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Diversification versus concentration trends in the housing construction and stock across Siberian regions

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ABSTRACT
Relevance. The processes of regionalization and localization are currently intensifying in the Siberian macro-region, where local markets act as drivers of socio-economic development. We associate their development with the diversification of the sectoral structure. Nevertheless, the demographic conditions contribute to the growth of spatial concentration, which affects the sustainability of the housing construction structure and negatively affects the housing market.
Research objective. This study aims to analyze the economic consequences of the diversification-related processes and the degree of the spatial concentration of these effects in Siberian regions.
Data and methods. The study relies on official databases for the calculation of the Herfindahl-Hirschmann and Gini-Struck coefficients. Econometric analysis was conducted with the help of E-Views software.
Results. The concentration phenomenon in housing construction becomes indirectly dependent on regional diversification of the urban and rural housing stock, with an intense and natural correlation for the urban housing stock, which is stronger than in the case of the rural housing stock. The multifactorial model of concentration in housing construction indirectly depends on the combined regional diversification of incomes and population and the urban or rural stock.
Conclusions. The evolution of the Siberian macro-region is shaped by the increasing urbanization and localization processes, which exacerbate the insufficient level of diversification. These factors are detrimental to the development of the local markets of resources; they have a negative effect on the rate of housing construction and on the supply in the housing market.

KEYWORDS
diversification (d), concentration (c), d vs. c coefficients, correlation matrix, econometric model, regional economics, local markets

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Тенденции диверсификации и концентрации жилого строительства и фонда в регионах Сибири

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АННОТАЦИЯ
Актуальность. В настоящее время в сибирском макрорегионе усиливаются процессы регионализации и локализации, где локальные рынки выступают драйверами социально-экономического развития. Мы связываем их развитие с диверсификацией отраслевой структуры. Тем не менее, демографические условия способствуют росту пространственной концентрации, что сказывается на устойчивости структуры жилищного строительства и негативно сказывается на рынке жилья.
Цель исследования. Настоящее исследование направлено на анализ экономических последствий диверсификационных процессов и степени пространственной концентрации этих эффектов в сибирских регионах.
Данные и методы. Исследование опирается на официальные базы данных для расчета коэффициентов Герфиндаля-Хиршмана и Джини-Штрука. Эконометрический анализ проводился с помощью программы EViews.

КЛЮЧЕВЫЕ СЛОВА
Диверсификация (D), концентрация (C), коэффициенты D и C, корреляционная матрица, эконометрическая модель, региональная экономика, местные рынки

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Результаты. Явление концентрации в жилищном строительстве оказывается в косвенной зависимости от региональной диверсификации городского и сельского жилищного фонда, при этом для городского жилищного фонда наблюдается интенсивная и естественная корреляция, более сильная, чем для сельского жилищного фонда. Многофакторная модель концентрации жилищного строительства косвенно зависит от совокупной региональной диверсификации доходов и населения, городского или сельского жилого фонда.
Выводы. Развитие Сибирского макрорегиона определяется усиливающимися процессами урбанизации и локализации, усугубляющими недостаточный уровень диверсификации. Эти факторы наносят ущерб развитию местных рынков ресурсов; они отрицательно сказываются на темпах жилищного строительства и на предложении на рынке жилья.

ДЛЯ ЦИТИРОВАНИЯ
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西伯利亚地区住宅建设与其存量的多样化和集中化

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摘要
现实性：目前，西伯利亚地区加强了宏观合理化和本地化进程。当地市场是社会经济发展的驱动力，我们将其发展归因于部门结构的多样化。虽然人口状况有助于空间集中度的增长，但这影响了住房建设结构的可持续性，并对住房市场产生了负面影响。
研究目标：本研究旨在分析多样化进程的经济后果以及这些效果在西伯利亚地区的空间集中程度。
数据与方法：该研究依赖官方数据库来计算赫芬达尔-赫希曼指数和基尼系数。使用 EViews程序进行计量经济分析。
研究结果：住房集中的现象与城市和农村住房的区域多样化有间接关系。城市住房存量比乡镇住房总量更紧张、更自然。住房建设集中度与地区多元化有关，其多因素模型间接依赖于收入、人口、城乡住房存量。
结论：西伯利亚宏观区域水平是由不断发展的城市化和地方化所决定的，这反而减少了多元化。这些因素不利于当地资源市场的发展；它们对住房建设速度和住房市场供应产生了负面影响。

关键词
多元化（D），集中度（C），系数 D 和 系数C，相关矩阵，计量经济模式，区域经济学，当地市场

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Introduction

Concentration can be defined as a close gathering of people (city dwellers, residents, etc.) and things (goods, services, companies, etc.) while diversification stands for the process of a business enlarging or varying its range of products or field of operation (Oxford Languages). Interestingly, as Google search shows that the term 'concentration' is used much more frequently in the English language than the term 'diversification'. The use of the word 'concentration' to refer to gatherings of elements having something in common is more typical of linguistics and communication studies while 'diversification' denoting the result of variation is more widely used in economics and statistics[1].

Understanding the diversification versus concentration (D vs. C) phenomenon becomes the key to economic growth or survival during crises or recessions. It is, therefore, all the more necessary to find adequate statistical instruments to measure it correctly.

Economic diversification signifies a shift from a more uniform structure (investor, consumer, product, income, etc.) toward a more varied structure. The concentric, horizontal, and conglomerate (lateral) types of diversification involve economic growth. Thus, regions are stimulated to change their spatial and structural differentiation over time, reducing risks, business volatility, maximizing profits and benefits, etc. Diversity maximization increases the level of the structure's adaptability on the labor market and wealth per inhabitant and helps to reach a higher level of consumer demand satisfaction.

[1] Săvoiu, G. (2009). Paradigm and Its Priority in Relation with the Method within the Statistic Thinking. *Limbaj si Context, Revista internaţională de lingvistică, semiotică şi ştiinţă literară*, 1(2), 79–88. Retrieved from: http://www.old.usarb.md/limbaj_context/volumes/v2/art/savoiu.pdf

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Within the data series of the given chronological structures of moments or intervals, any classical analysis of the D vs. C phenomenon extracts images or realities from the local, regional, and national economies. Almost all the interdisciplinary approaches point out distinctive structural energies (g_i^2), first trying to quantify these energies, and only after their statistical evaluation, to trace these energies' specific evolution through time and space. There are two classical logical methods of interdisciplinary analysis of the D vs. C phenomenon focusing on demand or offer as the first step of the investigation. The former method investigates the two significant demand flows (on the micro- and macro-economic levels) while the latter focuses on the flows of the offer. All these flows can be partially or fully compensated in time and space, generating a characteristic balance of prices and stratifying markets and economies, and finally, structuring and restructuring everything permanently, eliminating inefficient companies and gradually transforming the entire local, regional, and national economy.

The statistical methods, techniques, and instruments of a comprehensive evaluation as part of the interdisciplinary analysis of the D vs. C phenomenon constitute the core of our research. For a more detailed evaluation of the spatial forms of the D vs C phenomenon, a wide selection of methods and tools (from chronological indices, which have been constantly updated in the recent decades, to spatial coefficients) is needed. Original and unconventional statistical methodologies and tools can provide us with new insights into the nature of the D vs C phenomenon, especially regarding its dynamic and limitations, changes in the hierarchy and structure as well as the changes in the degree of impact and dependence (Săvoiu et al., 2012; Săvoiu, Dinu, 2012).

The research on the questions of spatial development requires a constant improvement of statistical tools, especially when dealing with the factors and conditions of the socio-economic development of regions in modern conditions. The growing spatial disparities between regions have resulted in an increased scholarly interest in territories with similar conditions. A productive approach to study a regional economy is to focus on its spatial aspect, especially the local and subnational levels. We are particularly interested in the demographic processes in the macro-regions with a high resource potential and vast territory. The most striking example of such a macro-region is Siberia, which comprises 10 regions of the Siberian Federal District (we are going to discuss it in more detail in the fourth subsection of this paper). The need for economic and social development to improve the quality of life, especially the housing conditions, is the most acute in this macro-region. Thus, the housing market[2] at the regional level becomes both a factor and a target indicator of regional development. The study of the spatial aspect of the housing market's development as D vs. C will explain how the concentration of the region's resources, which are the factors of the housing market, affects the spatial distribution of housing supply.

This paper aims to introduce a new approach to construct statistical instruments and measurements of the spatial aspects of the D vs. C phenomenon in regional research through local markets data analysis. We are going to test the hypothesis that the diversification of the housing stock increases the effect of spatial resources in different territories due to the influence of certain regional factors. The demographic criterion is the limitation of this study. Our assumption is that if, instead of focusing on the qualitative differences between housing markets (e.g. number of rooms, number of stories), we focus on the spatial aspect (urban vs. rural) and on the industry-specific aspect (construction vs. stock) of local housing markets (primary vs secondary housing markets; urban vs rural), we can bring to light the factorial dependencies in the processes of diversification and concentration in these markets. Hence, the main research tasks are to construct a statistical tool for the measurement of spatial aspects and to identify the determinants of the housing construction concentration based on the diversification process.

The remaining part of the paper proceeds as follows: the next section gives a brief overview of the conceptual framework and previous studies of the localization of regional housing markets; the third section deals with the importance of diversification and concentration analysis and underlines the significance of statistical instruments in the research on spatial trends and structural transformations in the regional economy; the fourth section describes the methodology and data; the

[2] In the research literature (that is, the studies in the field of regional economics but also land use studies, environmental studies, studies of the energy, industrial, demographic, town-planning and transport policies), the term 'regional housing market' is often used along with 'local housing market' and 'spatial housing market'.

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fifth section presents our findings regarding the case of Siberian macro-region and outlines the future trends based on the correlations matrix; and the last section contains the conclusions. Thus, this study described an innovative approach to measuring D vs. C trends in Siberian housing construction by using the economic data for the last two decades and statistical and econometric research methods (Săvoiu, Dinu, 2012).

Theoretical framework

Even though housing economics encompasses a vast body of research, there is a perceived scarcity of studies of the spatial aspects of local markets and the impact of these aspects on the determinants of the regional economy. This might be explained by the fact that the conditions under which the regional economy develops are endogenous to the conditions in which regional markets evolve and function. Many studies deal with the question of whether the structure of migration flows and incomes of the population affects the price indicators, which determine the quality and standards of life. However, the focus of such studies remains quite narrow since they discuss only such systemic factors as household incomes, bank interest rates, prices for new housing, and the state of the housing stock (Choi, Hansz, 2021). This limitation prevents us from establishing the connection between the spatial aspects of specific factors shaping the development of local housing markets within the given macro-region.

The most common approach to studying the impact of localization on the regional economy is to assess the uneven spatial concentrations of population, which, according to the new economic geography, reflects the spatial distribution of economic activity and the capacity of local markets. Similarly, this approach can be used in the structural analysis of material security, which is estimated by looking at the level of total income and the parameters of housing (Bobkov et al., 2018), and in the comparative analysis of regional economies' development parameters, which focuses on the industry-specific and market-related factors in large regional capitals (Turgel, Ulyanova, 2019).

In the classical sense, diversification does not explain the level of housing prices in a regional market (see, for example, Coulson (2020)). The spatial aspect can be considered, for example, in the study of spatial development in relation to labour migration flows and the existing housing stock (Kurichev, Kuricheva, 2019). Li et al. (2021) argue that the turnover of the existing housing stock and new housing affects the migration flows. In their study, Li et al. (2021) conduct a spatial analysis of the housing market in Melbourne and show how new dwelling development programs generate new vacancy chains, which, in their turn, shape migration toward outer urban areas. Other studies of suburban housing markets shed light on some additional determinants: for example, Moallemi et al. (2021) explore the influence of non-spatial factors, such as the similarity of socio-economic and demographic characteristics, on the localization of the housing market. All of the above points to the need to study the polarizing effect of the processes of urbanization and localization to identify the opportunities and constraints in the spatial development. This, in its turn, can be used by policymakers in resource-dependent regions (Dvoryadkina, Kaibicheva, 2017).

Another distinctive feature of the reviewed literature is that these studies mostly focus on the cases of specific countries and national markets. These studies have one thing in common: they analyze urban or suburban areas or national territories. A promising avenue for future research, however, would be to focus on the regions with similar sets of resources that could be united into macro-regions at the sub-national level for joint socio-economic development. These territorial formations can be identified by applying a combination of two principles: the spatial principle and the principle of industrial specialization. For historical reasons, these territories also have some similarities in the patterns of regional disparities. Thus, in addition to trend-based predictions, it is possible to take into account the factor of state regulation and thus make scenario-based predictions, which is particular pertinent today.

Diversification versus concentration

To study the diversification versus concentration (D vs. C) phenomenon, we can apply specific statistical methods based on the evaluation of selected coefficients for the quantitative assessment and modeling of the economic reality. The results of such analysis can be used for more effective decision-making and for choosing optimal scenarios. In this paper, we use coefficients instead of classical indices because this kind of calculus is the simplest as it uses decimals rather than percentages. The Herfindahl-Hirschman Index (HHI) remains the simplest and widely used mea-

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sure of the D vs. C process in a market, region, or economy (Hirschman, 1945; Herfindahl, 1950). Although in the name of the index Herfindahl goes first, it was actually Hirschman who first introduced it (Hirschmann, 1964; Calkins, 1983). The HHI is the sum of squared shares (specific weights) of various entities (products, companies, areas, regions, etc.) in total gross value (Săvoiu, Siminică, 2016; Nirpal et al., 2019; Beutel, 2021; Săvoiu et al., 2010):

$$HHI = \sum_{i=1}^{n} g_i^2, \quad (1)$$

where

$$g_i = \frac{x_i}{\sum_{i=1}^{n} x_i}$$

and as frequently as possible

$$\frac{1}{n} < g_i < 1.$$

The HHI reaches the minimum only when all the market, regional, and economic structures (specific weights) are equal (the case of complete diversification, where $g_i = 1/n_i$), and the maximum while there is only one component in the phenomenon in question (the case of complete concentration, where $g_i = 1.00$). The increasing values in time or space identify the concentration process, and the decreasing values suggest diversification in economics (Mishra, Kumar, 2012; Hall, Tideman, 1967; Foldvary, 2006).

In the practice of the banking sector's analyses (Freitakas, 2013), the HHI higher than 0.18 usually shows high concentration, and researchers use the HHI's alternative only for the portfolio's diversification (D) process known as the Berry ratio (BR):

$$BR = 1 - HHI = 1 - \sum_{i=1}^{n} g_i^2. \quad (2)$$

The Gini coefficient (GC) was introduced in 1912 as a measure of wealth or income distribution across any statistical population, and it was often represented graphically through the Lorenz curve (Gini, 1912; Gini, 1921):

$$GC = \sqrt{\sum_{i=1}^{n} g_i^2} = \sqrt{HHI}, \quad (3)$$

with the minimal variable limit

$$\sqrt{\frac{1}{n}} < GC < 1.$$

In practice, the Gini coefficient is used for measuring the inequality of distribution. The GC higher than 0.300 points to the existence of wealth inequality.

The standard Gini coefficient was modified by A. Struck, who offered a simplified solution for the original coefficient known as the normalised Gini-Struck coefficient (CGS), offering the interval from 0 to 1 with certain minimum and maximum limits to evaluate the market diversification versus concentration (D vs. C) in an aggregate territory, region, macro-region or even economy in general. The CGS may be used to analyse the homogeneity or heterogeneity in different sectors or classes of activities:

$$CGS = \sqrt{\frac{n\sum_{i=1}^{n}(g_i)^2 - 1}{n-1}}. \quad (4)$$

Finally, the Theil index (TI) based on sigma convergence changes the calculus utility in a new direction – toward entropy or informational energy (Bonet, Roca, 2009; Theil, 1967):

$$TI = \sum_{i=1}^{n}(g_i) \times \log(ng_i). \quad (5)$$

The studies of the diversification versus concentration (D vs. C) process continue and new solutions, methods, and coefficients constantly appear in statistical research (Goschin et al., 2008; Bharati et al., 2015).

Methodology

Data and metadata

The first dataset comprises an unbalanced panel of 10 regions of the Siberian Federal District and includes 10 variables; the data were quarterly and spanned (when available) over the period of 2000Q1–2019Q4. However, in the final calculus we used only the annual data. The empirical analysis presented in this paper was initially based on the following 10 regional-level variables from the survey by the Federal State Statistics Service of Russia: the volume of housing construction (total and per employee), housing prices in the primary and secondary sector, the total income of households, urban and rural housing stock, total housing stock per employee, population, and the volume of construction loans. Since it was impossible to convert the relative values into absolute values for all the initial variables, the final dataset included only six variables, adequate to the structural calculus of the D vs. C coefficients: housing construction (x_1), the total income of households (x_2), urban and rural housing stock (x_3 and x_4), population (x_5), and the volume of construction loans (x_6).

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The statistical and econometric models presented in this paper are based on the regional-level data and metadata from the survey by the Federal State Statistics Service. The primary temporal, regional, and structural criteria of data selection are the following: the year, region, primary and secondary sector, urban and rural areas, etc. All the six selected variables have shown the actual evolution, viewed chronologically, of Siberian regions, with only one exception – the specific stationary trend demonstrated by the volume of construction loans, which was revealed by the calculus of the D vs. C coefficients.

The original correlation matrix between the variables based on two different coefficients

This paper proposes an original symmetric correlation matrix illustrated by Fig. 1, where the blue part corresponds to the HHI and the grey part, to the CGS.

The major novelty of this new type of symmetric correlation matrix is the possibility of comparing the intensity of the correlation values for the two statistical instruments (HHI and CGS) before constructing econometric models. Our analysis shows that the higher value between $X_{5,6}$ and $Y_{5,6}$ reveals the optimal construction starting from the higher determination coefficient or ratio. It thus makes the task of selecting the most efficient econometric model easier. To estimate the diversification for all the causal factors or exogenous variables affecting concentration, we use the following base-line specification:

$$y_i = \beta x_i + \varepsilon, \quad (6)$$

where i indexes regressors, y is the HHI measure of concentration; x denotes the volume of diversification expressed in the CGS; ε is a heteroscedastic error. The coefficient of interest is β which captures the effect of diversification on concentration in the region's local markets of products and resources[3].

If Eq. 6 has several predictors, the entire sample should be evaluated to reveal the processes of urbanization and localization. If market agglomeration forces are included in the analysis, we can improve the basic specification for determining the regional disparities (Kolomak, 2020). Moreover, housing stock in rural areas and population were included as regressors to provide an explanatory set of factor attributes.

Results and discussion

To illustrate how the changes of the selected variables affect the diversification versus concentration process, it was necessary to evaluate the D vs. S coefficients over the sample period in Siberian regions. Practically, the HHI and CGS were determined as annual values at the level of regional economies in both cases, following the calculation model based on the statistical-mathematical ratios Eq. 2 and Eq. 4 and the significant number of final observations, close to two thousand detailed data (the HHI and CGS values are available on request).

Diversification and concentration coefficients

The quantified values of the HHI are more limited and the final interval of variability, in this case, is placed in a more limited statistical range from $1/n$ to 1. This aspect proves that the HHI seems to be less reactive to various phenomena. The evolutions of these real values of the HHIs also reveal different aspects for all the six valid variables in Siberian regions, as one can see from

[3] In this case, the independent explanatory variables are not the temporary data sets showing changes in the local markets' resources but the estimated value of the degree of their concentration and diversification because, depending on the chosen specification, they are going to alternate between y and *x*.

HHI coefficient	x_1	x_2	x_3	x_4	x_5	x_6	
x_6					$Y_{5,6}$	1.0000	x_1
x_5					1.0000		x_2
x_4				1.0000			x_3
x_3			1.0000				x_4
x_2		1.0000					x_5
x_1	1.0000	$X_{5,6}$					x_6
	x_6	x_5	x_4	x_3	x_2	x_1	CGS coefficient

Figure 1. *Symmetric correlation matrix to compare the D vs C coefficients*
Source: compiled by the authors

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the opposite trends (ascendant for x_1 or descendant for x_2) to the unusual stationary result for x_6.

The descriptive statistics present five homogeneous series of data (Table 1) but we removed the volume of construction loans as a significant factorial variable from the sample. The high level of the Jarque-Bera test (JB ≈ 8.888) shows the potential future risks in modeling for x_2, because of the possible trend of data abnormality in the medium or long term.

The calculus of the CGS confirms our previous conclusions about x_6. It brings even more exciting results generated by this more sensitive and volatile statistical instrument of D vs. C analysis, eliminating the risks for x_2 (Table 2).

The descriptive statistics reveal the same five series of data (Table 2), even more homogeneous than the coefficients' values and more symmetrical and flattened than the level of skewness and kurtosis, but lead us to exclude factor x_6 from the econometric modelling based on the HHI or CGS.

In the last two decades in the Siberian macro-region, both the HHI and CGS show a significant concentration trend in the market of housing construction (x_1), which obviously contradicts the trend of the diversification of the total income of households (x_2), urban (x_3) and rural housing stock (x_4), and even with the population size (x_5). To interpret the target values, we need to demonstrate the trend described in the

Table 1

Descriptive statistics of the HHI for all the series of valid variables*

Sample: 2000–19	x_1	x_2	x_3	x_4	x_5	x_6
Mean	0.149600	0.141450	0.146250	0.145900	0.135450	0.100000
Median	0.148000	0.139500	0.146000	0.146500	0.135000	0.100000
Maximum	0.161000	0.156000	0.148000	0.150000	0.136000	0.100000
Minimum	0.140000	0.135000	0.145000	0.140000	0.135000	0.100000
Std. Dev.	0.006056	0.005680	0.000967	0.003110	0.000510	0.000000
Skewness	0.491975	1.459255	0.560646	-0.378399	0.201008	NA
Kurtosis	2.286328	4.465514	2.468756	2.070090	1.040404	NA
Jarque-Bera	1.231238	8.887863	1.282930	1.197897	3.334694	NA
Probability	0.540306	0.011750	0.526521	0.549389	0.188747	NA
Sum	2.992000	2.829000	2.925000	2.918000	2.709000	2.000000
Sum Sq. Dev.	0.000697	0.000613	1.78E-05	0.000184	4.95E-06	0.000000

Note: * Software used: E-Views.

Source: The authors' calculations are based on the CGS described in this paper text by using the following dataset: "Regions of Russia. Main Characteristics of the Constituent Entities of the Russian Federation 2020". Retrieved from: https://rosstat.gov.ru/folder/210/document/13205.

Table 2

Descriptive statistics of the CGS for all the series of valid variables*

Sample: 2000–19	x_1	x_2	x_3	x_4	x_5	x_6
Mean	0.234500	0.212300	0.226550	0.225800	0.198550	0.003000
Median	0.230500	0.210000	0.226000	0.227500	0.198000	0.003000
Maximum	0.261000	0.229000	0.230000	0.236000	0.201000	0.003000
Minimum	0.211000	0.198000	0.223000	0.210000	0.197000	0.003000
Std. Dev.	0.014274	0.008939	0.002038	0.007682	0.001395	0.000000
Skewness	0.405818	0.259541	0.365962	–0.494964	0.372435	NA
Kurtosis	2.264391	1.997945	2.328165	2.218470	1.830431	NA
Jarque-Bera	0.999894	1.061299	0.822563	1.325623	1.602270	NA
Probability	0.606563	0.588223	0.662800	0.515400	0.448819	NA
Sum	4.690000	4.246000	4.531000	4.516000	3.971000	0.060000
Sum Sq. Dev.	0.003871	0.001518	7.90E-05	0.001121	3.70E-05	0.000000

Note: * Software used: E-Views.

Source: The authors' calculations are based on the CGS described in this paper text by using the following dataset: "Regions of Russia. Main Characteristics of the Constituent Entities of the Russian Federation 2020". Retrieved from: https://rosstat.gov.ru/folder/210/document/13205.

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first section: the imbalance between the concentration of housing construction and diversification of the housing stock in the Siberian macro-region. The stationary trend in the volume of construction loans (x_6) revealed by the HHI and CGS identifies a dummy variable.

The impact of the correlation matrix on econometric modelling process

After comparing the intensities of statistical instruments, the proposed correlation matrix identifies the symmetric correlation values in Paretian equilibrium (20/80). The CGSs offer 80% valid trust for future modelling and the HHI, only 20%. The dominance of the CGS can be justified by the calculus procedure and the final interval of values from 0 to 1, which makes this statistical tool more adequate (Fig. 2).

In a detailed analysis, it is possible to promptly select the CGS coefficient for future prognosis of the evolution of x_1 as the dependent variable, and thus the entire econometric modeling process is simplified.

Potential econometric D vs. C models

In this section, we are going to describe the theoretical aspect of the process of econometric modelling, starting from the final results of the proposed matrix. The matrix can facilitate the choice of the type of the D vs C coefficients (HHI and CGS). However, with regard to this study's goals and formal limitations, we are going to further focus on the concentration trends of the housing construction variable (x_1), explained by the diversification of the housing construction stocks (x_3 and x_4). We can define this econometric option as classical *non multa, sed multum* option. The general trend can be validated perhaps in a centennial term and explained by the total income of households (x_2) and by the decreasing population in Siberian regions (x_5). We substitute these independent variables on the macro-regional level with specific CGS coefficients, confirming the concentration of the endogenous variable based on the evolution of the diversification for all causal factors or exogenous variables.

Transitioning from the unifactorial to multifactorial criterion, the linear regression presents an original hierarchy. All the partial viable models emphasize different opposite trends according to the negative sign of the specific parameters, especially for the unique factor's case (classical *caeteris paribus*). Thus, the concentration phenomenon in housing construction (x_1) becomes indirectly dependent first (*Adjusted R-squared* = 0.56) on the regional diversification of the population (x_5) and only afterwards, on the regional diversification of income (x_2) as can be seen from the following two partial validated models in Table 3 (Durbin-Watson DW test being a major exception).

Furthermore, the concentration phenomenon in housing construction (x_1) becomes indirectly dependent on the regional diversification of the urban and rural housing stock (x_3 and x_4), with an intense and natural correlation for the urban housing stock (*Adjusted R-squared* = 0.36), which is stronger than in the case of the rural housing stock (columns 3 and 4). The multifactorial model of the dependence of concentration in housing construction (x_1) with the highest *Adjusted R-squared* describes the effect of the combined regional diversification of incomes and population indirectly, together with urban or rural stock (column 6), but remains invalidated as parameters (t-test and specific prob.) and as results to Durbin-Watson stat, is also affected by multicollinearity.

HHI	x_1	x_2	x_3	x_4	x_5	x_6	
x_6	NA	NA	NA	NA	NA	1.0000	x_1
x_5	*–0.5517*	*0.6890*	*0.5067*	*0.8255*	1.0000	**–0.7499**	x_2
x_4	**–0.6226**	*0.7237*	*0.5865*	1.0000	*0.7010*	**–0.6250**	x_3
x_3	*–0.5395*	**0.7646**	1.0000	**0.6426**	**0.8310**	*–0.6125*	x_4
x_2	*–0.6892*	1.0000	**0.8509**	**0.7582**	**0.9192**	**–0.7655**	x_5
x_1	1.0000	NA	NA	NA	NA	NA	x_6
	x_6	x_5	x_4	x_3	x_2	x_1	**CGS**

Figure 2. *The dominance of the CGS coefficients in comparison with the HHI coefficients based on the proposed symmetric correlation matrix*
(Notation: NA = Not available for correlation [a real stationary trend (co)exists])
Source: compiled by the authors

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Table 3

Partial validated econometric models of the CGS based on the unifactorial and multivariate OLS* regression

Regressors	1	2	3	4	5	6
x_2	–1.197** [0.249]				–0.473** [0.638]	–0.580** [0.651]
x_5		–7.835** [1.552]			–4.259** [4.470]	–6.205** [4.417]
x_3			–4.376** [1.288]		–0.714** [1.689]	
x_4				–1.138** [0.346]		–0.381** [0.381]
Adj. *R*-sq.	0.53808	0.56295	0.35673	0.34043	0.53000	0.53778
Log likelihood	65.3852	65.9386	62.0736	61.8233	66.3898	66.5567
F-statistic	23.13**	25.47**	11.54**	10.81**	8.14**	8.37**
DW stat	1.41506	1.34794	0.95988	1.36498	1.29243	1.26057

Notes: * The dependent variable is the CGS of housing construction in all the columns. All the regressions include a constant and the full set of variables of the baseline specification described in the text. Robust standard errors are in parentheses. **Significant at 1 %.

Source: the authors' evaluations were made with the help of E-Views software.

The regional diversification of the urban stock (x_4) is directly correlated with the concentration in housing construction (x_1) in the last econometric model, probably as a specific sign of the Siberian macro-region's evolution. These results were broadly consistent with those of Shmidt et al. (2016). Let us suppose that we can try to extend the factors combining the diversification of the urban and rural housing stock to the maximum. Then, the value of the Fisher test (F-statistic = 5.991098) invalidates the entire modeling process based on the multifactorial regression.

Conclusions

The transformational phenomena of the 21st century in the Siberian macro-region were characterized by the decreasing influence of globalization and an increase in the processes of regionalization and localization. Local markets are the drivers of socio-economic development of Siberian regions, most of which are resource dependent. This study has shown that the urban housing stock can go through the process of diversification, which can perhaps be more intense and faster. Even the indirect effect of diversification due to the existence of the rural stock may shape regional diversification, extending to other macro-regions and thus changing the general higher-level tendency and making it economically more efficient and demographically optimized.

The proposed statistical tool allows us to estimate the spatial aspects of regional development by identifying the optimal set of determinants of the new housing supply concentration based on the regional diversification of the economic structure.

Obviously, this demographic criterion is a real limitation of this study. We hope that in further research a more detailed analysis of the demographic factors (e.g. population decline caused by ageing and falling fertility rates) will be conducted. It might also be important to shed light on the cause-and-effect relationship between different levels of the negative influence that the diversification of the rural housing stock has on urban housing. This question also has a considerable practical significance for policy-makers devising state programs for stimulating housing construction in rural areas.

Finally, this paper shows a paradox of the housing construction concentration based on the diversification of the significant variables with the D vs. C coefficients (HHI and CGS). Thus, the Siberian macro-region is characterized by a high concentration and insufficient diversity in terms of housing in the given period. On the one hand, the concentration level shows the increasing urbanization and localization processes, which contribute to the general development of the local markets. On the other hand, the insufficient level of diversification inhibits the formation and functioning of the local resource markets, affecting the low rate of housing construction and reducing the supply in the housing market. The economic evolution from concentration to diversification means more opportunities for economic and social survival and development. The new generations living in the Siberian macro-region will have to deal with the challenging task of identifying and measuring these paradoxes, underlying the evolution of these territories.

The proposed statistical tool may be used to maximize the effectiveness of the econometric toolset for the research on the role of local markets in regional economic development. Our findings can also be of interest to policy-makers in implementing the programs for regional spatial and economic development.

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