0,0968 (0,0842)
tdisttp	0,0692 (0,0798)	-0,0750 (0,2454)	0,0791 (0,1582)	-0,0118 (0,1534)	0,0560 (0,0671)
tdisttm	0,0335 (0,0552)	0,0112 (0,1704)	0,0267 (0,1091)	-0,0456 (0,1063)	0,0598 (0,0468)
p-lev Sar	1	1	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.

[2] Instruments *deltay, dpre, dmre, dpma, dmma, dpno, dmno*

Table A7.9

Regression of the absolute concentration indexes by industries (the investor expectation regime-switching model differentiated by regions groups) [1]

	otrto[2]	*otren*[2]	*otrch*[2]	*otrcv*[2]	*otrhi*[2]
1	2	3	4	5	6
yl	1,1201* (0,0501)	0,1943* (0,0530)	0,8392* (0,0762)	0,5564* (0,0482)	0,4908* (0,0638)
idpre	0,7352 (0,4612)	1,4131* (0,3579)	0,6235 (0,4719)	0,3291 (0,6134)	1,32226* (0,4828)
idmre	-0,2483 (0,5101)	0,7261** (0,3532)	-0,2685 (0,4307)	-0,4593 (0,6855)	0,1954 (0,4219)
idpma	0,2884 (0,1875)	0,3154** (0,1409)	0,1283 (0,1682)	-0,0462 (0,2199)	0,0066 (0,1523)
idmma	0,0916 (0,1650)	-0,0412 (0,1252)	0,0086 (0,1505)	-0,1793 (0,2316)	-0,3273*** (0,1703)
idpno	0,7344*** (0,4502)	0,5182** (0,2640)	0,0266 (0,3625)	0,0085 (0,5067)	0,0287 (0,3359)
idmno	-0,0286 (0,3771)	0,2402 (0,2780)	-0,1668 (0,4243)	-2,0458* (0,4566)	-0,1930 (0,3303)
il	-0,3452* (0,1356)	-0,1402 (0,1170)	-0,1232 (0,1251)	0,1759 (0,1719)	0,0936 (0,1209)
transptp	-0,0476 (0,8910)	-1,5430** (0,6837)	-0,7041 (0,8198)	-0,7821 (1,1562)	-0,3731 (0,8209)
transptm	-0,2219 (0,6468)	-0,2593 (0,4933)	-0,5611 (0,5969)	-0,5385 (0,8416)	-0,6820 (0,5976)
tareatp	0,2566 (0,2533)	0,0077 (0,1879)	-0,0876 (0,2225)	0,9833* (0,3289)	0,0944 (0,2321)
tareatm	0,2447 (0,1705)	-0,0379 (0,1271)	0,0034 (0,1503)	0,4470** (0,2231)	-0,0054 (0,1566)
tdisttp	-0,0613 (0,1352)	0,2206** (0,1024)	0,1102 (0,1234)	-0,0994 (0,1751)	0,0310 (0,1245)
tdisttm	-0,0321 (0,0937)	0,0501 (0,0710)	0,0688 (0,0862)	-0,0237 (0,1218)	0,0862 (0,0867)
p-lev Sar	1	1	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.

[2] Instruments *deltay, dpre, dmre, dpma, dmma, dpno, dmno*

Table A7.10

Regression of the absolute concentration indexes by industries (the investor expectation regime-switching model differentiated by regions groups) [1]

	otrma[2]	*otrls*[2]	*otrpsm*[2]	*otrle*[2]	*otrpi*[2]
1	2	3	4	5	6
yl	0,0684 (0,0801)	0,1817** (0,0806)	0,5581* (0,0911)	0,5166* (0,0773)	0,6182* (0,0776)
idpre	0,4345 (0,4257)	1,5687* (0,6308)	0,5936 (0,5135)	0,5238 (0,5285)	0,4446 (0,2924)
idmre	-0,0911 (0,4247)	0,6634 (0,6066)	-0,1702 (0,5278)	0,1170 (0,4938)	-0,0416 (0,3031)
idpma	0,0304 (0,1516)	-0,0703 (0,2057)	0,4241** (0,1914)	0,4816* (0,1913)	0,2593** (0,1107)
idmma	-0,3925** (0,1721)	-0,5859** (0,2610)	-0,1684 (0,1863)	-0,0271 (0,1823)	-0,1390 (0,1082)
idpno	-0,0283 (0,3543)	0,3875 (0,4826)	0,4470 (0,4024)	0,3351 (0,4049)	0,3715*** (0,2231)
idmno	-0,1003 (0,4554)	-0,2313 (0,4454)	0,2784 (0,3949)	0,1540 (0,3825)	0,3118 (0,2484)
il	0,1537 (0,1218)	0,1634 (0,1662)	-0,2079 (0,1468)	-0,3849* (0,1450)	-0,1555*** (0,0870)
transptp	-2,7469* (0,8201)	0,4701 (1,1276)	1,0218 (1,0372)	0,7007 (1,0059)	-0,5088 (0,5773)
transptm	-2,1981* (0,5972)	0,4419 (0,8196)	-0,5040 (0,7307)	0,5437 (0,7086)	-1,2857* (0,4199)
tareatp	0,6339* (0,2310)	0,0302 (0,3152)	0,4809*** (0,2777)	0,3609 (0,2721)	0,4679* (0,1624)
tareatm	0,3880** (0,1562)	0,1907 (0,2130)	0,1958 (0,1867)	0,1377 (0,1835)	0,2863* (0,1096)
tdisttp	0,1795 (0,1244)	-0,0780 (0,1705)	-0,2576*** (0,1565)	-0,1875 (0,1515)	-0,0595 (0,0865)
tdisttm	0,1758** (0,0869)	-0,0973 (0,1189)	0,0104 (0,1055)	0,0324 (0,1024)	0,0964 (0,0604)
p-lev Sar	1	1	1	1	1

[1] *, ** and *** indicate 1%, 5%, and 10% significance level respectively, the fixed effects model are reported; the estimations of the regional fixed effects are not shown. Values in parentheses are standard errors.
[2] Instruments *deltay, dpre, dmre, dpma, dmma, dpno, dmno*

Appendix 8

List of variables used in the econometric model

Indexes:

i – index of region, $i = 1,2, \ldots, n$;

t – index of year , $t = 1,2, \ldots, T$.

Dependent variables (Y_{it+1})

prom - per capita industrial output in prices of 1990, million Rbl.

aggl - index of agglomeration of industrial production in region; is determined as a coefficient of variation of industries localization indexes in region;

*scale*2 - density of industries production in region having in the Russian Federation more then 2,6 % of the output to volume of industrial production of the Russian Federation.

The industrial indexes of concentration

The indexes of *relative* concentration in the industries	The indexes of *absolute* concentration in the industries	Industries
locen	*otren*	Power engineering
locto	*otrto*	Fuel industry
locch	*otrch*	Ferrous metals
loccv	*otrcv*	Non-Ferrous metals
lochi	*otrhi*	Chemical industry
locma	*otrma*	Mechanical engineering
locls	*otrls*	Wood industry

locpsm	*otrpsm*	Building materials industry
locle	*otrle*	Light industry
locpi	*otrpi*	Food-processing industry

Explanatory variables

I	Per capita investment in a fixed capital in prices of 1990, mlrd. Rbl.
idpus	Investments in the economy of the region in case of positive investors expectations
idminus	Investments in the economy of the region in case of negative investors expectations
idpre, idpma, idpno	Investment differentiated by regions groups: regions with predominance of extractive industries, manufacturing industries, the northern regions accordingly for positive expectations of investors
idmre, idmma, idmno	Investment differentiated by regions groups: regions with predominance of extractive industries, manufacturing industries, the northern regions accordingly for negative expectations of investors
Variables differentiated by depending on change of the transport tariff	
transptp, transptm	The ratio of the transport tariff to the industrial price index accordingly in case of a decrease and in case of increase of the transport tariff
taretp,tareatm	Product of the transport tariff and the natural logarithm of radius of the circle equaling to an area of region for a case of a decrease and for a case of increase of the transport tariff accordingly
tdisttp, tdisttm	Product of the transport tariff and the natural logarithm of distance

	from center of region up to Moscow for a case of a decrease and for a case of increase of the transport tariff accordingly

Instruments for the investment variables in regression with regimes switching of expectations of the investors and differentiation by groups of regions

*dpre = dplus*resourc*lnemp;*

*dmre = dminus*resourc*lnemp;*

*dpma = dplus*manuf*lnemp;*

dmma = dminus manuf *lnemp;*

*dpno = dplus*north*lnemp;*

dmno = dminus north *lnemp,*

where *resourc, manuf, north* – dummy variables for regions with predominance of extractive industries, for regions with predominance of manufacturing industries and the northern group of regions accordingly. Values of variables is equal to one if the region belongs to the indicated group, and is equal to zero otherwise; *lnemp* – natural logarithm of employment in the economy of the region.