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CITY: ECONOMIC GROWTH AND SOCIAL ATTRACTIVENESS ISSUES*

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Abstract. Background/Objectives: the city has always been seen as a place for productive forces. Therefore, it attracts investments and skilled personnel. The concentration of various enterprises on a relatively small area helps reducing costs, which, in its turn, increases the interest of the business towards product development. At the same time, city growth causes a variety of acute social problems. The article presents the main concepts of city development and considers methods of evaluating its social and economic evolution. Methods: The article defines the concept of "sustainable city development", identifies the leading indicators of the city attractiveness and economic growth, and suggests an integrated attractiveness index of life in a city. The main steps of the analysis of the city development dynamics are considered. An econometric model is built, which reflects the dynamics of the gross municipal product, and relation is studied between the growth of the gross regional product and the leading social and economic indicators. Methods of correlation and regression analysis were used to rank the main factors of sustainable development. Findings: It is established that the most significant and decisive factor influencing the gross municipal product is not an economic but a social one with the capital investment efficiency being a minimum of three years. Applications/Improvements: To ensure the growth of the gross municipal product there should be a correlation between social and economic interests of the residents and regional enterprises, which is expressed first of all in the public socioeconomic policy. Areas of interaction between the main structural components of the city system have been identified.

Keywords: city development concept; econometric model; integral attractiveness index; "convolution" of indicators; sustainable development; growth of economic indicators

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1. Introduction

The city has always been viewed as a place of location of productive forces. Territorial proximity of companies and enterprises, concentration of various institutions in a relatively small area, availability of social and economic infrastructure plays its role in cost reduction which, in its turn, increases the interest of the business community in production development and, consequently, attracts investments and skilled personnel thus favoring the city growth and development. Evolution of cities increasingly turns them into the community center in all of its aspects (economy, politics, culture, science, etc.) and generates new problems becoming the subject of new researches and new approaches (Kazantsev, Svetunkov, 2004; Doolina, Kuznetsova, Lebedeva, Tokarev, 2004; Bikas, Saponaitė, 2018; Vinogradova, 2015; Takhumova et al., 2018).

At the same time, the growth of cities, in its turn, leads to accumulation of too many people in small areas and comes with increasing inconveniences which gives rise to multiple acute social issues related with economic disparity, crime (which is much harder to tackle in urban conditions), rising resource consumption, and urban pollution. Excessive increase in resource consumption results in the sophistication of traffic streams and rise in the cost of cargo transportation, increase in costs for development and maintenance of urban economy, and upset of necessary interrelations within the city structure (Shmankevich, 2005, Ufimtseva, 2014; Balynskaya, Ponomarev, 2018). However, is the growth of cities always reasonable?

2. Literature review

There are various concepts of growth and development of cities (Table 1).

Table 1. Main city development concepts

Key points	Characteristics
1 A concept of primary and non-primary city activities: city justifies its existence and development in case if it can provide for: – external functions: reproduction processes conditioned by social and territorial division of labor and aimed at the communication with the outside world; – internal functions: reproduction processes satisfying various needs of city-dwellers themselves and intra-urban needs (Raman, 2010)	A comprehensive approach to the development of cities taking into account economic and social aspects.
2 A concept of local communities: the city may function appropriately if a combination of production factors in this city provides for the income which is typical for such community and the corresponding level of satisfaction of the population needs (Karkavin, 2001).	Social development of the territory is of the highest priority.
3 A concept of sustainable development: combines the aims of stable and dynamic social and economic growth on the one hand and reliable natural, resource and environmental safety of development on the other hand (Krynychky, Bezrukov, Lavrentyev, 2015, Bogomolov, Mashencova, 2015).	System approach taking into account not only economic and social aspects but also the ecological aspect which includes limitations on the growth of large cities.
4 “Smart city” concept: city “incorporating the engineering infrastructure, IT-infrastructure, social infrastructure, and business infrastructure to use the collective mental capacity of the city." The city follows a “green growth” policy when the economic growth is accompanied by simultaneous reduction of emissions and greenhouse gas pollution, i.e. minimum losses caused by inefficient use of natural resources and loss of biodiversity (Estevez, Vasco, Janowski, 2017; Harrison, Donnelly, 2011; Caragliu, Del Bo Ch. and Nijkamp, 2011; Komninos, 2015; Lazaroiu, Roscia, 2012; Lombardi, Giordano, Farouh, Wael, 2012; Pierce P., Andersson B., 2017; Sikora-Fernandez, 2013; Gandini, A., Garmendia, L., San Mateos, R. ,2017; García-Fuentes, M. A., de Torre, C., 2017; Oates, M., Melia, A., Ferrando, V., 2017; Daher, E., Kubicki, S., Guerriero, A., 2017).	Environmental pressure release, extensive use of innovations; “smart city” structure is heterogeneous, its basis – developed urban infrastructure. The digital environment binds structural components.

Source: compiled by the authors

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Despite the differences and specific features of each concept, yet they have one thing in common: the city should be comfortable for its residents and attractive for the business.

The city dynamics and sustainable development are the critical factors of the economic growth of the region and the entire country (Vining, 1982; McFarlane, 2010; Ufimtseva, Minaev, Volchkova, Merkuleva, 2015; Rakhimova, 2014). The sustainable city development is understood as a growth of economic indicators, improvement of life quality of city residents (increase in social indicators) and increase in these indicators as compared with the previous period, i.e., monitoring of changes.

Current methods of assessment of the city socioeconomic development are given in Table 2. Now we analyze the results of researches of sustainable development of the urban economy in works of Russian academic economists

Table 2. Econometric models used to investigate the sustainable development of the city economy

Author, source, city	Findings	Advantages of the method
Bogomolova I.V., Mashentsova L.S., (2015), Volgograd	Qualitative factors of the city sustainable development are transformed into quantitative indicators: city functionality; relation of salary towards the minimum of subsistence; retail and public catering turnover per capita concerning the minimum of subsistence; life expectancy; the number of officially registered unemployed. Each factor is assigned with its weight and has its scale of indicators, which is identified based on socioeconomic and statistical studies.	Assessment of factors of socioeconomic development is objective; indicators measurement is easy and inexpensive. The method can be used for any city and to compare different cities.
Khabibrakhma-nova R.R., (2011), Kazan	Developed econometric models, showing how the gross municipal product (GMP) volumes and GMP per head of urban population, depend on the change of various factors: industrial product output, investment in fixed capital, and retail turnover. Elasticity coefficients have been calculated to determine the degree of sensitivity of GMP volumes and GMP per head of population to their change.	Using this method, it is possible to identify scenarios of the city economic development and substantiate projected and analytical indicators of its development; it is possible to identify conditions required to achieve the strategic goals of the city development.
Manaeva I.V., Rastvortseva S.N., (2016), single-industry towns in the Central Federal District of Russia	Developed models showing the influence of endogenous and exogenous factors on economic and social conditions of a single-industry town: industrial output is chosen as a resulting indicator of the economic status, and local budget revenue per capita – as a resulting indicator of the social status. Model components: the proportion of the population involved in the enterprise; population involved in the town economy; investment in the town budget; density of public hard-top motor roads in a single-industry town; distance to Moscow along motor roads; export and import quotas; population increase rate; and gross regional product per capita. Natural logthm values of all indicators are used.	Powerful prognostic capabilities
Belova T.A., Bakhitova R.Kh., Lakman I.A., (2016), Ufa	Production function has been made based on panel data for urban economy sectors: industrial production, construction, wholesale and retail trade, transport, and communications.	Interrelations between the leading macroeconomic indicators have been taken into account; it is possible to make their short-term forecasting and find out competitive strengths and problems of functioning of the metropolis economic system.

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Author, source, city	Findings	Advantages of the method
Krinichansky K.V., Bezrukov A.V., Lavrentyev A.S., (2015), towns of Chelyabinsk region	The assessed dependency of the gross municipal product (calculated using a factorial method) on the municipal spending on education and free medical care, the proportion of the population involved in small business, and investment in fixed capital.	For the largest cities, a significant positive relationship has been identified between the gross municipal product per capita and variables of spending on education, free medical care, and investment in fixed capital. Smaller towns strongly depend on the factor of social expenses.
E.S. Vakulenko (2012) The Cities of the Central Federal District (CFD) and Siberian Federal District (SFD)	$M_{i,t} = \sum_{k \in K} \beta_k X_{k,i,t-1} + \gamma_t + u_i + \varepsilon_{i,t}$ where $M_{i,t}$ – rate of migration growth in i-city in t-year (i.e. number of migrants arriving to the city minus persons leaving this city per 10,000 of residents); $X_{k,i,t-1}$ – explaining variables reflecting the characteristics of i-city in (t-1) year; β_k – vector of coefficients being evaluated at explaining variables, constant in time and similar for all cities; γ_t – temporal effect considered using a set of dummy variables for different years; u_i – individual effect of i-city including influence of unaccounted factors with their influence on the rate of migration growth in i-city being constant in time; $\varepsilon_{i,t}$ – random component, with correlation allowed for random components in observations for the same city.	While models with positive growth rate were adequate for CFD, SFD cities were characterized, vice versa, by negative migration balance. The average wage is the most critical decisive factor of migration to CFD cities. Wage size has a positive effect on the inflow of migrants to CFD cities and outflow of migrants from SFD cities. The rate of registered unemployment has a significant negative effect on migration to SFD. It was found that this variable has the most significant effect on migration coefficients compared with other factors used in the model. Inaccessibility of housing affects the rate of migration growth only for CFD major cities without account for Moscow and Moscow region. This factor is a barrier to migration to these cities.
Chen A., Coulson N. E. (2002)	$y_{i,t} = \alpha + \beta X_{i,t} + \mu_i + \varepsilon_{i,t}$ i – city, t – year μ_i – specific effect of i-city, $\varepsilon_{i,t}$ – error	The employment structure of a city has turned out to be the most crucial factor of urban migration. Cities with higher percentages of employment in industry and services sector and with a higher percentage of private business turn out to be more attractive for migrants. On the other hand, urban life quality indicators such as housing market and urban transport infrastructure factors do not affect migration.

Source: compiled by the authors

- Production functions have been made based on panel data for various urban economy sectors;

- The industrial output is chosen as a resulting value indicating the economic status, and the local government revenue per head of population - As the resulting value of social status (for the single-industry city economy) (Fomina, Berduygina, Shatsky, 2018);

- To measure the development level of a city such indicator as the gross municipal product (GMP) is being used and econometric models have been worked out to reflect the dependency of this indicator per head of the city population upon changes of various factors. Still, there is no established unified procedure of this indicator calculation, and it is not used in the Russian statistical records. The following main methods of this indicator calculation have been documented in the scientific literature (production method (income approach); expenses approach and factorial method; all of them have both strengths and weaknesses (Karkavin, 2011).

3. Research methods

Is the increase in the GMP always linked to the upward trend of economic indicators? In other words: does the GMP increase the influence on the city sustainable development?

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Analysis of the city development dynamic indicators is required for answering these questions.

We shall now consistently consider the main steps of such analysis.

First of all, we need to analyze trends in and evaluate the growth of a city population. In a general case, the process of city population number variation can be modeled as time series including both a trend and a seasonal component. Preliminarily, the time series is checked for exceptional values using the Irwin Criterion (Sadovnikova, Shmojlova, 2011), which is based on the determination of λ–statistics. The parameter λ=|Xi-Xi-1 |/σ, where σ is a mean square root deviation for the series under consideration, is calculated for a pair of neighboring observations. This parameter is compared with the respective critical value (Kobzar, 2006): if λ exceeds this critical value, there is an exceptional value, and the time series should be smoothed out. Anomalous values are smoothed, for instance, using the moving average method (WMA, Formula 1):

$$WMA_i = 0.25X_{i-1} + 0.5X_i + 0.25X_{i+1}. \quad (1)$$

As for short-term forecasting and evaluation of population growth, it is suggested to use the Holt-Winters adaptive model (Hyndman, Koehler, Ord, Snyder, 2008) which is a modification of the exponential smoothing method. The series' representation as a multiplicative combination of the linear trend with the seasonal component is used as the series' model.

Holt-Winters model-based forecast for p periods ahead is determined by expression (2):

$$\tilde{X}_{t+p} = (F_t + pC_t)M_{t+p-k} \quad (2)$$

Where k is the number of phases in a full seasonal cycle,

Xt – original time series, each element of which is a migration balance, i.e., the difference between the number of persons arriving in the city and the number of persons leaving the city during the same year.

The coefficients are updated as follows (Formula 3):

$$\begin{aligned} F_t &= \alpha_F \frac{X_t}{M_{t-k}} + (1-\alpha_F)(F_{t-1} + C_{t-1}) \\ C_t &= \alpha_C(F_t - F_{t-1}) + (1-\alpha_C)C_{t-1} \\ M_t &= \alpha_M \frac{X_t}{F_t} + (1-\alpha_M)M_{t-k} \end{aligned} \quad (3)$$

Where αF, αM, and αC are parameters of adaptation. Each parameter belongs to the interval [0;1], and the nearer a parameter is to one, the greater weight is ascribed to the latest observations.

The criterion for parameter selection is the minimization of the model's mean relative error.

Initial values of F0 and C0 are evaluated using the method of least squares (4):

$$Xt=F0+C0t+\varepsilon t \quad (4)$$

The forecast obtained using the model (3) allows for the identification of a population migration trend. Then, we should assess how attractive life is in a particular city and on which

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1. We suggest using an integral urban life attractiveness index. The leading indicators, given in Fig. 1, have been chosen for the calculation. Those indicators, growth of which improves the attractiveness of a city for its residents, are highlighted in the Figure.

Other indicators can also be included in the calculation. The main requirement is that they should consider the specific character of a particular city. On the one hand, they should reflect the economic, social, and ecological aspects of urban life. On the other hand, they are divided into negative (their increase reduces the attractiveness and quality of life) and positive (life quality is increased while they are increased) ones. All values should be preliminary rated to the interval [0;1] according to formulas:

$$X_{norm} = \frac{X - Xmin}{Xmax - Xmin} \quad \text{for positive indicators} \qquad (1)$$

$$X_{norm} = 1 - \frac{X - Xmin}{Xmax - Xmin} \quad \text{for negative indicators} \qquad (2)$$

The integral life attractiveness index is calculated as the arithmetical average of the rated values.

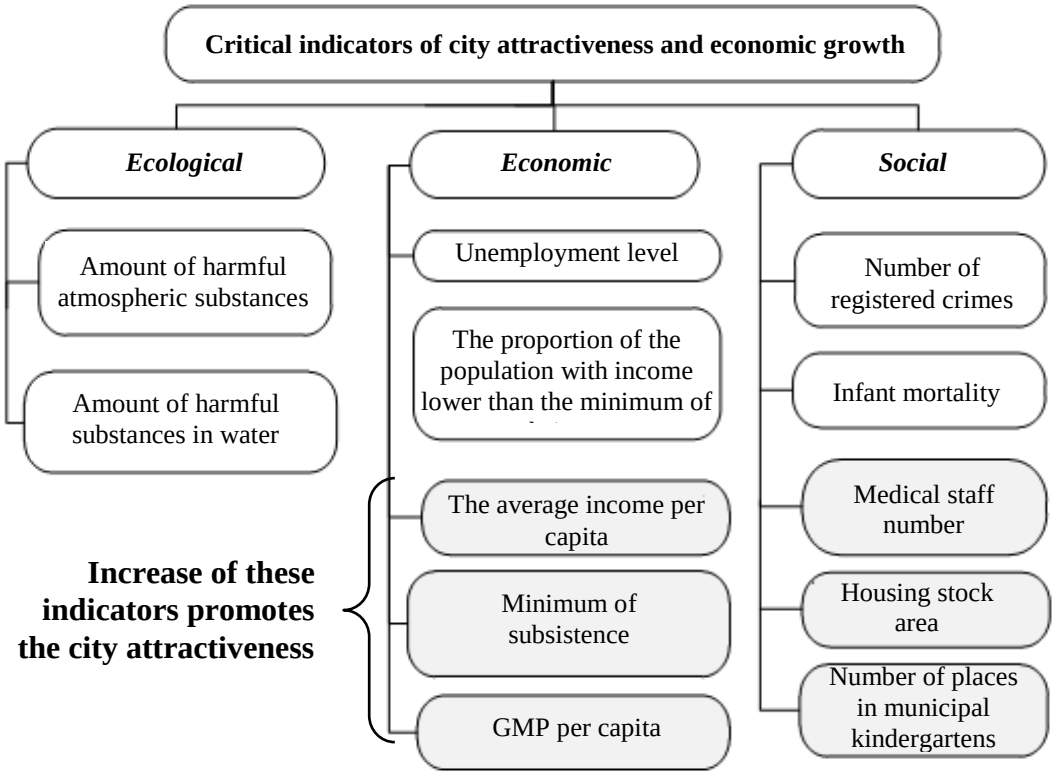

Fig.1. Indicators of city attractiveness and economic growth

It is convenient to use Harrington's desirability scale (Lyubushin, Brikach, 2014) to assess the attractiveness and quality of life; the scale reflects a relation between quantitative values of the non-dimensional index and human

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psychological perception (Table 3). Thus, the received integral index determined on the interval [0;1] acquires a subjective assessment of desirability. For a more comprehensive analysis of urban life attractiveness, the integral index should be considered in the dynamics.

Table 3. Harrington's scale value

Desirability	Desirability scale marks, non-dimensional value
Very bad	0.00-0.20
Bad	0.20-0.37
Satisfactory	0.37-0.63
Good	0.63-0.80
Very good	0.80-1.00

Source: Lyubushin, Brikach (2014)

2. Building a VMP time series – annual gross municipal product per capita. Series levels are calculated according to formula (3)

$$VMP = NC * VRP * m/NR \quad (3)$$

Where NC– number of city inhabitants; VRP – gross regional product; NR – the size of the region's population; $m = 1 + \Delta NC$, correction factor enabling to smooth violent fluctuations of the population size, ΔNC – annual rate of the city population growth.

3. Building ARIMA (Reiss, Wolak, 2007) model reflecting the GMP's dynamics and determining investment lags.

4. Identifying factors that form the GMP's tendency. We identify the following factors: economic, ecological, social, and exogenous (factors which may not be influenced at the municipal level). To analyze these factors, various indicators are required, which are calculated based on the available statistical records. Indicators may be grouped. Each group of indicators characterizes a particular aspect of the city development process. Indicators are grouped and represented in the form of the X-matrix. A minimum number of indicators is required for the analysis that reflect the reasons and expected impact of dynamic processes generated by the taken managerial decisions.

5. Transfer to the aggregates that characterize the economic and social aspects of the city life. Therefore, we use a method of "convolution" of indicators, which is described by us in detail (Oleinik, Zakharova, 2016).

We shall shortly mention here that "convolution" (quantity reduction) of indicators is performed by conversion to aggregate Zk, where k=1.2, which corresponds to the economic and social aspect. Each element of k-aggregate is calculated according to the following formula:

$$z_{ki} = \sum_{j=1}^{m_k} w_{kj} * x^{k}_{ij} / m_k \quad (4)$$

Where zki – the ith element of k-aggregate; mk – number of indicators in the group which is related to k-factor; xkij – the ith value of the jth indicator included in k-group; wkj – the weight of jth indicator in k-group which is calculated according to the formula (2)

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$$w_{k\,j} = R^{k}_{YXj} / \sum_{j=1}^{m_k} R^{k}_{YXj} \qquad (5)$$

Where Y– vector of GMP values for the selected period of record; RkYXj – correlation factor between jth indicator in group k (the corresponding column of the X-matrix) and the vector of GMP values.

6. Building multiple linear regressive models based on the aggregates (Eliseva, Kurysheva, 2008; Lager, Watson, 2010) comparative analysis of regression coefficients, and elasticity coefficients calculated based on the regression coefficients.

7. Selecting the most significant factor. Elasticity coefficients allow ranking the factors in order of importance of their influence on the GMP increase. The maximum coefficient of elasticity in absolute value will correspond to the most significant factor. The sign of both elasticity coefficient and the regression coefficient indicates what impact (positive or negative) the factor has.

8. Based on the obtained results, the municipal authorities take political decisions to increase the impact of positive factors and neutralize the impact of the main negative factors.

4. Results

The suggested approach was used to assess the sustainable development of the city of Vladivostok. The fact that Vladivostok was the largest city in the East of Russia, where the economy was undergoing intensification, and there was increasing economic interest from the countries of the Asia-Pacific region conditioned the choice. Fig. 2 shows the dynamic of arrivals and departures to/from Vladivostok. An annually increasing migration outflow was observed in 2002-2003, 2006 and 2010-2016. In absolute terms, the annual increase in this outflow was 765 persons on average. Each percentage point of absolute increase accounted for 123 persons. The highest increase rate was observed in 2011-2012 and accounted for 61.88% and 77.44% over the preceding period's outflow. The highest rate of inflow growth was observed in 2011 and accounted for 265.39% over the preceding period's inflow; its most significant reduction was registered in 2009 and 2010 – 17.55% and 19.13% over the preceding periods' figures, respectively. A sharp rise in the population number dynamic in 2011-2013 can be explained by the implementation of multiple governmental programs on the development of the Far East and significant investments in the region relating to the construction of major facilities on the eve of the 2012 APEC summit.

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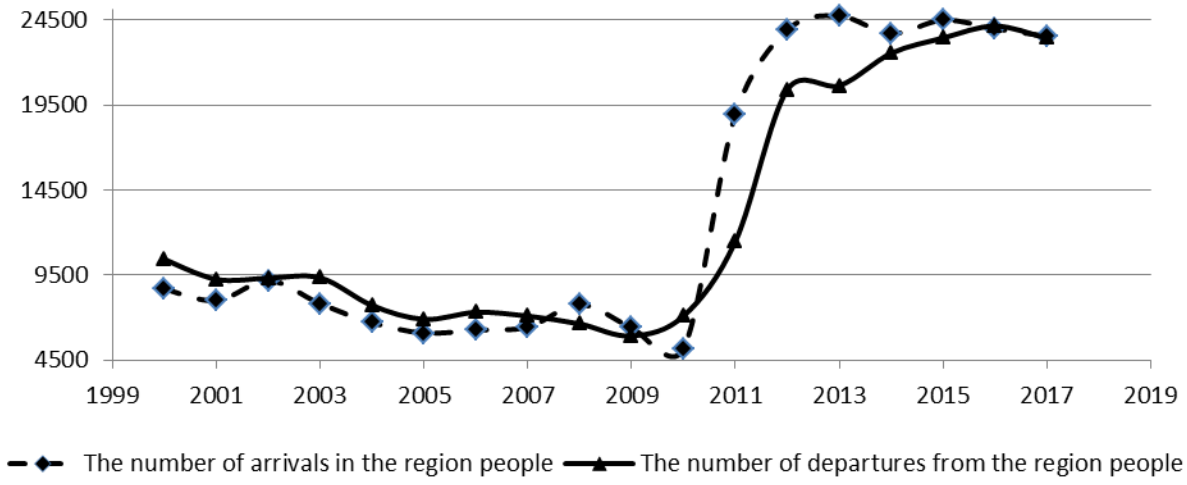

Fig. 2. Dynamic of arrivals and departures to/from Vladivostok in 2000-2017

The very fact of continuous migration outflow necessitates for analysis and forecasting of the migration situation in the city.

Let us use the Holt-Winters model to project population numbers and, in the beginning, calculate the migration balance, i.e., the difference between the number of persons annually arriving in and departing from Vladivostok during 2000-2017.

Annual migration balances for Vladivostok are input data for modeling. This time series contained two Irwin Criterion anomalous values in 2011-2012 which were smoothed out using Formula 1.

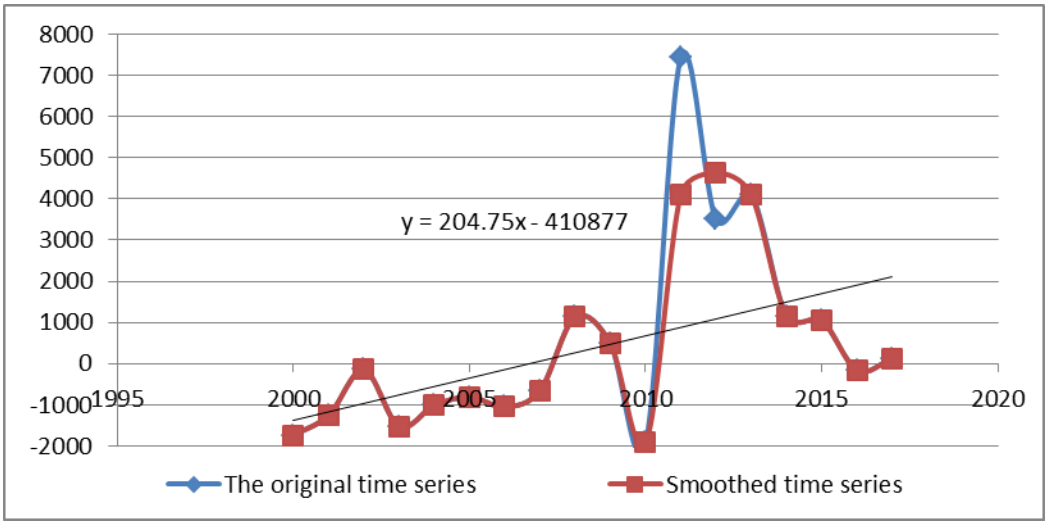

Fig. 3. Migration balance in Vladivostok during 2000-2017, persons

The graph above (Fig. 3) shows the equation of a trend line according to which mean annual growth of population is 205 persons.

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Table 4 presents calculations in accordance with adaptation parameters αF = 0.795; αM = 0.01; αC = 0.95 for migration balance forecasting in Vladivostok (Xt.). These calculations were performed using Formula (3). Adaptation parameters were obtained using the "Search for Solution" procedure in Excel. The search criterion was the minimization of mean relative error finalized at 0.025.

Table 4. Estimated values of the Holt-Winters model

Year	Xt	Ft	Ct	Mt	$\hat{X}_{t+p}$	Relative error
Original values F0 and C0		-1581,35	204,7503	1	–	–
2000	-1738	-1705,91	-0,26	1,02	-1737	0,000773
2001	-1251	-1344,18	4,61	0,94	-1253	0,001241
2002	-146	-391,43	10,52	0,40	-153	0,046451
2003	-1524	-1292,01	-8,02	1,14	-1483	0,026999
2004	-1010	-1067,77	3,23	0,96	-1017	0,007235
2005	-805	-858,82	3,08	0,94	-803	0,002612
2006	-1049	-1010,04	-0,52	1,03	-1044	0,004315
2007	-650	-723,75	3,85	0,90	-651	0,002177
2008	1141	759,03	15,82	1,47	1142	0,000522
2009	487	542,72	-1,17	0,93	502	0,029864
2010	-1921	-1416,34	-18,60	1,33	-1915	0,002934
2011	4117,5	2983,96	44,99	1,38	4173	0,013421
2012	4635,5	4297,20	14,12	1,09	4715	0,017186
2013	4092	4134,03	-0,64	1,00	4113	0,005089
2014	1152	1762,83	-22,72	0,67	1167	0,012905
2015	1053	1198,40	-4,65	0,87	1036	0,01568
2016	-157	120,64	-9,79	-1,19	-132	0,157728
2017	121	120,93	0,99	0,89	109	0,102299

Following the obtained adaptation parameters, our forecast for 2020 based on Formula (3) is 110 persons or twice less than mean expected growth of population. Such a situation is one of the key factors adversely affecting the development of this region due to the lack of labor resources required to support production processes.

So, what is the critical reason for such low migration attractiveness?

The following indicators for the period of 2004-2016 necessary for Vladivostok were chosen to calculate the integral attractiveness index.

– Ecological: carbon dioxide emissions, thousand tons; atmospheric emissions of particulate matters, thousand tons;

– Economic: minimum of subsistence, rubles; the proportion of the population with income lower than the minimum of subsistence, level of employment, %; average monthly salary, rubles; gross municipal product, rubles per capita;

– Social: life expectancy, in years; infant mortality, persons; number of registered crimes; housing stock area, thousand sq. m.

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The source of data for analysis and calculation of the integral attractiveness index and coefficients of econometric models have served as indicators of statistical compilations: Atmospheric pollution in cities of Russia in 2016, socio-economic indicators of Primorski Krai, as well as the results of the economic monitoring of the city Vladivostok for 2016. Fig. 4 shows the dynamics of the integral attractiveness index of life in Vladivostok.

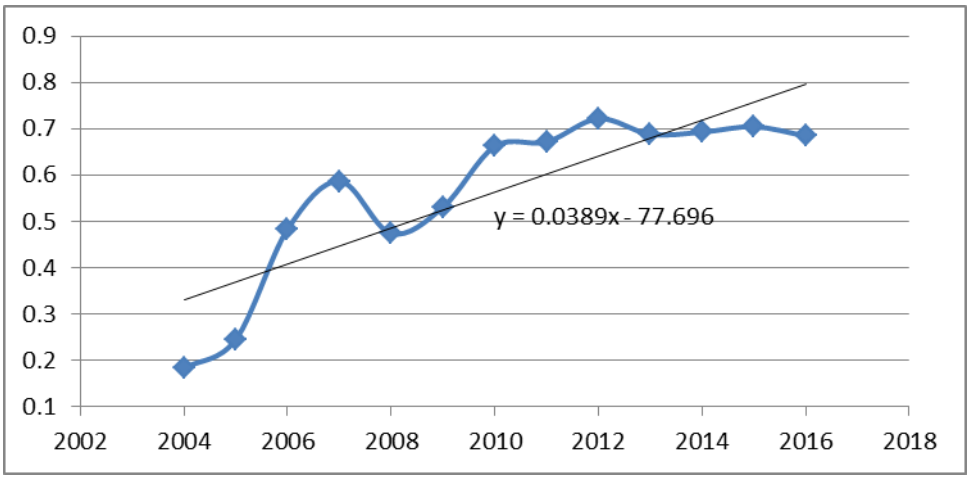

Fig.4. The dynamics of the integral index of attractiveness

The graph traces the remarkable rise of the attractiveness index of living in Vladivostok (the index value changed from 0.18 in 2004 to 0.72 in 2012), associated with the construction and preparations for the APEC Summit in 2012. Reducing the attractiveness of index values observed in 2013 (the index value of 0.68). During this period, there has been a substantial outflow of people, whose professional activity was associated with the construction and commissioning of the main objects of the Summit, which lasted from 2008. The attractiveness index value from 2013 is stable and corresponds to a relatively high standard of living on a scale of Harrington. In general, the attractiveness index value corresponds with a sufficiently high level of life according to the Harrington's scale.

Several measures aimed at economic and social city development are characteristic of each desirability scale. Therefore we shall now calculate the forecast for the leading economic indicator of the city development – gross municipal product, and determine the main factors influencing its growth.

A time series was used as initial data for building a model with the following elements: annual GMP growth rates for a period of record from 2003 to 2016. Augmented Dickey-Fuller test showed that the series of the first finite differences are stationary. The model was implemented in Gretl software package for econometric analysis.

After model fitting and validity check an ARMA-type model was received (2,1,1). Calculation data are given in Table 5. The calculation data are given in Table 4. All model coefficients are significant; the remains do not go beyond the boundaries of the confidence interval and are typically distributed.

The actual value of GMP2016 is 224.8 thousand rubles/person.

Table 5. Calculation data of ARIMA model coefficients (2, 1, 1)

Model: ARIMA, observations 2003-2016 were used (T = 14) Estimated using the Kalman filter (exactly Max likelihood method) Dependent variable: (1-L) VMP_temp	Mean square error (MSE) 0,020671 Root of mean square error (RMSE) 0,14377 mean absolute error (MAE) 0,10387

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Standard errors are calculated based on Hessian Coefficient St. error z P-value --- const −0,0191301 0,00591884 −3,232 0,0012 *** phi_2 −0,404941 0,245212 −1,651 0,0987 * theta_1 −1,035000 0,246846 −4,051 5,10e-05 ***	Average absolute percentage error (MAPE) 8,6796 U- Teil's statistics (Theil's U) 0,7474

For 95% confidence intervals, z(0,025) = 1,96

Observ.	VMP_temp	Prediction	St. error	95% confidence interval
2017	not defined	1,01618	0,122944	(0,775218, 1,25715)

The projected value of GMP2017 calculated according to the model equals to 228.4 thousand rubles/person. In general, the GMP growth rate has demonstrated a tendency to slow down (VMP_temp=-0.0202t+41.666), which is a backdrop for a small increase of the GMP volume forecasted for 2017 in comparison with the previous year.

Investment analysis showed that the investment lag is 3 years; to obtain this value we successively calculated correlation coefficients between the GMP and the volume of investments raised by the municipal budget with time lags of 1-4 years: R1 = 0.222; R2 =0.589; R3 = 0.656; R4 = 0.327. R1 = 0,222; R2 =0,589; R3 = 0,656; R4 = 0,327. This dependency is demonstrated by the graph (Fig. 5).

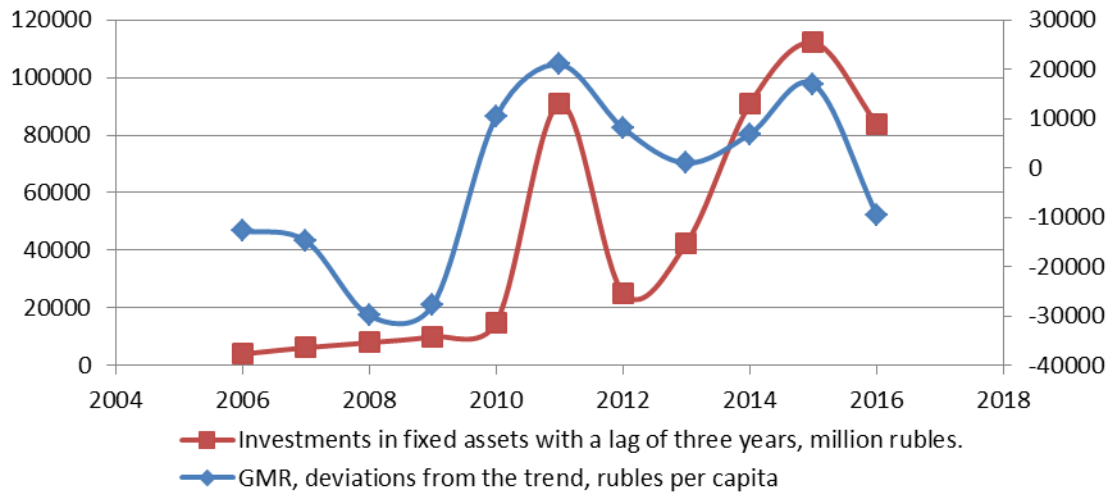

Fig. 5. The dynamics of investment in fixed capital in Vladivostok city and GMP trend deviations

Based on preliminary analysis of statistical database values X1 – X11 (Table 6) were selected, which were convolved (formulas 3-4 – 2) into aggregates Z1 – Z3. Each of them assays one of the main factors having an impact on GMP growth. The aggregates were used to build an equation of multiple linear regressions. Dependent variable Y – the GMP per head of population of Vladivostok city, rubles per person, modified to the level of 2002. Not all aggregates are significant according to the Student's t-test, which may be explained by a short period of record. However, we do not set ourselves a task of forecasting; that is why we included them in the regression model based on economic feasibility.

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Table 6. Assessment of factors of development of Vladivostok city, for the period of 2002-2016

Factor	Indicators of the level of development of Vladivostok city, modified to the level of 2002, %	Weight factors wi	Regression coefficients	Elasticity	Factor rank
Z1, m1=3 Economic	X1 Mining operation	0.30	0.79	0.44	2
	X2 Manufacturing	0.35			
	X3 Generation and distribution of power, gas, and water	0.35			
Z2, m2=4 Social	X4 Average monthly salary	0.43	0.86	1.54	1
	X5 Amount of registered crimes	0.28			
	X6 Number of passengers carried by buses per year using intra-urban routes	0.19			
	X7 Area of built domestic houses	0.10			
Z3 m3=4 Ecological	X8 Atmospheric emissions of particulate matters	0.31	-0.48	-0.09	3
	X9 Nitrogen dioxide emissions	0.16			
	X10 Sulphur dioxide emissions	0.38			
	X11 Carbon dioxide emissions	0.15			

5. Discussion

Analysis of data given in Table 6 provides for the following conclusions. The most significant and positive is not economic, but the social factor – the highest elasticity coefficient corresponds to it. Therefore, the more funds are invested in the development of social spheres and city infrastructure, the higher the GMP growth rate, and the more attractive the city becomes for the population (Bykanova et al., 2017).

Environmental factor has a significantly strong negative impact on the GMP growth of Vladivostok city despite significant investments in this field. Elasticity value of this factor is not the highest one, which is explained by a significant time lag between hazardous substances emission and consequences affecting the health of the city population. We consider that improvement of the environmental situation in the city shall be one of the essential areas of the outward-looking public policy.

To ensure the growth of the BMP, it is necessary to reconcile the social and economic interests of residents and local businesses which is expressed, first of all, in a comprehensive municipal policy (Fig. 6). Various forms of interaction are required to create and maintain partnership relations between representatives of business, municipal authorities, and urban community. We identify three key points of interaction.

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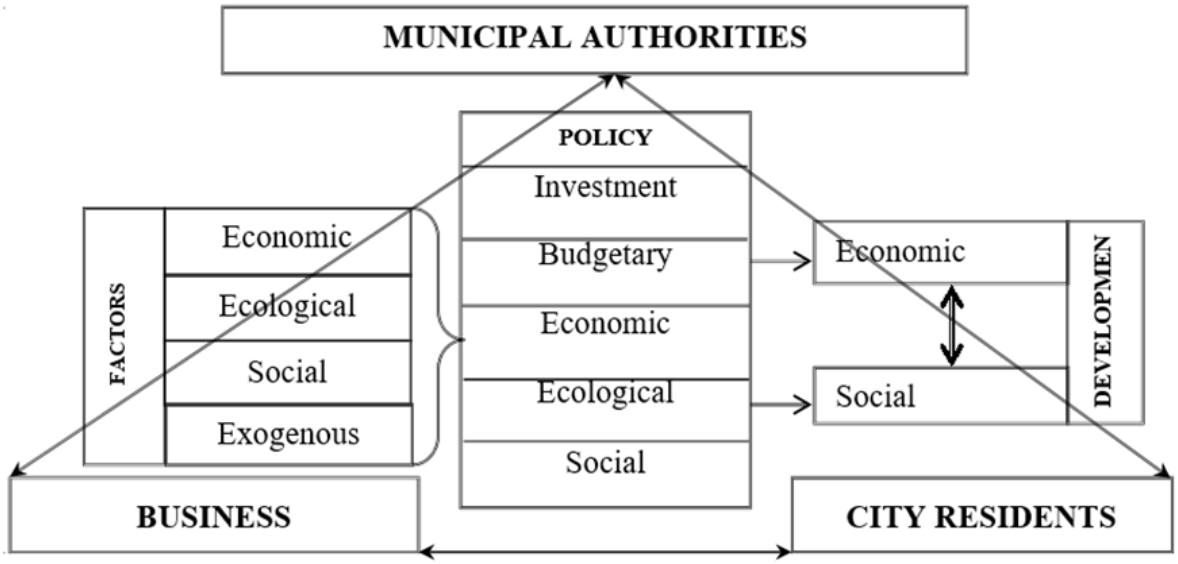

Fig. 6. The pattern of interaction between city structures

1 Local authorities – Business, areas: implementation of priority national projects and programs of the city socio-economic development; financial backing of environmental projects; promoting the development of various businesses.

2 Local authorities – City residents, areas: transparency and awareness; exposure of information about budget expenditures in the social sphere; civic responsibility, and public involvement.

3 Business – City residents, areas: job security for people; financial backing of donation funds

Conclusion

Our model will allow creating scenarios and justifying predictive and analytical indicators of the city economy. However, to assess the effectiveness of the local socio-economic policy, a system of feedback monitoring is required, i.e., the decision-making process shall be coordinated between all structural elements of the city system. Otherwise, the city will only be a point of attraction of federal investments, and not the "point of economic growth and social development."

References

Balynskaya, N. R., and Ponomarev, A. V. (2018). Current issues in the development of modern political and economic processes in Russia and Europe. *Economics and Politics*, *2*(12), 5-7.

Belova, T., Bakhitova, R., and Lakman, I. (2016). The Dynamic model of the economy of the city of Ufa. *Reports of the University of Bashkir*, *1*(1), 178-182.

Bikas, E., and Saponaitė, V. (2018). Behavior of the Lithuanian investors at the period of economic growth. *Entrepreneurship and Sustainability Issues*, *6*(1), 44-59. http://doi.org/10.9770/jesi.2018.6.1(4)

Bogomolova, I., and Mashentseva, L. (2015). Methods of assessment of factors ensuring sustainable development of major cities. *Journal of Russian entrepreneurship*, *16*(16), 2509-2520.

Bykanova, O. A., Akhmadeev, R. G., Kosov, M. E., Ponkratov, V. V., Osipov, V. S., and Ragulina, Y.V. (2017). Assessment of the economic potential of sovereign wealth funds. *Journal of Applied Economic Sciences*, *12*(1), 70-84.

Caragliu, A., Del Bo, C., and Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology*, *18*(2), 65-82.

Chen, A., and Coulson, N. (2002). Determinants of urban migration: Evidence from Chinese cities. *Urban Studies*, *39*(12), 2189–2197.

Daher, E., Kubicki, S., Guerriero, A. (2017). Data-driven development in the smart city: Generative design for refugee camps in Luxembourg. *Entrepreneurship and Sustainability Issues*, 4(3), 364-379. https://doi.org/10.9770/jesi.2017.4.3S(11)

Doolina, N., Kuznetsova, S., Lebedeva, V., and Tokarev, N. (2004). *Modern Russian city: theory, methodology, and practice of research. The collective monograph.* Volgograd: Publishing house: VSTU, 453p.

Eliseva, I., Kurysheva, S., Kosteeva, T., Pantina, I., Mihajlov, B., Neradovskaja, Y., Rybkina, L. (2008). *Econometrics.* Moscow: Finance and statistics Publ., 256p.

Estevez, E., Vasco Lopez, N., and Janowski, T. (2016, April). *Smart Sustainable Cities – Reconnaissance Study. United nations university. Operating unit on Policy-driven. Electronic Governance.* Retrieved from joinup.ec.europa.eu: https://joinup.ec.europa.eu/sites/default/files/document/2016-04/smart_cities_report.pdf

Fomina, A. V., Berduygina, O. N., Shatsky, A. A. **(**2018). Industrial cooperation and its influence on sustainable economic growth. *Entrepreneurship and Sustainability Issues*, *5*(3), 467-479. https://doi.org/10.9770/jesi.2018.5.3(4)

García-Fuentes, M. A., de Torre, C. (2017). Towards smarter and more sustainable regenerative cities: the REMOURBAN model. *Entrepreneurship and Sustainability Issues*, 4(3), 328-338. https://doi.org/10.9770/jesi.2017.4.3S(8)

Gandini, A., Garmendia, L., San Mateos, R. (2017). Towards sustainable historic cities: mitigation climate change risks. *Entrepreneurship and Sustainability Issues*, 4(3), 319-327. https://doi.org/10.9770/jesi.2017.4.3S(7)

Habibrahmnova, R. (2011). *Strategic management development the most significant city as a spatial socio-economic system of the thesis for a degree of candidate of economic sciences.* Kazan, 254p.

Harrison, C., and Donnelly, I. (2011). *Theory of smart cities. Proceedings of the 55th Annual Meeting of the International Society for the Systems Sciences.* Canada: niversity of Hull Business School

Hydan, R., Koehler, A., Ird, J., and Snyder, R. (2008). *Forecasting with Exponential Smoothing: The State Space Approach.* Berlin: Springer-Verlag Berlin Heidelberg.

Karkavin, M. (2011). Conditions and trends of strategic socio-economic development of small and medium-sized cities. *Fundamental research*, *8*(3), 694-697.

Kazantsev, I., and Svetunkov, M. (2004). *Urban sociology: textbook.* Moscow: Publishing house Mashinostroenie.

Kobzar, A. (2006). *Applied mathematical statistics.* Moscow: PHYSMATHLIT, 375p.

Kominos, N. (2015). *The Age of Intelligent Cities. Smart environments and innovation-for-all strategies.* New York: Routledge, 453p.

Krinichansky, K., Bezrukov, A., and Lavrent'ev, A. (2015). The Factors of economic development of cities in the region. *Regional economy: theory and practice*, *28*, 54-68.

Lazaroiu, G., and Roscia, M. (2012). Definition methodology for the smart cities model. *Energy*, *47*(1), 326-332.

Lombardi, P., Giordano, S., Farouh, M., and Wael, Y. (2012). Modelling the smart city performance. *Innovation: The European Journal of Social Science Research*, *25*(2), 137-149.

Lyubushin, N., and Bricats, G. (2014). The Use of the generalized desirability function of Harrington in multivariable economic problems. *Economic analysis: theory and practice, 18*(369), 2-10.

Manaeva, I., and Rastvortseva, S. (2016). Economic and mathematical model of forecasting the socio-economic development of a single-industry town. *Economic analysis: theory and practice, 10*, 131-139.

McFarlane, C. (2010). The comparative city: knowledge, learning, urbanism. *International Journal of Urban and Regional Research, 34*(4), 725-742.

Oates, M., Melia, A., Ferrando, V. (2017). Energy balancing accross cities: Virtual Power Plant prototype and iURBAN case studies. *Entrepreneurship and Sustainability Issues*, 4(3), 351-363. https://doi.org/10.9770/jesi.2017.4.3S(10)

Oleinik, E., and Zakharova, A. (2016). Evaluation of the Major Factors of the Region's Investment Activity. *Indian Journal of Science and Technology, 9*(36), 1-7.

Pierce, P., and Andersson, B. (2017). Challenges with smart cities initiatives - A municipal decision makers' perspective. *Proceedings of the 50th Hawaii International Conference on System Sciences*, 2804-2813.

Rakhimova, G. (2014). Structural elements of the sources of potential of regional economy. *Journal of Contemporary Economics Issues*, *1*. https://doi.org/10.24194/11406

Raman, S. (2010). Designing a Liveable Compact City: Physical Forms of City and Social Life in Urban Neighborhoods. *Built Environment, 36*(1), 63-80.

Reiss, P., and Wolak, F. (2007). Structural econometric modeling: Rationales and examples. From the industrial organization. *Handbook of Econometrics, 6A*.

Sadovnikova, N., and Shmojlova, R. (2011). *Time series analysis and forecasting. Tutorial.* Moscow: University Publishing House "Synergy".

Shmankevich, T. (2005). *Baikal Siberia: what constitutes stability.* Moscow: Natalis.

Sikora-Fernandez, D. (2013). Smart city concept in the assumptions of the urban development policy – polish perspective. *Acta Universitatis Lodziensis Folia Oeconomica, 290*, 83-94.

Stock, J., and Watson, M. (2010). *Introduction to Econometrics. 3rd edition.* Addison-Wesley.

Takhumova, O. V., Kasatkina, E. V., Maslikhova, E. A., Yumashev, A. V., and Yumasheva, M. V. (2018). The main directions of increasing the investment attractiveness of the Russian regions in the conditions of institutional transformations. *Espacios, 39*(37), 6.

Ufimtseva, E. (2014). The study of public infrastructure facilities in terms of regional socio-economic processes. *Economic Revival of Russia, 2*, 85-92.

Ufimtseva, E., Minaev, N., Volchkova, I., and Merkuleva, Y. (2015). Infrastructural Interactions Governance Model of Urban Services in the Context of Socio-Economic Development of the City. *Mediterranean Journal of Social Sciences, 6*(3), 183-189.

Vakulenko, E. (2012). Migration in Russia: econometric analysis. *Applied econometrics, 1*(25), 25-50.

Vining Jr., D. (1982). Migration between the Core and the Periphery. *Scientific American, 247*(6), 37-45.

Vinogradova, N. (2015). Methods of evaluation of social development. *Journal of Contemporary Economics Issues*, *1*. https://doi.org/10.24194/11506

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