Methodological Approaches to Homogenous Regional Clusters Formation for Human Capital and Quality of Life Assessment in the Yenisei Siberia Macro-Region

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The article addresses the approaches to measuring and assessing the limited and specific resource for the economy — human capital — in terms of information support for the quality of life management in the regions where "Yenisei Siberia" integrated investment project is being implemented (hereinafter — "Yenisei Siberia"), given the settlement system features and its professional structure, the current level of economic development and trends in production and demography, as well as the impact of ethnocultural, natural and geographical factors. The quality of life here is considered both as a statistically measurable quantity and as an estimated, subjective category determined by human behavior. It is the peoples' wellbeing, based on the quality of life interpretation in the region that supports the human capital formation and its investment behavior, as well as the basis for cutting spatial inequality in the regions through coordination and joint management of the socio-economic spatial development. Taking into account such asymmetry in the socio-economic and socio-cultural situation in the regions, the authors propose an approach to the formation of homogeneous regional clusters for measuring the level of human capital and QOL in the territories of the macro-region of the Yenisei Siberia.

Keywords: quality of life (QOL), human and social capital, spatial development, region, homogeneous clusters.

Research area: economics.

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Introduction

Spatial development of today's Russia and ensuring living standards in the eastern territories of Siberia and the Far East rely on a resource-export model of economic development inspired by paternalistically bureaucratic rationality, peculiar to "catching up modernization" societies. At the same time, the exceptional nature of the needs among the people who share their experience to the regional economy, as well as the effect of spatial differentiation and integration over the past decades, have got little attention. Such approach to the spatial management of the territories with high socioeconomic asymmetry and weak spatial coherence, typical to the modern Siberia, has largely led to poor indicators of the migration "outflow" and "inflow" in the resource regions of Siberia, low quality of human capital and obstacles in innovative development of the eastern territories in Russia.

The Spatial Development Strategy of the Russian Federation — 2025 basically suggests: "… a differentiated approach to efforts and measures of the state support for socio-economic development of territories, including demographic situation, characteristics of resettlement system, level and dynamics of economic development and specific environmental conditions; an integrated approach to socio-economic development of territories; extension of inter-regional and inter-municipal cooperation; inclusion of the interests and opinions of population and business when planning socioeconomic development of the territories; regard to ethnocultural factor while ensuring socio-economic development of the constituent entities of the Russian Federation" (Strategiya prostranstvennogo razvitiya…, 2019). Regional development and QOL improvement are undoubtedly based on human capital (Becker, 1964). The presence and level of human capital implies peoples' ability to participate in new investment projects that ensure the development of the territory and increase living standards there.

The task of assessing the regional human capital appears to be relevant since there is a clear correlation between human capital and QOL, which is justified in many modern economic studies (Grishina, Polynev et al., 2012). At the same time, through that interdependence of human capital and economic development and, oppositely, possibilities for further human capital expansion with the achieved level of economic

development, it is important to identify and study the basic administration tools that explain and make effective progress in each direction (Kraay, 2018). This is largely important for the regions that are planning to implement leading investment projects, such as "Yenisei Siberia" (KEF).

This work aims articulation of formalized approaches and recording methods for socio-economic, behavioural, national-cultural, ethno-linguistic and other features of the region, which will allow obtaining a complex response on the relationship between these factors and QOL assessments, alongside with economic development of the territory.

Through the example of complex investment projects implemented in the Yenisei Siberia, the methods of cross-influence dynamic assessment are considered: on the one hand, how the human capital will impact the efficiency of investment projects and economic development; on the other — how new types of economic activity will act towards further development of the human capital in the area and increase regional QOL, including the assessment of possible changes in the socio-economic behavior of the population.

Quality of life is an estimated, subjective category, contrary to living standards. It is the population's well-being, based on understanding the quality of life in the region that acts as the main reason in building a pragmatic element of human capital (making decisions, professional growth, leadership role, skills invested in the regional economy) under economic development. In the process of accumulated human capital and economic development cross-coupling, in many cases the context of cultural scope, including linguistic and ethnic diversity, which largely determines the level of social capital development in the region, is important (Davydov, Weber, 2016). In that way, social capital concerns historically established traditions in social and economic interaction between people and involvement of the population in politics and management to solve the problems facing the region (Putnam, 1993). The factors born of the previous development, such as national-cultural environment, specifics of traditional activities, type of settlement, ethnic groups diversity, territory — they all impact the quality of human capital and the level of social capital, which will consequently measure both the efficiency of future development projects implementation, and the steps needed to create favourable conditions for successful social capital building.

The key factor in sustainable development of complex socio-economic systems (in this case, the Yenisei Siberia's macro-regions that exploit integrated investment project) is socio-cultural diversity and creation of equal opportunities under the social

capital development. The socio-cultural diversity in the region's economy suggests regarding peculiarities and constructing equal opportunities, which will provide an environment of mutually-beneficial exchange between social and economic entities in the region.

In our observation, creating equal opportunities for the social capital building means the territory management culture realization, characterized by understanding, appreciation and smart use of socio-cultural diversity. Openness and socio-cultural diversity allow the territory to form a "magnetic" properties for potential investment groups, "driving forces" of the development and formation of essential, from the perspective of regional strategy, professional textures.

The objective of this research is to assess the level of influence of both measurable and weakly measurable factors on the dynamics of relationship between the quality of life (QOL), level of human potential and level of social capital. The sampling area is represented through the Yenisei Siberia cluster, which includes three entities of the Russian Federation — Krasnoyarskiy Krai, the Republic of Khakassia and the Republic of Tyva, testing the large-scale integrated investment project on infrastructure and economic development (KEF). At the same time, the regions of Yenisei Siberia are characterized by prevailing resource type of economic development, and require detailed review of theoretical items for assessing the quantitative and qualitative characteristics of human capital and QOL. Moreover, the Yenisei Siberia has a high level of spatial socio-economic asymmetry, regarding which one will be provided with more flexible quantitative estimates of human capital next to popular approaches that do not reflect such specificity. The task at hand in this article is to identify the groups of regions — meso-regional clusters that are homogeneous in terms of socio-economic and socio-cultural conditions for the human capital and QOL development — which is important in building mechanisms for a differentiated spatial development policy.

Materials and methods

When concerning the problem of assessing inter-influence of measurable and weakly measurable factors on the dynamics of QOL and human capital correlation in the sampling regions, we have applied mixed assessment methods due to the following reasons.

In shaping proper socio-economic measures, at least two main aspects usually arise. Firstly, a complete selection of those indicators is needed, which, on the one

hand, are the most informative to the topic in question, and, on the other, exclude their redundancy and multicollinearity. Secondly, the choice of indicators usually implies the creation of implicit decision-making mechanism, according to which a change in the set over the time is seen as a signal to adjust the current control system.

In terms of regional development, all this determines the prerequisites for socalled "index measurements", including both a proper choice of the most important, informative indicators of development heterogeneity in certain territories, and a format of simultaneous recording the data received, often arranged as "criteria convolution". In this case, correct aggregation of heterogeneous source data becomes possible only in a "non-dimensional" form (relative scale), for example, by comparing each indicator with existing values sample: maximum and / or minimum value and / or sample spread and / or average value and / or median sampling, etc. (Mailyan, 2010).

In this context, various indices are usually used, which allow getting practical tool enabling to rank different objects among themselves or in dynamics, following the selected criterion.

The approaches to modelling and assessing QOL of the population, as the environment for the territory's human capital development i.r.t. the measured parameters, can be divided into objective (Bukharova et al., 2015), subjective (Campbell, Converse et al., 1979), and integral (Andrews, Withey, 1979). The one to QOL assessment basing on objective indicators provides comparative analysis of QOL in the regions of Siberia, since official statistics are available there. However, they do not signal "thresholds" in the peoples' behavior and labour resources, leading to their outflow, inflow and dwelling in the territory, while the migration (active and passive) demonstrates that cumulative effect of QOL on the regional human capital formation and development. This is especially the case for the territories of Siberia, that obtain its human capital mainly through migration.

To make balanced decisions, the information that would suggest not only recording the characteristics of migration behavior, context of decisions, professional development or other activities taken by the key communities, but, more importantly in terms of spatial policy, predicting migration behavior and human capital development is required. Classical sociology has enough tools for recording social situation, but not — for its forecasting (Yadov, 2012). Standard approaches to the study of human capital and quality of life, based mainly on objective indicators, require refinement by incorporating sociological and psychological ones that characterize the attitude of the population to the existing environment and support decisions about the forms

and specifics of activities. The latter allows getting more complete information for developing a strategy for the human capital development in the region.

Due to these reasons, firstly, to systematize indicators characterizing QOL in the Yenisei Siberia, factor analysis based (FA-based) longitudinal research methods and multi-level system of econometric models have been used (Baltagi, 1995; Gorban, Kegl et al., 2007). For the set of indicators on monitoring QOL and the level of human capital development in the Yenisei Siberia, a 2007–2017 data longitude has been generated. The study has used integrated indicators of social development, environmental status and living comfort of the population in the regions, which are expected to be used for QOL complex assessment in the regions, given the spatial inequality and asymmetry, and calculated regarding the state statistics (Ratnikova, 2006). Each of the integral indicators is a rank variable, which allows them to be used in shaping a composite indicator and typology procedure (attributes alignment) using the "logical square" method. The method of statistical involvement of the regions into homogeneous clusters is based on combining the values of the source variables on the degree of properties manifestation so that the derived property (Nepomnyaschaya, Semenova, 2016) could turn up.

Secondly, to assess statistically weak factors related to human behavioural characteristics, the approaches based on focus groups expert survey (Merton, Fiske et al., 1991) have been used. The surveys conducted in each homogeneous cluster within focus groups have revealed a range of opinions on assessing the existing interrelations of the quality of life and human capital in particular homogeneous group of regions, estimating possible trends in the implementation of large-scale investment projects and explaining the behavior of the population in changing investment conditions development.

Results

Relying on the methodological approach for identifying the structure of basic socio-economic and socio-cultural factors, as well as their hierarchy, necessary for accurate and comprehensive assessment of particular regional human capital, for the Yenisei Siberia in particular, a list of 31 indicators has been formed, the values of which have been calculated on the basis of state statistics (Davydov, Krutikov et al., 2019); a longitude of case monitoring in the selected indicators on QOL and human capital assessment in 2007–2017 has been also figured out.

The Yenisei Siberia macro-region has been assessed through the methodology which identifies homogeneous meso-regional clusters based on econometric methods for

analyzing socio-economic and other indicators across the municipalities of the Krasnoyarsk Territory, the Republics of Khakassia and Tyva. The long meridional extent of the Yenisei Siberia (Krasnoyarskiy Krai, the Republics of Khakassia and Tyva) from north to south gives a place to a wide variety of climatic and geographical features in the municipal areas that make a certain areas specific and cause regional differentiation in indicator values. The previous studies on the spatial development of the Krasnoyarsk Territory have shown significant intra-regional asymmetries in the socio-economic situation in the municipalities of Krasnoyarskiy Krai (Nepomnyaschaya, Semenova, 2016). By entering this list of concerns, the Republics of Khakassia and Tyva will further demonstrate these trends. When considering the whole Krasnoyarskiy Krai, the data on observations (variables) significantly exceed the values for Khakassia and Tyva, and the data for municipal districts of the territory are not comparable with the ones of the Republics.

Thus, analyzing QOL differentiation among the population living in the Yenisei Siberia though Gini index, one can notice considerable degree of inequality in terms of accumulated wealth and level of social stratification.

Figure 1 demonstrates that Krasnoyarskiy Krai significantly differs from the Republics of Tyva and Khakassia.

To increase homogeneity in the regions under consideration the analysis has been done, and, thus, some homogeneous meso-regional clusters have been singled out for the Krasnoyarsk Territory as well. To solve such representation of this region, the municipalities of Krasnoyarskiy Krai, similar to each other in certain characteristics, have been combined into homogeneous meso-regional clusters that would be comparable with the data of Khakassia and Tyva.
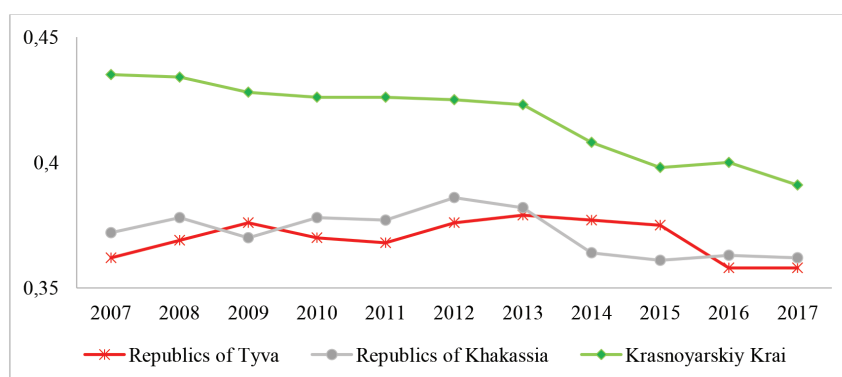

Fig. 1. Gini index (income concentration index
(calculated according to the data of Regiony Rossii (Regions of Russia)) (2018)

Such clustering has resulted in allocation of 6 meso-regional clusters: *the Northern cluster* (Norilsk, Taimyr (Dolgan-Nenets), Turukhanskiy, Evenkiyskiy municipalities), *the Angara cluster* (Yeniseisk, Lesosibirsk, Boguchanskiy, Yeniseiskiy, Kazachinskiy, Kezhemskiy, Motyginskiy, Pirovskiy, Severo-Yeniseiskiy municipalities), *the Eastern cluster* (Borodino, Kansk, Abanskiy, Dzerzhinskiy, Ilanskiy, Irbeyskiy, Kanskiy, Nizhneingashskiy, Partizanskiy, Rybinskiy, Sayanskiy, Taseevskiy, Uyarskiy municipalities), *the Western cluster* (Achinsk, Bogotol, Nazarovo, Sharypovo, Achinskiy, Birilyuskiy, Bogotolskiy, Bolsuluyskiy, Kozulskiy, Nazarovskiy, Novoselovskiy, Tyukhtetskiy, Uzhurskiy, Sharypovskiy municipalities), *the Central cluster* (Divnogorsk, Krasnoyarsk, Sosnovoborsk, Balakhtinskiy, Berezovskiy, Bolshemurtinskiy, Emelyanovskiy, Manskiy, Sukhobuzimskiy municipalities), *the Southern cluster* (Minusinsk, Ermakovskiy, Idrinskiy, Karatuzskiy, Krasnoturanskiy, Kuraginskiy, Minusinskiy, Shushenskiy municipalities).

Thus, 8 meso-regional clusters have been distinguished: 6 clusters in the Krasnoyarsk Territory — the Eastern, Western, Angara, Northern, Central, Southern, and 2 clusters in the Republics of Khakassia and Tyva, for which the panel values for 31 indicators have been recorded from 2007 to 2017.

3. As an optimality criterion in the selection of homogeneous groups of clusters, the Euclidean metric (Evclidean distances) has been used, i.e. geometric distance in a multidimensional space, calculated from the source, not from standardized data.

$$d_l\left(X_i - X_j\right) = \left(\sum_{k=1}^{n}\left(X_{ik} - X_{jk}\right)^2\right)^{1/2}.$$

During the clustering process, the singkLinkage (single link) principle has been applied, which at the first step combines the two closest objects, i.e. those which have maximum similarity, and then adds the ones with maximum similarity with one of the objects in the cluster, i.e. their further inclusion in the cluster requires maximum similarity with only one member of the cluster (Fig. 2 and Table 1).

The findings show that over a ten-year observation period, 8 sustainable clusters with homogeneous averages and dispersions are distinguished. Among these eight objects, the Northern cluster has always stood out. The Angara cluster and the Republic of Tyva show up as well. The remaining entities can be considered homogeneous, for them the average value is 273,376.8 over all the years of observation (Table 2).
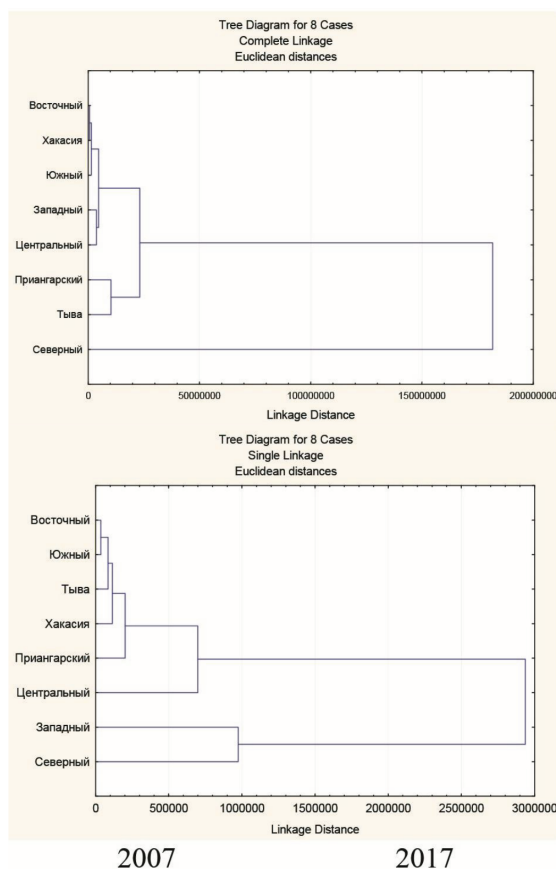
Fig. 2. Euclidean distances-based clusters for 2007 and 2017

4. The concern over particular indicators characterizing QOL of the population by the clusters during a decade results in the fact that there are persistent trends in the values differentiation between the clusters and the dynamics of indicators (Fig. 3–9).

The population in the Republics of Tyva and Khakassia is increasing due to natural population growth. In the remaining territories for the entire period under review, there are no significant changes, except for the last year (Fig. 3–4).

The population under employable age does not always exceed those who are over the working age; such excess can be seen only in the Republic of Tyva — 3.2 times over the entire period. In 2016–2017, the load upon employable population was more than

Table 1. Single linkage Euclidean distances (2007 and 2017)

2007	Amalgamation Schedule (Spreadsheet1) Single Linkage Euclidean distances							
linkage distance	Obj. № 1	Obj. № 2	Obj. № 3	Obj. № 4	Obj. № 5	Obj. № 6	Obj. № 7	Obj. № 8
35136,73	Eastern	Southern						
84684,16	Eastern	Southern	Tyva					
114172,6	Eastern	Southern	Tyva	Khakassia				
201644,3	Eastern	Southern	Tyva	Khakassia	Angara			
698551,9	Eastern	Southern	Tyva	Khakassia	Angara	Central		
974514,8	Western	Northern						
2938088,	Eastern	Southern	Tyva	Khakassia	Angara	Central	Western	Northern
647155,5	Eastern	Khakassia						
1395253,	Eastern	Khakassia	Southern					
3698858,	Western	Central						
4707074,	Eastern	Khakassia	Southern	Western	Central			
102774E2	Angara	Tyva						
232488E2	Eastern	Khakassia	Southern	Western	Central	Angara	Tyva	
181786E3	Eastern	Khakassia	Southern	Western	Central	Angara	Tyva	Northern

Table 2. Average values and normal dispersion for the objects in 2007–2017

	2007		2017	
	Mean	Std. Dev	Mean	Std. Dev
Eastern	243 667,5	1 199 675,0	243 668,0	1 199 675,0
Western	328 219,5	1 145 894,0	328 220,0	1 145 894,0
Angara	911 054,4	4 902 123,0	911 054,0	4 902 123,0
Northern	6 169 260,0	33 359 620,0	6 169 260,0	33 359 620,0
Central	274 840,3	772 710,6	274 840,0	772 711,0
Southern	265 729,3	1 341 998,0	265 729,0	1 341 998,0
Khakassia	254 427,4	1 101 105,0	254 427,0	1 101 105,0
Tyva	584 667,2	3 056 537,0	584 667,0	3 056 537,0

800 old people and children per 1000 working in Tyva, Khakassia, in the Southern, Western and Eastern macro-districts (Fig. 5).

One of the factors in QOL assessment is migration driven by the desire to leave the place of residence for more favourable one. Citizens are looking for a place with high QOL, with an opportunity to increase their income, with high-tech medicine, prestigious education and with more or less comforTable climate and ecology. However, Fig. 6 shows that for all territories recently the number of leaving citizens has prevailed over the number of arrivals.
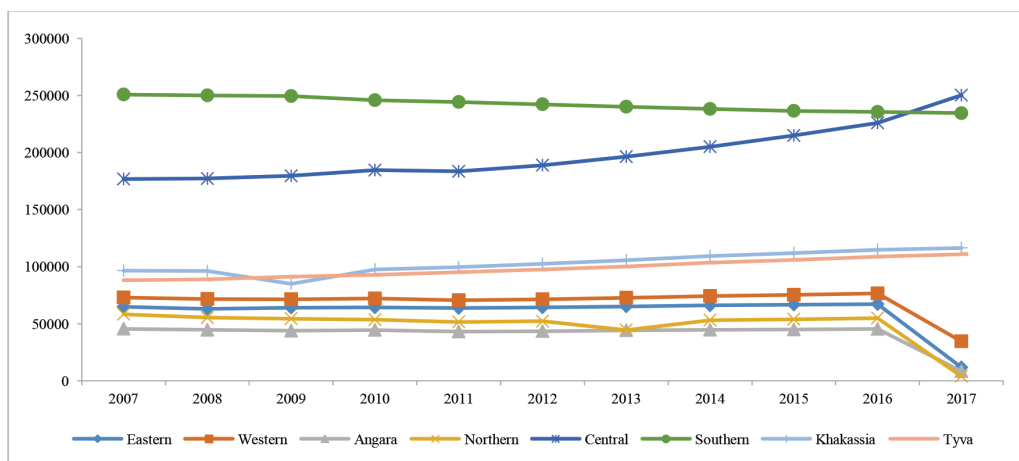
Fig. 3. Resident population, on average over the period, people
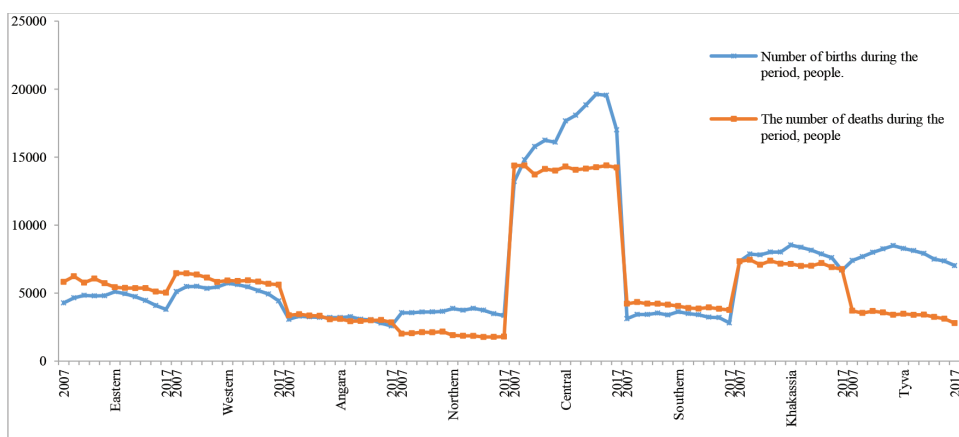(calculated according to the data of Regiony Rossii (Regions of Russia)) (2018)

Fig. 4. Dynamics of fertility and mortality in the macro-districts over the period
from 2007 to 2017 (calculated according to the data of Regiony Rossii
(Regions of Russia)) (2018)

Migration processes are associated with low per capita incomes, high unemployment, crime rates and environment (Fig. 7–8).

The labour market strains index in these macro-districts is on average quite high. However, in the Krasnoyarsk Territory it has decreased to 1–2 units over the last two years, in the Republic of Khakassia it rates with 4–5 units, while in the Republic of Tyva this figure exceeds 10 units.

The quality of life is a set of indicators on peoples' general well-being which characterizes the level of material consumption (living standard), as well as the
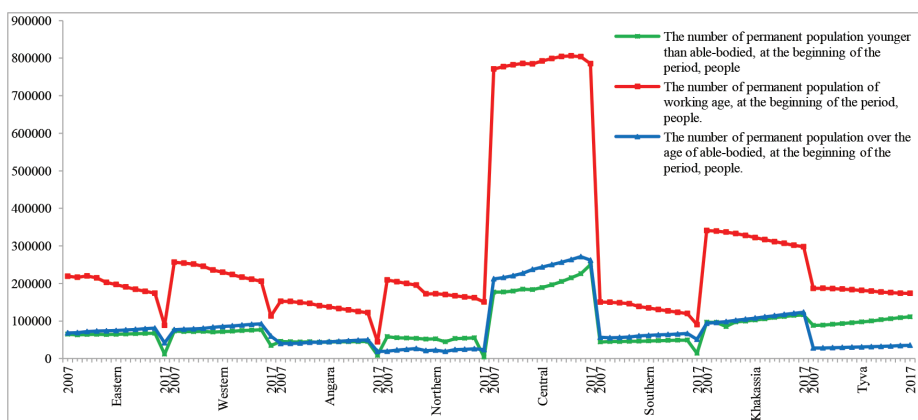
Fig. 5. Categories of the resident population: under working age, working age
and over working age by macro districts within the period from 2007 to 2017
(calculated according to the data of Regiony Rossii (Regions of Russia)) (2018)
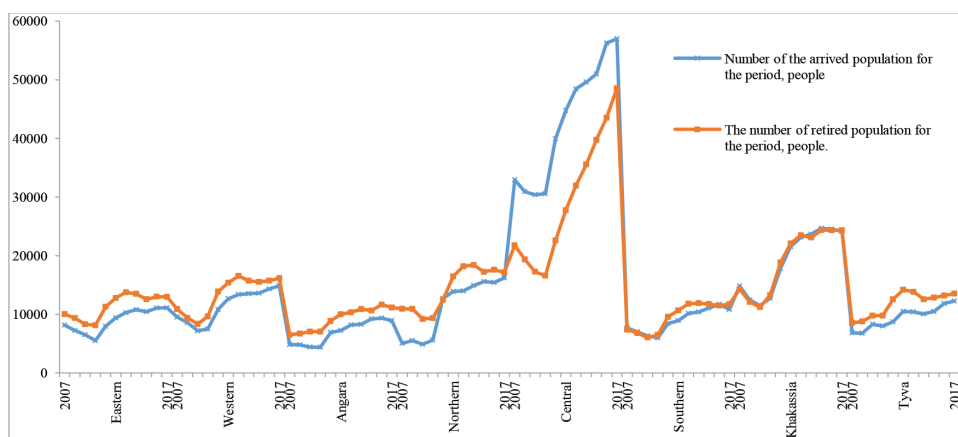

Fig. 6. Population movement by macro-regions from 2007 to 2017
(calculated according to the data of Regiony Rossii (Regions of Russia)) (2018)

consumption of directly non-paid benefits. It should be noted here that the per capita income for all the studied macro-districts in 2007 amounted to slightly above 9.5 ths rub; by 2017 this figure has increased to 21 000 rub, thus, the growth is more than 2.2 times. At the same time, over the past 4 years in Tyva this indicator averaged 14 824 rub, in Khakassia — 19 128 rub, and 14 116 rub in the macro-districts of Krasnoyarskiy Krai, excluding the Northern and the Angara Regions (Fig. 8).

Herewith, the average retail turnover is 100 410 rub per capita, and the volume of paid services provided per capita is 25 826 rub. The minimum values of these
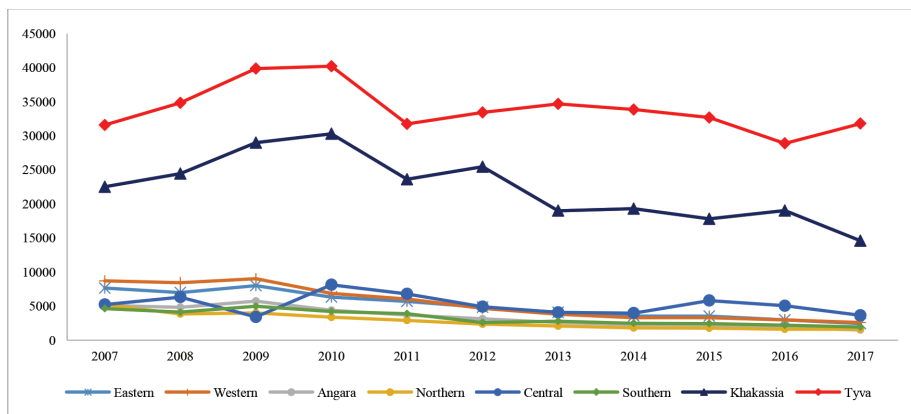
Fig. 7. The number of unemployed citizens registered in public employment services
at the end of the period, people (calculated according to the data of Regiony Rossii
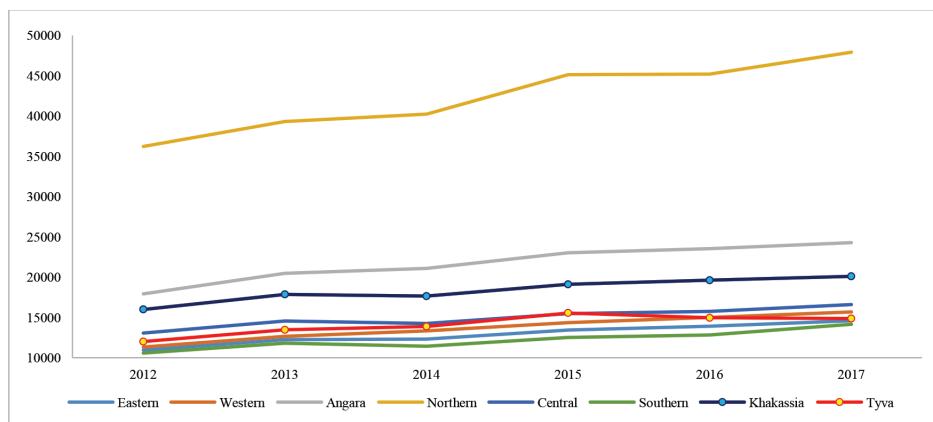(Regions of Russia)) (2018)

Fig. 8. Per capita income (per month), rub
(calculated according to the data of Regiony Rossii (Regions of Russia)) (2018)

indicators belong to Tyva, the Southern, Western and Eastern meso-clusters, which may mean that the population of these territories is supported mainly with subsistence farming.

5. To assess statistically weakly measurable factors determined by the human behavioural characteristics (Dhongde, Haveman, 2015; Regiony Rossii, 2018) and to structure the challenges in the human capital and QOL development in the Yenisei Siberia regions caused by the large-scale investment projects, particular focus-groups surveys have been conducted in this macro-region. The results of work with the focus-groups experts of the Yenisei Siberia have made it possible to formulate the key

challenges to the practice of measuring human capital in terms of taking the actions on ensuring economic development across the territories:

– "rotational" way of life and work in some territories of the Yenisei Siberia (the Angara and Northern meso-regional clusters);

– the population does not feel themselves as a part of large-scale investment projects implementation and does not see prospects for QOL improving in the region as a result of these projects implementation;

– excluding the Central cluster, there is a labour shortage in the industries involved in QOL ensuring in the regions: education, healthcare, physical education, tourism, culture and art;

– unsTable migration situation: the tendency for youngsters to leave the regions and the inflow of low-skilled migrants from the countries near abroad is intensifying; the latter undermines the idea when population recognized themselves as "highly professional team";

– focus on external sources of human resources reproduction (the Angara, Northern, Southern meso-regional clusters, the Republic of Tyva);

– excluding the Central cluster, there is no integrated system of training and retraining of modern qualified personnel;

– lack of training infrastructure for digital technologies implementation;

– ethnic specifics of the Far North and Arctic territories, when the indigenous peoples of the North and some social groups are poorly integrated into the daily life of the territories;

– some worries that the "Yenisei Siberia" projects implementation will generate destruction of the national identity (the Republic of Tyva);

– lack of internal financial resources in the regions for co-financing of human capital development projects within the "Yenisei Siberia" investment program, since most regions have deficit budgets;

– remoteness of regions from the central units and low degree of regional participation in decision-making actions about development projects (excluding the Central cluster);

– poor transport and infrastructure coherence of the Yenisei Siberia's regions and difficult regular transport connection with other parts of Russia (excludin the Central cluster).

Conclusions

Given such heterogeneous socio-economic situation in the regions and high spatial asymmetry, it is necessary to form certain mechanisms and tools for differentiated policy of spatial development aimed at reducing gaps in the level and quality of life of the residents. The most important criterion for the spatial policy efficiency is creating the environment for human capital development and QOL growth in particular regions. In this context, the efforts of both the state and business in the large-scale investment projects of the Yenisei Siberia, as the basis for the economic growth, should be focused not only on obtaining economic results, but first of all, on establishing conditions for QOL increasing and human capital accumulation in the regions, with an eye on declining the asymmetries in socio-economic and socio-cultural situations.

The methodology proposed in the article for outlining homogeneous meso-regional clusters following particular econometric methods of socio-economic and other indicators analysis across the municipalities of Krasnoyarskiy Krai, the Republics of Khakassia and Tyva, has allowed identifying 8 homogeneous meso-regional clusters based on the ten-year panel data. The dynamics of QOL indicators 2007–2017 for these meso-regional clusters shows a strong tendency to maintain a high level of living standards and human capital quality differentiation in these territories.

The generalized results of expert surveys in these regions have made it possible to formulate the key challenges in the large-scale investment projects implementation, which must be taken into account when creating the mechanisms for differentiated spatial policy applied in the Yenisei Siberia.

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Методологические подходы к формированию однородных региональных кластеров для измерения уровня человеческого капитала и качества жизни населения территорий макрорегиона «Енисейская Сибирь»

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В статье рассмотрены подходы к измерению и оценке ограниченного и специфического ресурса экономики — человеческого капитала — в контексте информационного обеспечения управления качеством жизни в регионах и реализации комплексного инвестиционного проекта «Енисейская Сибирь» (далее — КИП «Енисейская Сибирь») с учетом особенностей системы расселения и профессиональной композиции поселений, сложившегося уровня экономического развития и тенденций в изменении структуры производства, демографической ситуации и влияния этнокультурных факторов, а также природно-географического воздействия. Качество жизни населения

в исследовании представлено и как статистически измеримая величина, и как оценочная, субъективная категория, определяемая поведением человека. Именно «самочувствие», основанное на интерпретации качества жизни в регионе, выступает основным мотивом формирования деятельностной компоненты человеческого капитала и инвестиционного поведения населения, а также основой снижения территориального неравенства регионов за счет координации и совместного управления социально-экономическим пространственным развитием территорий. С учетом асимметрии социально-экономического и социокультурного положения регионов предложен подход к формированию однородных региональных кластеров для измерения уровня человеческого капитала и качества жизни населения территорий макрорегиона «Енисейская Сибирь».

Ключевые слова: качество жизни, человеческий и социальный капитал, пространственное развитие, регион, однородные кластеры.