

Factor Analysis of Fixed Capital Investments: Regional Aspect

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Abstract – This paper aims to develop a multifactor model of the impact of attracting investment in the fixed capital of a region. To this end, the authors conducted a factor analysis of regional investment attractiveness. Correlation and regression analysis served as the methodological basis for determining the qualitative dependencies of regional fixed capital investments. Testing of the examined model allowed the authors to identify dependencies between controlled variables (factors that can be influenced at the regional level) and the resulting indicator (investment in the fixed capital of a region) for the Russian federal subjects. The significance of the model lies in the possibility of developing practical measures (focused on specific conditions of territorial functioning) to improve regional investment policies.

Keywords - regional investment attractiveness, investment attraction, fixed capital investment, econometrics, regression analysis, multifactor model.

1. Introduction

Economic transformations aimed at solving socio-economic problems are one of the key directions of national policy.

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Investment is the main source of progressive economic development. In the economy of any country, including Russia, investment is a catalyst for economic growth, as it helps to overcome crises and ensures restructuring of the national economy, facilitating the transition towards new technological paradigms [1]. Attracting fixed capital investments (FCI) is the most significant direction in territorial development. Investments form the basis of regional competitiveness, but the level of their inflow depends on many socioeconomic factors [2]. At the macro level, a combination of factors can favorably or negatively affect the investment attractiveness of regions.

Despite market volatility, it is possible to identify factors that determine the potential for the socio-economic development of territories. These factors shape the territory's investment climate and investment attractiveness [3]. Investment is an effective tool for completing strategically significant objectives of spatial development, but regional strategies need to be developed based on a factor analysis of the environment to increase investment attractiveness. In Russia investment is a prerequisite for the renewal and modernization of national fixed assets, which begin to negatively affect the creation of competitive industries corresponding to technologically developed countries as they become obsolete [4]. Without purposeful assistance in creating a favorable investment climate, it is impossible to achieve the goals of innovative development at all levels of management [5], [6]. This increases the relevance of determining the factor basis of the investment attractiveness of territories and identifying the determinants of FCI attraction.

It should be noted that investment concentration in a region determines the strategic opportunities for its sustainable development in the ever-increasing macroeconomic space. Regional structures need to be able to manipulate the investment potential of territories to support the real sector of the national economy, modernize outdated infrastructure, and create future-oriented industries [7]. The problems of the regional economy require more ways to increase the efficiency of territorial development based on

attracting capital resources. This makes it important to develop models of the dependence of regional FCI on macro factors characterizing the socioeconomic state of the territory.

This paper aims to build a multifactor model of the impact of attracting investment in the fixed capital of a region. To achieve the set aim, a factor analysis of regional investment attractiveness was performed.

2. Literature Review

The authors propose to examine several studies in the field of investment analysis and related scientific areas to build the model. All of the available points of view make it possible to determine the fundamental provisions for improving the effectiveness of the national investment policy in the context of building an efficient system for the sustainable development of the economy, society, and the state. By analyzing scientific and practical research, it becomes possible to identify relevant factors and indicators to focus on when building models of socio-economic development at the regional level, including increasing investment attractiveness by manipulating determining factors.

Existing materials on investment practice indicate that investment flows are controlled by individual economic entities and financial institutions, which consolidate powers and tools that allow them to affect investment potential [8], [9], [10]. However, in the globalizing world economy, the dynamics of investment decision-making are changing, transforming the capital markets and value orientations of business entities that developed during the industrial period. From a regional perspective, attention should be paid to the investment strategies of enterprises, making it possible to identify factors influencing the investment decisions of market actors [1], [10]. At the macro level, these factors serve as the determinants of investment attraction.

The experience of creating investment centers shows that a targeted impact on investment promotion can be expanded through the identification of key determinants. That said, in order to make investment decisions, it is necessary to build models that make it possible to identify dependencies between investment attraction and specific factors. First of all, financial analysis methods that can be adapted to the conditions of regional development proving to be the most effective for assessing the investment attractiveness of specific economic entities and industries [11], [12]. It should be noted that attracting investment not only expands the production capacity of a single enterprise, enhancing its competitiveness, but also creates a foundation for economic development at the regional level.

However, the potential risks of reducing the investment attractiveness of enterprises and industries may negatively affect the sustainability of the region's functioning [13].

The conceptual significance of investment capital in investment centers and national industrial parks is manifested in the formation of regional policy instruments. Due to this, it is necessary to select the very factors that can affect local development [7]. The favorable influence of FCI at the regional level can affect not only economic entities, but also the stability of public relations – for example, through an increase in local revenue, which provides resources for expanding social and infrastructure programs. Thus, FCI flows make it possible to develop innovative infrastructure and train staff for modern production facilities [14]. Investment attractiveness can be objectively assessed by identifying factors in the following areas: availability of labor resources, infrastructure development, development of domestic markets, natural resources, agglomeration, and bureaucracy. By using indicators from these areas in economic and mathematical models, it is possible to rank enterprises according to their investment attractiveness [15]. External factors are particularly important for investment decisions since they cannot be manipulated by enterprises, but can be actively used by regional structures [5].

Investment should be considered as the long-term injection of capital into various sectors of the economy, infrastructure, social programs, and environmental protection. However, in regional development, the focus is on FCI, namely: new construction; retrofitting and upgrading; acquisition of buildings, structures, machinery, and equipment [16]. These investments are long-term in nature and real since investors acquire real assets. The implementation of investment planning at an enterprise can be based on a factor assessment of regional investment attractiveness. Thus, forecasting of the most efficient way to invest financial resources should take into account all aspects of economic activity, including external factors [17].

Maintaining the financial stability and competitiveness of the business sector requires rational use of resources when investing, especially in the field of innovation [6]. The criteria for assessing regional potential in the business environment include the intellectual factor, location, infrastructure, sustainability, digital aspects, and the state of innovation. At the same time, depending on regional conditions, certain indicators may become the determining factors. However, it is their assessment that makes it possible to develop a stable apparatus for rationalizing regional investment policy in terms of ensuring the progressive economic development of entities at different levels [18].

Considering the need for innovative transformations, researchers note the expanded impact of such indicators as research and development costs and the state of the innovation infrastructure on the investment attractiveness of the region. When deciding whether to invest their capital, investors pay attention to the region's intellectual potential rather than the availability of labor resources [19]. A wide range of examples of evaluating acquisition and investment strategies in R&D are considered in practical science. However, quite often only the business level can be analyzed, and the regional aspect is ignored [20].

If we focus on the state of corporate development through investment attraction, it is necessary to keep in mind the indicator of enterprise market value, which is interconnected with the level of its innovative potential. Innovative activity is an integral factor of sustainable development at all levels of management, affecting both the enterprise and the territory of its operation. It characterizes the competitive position of entities and has a direct impact on the market value of the enterprise. At an insufficient level of innovative development, it is almost impossible to increase the market value in modern conditions, which negatively affects investment attraction [21]. At the global level, gross FCI are mostly provided by multinational firms capable of creating value through expanded reproduction of innovative resources. In this case, investment attractiveness is determined not only by production factors, demand, and the state of the labor market, but also by integral components with related external entities and the state of the innovation infrastructure [22].

To determine the investment attractiveness of a region, it is essential to assess the state of business models in the entrepreneurial sector according to pre-selected criteria. This makes it possible to ensure the rationality of regional impact on specific factors aimed at increasing investment capital [23]. For example, in order to support the entrepreneurial sector, it is possible to promote the use of venture capital, which can help to activate innovation and ensure stable inflows of FCI into the crucial industries of the region [3]. However, there is still a serious gap between economic theory and practice. The developed tools of managerial influence on the market value of enterprises and their innovative activities through investment parameters do not always provide the desired effects at the regional or national levels [24]. This practice paves the way for new studies that would make allowance for the need to achieve certain parameters that are embedded in the objectives of economic and mathematical modeling.

Unfortunately, the existing investment management apparatus is imperfect due to the unavailability of auxiliary information and high error rates [25]. Management of any enterprise should be aimed at finding and implementing the most economically efficient projects to achieve strategic goals. However, it should be borne in mind that the amount of investment does not always indicate the resulting quality of the action taken. For example, investment in lean manufacturing technologies may be insignificant in volume, but it can still significantly increase the efficiency of activities by optimizing the business operations of the enterprise and reducing costs [26], [27]. Many other significant factors can increase the efficiency of activities with minimal investment. In Russia, low labor productivity is largely due to insufficient wages. The current salary level of production workers does not improve the quality of human capital and hinders the intellectualization of enterprises. Depending on the regional socioeconomic situation, the development of government and public institutions, and the state of the regulatory framework, investment attractiveness can be favorable, increasing the concentration of investment resources, or negative, hindering territorial development. However, it is the business sector that serves as the final destination of FCI.

Investment and financial solutions are aimed at creating new value not only for investors, but also for concerned parties. Based on the assessment of regional investment attractiveness, ordinary and institutional investors and business representatives can make objective decisions about the implementation of capital investment in the economic entities of the region. An imperfect investment environment increases the risk of losing potential capital, which in turn narrows the range of alternatives for the socio-economic development of the territory [10]. A decrease in the investment attractiveness of the region may lead not only to an outflow of FCI, but also to business decline. In particular, there is a high risk of conflicts between shareholders and enterprise managers, and the system for the prevention and settlement of corporate conflicts may not be able to cope with the problem, forcing the enterprise to leave the unattractive region [1], [28].

Today, most models confirm the statistical relationship between FCI and the added value of the regional product. Management tools can be used to influence the investment market at the macro level, providing an additional increase in investment attractiveness – for example, by taking into account monetary policy [29]. The need for sustainable development has led to the reorientation of the instruments of regional influence for financing large-scale projects and activities. In this context, attracting

investment only from national sources is no longer sufficient to cover strategically significant tasks. The urgency of attracting foreign direct investment to ensure the economic growth of territories and solve social problems is increasing. In Russia the peculiarities of the non-human-oriented corporate governance model and the unfavorable investment environment for foreign capital lead to a conclusion that it is inappropriate to consider foreign direct investment as the basis of economic development. The effect of attracting foreign capital is more ambiguous and usually insignificant [30]. Corporate governance issues have become a dominant topic in developed and developing countries, with foreign capital recognized as an important element in the development of projects of national significance, which allows it to be taken into account when building econometric models. For example, they can be included in FCI and evaluated as a resulting indicator by developing a data analysis tool based on multiple regression and correlation analysis [30].

Investment activity in developing countries is slowing down due to non-market conditions. At the regional level, the slowdown is caused by the preference for individual industries, which leads to irrational investment behavior and long-term investment inefficiency. Investments are more likely to flow into regions with supported industries. This fact should be taken into account during the implementation of regional investment policy, laying the groundwork for modernization of certain industry areas and prevention of irrationality [31]. In extended econometric models, it is possible to introduce correction coefficients for the political factor and the state of the region's industry profile. Existing studies confirm the thesis that it is impossible to build universal models that can explain specific investment policy features in any region [3], [18].

Investment activity is one of the most important indicators of economic opportunities and development dynamics of the national economy. For the economic systems of emerging markets, including Russia, the attraction of investment capital plays a crucial role in the effective functioning of the national economy. Investment policy, on the other hand, acts as an instrument of influence on key areas of economic development through capital investment in production, science, technology, etc. [2]. In addition, in the scientific community and practice, it is observed that the Russian economy is characterized by speculative investment, which does not meet national interests and is often threatening. Irrational use of investments slows down the innovative development of enterprises. By attracting FCI, it will be possible to implement projects aimed at promoting staff development, enhancing the innovative activity of enterprises, reducing the

depreciation of fixed assets, etc. The task of the modern national economy is to achieve economic growth by increasing the competitiveness of enterprises based on the generation of new knowledge. In this paradigm, investment should be considered as a catalyst for these processes [4], [18].

Russian conditions for the formation of regional investment policy are far from perfect and do not comply with the required parameters of strategic development. In many ways, investment activity is speculative and does not facilitate the attraction of FCI, which is necessary for large-scale transformations [19], [24]. To promote economic development, regional authorities use political, legal, and economic instruments to adjust the regulatory framework and create economic conditions for effective investment activity [32]. The role of these elements in regional investment development lies in eliminating the identified imbalances by improving investment policy. Factor analysis provides the information necessary for the formation of mid-term investment development models that would make allowance for the problems and opportunities for territorial unification based on statistics [31].

Researchers agree that in order to form strategic guidelines for investment activity in the regional aspect, it is necessary to analyze the determining factors. Based on their analysis, it is possible not only to develop strategies for the modernization of regional investment policy, but also to facilitate the normalization of the investment climate within the territory. The investment behavior of economic entities can be subjected to economic and mathematical modeling by identifying factors that can be directly or indirectly controlled. Thus, it becomes possible to develop a behavior strategy for investors and enterprises depending on the impact of regional investment policy on specific activities. Game theory can be used for probabilistic measurements, risk activities of project areas should be assessed to build strategies for progressive growth, and the investment attractiveness of business models should be evaluated in a timely manner to analyze their efficiency [13], [23].

Despite the expanded apparatus of investment analysis, most studies consider regional investment attractiveness through universalizing assessment methods and using identical indicators to evaluate different regions. Most developed econometric models cannot always be adapted to similar research objects, and the resulting parameter does not always reflect the quality of the investment position of the territory. This fact determines the need to expand the ability to evaluate investments based on specific factors for each region. The FCI indicator should be considered as the key indicator of regional investment activity, as it objectively reflects the quality of investments. A diagram of factors is shown

in Figure 1. It should also be noted that these factors affect not only the region, but also the enterprise and the national economy as a whole. Their use in economic and mathematical models enables modern monitoring of the macro-environment to reveal the qualitative impact of a particular factor on the investment attractiveness of an entity.

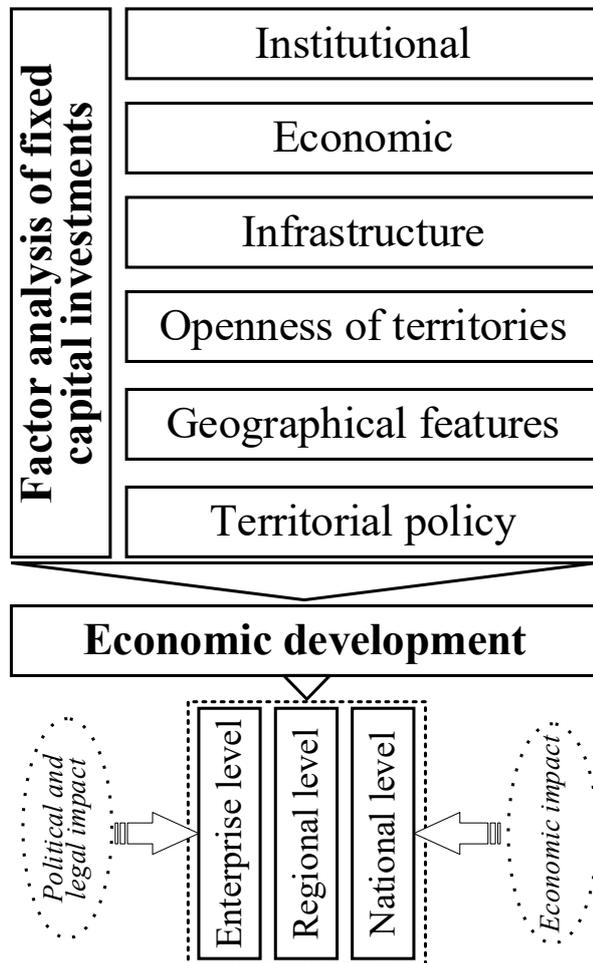


Figure 1. Factor analysis of investment attraction: regional analysis

3. Methodological Aspects of Factor Analysis

The authors propose using a correlation and regression analysis as the methodological basis for determining the qualitative dependencies of FCI. Multiple regression makes it possible to perform factor analysis: factors are controlled parameters in the model; FCI are the resulting indicator. The econometric model of regional investment attractiveness is built by analyzing and selecting regional statistics with allowance for its historical dynamics and formulating forecasts and trends based on the data obtained.

When building the model, the authors keep in mind that indicators for assessing regional investment attractiveness should be selected individually. However, the overall set of primary selection factors should be the same for all regions, which would make it possible to use a uniform distribution of

indicators in multifactor models. The total set of factors can be grouped by management levels as shown in Table 1.

Table 1. Factor analysis of investment attractiveness at different levels of management

Level	Group of factors
National	Indicators of political and legal stability, macroeconomic indicators, fiscal policy, the pace of economic development, the state of public relations and the institutional environment, etc.
Regional	The resource potential of the territory, the geographical location of the regions, natural resources, human capital potential, environmental situation, etc.
Industrial	The state of intercorporate and cluster relations, the development potential of the industrial market, the direction of industry support, the business activity of industrial enterprises, etc.
Business	The capital intensity of production, the level of innovation, the availability of specialists, available resources, pricing policy, etc.

These factors of investment attractiveness at different levels of management are not conclusive, they can be expanded by assessing the significance of parameters for increasing investment activity. In the regional aspect, factor analysis of investment attractiveness is used to determine the available opportunities for attracting FCI to the region. The increase in investment inflows is an important indicator for determining the current state and trajectories of economic development of a territory as it determines its strategic investment potential, which can be grouped according to the following elements: labor potential; production potential; financial potential; innovation potential; infrastructure potential; organizational and managerial potential; institutional potential.

Regional structures need to promptly identify elements of the macro-environment that hinder the formation of investment attractiveness. For this purpose, it is advisable to assess the following risks: economic; regulatory; political; global; geopolitical; environmental; institutional. Taking into account the maximum number of factors makes it possible to rationalize investment attraction strategies for the implementation of socio-economic programs. Efficient regional distribution of limited investments requires a wide variety of financial instruments. For their econometric model, the authors selected indicators for Russian regions (Table 2) that can fully reflect the effectiveness of regional investment policy. A total of 21 indicators reflect social, infrastructural, and economic aspects of regional development.

Table 2. Designations of research parameters

Designation	Indicator	Unit of measurement
Y	Fixed capital investments	mill. rub.
X1	Regional population size	thousand people
X2	Average annual number of employees	thousand people
X3	Employment level	%
X4	Number of the unemployed	thousand people
X5	Unemployment rate	%
X6	Per capita monetary income of the population	rub.
X7	Number of private vehicles per 1,000 people	qty
X8	Housing stock	mill. sq m
X9	Pollutant emissions into the atmosphere	thousand tons
X10	Number of enterprises and organizations	qty
X11	Turnover of organizations	bill. rub.
X12	Balanced financial performance of organizations	mill. rub.
X13	Industrial production indices (compared to the previous year)	%
X14	Export to non-CIS countries	mill. USD
X15	Commissioning of residential and non-residential buildings	qty
X16	Retail turnover	mill. rub.
X17	Wholesale turnover	mill. rub.
X18	Amount of paid services	mill. rub.
X19	Consumer price indices	%
X20	Number of employees engaged in scientific research	qty
X21	Amount of innovative goods, works, services	mill. rub.

As a result, it becomes possible to build a correlation to assess factors that have the greatest impact on FCI inflows. It should be noted that the

correlation between factors will be different for each region. Correlation formula 1:

$$r_{(Y \& X)} = \frac{cov_{Y \& X}}{\sigma_Y \sigma_X}, (1)$$

$r_{(Y \& X)}$ is the degree of the linear relationship between FCI and selected factors;

$cov_{Y \& X}$ is the covariance moment between FCI and selected factors;

σ_Y is the mean square deviations of FCI;

σ_X is the mean square deviations of selected factors

After the correlation selection is made, regression analysis can be applied. It is possible to assess the impact of the most significant factors on changes in FCI, making the management of selected factors a part of regional investment policy. Regression formula 2:

$$Y = a + b_i * X_i, (2)$$

$$\begin{pmatrix} iv_{11} & iv_{12} & iv_{13} & iv_{1n} \\ iv_{21} & iv_{22} & iv_{23} & iv_{2n} \\ iv_{31} & iv_{32} & iv_{33} & iv_{3n} \\ \vdots & \vdots & \vdots & \vdots \\ iv_{m1} & iv_{m2} & iv_{m3} & iv_{mn} \end{pmatrix}, (1)$$

Y_i is the resulting parameter (FCI);

X_i is the controlled parameter (X factors after making allowance for correlation);

a is a constant;

b_i is the regression coefficient;

i is the factor number.

4. Results and Discussion

The authors propose to test the factor analysis of FCI on Russian regions. The following regions were considered: Leningrad region, Kaliningrad region, and Novgorod region. Based on statistics on socioeconomic indicators, the dynamics of changes in the indicators proposed in Table 1 were analyzed. An example of the dynamics of indicators for the Leningrad region in 2000–2019 is presented in Table 3 (20 observations). Similar statistics are provided for Kaliningrad and Novgorod regions.

Table 3. Dynamics of selected socio-economic indicators for the Leningrad region in 2000-2019

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Y	19241	32273	28212	49704	68561	82859	127209	126296	166112	190860
X1	1680.4	1672.7	1667.1	1673.3	1681.5	1685.4	1691.1	1692.5	1698.9	1704.9
X2	710.6	715.8	718.3	725.3	733.6	738.6	746.8	753.6	749.2	744.9
X3	58.8	62.1	59.4	60.4	63.2	63.6	65.2	67.9	66.5	65.7
X4	82	62	59	75	62	66	54	37	58	67
X5	9.6	7.0	7.0	8.6	6.9	7.2	5.8	3.9	6.0	6.9
X6	1355	1869	2418	3040	4399	5687	8055	10201	11567	12538
X7	138.1	141.4	154.9	159.2	164.4	174.9	191.4	213.6	235.9	244.5
X8	37	38	38	39	39	39	40	41	42	43
X9	192	182	181	184	177	209	247	237	219	215
X10	31268	33689	35990	38504	40781	43662	44652	46373	46013	46472
X11	295	295	295	295	295	295	382	516	661	623
X12	10379	8732	10871	17281	18332	40249	41580	63397	60069	44065
X13	109.1	104.8	119.8	113.3	123.2	108.1	126.4	102.8	101.0	96.9
X14	2070.9	2066.7	2111.8	2794.1	4606.8	5781.3	6614.9	8033.7	11225.1	6918.6
X15	1966	2053	2382	2776	2751	3136	3061	5109	5261	5826
X16	15854.2	21578.1	26653.4	30924.4	46000.4	62653.0	79165.6	100218.3	130852.0	141313.1
X17	15622	23417	33710	36648	68256	96683	161863	246357	331085	213725
X18	3170	4638	6741	8516	10703	14823	18488	21535	25616	31178
X19	123.5	119.6	114.8	113.0	114.9	112.0	109.9	112.8	114.9	110.1
X20	6246	6384	6129	6596	6446	6388	6422	6467	6374	6463
X21	694.4	948.5	905.8	490.6	639.2	914.5	892.0	1033.6	4933.7	5594.2
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018
Y	278864	305699	330721	253619	170502	225915	264213	337674	511164	419126
X1	1718.6	1733.9	1751.1	1763.9	1775.5	1778.8	1791.9	1813.8	1847.9	1875.9
X2	837.2	839.6	841.9	847.6	843.1	842.1	820.2	790.9	778.4	783.8
X3	67.1	68.5	69.3	67.5	66.6	66.6	66.8	61.7	60.6	60.0
X4	50	42	32	41	43	49	44	45	40	38
X5	5.2	4.3	3.2	4.3	4.5	5.1	4.6	4.6	4.1	3.9
X6	14798	15932	17967	19873	21578	25541	28524	29668	31341	32306
X7	265.8	282.3	284.4	283.7	294.8	298.4	322.4	320.9	320.8	322.9
X8	44	45	47	39	44	46	48	52	54	56
X9	226	216	229	245	272	247	243	226	218	194
X10	41260	39772	38947	38070	37907	38320	37057	36028	32743	33466
X11	685	872	961	1105	1305	1506	1652	1674	1952	1881
X12	64399	65879	81825	95997	38473	109590	198664	145358	161923	144168
X13	114.3	110.6	105.7	95.6	100.2	99.8	104.1	100.5	104.9	104.9
X14	9638.9	15323.7	15718.8	13136.8	15300.5	9616.9	4474.4	5217.1	6625.3	6154.1
X15	4285	4794	5269	4647	6989	6794	5462	5856	6737	10317
X16	169587.4	209684.5	230530.4	247986.9	277458.2	311317.6	342645.4	370676.2	405492.0	438860.3
X17	235393	278054	316646	349848	414886	418701	493078	524500	582900	608018
X18	36702	41774	46800	53906	57997	63004	69067	73632	78538	83249
X19	111.1	106.4	106.5	106.0	111.5	113.3	105.7	102.7	104.0	102.9
X20	6477	6431	6476	6409	7135	7229	7247	7265	7190	7146
X21	9959.2	11770.6	4939.1	14077.0	32776.6	13906.7	20565.3	22072.5	33282.5	29055.7

A large number of indicators (21 indicators) does not allow us to identify clear trends and their dependencies. Thus, the authors propose to consider

the correlation of the selected factors with the resulting indicator according to formula 1. The modeling was done using the Gretl software. The correlation is presented in Table 4.

Table 4. Correlation between FCI and selected indicators in the analyzed regions

Indicator	Leningrad region	Kaliningrad region	Novgorod region
X1	0.8857	0.7158	-0.9072
X2	0.6457	0.7538	-0.6871
X3	0.2038	0.262	0.2634
X4	-0.7434	-0.3705	-0.7569
X5	-0.7769	-0.4319	-0.711
X6	0.8944	0.9046	0.9622
X7	0.8991	0.8935	0.9486
X8	0.9105	0.9134	0.9168
X9	0.3591	-0.6574	0.0692
X10	-0.2178	0.6261	0.7588
X11	0.8617	0.9204	0.8613
X12	0.8253	0.714	0.5622
X13	-0.37	-0.3129	-0.0851
X14	0.4353	0.462	0.6809
X15	0.777	0.6307	0.7996
X16	0.9019	0.9161	0.9477
X17	0.8835	0.9124	0.7457
X18	0.8956	0.9305	0.9598
X19	-0.8494	-0.7062	-0.7044
X20	0.6342	-0.817	0.6576
X21	0.769	-0.0347	0.3362

Based on the data obtained, it is possible to determine the qualitative dependence between factor indicators and the FCI indicator for the analyzed regions:

1. Leningrad region

An inverse relationship is observed with the indicators X4, X5, X10, X13, X19. However, the greatest attention should be paid to the indicators X5 and X19.

The remaining indicators have a direct relationship with the FCI indicator. Due to this, the greatest attention should be paid to the indicators X1, X6, X7, X8, X11, X12, X15, X16, X17, X18, and X21.

Figure 2 shows a correlation matrix of factors for Leningrad region, making it possible to select the most significant indicators for regression analysis.

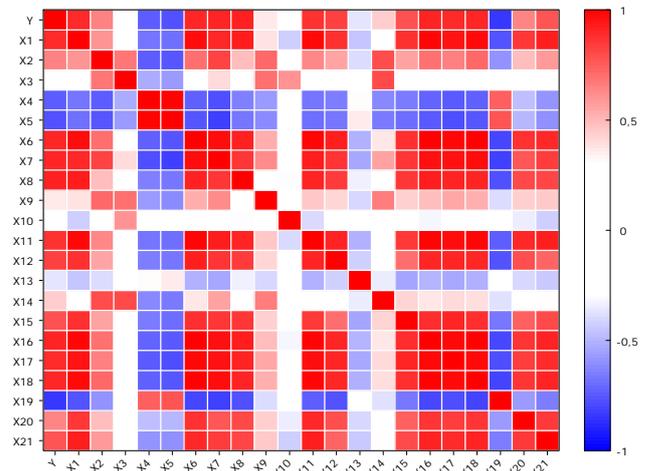


Figure 2. Correlation matrix of factors for Leningrad region

2. Kaliningrad region

An inverse relationship is observed with the indicators X4, X5, X9, X13, X19, X20, and X21. However, the greatest attention should be paid to the X20 indicator.

The remaining indicators have a direct relationship with the FCI indicator. Due to this, the greatest attention should be paid to the indicators X2, X6, X7, X8, X11, X16, X17, and X18.

Figure 3 shows a correlation matrix of factors for Kaliningrad region, making it possible to select the most significant indicators for regression analysis.

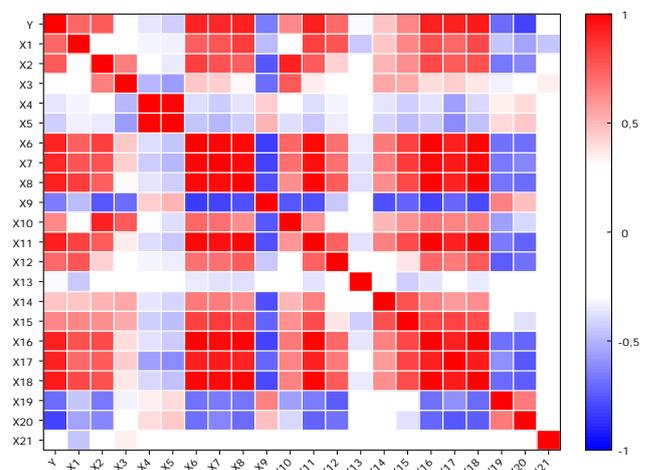


Figure 3. Correlation matrix of factors for Kaliningrad region

3. Novgorod region

An inverse relationship is observed with the indicators X1, X2, X4, X5, X13, and X19. At the same time, the greatest attention should be paid to the indicators X1 and X4.

The remaining indicators have a direct relationship with the FCI indicator. Therefore, the greatest attention should be paid to the indicators X6, X7, X8, X10, X11, X15, X16, and X18.

Figure 4 shows a correlation matrix of factors for Novgorod region, making it possible to select the most significant indicators for regression analysis.

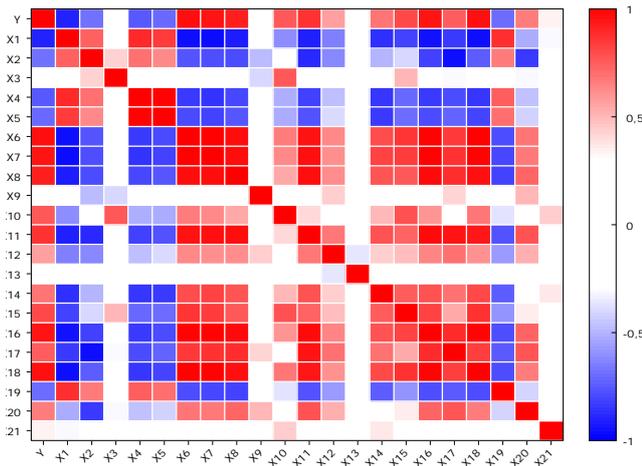


Figure 4. Correlation matrix of factors for Novgorod region

A significant number of indicators suggest that there are ample opportunities for regulating regional investment policy by providing mechanisms for regulating investment flows through the influence of regional authorities on the selected factors. Nevertheless, it is obvious that not all factors have an identical direct or reverse effect on the dynamics of regional FCI. This emphasizes the need for a customized approach to the formation of a system for increasing the investment attractiveness of each region with allowance for its current parameters and dynamic changes in all aspects of management over the previous periods.

As the next step, the authors propose building a model of the dependence of the resulting indicator (fixed capital investments) for Russian regions on controlled parameters (factors that can be influenced by regional authorities) based on a regression analysis. As a result of regression without taking into account the correlation, the following values were obtained for each region:

- Y1 – Leningrad region;
- Y2 – Kaliningrad region;
- Y3 – Novgorod region.

$$Y1 = 950554 - 5614.41 * X3 + 3.9141.2 * X4 - 3.77089 * X5 - 681.982 * X9 - 11.166 * X10 + 0.496 * X12 + 2174.41 * X13 + 0.402 * X21; T = 20, R-square = 0.911.$$

$$Y2 = - 137544 - 186,995 * X2 + 2.52 * X6 - 657 * X7 + 14644.8 * X8 - 9.5 * X11 - 42.9 * X15 + 2.22 * X16 + 0.695 * X17 - 7.26 * X18 + 34.7 * X20; T = 20, R-square = 0.958.$$

$$Y3 = - 78044,2 - 0,895 * X1 + 489.44 * X4 + 3.61 * X6 - 145.2 * X7 + 1888.3 * X8 + 5.18 * X10 - 107.74 * X11 - 16.5 * X15 + 0.462 * X16 - 0.492 * X18; T = 20, R-square = 0.989.$$

Despite the possibility to assess the importance of specific factors for the creation of regional FCI, the obtained regression models of the dependence of FCI attraction on factors cannot be applied in practice. The P-value of most indicators does not meet the required parameters, and there is a correlation between the indicators (Fig. 2, 3, 4). The method of inflation factors can be used to select indicators between which multicollinearity is not observed and the P-value is within the acceptable range. As a result of sampling, only factors with the most important criteria for building a multiple regression model remained:

$$Y1 = 896314 + 39190.6 * X4 - 374073 * X5 - 16,355 * X10; T = 20, R-square = 0.85.$$

$$Y2 = - 4358,54 - 22,857 * X15 + 0.5 * X16 + 0.287 * X17; T = 20, R-square = 0.943.$$

$$Y3 = - 94992,1 + 871,92 * X4 + 3,082 * X6 + 6,715 * X10 - 18.83 * X15; T = 20, R-square = 0.988.$$

In these models, the P-value corresponds to acceptable values, the determination coefficient is high, and the relationship between factors is at an acceptable level when checking for multicollinearity.

Testing of the model allowed the authors to identify controllable parameters that can be influenced at the regional level. These factors include:

- Leningrad region – X4; X5; X10.
- Kaliningrad region – X15; X16; X17.
- Novgorod region – X4; X6; X10; X15.

Consequently, the performed analysis indicates a direct or inverse dependence of FCI attraction on the selected factors. The significance of factor analysis lies in the possibility of developing managerial and practical measures based on economic and mathematical modeling to improve regional investment policy. Besides, as mentioned earlier, the adaptation of identical indicators to other regions will lead to inaccurate data.

Creating a favorable level of regional investment attractiveness is impossible without considering the investment climate. It can be said that investment attractiveness is a component of the investment climate, which makes allowance for the whole set of factors affecting the macro-environment. In general, the increase in regional investment attractiveness should not be limited to factors obtained using the proposed econometric model. It should be noted that, under modern conditions, institutional and ordinary investors assess the institutional environment paying considerable attention to the analysis of social factors, which include the living standards of the population. Regional investment attractiveness determines the region's competitiveness at the national and international levels. To maintain regional competitiveness, investment strategies should take into account the needs of the population (for example, the model makes allowance for such factors as housing stock and personal vehicles). Depending on the state of the investment climate, the inflow of investment into the region may increase or decrease, and regional investment attractiveness can be used to assess the effectiveness of the region's government apparatus. With regard to Russia, it should be noted that the regulation of investment processes at the regional level is inefficient, which leads to the need of finding new ways to increase regional investment attractiveness and identifying problems in existing management schemes [10], [20], [31].

5. Conclusion

It is important to recognize that FCI form the economic framework of the national economic system, determining the production, financial, and trade structure of the national economy. Without high-quality investment policy instruments, it is impossible to ensure expanded reproduction, particularly in the field of innovation, and improving the business and investment climate should become the priority direction of regional policy as a prerequisite for ensuring strategic competitiveness at all levels of management.

The results of this study include: theoretical analysis of the problem of assessing regional investment attractiveness, methodological substantiation of the model of dependence of FCI on determining indicators, and practical identification of key factors affecting the inflow of FCI to Russian regions.

By testing the model with identical factors in different regions, the authors confirmed their hypothesis that the investment aspects of each region need to be considered individually, and that ratings with identical parameters cannot reflect the essence of the formation of regional inflows of FCI. The

significance of the obtained model lies in the possibility of implementing measures aimed at increasing regional investment attractiveness with allowance for the most important factors in each particular region.

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