Artículo de investigación

Cenological Model of International Migration Management in the Regional Business System

Ценологическая модель регулирования международных миграционных потоков в региональной предпринимательской системе

Modelo Cenológico de Gestión de Migraciones Internacionales en el Sistema Regional de Negocios.

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Abstract

The article suggests a model for determining the needs of a regional business system in migrants and assessing the impact of international migration on the sustainability and development of a regional business system based on the cenological approach. The authors conducted a study of the business system of the Kamchatka Region – a region with high migration activity. Methodology. Data on the revenue of 100 enterprises was the empirical base for this research. The availability of these data was the only criterion for this sample. Results and applications. The cenological model for assessing the impact of migration on stability of the regional business system described in this article allows to predict the need for the number of migrants, including by industry. The research has proved that the regional business system of the Kamchatka Region is part of a cenological system, and revealed that the increasing of small enterprises number and filling the gap in the labor market with migrants is necessary for building an optimal regional entrepreneurial system. Limitations and conclusion. However, this model does not consider such factors as age, gender, level of qualifications and migrants' education. Therefore, further research in this direction will be a significant contribution to the field of

Аннотация

Авторы предлагают модель оценки влияния международной миграции на устойчивость и развитие предпринимательской системы региона на основе ценологического подхода. Гипотеза: региональная предпринимательская система относится к экономическому
ценозу. Методология. Эмпирическая база - данные о выручке 100 предприятий Камчатского края сое к я Единственный критерий выборки - доступность этих данных в сети интернет, которая в открытом доступе содержит данные финансовых отчетов предприятий, представленных службе статистики. Результаты и практическая значимость. Модель позволяет определить потребности региональной предпринимательской системы в мигрантах, что позволит повысить эффективность прогнозирования потребности в иностранной рабочей силе в рамках региональной миграционной политики. Доказано, что предпринимательская система Камчатского края относится к састеме ценологического типа. Такие свойства ценозов, как структурно-топологическая динамика, непрерывное воспроизводство и самоорганизация позволяют исследовать

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scientific knowledge and migration management of states and regions. The model may improve the forecasting efficiency of the need for foreign labor and improve regional migration policy.

Keywords: Cenology, *H*-distribution, migration processes, economic cenoses, rank distribution.

устойчивость и развитие структур ценологического типа. В качестве фактора, влияющего на стабильность предпринимательская v. Per. Произведены расчеты posts оценке влияния международной трудовой миграции на устойчивость предпринимательская система Камчатского края, которые позволят улучшить структуру данной предпринимательской системы и повысить ее устойчивость. Выявлено, что для формирования оптимальной региональной предпринимательская система необходимо увеличить количество малых предприятий и недостающую потребность в рабочей силе восполнить за счет мигрантов. Ценологическая модель оценки влияния миграции на устойчивость региональной предпринимательская система, описанная в данной статье, позволяет прогнозировать потребность в количестве мигрантов, в том числе в отраслевом разрезе. Ограничения и выводы. В то же время, модель не учитывает такие факторы, как возраст пол а а Поэтому считаем, что дальнейшие исследования в данном направлении станут существенным вкладом в область научных знаний и управление миграционными потоками государств и регионов. уровень квалификации и образования мигрантов. Поэтому считаем, что дальнейшие исследования в данном направлении станут существенным вкладом в область научных знаний и управление миграционными потоками государств и регионов. уровень квалификации и образования мигрантов. Поэтому считаем, что дальнейшие исследования в данном направлении станут существенным вкладом в область научных знаний и управление миграционными потоками государств и регионов.

Ключевые слова: Ценология; H-распределение; миграционные процессы; экономические ценозы; ранговые распределения.

Resumen

El artículo sugiere un modelo para determinar las necesidades de un sistema de negocios regional en migrantes y evaluar el impacto de la migración internacional en la sostenibilidad y el desarrollo de un sistema de negocios regional basado en el enfoque cenológico. Los autores realizaron un estudio del sistema de negocios de la región de Kamchatka, una región con una alta actividad migratoria. Metodología. Los datos sobre los ingresos de 100 empresas fueron la base empírica para esta investigación. La disponibilidad de estos datos fue el único criterio para esta muestra. Resultados y aplicaciones. El modelo cenológico para evaluar el impacto de la migración en la estabilidad del sistema comercial regional descrito en este artículo

permite predecir la necesidad del número de migrantes, incluso por industria. La investigación ha demostrado que el sistema comercial regional de la región de Kamchatka es parte de un sistema cenológico, y reveló que el aumento del número de pequeñas empresas y la brecha en el mercado laboral con migrantes es necesario para construir un sistema empresarial regional óptimo. Limitaciones y conclusión. Sin embargo, este modelo no considera factores como la edad, el género, el nivel de calificaciones y la educación de los migrantes. Por lo tanto, una mayor investigación en esta dirección será una contribución significativa al campo del conocimiento científico y la gestión de la migración de los estados y regiones. El modelo puede mejorar la eficiencia del pronóstico de la necesidad de mano de obra extranjera y mejorar la política de migración regional.

Palabras clave: Cenología, distribución de H, procesos de migración, cenosis económicas, distribución de rangos.

Introduction

Entrepreneurial activity is the basis of economic growth in the market economy of any state. Development of entrepreneurship may vary in different regions due to their historical, geographical, economic and other characteristics. Thus, the problem of assessing the impact of international migration on the development and stability of the regional entrepreneurial system is particularly relevant.

Authors use the indicators related to the economy's need for labor migrants developed in policy documents (State program of the Russian Federation "Promoting Employment", approved by the RF Government Decree No. 298 of April 4, 2014). It is also necessary to take into account the factor of a constant increase in migration flows and its impact on the development of entrepreneurship in various regions of Russia, especially in the Far East, where there is an acute shortage of labor resources. The current practice of state regulation of international migration requires significant modification to the emerging problems of efficient use of foreign labor in the economy of the Primorye Territory and the entire Far-East region (Latkin & Kuzmina, 2014). The influence of migration on the regional entrepreneurial system of the Far East is explored in the works by Alferov (2015), Didukh (2009), Levskaya and Alferov (2017).

Theoretical Framework

Such properties of cenoses as structural and topological dynamics, continuous reproduction and self-organization allow investigating the stability and development of cenological structures. The authors consider the flows of international labor migration as a factor affecting the stability of a business system.

The theoretical analysis of entrepreneurial activity development, its impact on economic stability and growth of cities and regions are presented in the studies by Glaeser, Rosenthal & Strange (2016) and Boschma (2015). However, these works only mention the migration factor.

Migration as a factor affecting various economic indicators and aspects of the economic and social life of society is widely discussed in scientific literature all over the world.

Some researchers study the influence of migrants' intercultural experience on the level of entrepreneurial activity (Vandor & Franke, 2016; Lintner, 2015). The research methodology in these papers is based on the experiment held among student groups, which included migrants from other states. These studies showed that the potential of entrepreneurial activity among visiting students is higher than that of non-migrant students.

Gurgand, Lambert, Rapoport & Zenou (2012) and González-González, Bretones, Zarco & Rodríguez (2011) study the factors and motives of migration processes. The first group of scientists also examines various effects of international migration – positive and negative impact on the sending country and the receiving country. They study the impact of financial flows from migrants' cash transfers on the countries' economies and the problems of control over these flows. The authors also discuss the problem of opening and developing business by migrants who have returned to their country. The other study explores reasons that motivate women who immigrated to Italy to start an entrepreneurial activity.

Some researchers examine the problem of duration ("survivability") of entrepreneurial activity among migrants (Wahba & Zenou, 2012; Marchetta, 2012; Georgarakos & Tatsiramos, 2009). In these works, the research methodology is based on the construction of econometric

models. The models of Wahba & Zenou (2012) and Marchetta (2012) investigate the likelihood of continuous business activity among Egyptian migrants who returned to their country. They study the impact of the loss of the accumulated social capital in their country on the decision to migrate to get an education, to raise capital and start their own business. Marchetta (2012) provides an assessment of the influence of various factors on the level of business activity. The regression models suggested by Georgarakos & Tatsiramos (2009) allowed estimating the likelihood of starting entrepreneurial activity in the US among migrants and their offspring, compared with the local population. The results of both studies showed a rather high probability of business development among migrants.

Migration as a factor of human capital accumulation and the growth of public welfare is examined in the works by Di Maria and Lazarova (2012), Brunow, Nijkamp & Poot (2015), Aubry, Burzyński & Docquier (2016). The authors of these articles conduct empirical studies with the construction of econometric models. Di Maria & Lazarova (2012) revealed the relationship between the migration of skilled labor from less developed to more developed countries, the accumulation of human capital (measured by the level of education and qualifications) and productivity growth. Such migration has a positive impact on receiving countries and negative on the sending countries. Brunow et al. (2015) examine the impact of international migration on economic growth in the global economy. Aubry et al. (2016) built models making it possible to assess the impact of international migration on the welfare of receiving and sending countries. These models consider gender, age, level of qualification and education of migrants. As a result, it was revealed that migration has a positive effect on both the sending country and the receiving country.

Kalantaridis (2010) and Deller & Kures (2019) study the impact of migration on the development of entrepreneurship in rural areas. Kalantaridis (2010), using statistical data, focuses on two aspects: whether the number of migrant arrivals affects the increase in entrepreneurship and whether migrant entrepreneurs are able to mobilize capital and information resources in foreign markets. Deller & Kures (2019) built econometric models with several different variables: age, education, income, level of migration and other factors. They revealed a correlation between the number of startups and migration.

Unlike most of the works related to the study of the positive impact of international migration on the level of entrepreneurial activity, Sheehan & Riosmena (2013) investigated the impact of migration on the development of the shadow economy in Mexico. The study found that migration could contribute to the formation of illegal business.

While deeply appreciating the input of the considered approaches to the study of migration, it is also necessary to mention the shortcomings. First, as noted by the authors themselves, most studies used insufficiently accurate data, which may be reflected in the distortion of results. Secondly, none of the studies focuses on predicting the need for migrants.

Despite many scientific studies on the phenomenon of migration and its impact on various social and economic processes, many aspects of the impact of international migration on the sustainability of a regional business system require further examination. The study assumes that a regional business system is part of the economic cenosis.

Development and sustainability of entrepreneurial systems of the Russian regions, along with the standard economic (statistical, investment, industry) approaches, should be considered as part of its affiliation to the community of economic cenosis.

Materials and Methods

Such cenosis properties as structural and topological dynamics, continuous reproduction and self-organization allow investigating the stability and development of cenological structures. For this, the obtained rank parametric distributions should be compared with the ideal classical hyperbolic *H*-distribution (Kudrin, 2006, 2009, 2015):

$$P(r) = P_1 / r^{\beta}, \quad (1)$$

where $P(r)$ is a certain economic parameter of a company with the rank r; P_1 is the constant value equal to the maximum value of this parameter (corresponds to rank 1), β is a rank coefficient determining the degree of curvature of *H*-distribution hyperbola. The higher the β value, the steeper the hyperbolic graph and the bigger the difference between large companies and other enterprises in the business system. The parameters P_1 and β clearly determine the curve shape of the *H*-distribution function.

The authors of this article suggest a methodological approach to the use of this theoretical provision by the example of the Kamchatka Region based on the revenue of 100 enterprises of the regional business system for 2014. The sources of information used for this study included various Internet resources, which contain publicly available data on financial reports of enterprises submitted to the statistics service. To construct a parametric rank distribution, the authors sorted revenues of the companies under consideration in descending order, sequentially assigning them serial numbers – ranks.

Results

Figure 1 shows the graph of the rank parametric distribution of 100 companies of the Kamchatka Region and the closest *H*-distributions for the rank coefficients β (0.85 and 0.9); the value of annual revenue for 2014 is chosen as a characteristic parameter.

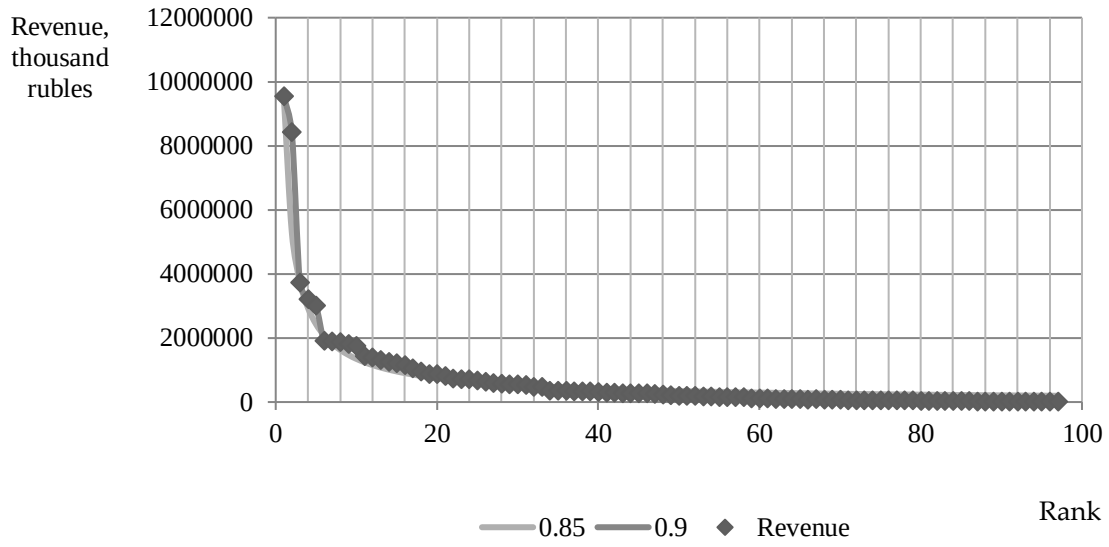

Figure 1. Rank parametric distribution of companies in the entrepreneurial system of the Kamchatka Region for 2014 and H-distributions for various rank coefficients. Compiled by the authors.

Long-term statistical studies show that rank parametric distributions of cenoses in the process of formation, self-organization, and their reproduction under conditions of market competition will tend to cenologically optimal models – hyperbolic *H*-distributions with rank coefficients lying in the range $0.5 \leq \beta \leq 1.5$. At the same time, any cenoses are most stable if the condition for the parametric distribution is met: an indicator equal to the ratio of the sum of economic parameters of 10% companies with the largest values to the total value of parameters of 10% companies with the lowest values should not exceed 10 (the so-called "large-small" ratio) (Kudrin, 2015).

Evaluation of the impact of international labor migration on the sustainability of the region's entrepreneurial system involves the development of sustainability models for the regional entrepreneurial system and the impact of international labor migration on the sustainability of this system.

1. **Evaluation model of the impact of international migration on sustainability of the regional business system.**

The model includes five modules:

1. Allocation of the economic cenosis and its parameters from the economic statistics of companies in the regional business sector (this stage involves examination of the multitude of companies in the regional business system and their financial and economic indicators are examined at each time stage of their prehistory).

2. Formation of a database using the economic indicators of the allocated economic cenosis.

On the next stage, the authors suggest analyzing publicly available economic statistics of the region on the companies of the business system for a certain period, for example, over the past few years. From the array of these statistics, it is necessary to distinguish those financial and economic indicators (parameters) of companies that are the most functionally significant, physically measurable and available for research. At the same time, these parameters must adequately reflect the economic activities of companies: their revenue, net profit, and free cash flow. Parametric description of the business system is formed in a corresponding database of the most complete, systematic and standardized information on the companies of economic cenosis.

Based on the database formed and ordered by time, the authors build rank parametric distributions for each time stage (usually a year) and economic parameter. Rank distribution is the dependence of the parameter value on the sequence number – the rank in the process of ordering the parameter values in descending order (Table 1).

Table 1. Type of parametric distributions for each time stage and economic parameter.

Rank (R)	Company name	Economic indicator value	Rank (R)	Company name	Economic indicator value
1	Comp. P11	P11	1	Comp. P i1	Pi1
2	Comp. P12	P12	2	Comp. P i2	Pi2
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N	Comp. P1N	P1N	N	Comp. P iN	PiN

Compiled by the authors.

The tabular data for subsequent analysis, by analogy with Figure 1, is illustrated by graphics showing the susceptibility of an economic indicator to the rank value (rank parametric distribution) built for each time stage (usually a year) and for each economic parameter.

To check if the constructed empirical parametric distributions belong to the cenosis, the authors suggest using Kendall's coefficient of concordance (agreement) (Fufaev, 2006), which characterizes the statistical relationship between the parametric distributions for each time stage and the economic parameter. In this case, it shows whether the data from different time periods satisfy the cenological law. The calculation of this criterion is made for all data presented in Table 1. Whereas, the parameter *D* from the formula (2.8) in accordance with the data from Table 1 is determined from the expression:

$$D = \sum_{i=1}^{N}\left(\sum_{j=1}^{T} Rij\right)^2 - \left(\sum_{i=1}^{N}\sum_{j=1}^{T} Rij\right)^2 /\mathrm{N}, \quad (2)$$

where R_{ij} is the *i*-th rank of the *j*-th time period. If the Kendall coefficient exceeds 0.5, then the set of companies in the business system under consideration belongs to the cenosis.

3. The third module is the formation of the rank parametric distribution for each stage and economic parameter and their verification for belonging to the cenosis, construction of hyperbolic *H*-distributions that are best approximated to empirical points of rank distributions.

For each time stage and economic parameter, based on the parametric distribution of the empirical data presented in Table 1, the authors suggest determining the parameters of the

desired distribution function – P and β. This is followed by the construction of *H*-distribution (1), which, as shown by the long-term study of cenoses, is the optimal configuration of this system in terms of dynamic stability, if the condition $0.5 \leq \beta \leq 1.5$ is met (Fig.1).
In this case, if the approximating curve of a hyperbolic *H*-distribution does not lie in this area, it is necessary to develop certain measures to optimize the business system (to bring it to an optimal state).

One of the most effective methods for building a rank-specific distribution of the optimal structure of the regional business system based on the properties of cenological entities is the method, based on the fact that the repeatability of primes in the factorial decomposition of an arbitrary natural number into prime factors approaches (coincides with) the canonical hyperbolic *H*-distribution. Due to lengthy computing operations, such tasks require a numerical solution done automatically with a computer program (Vukolov, 1984).

4. The fourth module is the construction of the optimal structure of the regional business system for a given economic cenosis, approximation of the parametric distributions of empirical data and analysis of variance of empirical data from the points of the optimal structure of the regional business system.

This module considers approximating curves constructed for each time period and a given economic parameter, and the optimal parametric distributions of the regional business system**.** The estimation of the accuracy of obtained approximation of empirical values and the discrepancy between the optimal constructed parametric distribution is implemented through a statistical comparison of the corresponding points (data) using the following criteria: maximum error; sums of error modules; relative error and correlation coefficient (Fufaev, 2006).

5. The fifth module is the construction of the rank surface of empirical data from the economic cenosis and the study of the ranks evolution behavior.

Based on the generated database of the development of the economic cenosis, the authors construct parametric rank distributions and a rank surface. The examination of the temporal evolution of ranks and the assessment of the forecast values of arbitrary-rank economic indicators is implemented based on an economic-mathematical model for the development of cenoses and with the use of cluster analysis.
The model of influence for the international labor migration on its evolution and sustainability contains the following components:

- definition of the relationship between the volume of international labor migration flows and changes in the cenological configuration of the regional business system;

- sustainability assessment of the regional business system, which forms the economic cenosis.

Based on the constructed optimal parametric distributions of empirical data for each time period and a given economic parameter, the authors assess indicators (module 4), characterizing the degree of sustainability of the regional business system. The value of the international labor migration flow is considered the external factor affecting the business system. The correlation between the magnitude of the migration flow and the deviation from the state of stability of the entrepreneurial system (optimal parametric distribution) is determined using the correlation analysis methods. The correlation coefficient is used as a criterion characterizing this dependence.

Construction of hyperbolic *H*-distribution, approximating empirical data, is shown in Figure 2.

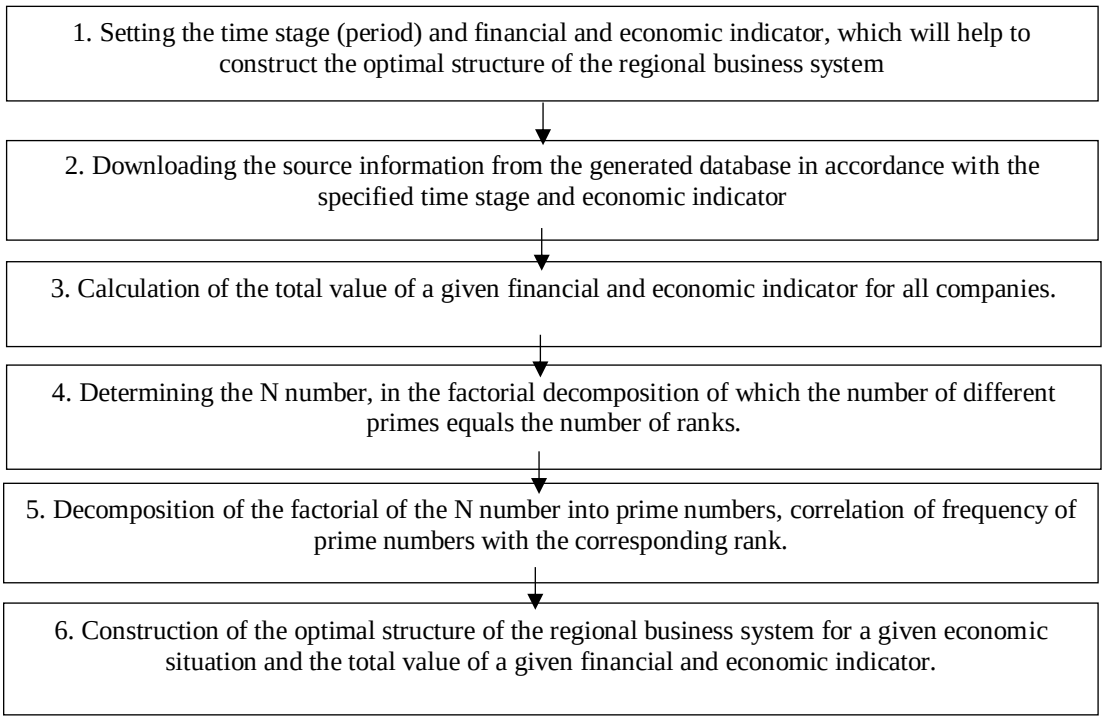

Figure 2. The flowchart of constructing the *H*-hyperbolic distribution approximating empirical data based on the model of primes. Compiled by the authors.

2. Empirical studies.

The results of the calculations revealed a strong regression relationship between the increase in the number of international migrants and the sustainability of the business system of the Kamchatka Region (with an increase in the number of migrants, the structural stability of the Kamchatka Region business system also increases).

The authors found that the constructed rank parametric distributions based on empirical data do not fully satisfy the condition of a "decile" ratio (an indicator equal to the ratio of the total macroeconomic indicator of 10% of companies in the region with its highest values to its total value of 10% of companies in the region with the lowest values is much higher than 10). Therefore, the study concluded that in order to increase the sustainability of the business system, it is necessary to increase the revenues of small companies in the region – to meet the sustainability condition by the "decile" indicator. However, an increase in the number of small companies requires additional labor for their normal functioning. Given these assumptions, an estimate was made of the number of labor migrants needed for these additional small enterprises.

For this, it is necessary to use the empirical data generated in Appendix A, and the statistics on the key indicators of activity of small and medium-sized businesses in the Kamchatka Region, presented by the territorial body of the Federal State Statistics Service for the Kamchatka Region (Rosstat, 2019). Based on these data, the authors have formed tables of rank parametric distributions for one of the main sectors of the economy in the Kamchatka Region – the fishing industry. Table 2 presents the data of the constructed rank parametric distributions of the fish industry enterprises in the business system of the Kamchatka Region for 2014 and 2015.

Table 2. Type of parametric distributions for each time stage and economic parameter.

Rank	Company name	Revenue, thousand rubles, 2014
1	PJSC Oceanrybflot	8,424,263
2	JSC Akros	3,731,247
3	Collective Farm Fishery named after V.I. Lenin	3,203,186
4	JSC Ozernovsky FCP No. 55	1,903,476
5	PJSC Collective Farm named after Bekerev	1,215,229
6	LLC Luntos	1,037,612
7	JSC YAMSy	944,983
8	LLC Koryakmoreproduct	722,624
9	LLC Bolsheretsk	710,822
10	LLC Tymlatsky Fish Factory	670,464
11	LLC Polluks	559,644
12	Fisherman Collective Artel Red Worker	549,502
13	Unitary Municipal Enterprise Experimental Farm Zarechnoye	332,831
14	LLC Pelagil	330,113
15	LLC Narody Severa	307,007
16	JSC Kolkhoz October	286,377
17	CJSC Company Atoll-West	278,167
18	LLC Nichira	271,535
19	LLC Collective Farm Udarnik	221,680
20	LLC Loyd-Fish	211,936

21	PJSC UTRF-Kamchatka	111,210
22	PJSC Kamchatryprom	62,138
23	LLC Hunting and Fishing	59,881
24	LLC Northern crafts	38,503
25	LLC Fisherman of Kamchatka	1,998
26	LLC Atlantic Fish Trading	1,843
Rank	Company name	Revenue, thousand rubles, 2015
1	PJSC Oceanrybflot	16,121,330
2	JSC Akros	5,452,442
3	Collective Farm Fishery named after V.I. Lenin	5,442,826
4	JSC Ozernovsky FCP No. 55	3,336,688
5	LLC Tymlatsky Fish Factory	2,435,240
6	JSC YAMSy	1,836,507
7	PJSC Collective Farm named after Bekerev	1,747,353
8	LLC Luntos	1,615,688
9	LLC Koryakmoreproduct	1,087,238
10	LLC Narody Severa	888,713
11	Fisherman Collective Artel Red Worker	783,694
12	LLC Bolsheretsk	749,614
13	JSC Kolkhoz October	728,129
14	LLC Pelagil	648,856
15	LLC Polluks	490,924
16	LLC Collective Farm Udarnik	336,032
17	LLC Nichira	321,657
18	LLC Loyd-Fish	287,308
19	CJSC Company Atoll-West	259,828
20	PJSC UTRF-Kamchatka	198,783
21	LLC Zhupanovo	119,412

22	PJSC Kamchatryprom	58,651
23	LLC Hunting and Fishing	57,104
24	LLC Northern crafts	41,900
25	LLC Atlantic Fish Trading	2,019
26	LLC Fisherman of Kamchatka	1,365

Compiled by the authors based on the data obtained from the Federal State Statistics Service (Rosstat, 2019).

The result is the analytical functions of hyperbolic *H*-distribution, which are best approximated to the empirical points of the parametric rank distributions of fish industry enterprises in the Kamchatka Region business system for 2014 and 2015.

The graphs illustrated in Figure 3 and Figure 4 show the constructed rank parametric distributions of empirical data on the revenue of companies in the fishing industry of the business system for 2014 and 2015, indicated by dots, and the corresponding approximating hyperbolic *H*-distribution curves.

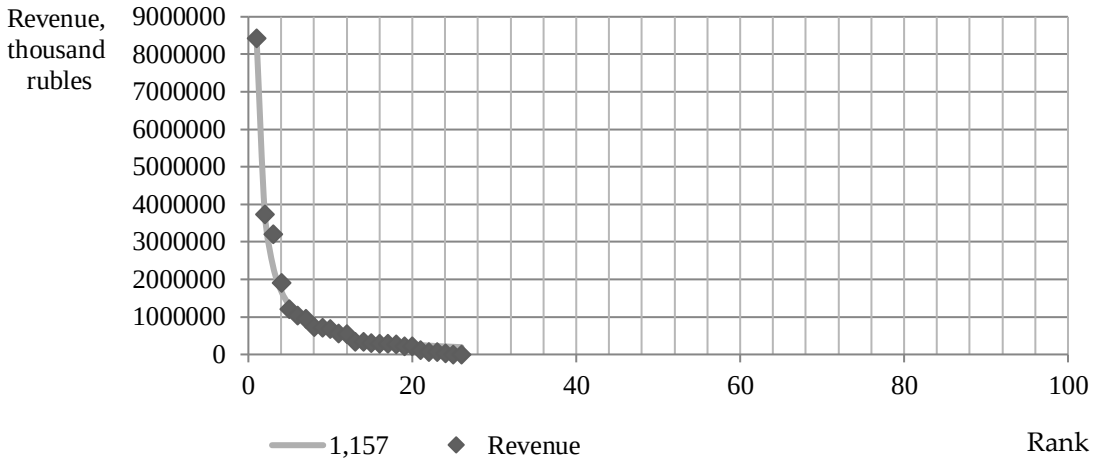

Figure 3. Empirical rank parametric distribution of fish industry companies for 2014 and its approximating hyperbolic *H*-distribution.
Compiled by the authors.

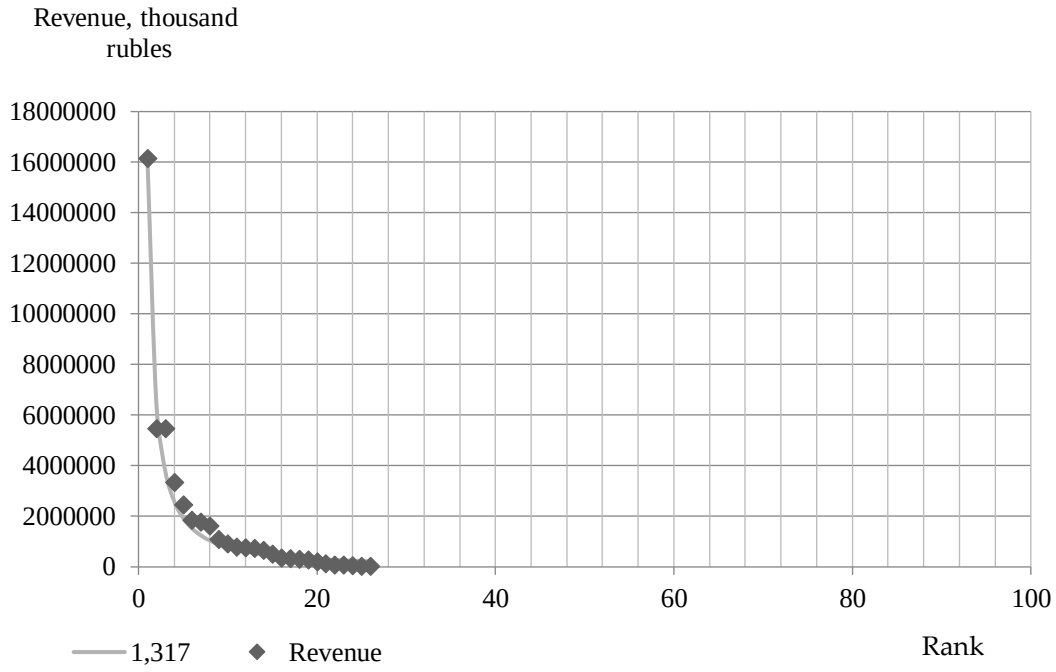

Figure 4. Empirical rank parametric distribution of fish industry companies for 2015 and its approximating hyperbolic *H*-distribution.
Compiled by the authors.

The graphs in Figures 3 and 4 show that the rank parametric distributions of the fishing companies are quite close to the *H*-distributions. At the same time, the rank indicators β of the *H*–distributions lie in the interval [0.5;1.5]. That is, the multitude of companies in the fishing industry of the Kamchatka Region form an ample equilibrium structure of economic cenosis in terms of the parameter under consideration – the revenue.

Based on the data presented in Table 1, the authors calculated the "decile" indicator for the rank parametric distributions of enterprises in the fishing industry of the business system of the Kamchatka Region for 2014 and 2015. The calculation results are presented in Table 3.

Table 3. "Decile" indicator of rank parametric distributions of fish industry enterprises in the Kamchatka Region.

Year	2014	2015
1	2	3
Decile indicator	362.71	596.60

Compiled by the authors.

The calculated data of Table 3 for the companies in the fishing industry of the Kamchatka Region indicate that the indicators of the "large-small" ratio ("decile" indicators) for 2014 and 2015 significantly exceed 10. Accordingly, these economic cenoses do not fully satisfy the conditions of sustainability and their structure is not optimal. Therefore, to meet the conditions of sustainability, it is necessary to increase the revenue of the fish industry enterprises in the Kamchatka Region so that the "decile" indicator does not exceed 10. Table 4 presents the performed calculations of the revenue of 10% of small enterprises in the fishing industry, satisfying the stability condition on a "decile" indicator, as well as the amount by which the revenue should be increased to meet the sustainability conditions.

Table 4. Estimated revenues of 10% of small enterprises in the fishing industry, which satisfy the "decile" indicator.

Indicators	2014, thousand rubles	2015, thousand rubles
1	2	3
The revenue value of 10% of small enterprises, which satisfy the "decile" indicator	1,535,870	2,701,660
The actual revenue value of 10% of small enterprises	42,344	45,284
The difference between the estimated and actual revenue values of 10% of small enterprises	1,493,526	2,656,376

Compiled by the authors.

The results of calculations presented in Table 4 show that for a stable configuration of fish industry enterprises in the Kamchatka Region, it is necessary to increase the total revenue of 10% of small fish industry enterprises by 1,493,526 thousand rubles in 2014 and 2,656,376 thousand rubles in 2015.

Similarly, the authors calculated the "decile" indicator for the rank parametric distributions of the entire business system of the Kamchatka Region for 2014 and 2015 (Table 5) and determined the revenue of 10% of small enterprises of the entire Kamchatka Region business system, which satisfy the "decile" indicator. The researchers also calculated the values by which it is necessary to increase the total revenue of small enterprises of the business system in the region to meet the sustainability conditions (Table 6).

Table 5. "Decile" indicator of the rank parametric distributions of the enterprises in the fishing industry of Kamchatka Region.

Indicators	2014	2015
1	2	3
Decile indicator	560.927	813.674

Compiled by the authors.

Table 6. Estimated revenue of 10% of small enterprises in the regional business system, which satisfy the "decile" indicator (in thousand rubles).

Indicators	2014	2015
1	2	3
The revenue value of 10% of small enterprises, which satisfy the "decile" indicator	3,713,165	5,683,268
The actual revenue value of 10% of small enterprises	66,197	69,847
The difference between the estimated and actual revenue values of 10% of small enterprises	3,646,968	5,613,421

Compiled by the authors.

To achieve the optimal structure by the enterprises of the fishing industry of the Kamchatka Region, as well as the entire business system of the region, it is necessary to increase their total revenue before the sustainability conditions are met by the "decile" indicator. To do this, it is necessary to increase the number of small businesses. The assessment of the necessary labor force for the functioning of that many companies is determined from the ratio of the estimated total revenue, by which it is necessary

to increase the actual total revenue, to the average revenue per person for small businesses in the Kamchatka Region. The calculation results are presented in Table 7.

Table 7. Estimates of the number of migrants needed to ensure the sustainability of the business system of the Kamchatka Region.

Indicators	Unit	2014	2015
1	2	3	4
The number of employed in small businesses	people	30,954	30,591
Turnover of small enterprises	million rubles	86,972.5	91,899.9
Average annual turnover per person in small enterprises	million rubles/person	2.80973	3.00415
Estimated number of migrants needed to ensure the sustainability of fish industry enterprises in the Kamchatka Region	people	532	884
Estimated number of migrants needed to ensure the sustainability of business enterprises in the Kamchatka Region	people	1,298	1,869

Compiled by the authors.

Appropriate management of migration flows should be subject to the number of migrants needed to ensure the development of enterprise business system of the Kamchatka Region (1,298 people in 2014 and 1,869 people in 2015).

Discussion

The article presents calculations for assessing the impact of international labor migration on the sustainability of the business system of the Kamchatka Region, which can improve the structure of this entrepreneurial system and increase its sustainability.

Analysis of the methods for assessing the impact of international labor migration on the sustainability of the regional business system has shown that it is advisable to use methods and tools based on the provisions of the cenological theory to study the influence of migration on the stability of economic systems. Whereas, the sustainability of the business system is assessed by indicators determining the deviations attributed to the effect of migration flows, the values of the empirical parametric distribution of cenosis from its canonical distribution.

In particular, the calculated data for all companies in the Kamchatka Region business system show that the "large-small" ratio for 2014 significantly exceeds 10. For all companies, it is about 561, and for the fishing industry, its value is about 512. Accordingly, these economic cenoses do not quite satisfy the conditions of sustainability, and their structure is not optimal. Consequently, to achieve the optimal structure of the business system of the Kamchatka Region, it is necessary to increase the number of small companies to increase their total revenues by about 50 times.

To estimate the necessary labor force for the functioning of such amount of companies, it is necessary to find the ratio of the revenue value by which the actual total revenue should be increased to the average revenue per person for small businesses in the Kamchatka Region.

In contrast to the regression models by Wahba & Zenou (2012), Marchetta (2012), Georgarakos & Tatsiramos (2009), Di Maria & Lazarova (2012), Brunow et al. (2015), Aubry et al. (2016), Deller & Kures (2019), which allow evaluating the impact of migration on various socio-economic indicators, the cenological model for assessing the impact of migration on stability of the regional business system described in this article allows predicting the need for the number of migrants, including by industry. However, this model does not consider such factors as age, gender, level of qualifications and migrants' education. Therefore, the authors believe that further research in this direction will be a significant contribution to the field of scientific

knowledge and migration management of states and regions.

Conclusions

The study concluded that migration flows have both positive and negative effects on the socio-economic situation of countries and regions, and therefore require government regulation. The proposed model for assessing the impact of international migration on the sustainability of a regional business system, based on cenological analysis, allows determining the optimal ratio of small and large enterprises and predict the need for additional jobs, filled by migrants.

The cenological analysis of the structure of the business system of the Kamchatka Region based on annual revenue data revealed that many companies in the entrepreneurial system do not satisfy the conditions of correlation by the decile index. This indicates the unstable structure of this economic cenosis – a regional business system.

The authors suggest assessing the impact of international migration on the sustainability of the regional business system by constructing its empirical rank parametric distribution. The researchers have developed indicators of the sustainability of the business system, characterizing the degree of deviation attributed to the effect of migration flows, the values of the empirical parametric distribution of the regional business system from the constructed optimal cenological models (canonical *H*-distributions).

The proposed model of managing international migration flows in the regional business system is used to determine the need for international labor migrants to ensure the sustained operation of the regional business sector and will be considered in the development of socio-economic development forecast of the Kamchatka Region for the planning period of 2020-2025. This model can be used for the construction of migration policy at the level of regions and states.

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