Structural Approach to Evaluating Investments into the Region Economy

Elena Oleinik* and Alena Zakharova

Department of Business Informatics and Economics and Mathematical Methods, Far Eastern Federal University, Vladivostok, Russia; oleinik.elena@gmail.com, zakharovaalena@mail.ru

Abstract

Background: The attraction of investment resources into the economy is a priority, since further economic development depends on the required amount of investments. Research related studies of the dynamics of investments and shifts taking place in the structure of investments are becoming particularly relevant. The aim of this study is to analyze and evaluate the shifts in the structure of investments using the developed methodology. **Methods:** The article provides the comparative analysis of different approaches to the definition of 'structural shifts' and methods for evaluating them. The analysis revealed the need to develop a comprehensive methodology for evaluating shifts in the structure of an economic entity. The article considers the methodology of studying structural changes and dynamics of investment flows. The authors have elaborated the methodology that allows for carrying out a comprehensive assessment of the status and dynamics of the economic object structure. **Findings:** With the help of the suggested methodology, the authors have carried out structural-dynamic analysis of the investment in the economy of the Far Eastern Federal Okrug, which revealed the presence of significant imbalances in the investment structure. The region is mainly focused on the extraction and export of raw materials, rather than processing them, which significantly reduces the rate of economic growth in the region. Investors do not invest in long-term projects for the region's economy development. Short-term investments are aimed at fast and risk-free return on investment. **Improvements:** The article formulates the problem of attracting investments into the region's economy and proposes measures that would improve the investment climate and investment efficiency. The methodology of investment structure analysis can serve as a basis for further theoretical and applied research in the field of regional investment policy.

Keywords: Integrated Coefficient, Intensity of Structural Shifts, Investments, Proportion Change, Structural Shifts

1. Introduction

The intensity of economic growth is largely determined by active investment activity and the problem of attracting investment is one of the key problems of economic development. The crisis in the Russian economy affects the changes in investment levels and there is a trend of investment reduction in joint ventures. Foreign investors are not keen to invest in the development of products with high added value, thus creating competitive products and jobs on the territory of our country.

In the process of implementation of investment projects aimed at economic development of the country and the regions, special transformations take place i.e. the change of economic structure: Changes are observed in the ratio of shares and proportions as well as in the direction and strength of the links between its elements. The dynamics of these changes depends heavily on investment, on prioritized directions of investment activity and the volume of investment, on changes in the structure of investments.

The analysis and evaluation of structural changes of the economy is based on the notion of structural shift. Various definitions of structural change can be found in the scientific literature. Most often, structural shifts are referred to as a change of economic system proportions that occurs under the influence of core factors over the course of time. Structural shifts are the result of differences in the growth rates of the elements that make up the economic system. By assessing and analyzing the

*Author for correspondence

structural shifts it is possible to make a conclusion about the efficiency of the structure and take measures if necessary. The assessment of changes in the structure of investments will identify problems of investment policy and improve its effectiveness.

As a result of fundamental changes in the economy, there appeared scientific studies, which focused on theoretical and methodological issues of the structural transformation of economy. Modern science continues generating unabated interest in the study of problems and identifying patterns of structural shift, their focus, the interdependence between the level of development of the economy and its structure. Active development can be observed in the mechanism of adapting a large number of different statistical indicators of assessing structural shifts to the specific features of economic development of particular countries and regions (Malaysia[1], Slovakia[2], Brazil[3,4], Asia[5,6] and the United States[7]).

2. Literature Review

Scientific literature provides various approaches to the definition of the category of structural shifts'.

- A structural shift is a qualitative change in the relationships between comparable elements of an economic system caused by uneven dynamics of the ratio between their quantitative characteristics. Comparable elements are referred to as elements which belong to the same level or segment of an economic system. A structural shift in the economic system of a higher level cannot be reduced to a simple arithmetic sum of its components[8];
- A structural shift is the change of the internal structure of the economic system, the relationship between its elements, which are accompanied by the transformation of the main (integrated) system properties[9,10].
- In the studies[11,12], a structural shift means a change of proportions of the economic system, which occurs under the influence of the structure-forming factors. Structural changes are associated with the intensification of production. This definition implies that any change in the structure can be seen as a structural shift, which is regarded as the accumulation of imbalances.

The definition provided[13] is considered to be the most complete: Changes in the structure of the economy represent a complex system of interrelated changes in the proportions

taking place under the influence of the existing technical basis, social mechanisms of production, distribution and exchange, in accordance with social needs, available resources and the achieved level of productivity. Structural changes are a certain difference between the new and the old structures, which reflects not only the difference in the organization of production, but also the development of the entire system of economic relations.

Despite the fact that the definition of 'a structural shift' was highlighted in a great number of studies done by Russian and foreign economists, a single definition has not been formulated and subordination between the notions of 'structural shift' and 'structural change' has not been elaborated. The processes of structural change and reallocation of jobs related to the development of innovative sectors of the economy are studied in[14]. The classification of indicators of structural changes is proposed in[15] and completed in[16]. Structural changes of economy under the influence of various factors are investigated and explained in[17–20]. Having studied the basic and applied indicators of evaluating structural shifts, let us highlight their characteristics (Table 1).

It could be argued based on Table 1 that the literature describes a sufficient number of various indicators used to evaluate the structural shift, but only some of them contain the scale of values and recommendations for using them.

3. Research Methods

The considered existing evaluation indicators do not allow for a comprehensive study of structural shifts and measuring the proportions between the structural elements. In our opinion, complex evaluation of shifts in the structure of investments requires a combination of some of the methods. Table 2 presents basic approaches, areas of research, types and methods of analysis of structural changes in investment flows.

We offer a comprehensive, step-by-step methodology for the analysis and evaluation of structural shifts.

- The choice of the study period and the definition of the input parameters. Input parameters: the share of structural elements and the proportion of the j-element of the structure in the current (f_j^l $f_j^{l-1}l$) and previous (l-1) periods; n- the number of structural elements; m is the number of time intervals from the base to the current period).

Table 1. Features of indicators for evaluating structural shifts

Author, source	Features of used indicators for evaluating structural shifts
V. Bessonov[21]	Chain and basic index is used the higher the value of the chain index, the more intensively structural shifts occur, and vice versa. The basic index serves as an indication of the extent of the tendency which underlies the structural shifts, and to what extent they are merely the result of irregular fluctuations.
K. Gatev[22]	The integrated coefficient that considers the intensity of the changes by individual group and the proportion of groups in comparable structures.
L. Kazinets[15]	Absolute and relative growth rate and the shift intensity. The coefficients indicate the intensity of shifts, but do not give a qualitative characteristic of the processes taking place.
V. Ryabtsev[23]	Integrated coefficient of structural differences does not depend on the number of gradations of aggregate structure. The author suggests an evaluation scale for measuring importance of structural differences.
O. Spasskaya[24]	The intensity of structural shifts (taking values from 0 to 1) is evaluated through the change in the angular distance between the vectors of economic structure in the initial and final periods.
L. Dedov, V. Kapustin[25]	The importance of the structural transformation evaluates the index, λ the evaluation is considered to be significant if the value of the index is significant λ(a change of 15% in the index λ over 5 years)
E. Urkunchiev[13]	Proportionality coefficient is a numeric measure of the proximity between the estimated structure and reference one, it allows for comparing two structures

Table 2. Methodology of the study of structural changes in investment flows

Approaches	The main area of research	Types of analysis	Methods of analysis
Dialectic and empirical	Internal connections, the dynamics of economic processes	Objective, trending	Statistical Graphic Index Econometric Comparison Specification
Evolutionary	Dynamical processes in the structure	Dynamical, comparative	
System	The interaction and interrelation of elements	Economics and statistics	
Structural	Reasons for changing the ratio between shares and proportions in the structure	Quantitative and qualitative	

- Calculation of linear structural shifts that show absolute changes in the relative weight of each element of the structure.

$$S_{ij}^{abs} = f_{ij}^{l} - f_{ij}^{l-1} = \Delta f_{ij}$$

- Calculation of the quadratic structural shifts that are calculated based on linear structural shifts. S_{abs} coefficient allows for getting a summary assessment of the total speed of branch shifts and S_{relat} coefficient is their uniformity. Treated dynamically, these coefficients characterize the trend of change in the industrial structure.

$$S_{abs} = \sqrt{\frac{\sum_{j=1}^{n}(f_j^l - f_j^{l-1})^2}{n}}$$

$$S_{ij}^{relat} = \frac{f_{ij}^l - f_{ij}^{l-1}}{f_{ij}^{l-1}} * 100\%$$

- Calculation of intensity of structural shifts of a branch and branch structure as a whole. Intensity coefficient characterizes the importance of structural shifts. Sudden changes in intensity coefficients over time indicate instability and uneven development of structural elements.

$$K_{int} = \frac{f_{ij}^l}{f_{ij}^{l-1}} * 100\%$$

- Calculation of integral structural shifts. Integrated coefficient allows for evaluating the structural differences: the closer the K_{int} to 1, the more significant the structural changes are and, therefore, the differences in the structure.

$$K_{int} = \sqrt{\frac{\sum_{j=1}^{n}(f_j^l - f_j^{l-1})^2}{\sum_{j=1}^{n}(f_j^l)^2 + \sum_{j=1}^{n}(f_j^{l-1})^2}}$$

- Evaluation of the importance of structural changes using the Chow test[26]. Dynamic analysis of structural changes allows for distinguishing the change of structural shift trends. If structural changes are significant, there is a structural shift and for modeling the dynamics of structure a piecewise-linear function is used, otherwise - a non-linear trend is used.
- Evaluating the quality of structural shifts using Wilcoxon's criteria[27]. Wilcoxon's criteria allow you to evaluate the significance of shifts in a structure. The statistical criterion is used to compare the indicators measured on the same sample before and after exposure. Under the influence we mean measures of economic policy.

Output parameters are a set of integrated assessments of the state and dynamics of the structure.

The proposed method allows a comprehensive analysis of the nature of structural shifts, their interaction and orientation and thus enables us to evaluate the presence of distortions as well as quantitative and qualitative structural changes.

4. Results

The rationale for large-scale investment in Primorsky Krai is introduced by the authors in the study[28].

Let us choose the period of analysis. In 2000-2004 the volume of investments in the economy of the Far Eastern Federal Okrug (FEFO) was fairly stable, monotonically increasing on average by 25,634 million rubles per year (Figure 1). Since 2005 there have been abrupt changes in the volume of investments (on average they increased by

85,380 million rubles per year) and it is in this period that noticeable structural changes can be observed.

Let us carry out a structural analysis of investment dynamics in FEFO based on the selected data. Issues of comparability of statistical data when conducting long-term research comparisons are studied in[31]. Calculation results[29,30] are presented in Table 3.

The following conclusions can be made based on Table 3:

- The most drastic changes occurred in the structure of ownership and in the structure of funding sources in 2000–2005. (Quadratic coefficients of structural changes that characterize speed are respectively, 20.2 and 23.2). This period is characterized by an "explosive" speed of changes of shares of different forms of ownership and funding sources and the low level of identity structures, which can be explained by the start of large-scale works on the project "Sakhalin-1", presupposing the development of three oil and gas fields
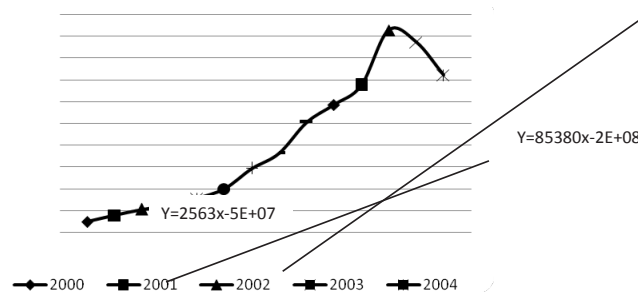

Figure 1. Changes in the volume of investments into the economy of FEFO[29,30].

Table 3. Structural analysis of investments in FEFO

Aspects of structural analysis of investments in FEFO	Absolute quadratic coefficient (speed)		Relative quadratic coefficient		Intensity coefficient (importance)		Integral coefficient of identity.	
	2005/ 2000	2012/ 2005	(evenness)	2012/ 2005	2005/ 2000	2012/ 2005	(structural differences)	2012/ 2005
In the basic capital according to subjects of FEFO	0.098	0.087	0.791	0.528	0.338	0.303	0.641	0.706
Foreign investment according to subjects of FEFO	0.148	0.019	0.814	0.235	0.334	0.035	0.763	0.998
By type of fixed assets	4.292	2.779	1.574	2.279	0.062	0.039	0.989	0.995
By forms of ownership	20.175	19.957	10.363	7.848	0.405	0.393	0.516	0.537
By sources of funding	23.192	9.217	8.787	4.435	0.403	0.154	0.522	0.929

located on the northeastern shelf of Sakhalin Island in the Okhotsk sea. During the period 2005-2012 the speed of changes in these structures dropped significantly. The structure of the funding sources remained almost unchanged (identity coefficient is very high - 0.929) - The shifts in the structure of investments by type of fixed assets for the whole period of observations are insignificant (intensity coefficient of 0.062 corresponds to a very low level of importance of structural changes, the identity of the structures is close to 1). Investments are fairly evenly distributed among all types of fixed assets - Dwellings, buildings and structures, machinery and equipment, etc.;

- Redistribution of investments in fixed capital and foreign investment by subjects of FEFO happened fairly evenly, the speed of structural shifts changed slightly. However, the shifts in investment allocation are very significant during the whole period of observation (integrated coefficient is above 0.3).

Let us complete the structural analysis by distributing the investments into the types of economic activity (Table 4).

Legend: x_1 - agriculture, hunting and forestry; x_2 – fishing, fish farming; x_3 - extraction of commercial minerals; x_4 - manufacturing; x_5 - production and distribution of electricity, gas and water; x_6 - construction; x_7 – whole-

sale and retail trade; repair of motor vehicles, motorcycles, products and personal demand items; x_8 - hotels and restaurants; x_9 - transport; x_{10} - communication; x_{11} - financial activities; x_{12} - operations with real estate, renting and business activities; x_{13} - state management and defense; social insurance; x_{14} - education; x_{15} - health care and social services; x_{16} - other community, social and personal services.

The largest amount of investment accounts for the development of communication means (x_{10}) and the extraction of commercial minerals (x_3). The smallest volume of investments accounts for the development of agriculture, hunting and forestry (x_1), fishing and fish farming (x_2), health care (x_{15}); providing other communal, social and personal services (x_{16}). And this trend remained unchanged throughout the period of observation. For the period 2005-2012 there was a significant flow of investments from the Sakhalin Oblast to Primorsky Krai in connection with the preparation for the Summit on the development of Asia-Pacific Economic Cooperation (APEC) and to the Republic of Sakha (Yakutia), which is associated with the implementation of projects dealing with the extraction of commercial minerals. The bulk of investments (more than 30% on average for the period) accounted for the development of means of communication; in 2008 a significant investment increase was observed in the development of transport infrastructure

Table 4. FEFO investment structure by types of economic activity,%

Types of activity	2005	2006	2007	2008	2009	2010	2011	2012	2013	average
x_1	1.7	1.4	1.3	1.1	1	0.7	0.8	0.7	1.2	1.1
x_2	0.6	0.7	0.4	0.3	0.3	0.3	0.4	0.6	0.7	0.47
x_3	21	30.3	27.1	21.3	22.3	19.6	20.5	23.6	31.9	24.18
x_4	4.1	2.7	3.1	4.6	2.9	3.8	3.4	5.6	8	4.23
x_5	17.5	14.7	11.1	0.9	6.4	7.8	9.7	14.7	10.2	10.33
x_6	2.7	3.7	4.8	3.4	3.2	3.9	1.9	1.8	2.3	3.07
x_7	1.1	1	0.9	0.7	0.7	0.5	0.4	0.7	0.9	0.76
x_8	0.3	0.4	0.4	0.2	0.1	0.2	0.2	0.5	0.2	0.27
x_9	0.6	3	3	5.5	2.1	3.3	2.3	2.1	2.5	2.71
x_{10}	32.9	26.2	30.8	44.8	47.7	43.9	45.3	33.1	23.7	36.48
x_{11}	9.4	0.8	0.9	1.2	1.5	1.2	0.9	1.2	1.4	2.06
x_{12}	2.1	8.2	8.7	8.5	5.3	5.7	5	5.9	8.1	6.38
x_{13}	1.8	2.1	2	2.2	1.4	1.6	1.4	3.4	2.3	2.02
x_{14}	1.6	1.6	2	1.9	2.4	4.6	4.8	2.3	2.4	2.62
x_{15}	2	1.6	2.1	2.3	1.5	1.3	1.5	2	2.4	1.85
x_{16}	0.6	1.6	1.5	1.5	1.1	1.7	1.5	1.8	2	1.47

in the region, which was connected with APEC Summit taking place in Primorsky Krai. However, the downside is the fact that one of the biggest share of investment (31.9% in 2013) accounts for the extraction of minerals and only 5.6 per cent accounts for the development of manufacturing industries. The share of investments which accounts for manufacturing, despite the ascendant trend, was insignificant and remains unchanged.

Additional calculations are required for a consolidated and integrated assessment of structure dynamics. The results of calculations in accordance with the suggested methodology are presented in Table 5. High intensity coefficients indicate uneven structural changes. Their speed and importance allow us to assess quadratic and integrated coefficients.

Maximum speed of restructuring and significant differences in the structure of investments was observed in 2008 and 2012. A dramatic increase in intensity coefficient indicates the change of trend (Figure 2), i.e. it indicates that the changes are possible not only in the structure, but structural shifts could take place in these periods (significant structural changes that lead to a new quality of structure)[26].

With the help of Chow test it is possible to evaluate the significance of changes of the integral coefficient of structural shifts with the course of time. To do this, let us examine its dynamics: if the dynamics of the integrated coefficient is described by a single equation trend, then structural changes are insignificant. Otherwise, there is a change of trend, the changes are described by two regression equations and there is a structural shift.

Build joint regression $Y = -0,004 x + 8.0928$ (2006–2013) and the regression of subsample $Y_1 = -0,0199x + 40.09$ and $Y_2 = 0,0428x - 85.961$.

Table 5. Evaluation of structural shifts compared to the previous year

Year	Structural shifts, shares		Intensity,%
	quadratic	integrated	
2006	0.040	0.185	
2007	0.017	0.077	42.4
2008	0.046	0.198	252.5
2009	0.020	0.078	40.1
2010	0.014	0.055	70.2
2011	0.009	0.035	64.0
2012	0.035	0.169	419.9
2013	0.034	0.140	107.1

$Y_1 = -0.0199x + 40.09$

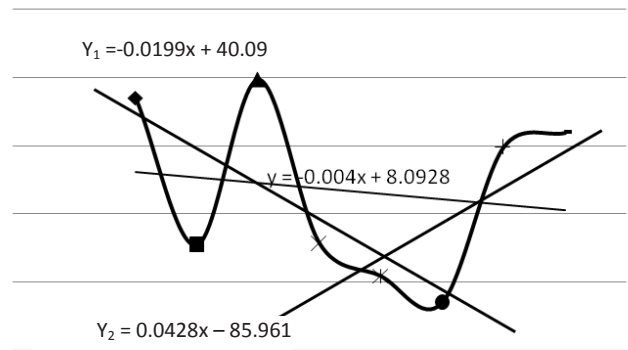$y = -0.004x + 8.0928$

$Y_2 = 0.0428x - 85.961$

Figure 2. Joint regression and regression of subsamples of an integral structural shift.

Let us find the sum of squared residuals: For joint regression S = 0.027043; for the other two S_1 = 0.011076 and S_2 = 0.003027

Let us calculate F-statistics (k + 1), and (n – 2 k – 2) degrees of freedom, where k is the number of variables in the regression. In our case, k = 1; n = 8.

$$F = \frac{(S - S_1 - S_2)/(k+1)}{(S_1 - S_2)/(n - 2k - 2)} = 1,83529$$

F_{table} = 6.94. The estimated value was less than tabular, the samples are homogeneous, therefore, the trend is described by a single equation trend and there are no significant changes in the structure of investments for the period of 2005-2013.

Let us complete the analysis by adding quality control of structural shifts with the help of statistic nonparametric T-criterion of Wilkinson. There are two periods of trend change in 2008 and 2011(Figure 2). In order to use the criterion we need to rank linear developments for each of 16 structural elements that occur in 2011 in comparison with 2008. There are ten negative shifts and 6 positive ones. Therefore, the negative shifts will be typical and positive ones will be atypical. The sum of the ranks of atypical shifts: T_{emp} = 42. In the table of critical values of T-criterion by Wilcoxon[32] we define T_{cr} for n = 1 and the significance levels P ≤ 0.05 и P ≤ 0.01:

$T_{cr} = 23$ for $P \leq 0.05$ and $T_{cr} = 35$ for $P \leq 0.01$

The analysis of the 'relevance axis' (Figure 3) showed that the T_{emp} falls into the zone of irrelevance. Consequently, changes in the structure of investments according to economic activities are irrelevant.

Similarly, when ranking linear structural shifts for 2011–2013 we get 5 negative shifts and 11 positive ones.
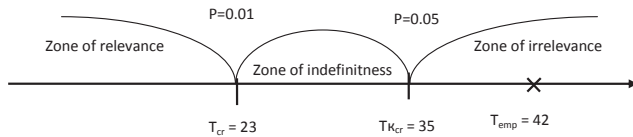
Figure 3. The axis of "relevance"

Thus, negative shifts will be atypical and positive shifts are typical ones. The sum of the ranks of atypical shifts: T_{emp} = 37 and also falls into the zone of irrelevance. Thus, the qualitative changes in the structure of investments according to the type of economic activity are not observed.

5. Discussion

The conducted analysis reveals that, in spite of the fact that the volume of investments into the economy of FEFO for the period from 2005 to 2013 increased more than threefold, imbalances remain in the structure of investments. Throughout the period of investigation the largest share of investments falls within the extraction of commercial minerals, electricity and gas production, which entails the developing offshore hydrocarbon fields on Sakhalin and on the development of the means of communication. All these three economic activities taken together accounted for 65.8 percent of all investment in the economy of the region in 2013 (Table 5). The region has a large forest and fishery resources, but the share of manufacturing industries in the investment structure is negligible (about 2 %).

Despite the high rate of structural shifts in 2012, (Table 6) changes that took place in the investment structure are not of any significant in quantitative or qualitative terms, which is confirmed by Chow test and Wilkinson criterion and did not lead to an increase in the efficiency of the economic structure of the region.

Investors do not invest in the development of the region. Short-term investments are aimed at fast and risk-free return on investment. The region is mainly focused on the production and export of raw materials, rather than processing them, which reduces the level of its economic development. It follows that there are serious problems of attracting investments:

- The lack of a targeted investment policy and formalized sustainable development priorities of the country and regions; an unfavorable investment climate; the growth of long-term investment risks and the tightening of long-term credit conditions.

- A poorly-established administrative framework, the regulatory legal acts regulating investment activity which are unsystematic and often contradictory, bureaucratic hurdles, the long process of obtaining various permits and approvals.
- The absence of scheme of spatial distribution of processing industry types, depending on the availability of resources and the demand of the domestic market.
- Weak infrastructure and road networks (even their records are not maintained by Rosstat), a lack of economic and legal framework for the establishment and maintenance of the road network, high electricity tariffs and rail transportation costs.

These problems hinder the inflow of investments and reduce their effectiveness.

6. Conclusion

In order to attract investors, it is necessary to create a favorable investment climate. Rich natural resources, the availability of cheap and skilled labor force or the high scientific and technical potential cannot attract investors if there is no favorable investment climate in the region.

Recently, at the federal and regional levels, attempts have been made to improve the investment climate.

First, it is administrative support:

- Provision of the regional government guarantees to obtain credit resources.
- Reduction of rent for the use of resources.

Second, tax exemption on income tax and property should be introduced for the whole period of the investment project implementation.

Third, public-private partnerships should develop as priority investment projects.

The average payback period of priority investment projects is about 6 years. The shorter this period, the more efficient is the project, but this approach is not beneficial to the investor since he is interested in maximizing the payback period in order to extend preferential terms.

Public-private partnerships allow us to maximize the use of capabilities of each project participant with overall risk reduction. State entering into an alliance with the business receives, as a rule, not only its financial resources and reduction of burden on the budget, but also a more flexible project management system. Business is also interested in the use of public resources, guarantees and preferences for solutions to their problems.

Fourth, a leasing scheme of attracting investments should develop:

- The creation of pledge funds for the provision of investment banking for lease with the use of public assets.
- Improvement of the legal framework to ensure that the interests of leasing transaction participants are protection.
- Establishing a fund of state guarantees for exports while implementing international leasing of domestic machinery and equipment.

All these measures will help to attract investments, improve the structure efficiency and economic growth of the Far Eastern Region.

The proposals and approaches to improve the efficiency of the investment policy in the Far Eastern Region, as well as the method for analysis of investment structure can serve as a basis for further theoretical and applied research in the field of regional investment policy.

7. Acknowledgements

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