Integration potential of the economic and geographical position of the regions of Asian Russia

S N Sokolov¹, E A Rjepka² and E A Kuznetsova³

¹Nizhnevartovsk State University, Nizhnevartovsk, 628605 Russia
²Baikal State University, Irkutsk, 664003 Russia
³Tyumen State University, Tyumen, 625003 Russia

E-mail: snsokolov1@yandex.ru

Abstract. Currently, the development of the mathematical and geographical apparatus for assessing the economic and geographical position (EGP) is practically absent, and therefore the authors offer their own methodology for calculating the assessment of the integration potential of the EGP. This potential consists of the potential of the neighbouring position, the permeability of the borders and the transport accessibility of the regions. EGP objectively reveals the individual features and properties of any territory, it has a potential character. The highest indicators of the integration potential of EGP in Asian Russia (AR) are typical for the Kemerovo Region – Kuzbass, the Altai Krai and the Republic of Khakassia. Kamchatka Krai, the Magadan Region and the Chukotka Autonomous Okrug are characterized by the lowest values of such potential. Thus, the EGP of the regions is ambiguous and varies from very convenient to very inconvenient. Territories with a more favourable EGP develop better and faster. The use of the region’s EGP data facilitates its assessment and allows us to determine negative and positive aspects of the socio-economic development of the region, to make a forecast for the further development of a particular region.

1. Introduction

Studies of regional socio-economic issues are in the focus of attention of both Russian and foreign scientists. At the same time, the development of a mathematical and geographical apparatus for assessing the economic and geographical position (EGP) is practically absent [1]. It defines many of the most important features of a country, district, city, highlights the properties of their distinctiveness and uniqueness. A G Druzhinin asserts that within the framework of positioning, it is possible to change the EGP, including its improvement [2]. From the point of view of M M Golubchik, through the system of multiple relationships of this object with other objects, the EGP objectively reveals the distinct features and properties of any territory, it has a potential character [3].

P Ya Baklanov explains that EGP is a very dynamic category [4]. Any geographical object is distinguished by its borders and its position in the geographical space, outside of which it is undefinable. E E Leyzerovich believes that the richness of the content of EGP concept causes makes it difficult assess quantitatively [5].

L A Bezrukov points out that, in general, qualitative rather than quantitative assessments usually prevail in the characterization of EGP [6]. EGP is one of the factors that impacts changes in functions,
economic and territorial organization of regions, and, as A I Treivish notes that development of these objects makes them influence their EGP [7].

EGP is one of the keys and one of the most developed concepts in modern Russian socio-economic geography [8]. L V Smirnyagin believes that in the modern world, as in geography, the characteristics of the place itself play an increasingly important role in comparison with its location [9]. S P Moskalkov emphasizes that at present the importance of studying the processes of formation, approval and transformation of industrial and territorial systems in their spatio-temporal existence, EGP being one of the forms of its manifestation, is due to the fact that they are increasingly developing and transforming under the influence of objectively inevitable trends of economic globalization [10]. At the same time, when forming the principles of positioning, it is important to use EGP of the territorial object and strategic development priorities as the basis.

It is advisable to take into account the general features characteristic of the EGP, which were pointed out by the founders of the theory of economic and geographical position N N Baransky and I M Maergoiz [11, 12]. We are talking about the probabilistic (potential) nature of the impact of the EGP itself and the need to study the EGP as a historical category.

2. Models and Methods

The formation of the EGP, including the transport and geographical position (TGP), involves the creation of conditions for the development of objects through their interaction with each other. Thus, TGP is a prerequisite for establishing spatial links between regions. Despite a fairly large number of publications on TGP, no one has previously considered the possibility of assessing the integral potential of such a situation, although R K Sabitov proposed a method for quantifying TGP based on a combined analysis of three characteristics: the economic potential of neighbouring territories; the density of economic development of the environment and the presence (quantity and quality) of direct transport connections to neighbours, and their frequency [13]. Geographical connections occur when distance is covered, and in relation to integration process – the growth of such connections [14].

In our opinion, several other indicators are needed for the calculation: the integration potential of the neighbouring position, the permeability of borders and the transport accessibility of the region. Under the integration potential, V I Blanutsa understands the possibility of an object to unite with its neighbours in structures for close socio-economic interaction [15]. The more neighbours a region has, the more different options for cooperation there are, consequently, the higher the integration potential. To take into account the possible attenuation of the intensity of interaction as we move away from the region, V I Blanutsa proposed a scale of correction coefficients [16].

To calculate the potential of the neighbouring position for the regions of AR we used the following formula:

$$T = \sum N_i \cdot 0.5^{i-1}$$  \hspace{1cm} (1)

where: $i$ – the order; $N_i$ – the number of neighbours of the $i$-th order.

The indicator of the permeability of borders between regions can be determined by the formula:

$$D = 100(2R + H + 0.5W + 0.5M + 0.25A)(4\pi S)^{-1/2}$$  \hspace{1cm} (2)

where: $R$ – the number of border crossings between districts by railways, $H$ – by highways, $W$ – by waterways; $M$ – the number of seaports and terminals; $A$ – the number of airports (civil aviation); $S$ – the area of the territory (in square kilometres), $\pi = 3.14$.

As an indicator of transport accessibility, the relative value of the Engel coefficient can be used, in which the reduced length of roads is previously calculated, taking into account the coefficients of conversion to conditional equivalents of railways according to L I Vasilevsky [17]:

$$L = L_1 + 0.45L_2 + 0.15L_3 + 0.01L_4 + L_5 + 0.025L_6$$  \hspace{1cm} (3)
where: $L_1$ – the length of railways, $L_2$ – improved roads, $L_3$ – paved roads (excluding improved ones), $L_4$ – unpaved roads (including winter roads and tractor roads), $L_5$ – navigable waterways (river, lake, sea), $L_6$ – air routes (between local airports).

The length of the airways can be calculated through the formula:

$$L_6 = \frac{2}{3} \cdot \frac{A(A-1)}{2} \cdot \left(\frac{5}{R}\right)^{1/2}$$ (4)

The Engel coefficient is calculated by the formula:

$$K_E = L \cdot (P \cdot S)^{-1/2}$$ (5)

where: $P$ – the number of residents (thousand people).

The relative value of this coefficient is calculated as a comparison of the Engel coefficient for a given region with the arithmetic mean value of the coefficient for neighbouring regions.

3. Results and Discussion

Table 1 shows the calculation of the potential of the neighbouring position of the subjects of AR.

| Subjects of AR | Number of neighbours | Potential |
|---------------|----------------------|-----------|
|               | 1st order | 2nd order | 3rd order | 4th order | 5th order |
| Krasnoyarsk Krai | 8         | 11        | 4         | 0         | 0         | 14.50     |
| Republic of Sakha (Yakutia) | 7         | 11        | 5         | 0         | 0         | 13.75     |
| Irkutsk Region | 5         | 10        | 8         | 0         | 0         | 12.00     |
| Kemerovo Region - Kuzbass | 6         | 7         | 6         | 4         | 0         | 11.50     |
| Tomsk Region | 6         | 7         | 6         | 4         | 0         | 11.50     |
| Khabarovsk Krai | 6         | 5         | 7         | 5         | 0         | 10.88     |
| Republic of Tyva | 5         | 7         | 7         | 4         | 0         | 10.75     |
| Republic of Khakassia | 4         | 8         | 7         | 4         | 0         | 10.25     |
| Khanty-Mansi Autonomous Okrug-Yugra | 4         | 7         | 8         | 4         | 0         | 10.00     |
| Amur Region | 4         | 7         | 7         | 5         | 0         | 9.88      |
| Magadan Region | 4         | 7         | 7         | 5         | 0         | 9.88      |
| Zabaikalsky Krai | 4         | 6         | 9         | 4         | 0         | 9.75      |
| Chukotka Autonomous District | 3         | 6         | 9         | 5         | 0         | 8.88      |
| Altai Republic | 4         | 5         | 6         | 4         | 4         | 8.75      |
| Republic of Buryatia | 3         | 5         | 9         | 6         | 0         | 8.50      |
| Novosibirsk Region | 4         | 5         | 4         | 6         | 4         | 8.50      |
| Yamalo-Nenets Autonomous District | 2         | 7         | 10        | 4         | 0         | 8.50      |
| Altai Krai | 3         | 5         | 6         | 5         | 4         | 7.88      |
| Omsk Region | 3         | 4         | 6         | 6         | 4         | 7.50      |
| Tyumen Region (without Autonomous Districts) | 3         | 4         | 6         | 6         | 4         | 7.50      |
| Sakhalin Region | 2         | 6         | 3         | 7         | 5         | 6.94      |
| Jewish Autonomous Region | 2         | 5         | 5         | 6         | 5         | 6.81      |
| Kamchatka Krai | 3         | 2         | 6         | 7         | 5         | 6.69      |
| Primorsky Krai | 1         | 5         | 5         | 7         | 5         | 5.94      |
As can be seen from the table, the highest indicators of the potential of the neighbouring position are characteristic of the Krasnoyarsk Krai, the Republic of Sakha (Yakutia) and the Irkutsk Region. The Primorsky Krai, the Kamchatka Krai and the Jewish Autonomous Region are characterized by the smallest values of such a potential. Table 2 shows the calculation of the permeability of the borders between the regions of the AR.

Table 2. Permeability of the borders between the regions of the AR.

| Subjects of AR                        | Area of the territory | Number of border crossings | Number of permeability | Indicators of the permeability |
|---------------------------------------|-----------------------|----------------------------|------------------------|-------------------------------|
| Novosibirsk Region                   | 177.8                 | 9                          | 106                    | 8.60                          |
| Kemerovo Region - Kuzbass            | 95.7                  | 7                          | 76                     | 8.50                          |
| Omsk Region                          | 141.1                 | 4                          | 80                     | 6.83                          |
| Altai Krai                           | 168.0                 | 9                          | 76                     | 6.69                          |
| Tyumen Region (without Autonomous Districts) | 160.1                 | 3                          | 74                     | 6.10                          |
| Republic of Khakassia                | 61.6                  | 3                          | 38                     | 5.26                          |
| Republic of Buryatia                 | 351.3                 | 5                          | 50                     | 3.50                          |
| Altai Republic                       | 92.9                  | 0                          | 34                     | 3.31                          |
| Republic of Tyva                     | 168.6                 | 0                          | 42                     | 3.07                          |
| Zabaikalsky Krai                     | 431.9                 | 6                          | 50                     | 3.00                          |
| Primorsky Krai                       | 164.7                 | 4                          | 20                     | 2.92                          |
| Jewish Autonomous Region             | 36.3                  | 3                          | 10                     | 2.81                          |
| Irkutsk Region                       | 774.8                 | 6                          | 54                     | 2.63                          |
| Tomsk Region                         | 314.4                 | 1                          | 43                     | 2.59                          |
| Krasnoyarsk Krai                     | 2,366.8               | 8                          | 86                     | 2.26                          |
| Amur Region                          | 361.9                 | 5                          | 31                     | 2.24                          |
| Khanty-Mansi Autonomous District-Yugra| 534.8                 | 4                          | 34                     | 1.89                          |
| Khabarovsk Krai                      | 787.6                 | 5                          | 27                     | 1.77                          |
| Sakhalin Region                      | 87.1                  | 1                          | 0                      | 1.46                          |
| Yamalo-Nenets Autonomous District    | 769.3                 | 2                          | 24                     | 1.19                          |
| Republic of Sakha (Yakutia)          | 3,038.5               | 3                          | 39                     | 1.13                          |
| Magadan Region                       | 462.5                 | 0                          | 5                      | 0.41                          |
| Chukotka Autonomous District         | 721.5                 | 0                          | 1                      | 0.31                          |
| Kamchatka Krai                       | 464.3                 | 0                          | 1                      | 0.29                          |

As can be seen from the table, the highest indicators of the permeability of the borders between the regions are characteristic of the Novosibirsk Region, the Kemerovo Region - Kuzbass and the Omsk Region. Kamchatka Krai, the Chukotka Autonomous District and the Magadan Region are characterized by the smallest values of such indicator.

Data on the length of transport routes are summarized in Table 3. As can be seen from the table, the highest indicators of the reduced length of transport routes are characteristic of the Republic of Sakha (Yakutia), the Irkutsk Region and the Krasnoyarsk Krai. The Jewish Autonomous Region, the Republic of Tyva and the Altai Republic are characterized by the smallest values of such indicator.
Table 3. Length of transport routes of the regions of the AR.

| Subjects of AR                              | railways | improved roads | paved roads | unpaved roads | navigable waterways | air routes | reduced length |
|---------------------------------------------|----------|----------------|-------------|---------------|----------------------|------------|----------------|
| Republic of Sakha (Yakutia)                 | 525      | 2,132          | 9,915       | 18,298        | 18,717               | 23,217     | 96,149         |
| Irkutsk Region                              | 2,494    | 9,154          | 15,322      | 6,743         | 7,930                | 4,853      | 17,030         |
| Krasnoyarsk Krai                            | 2,078    | 3,312          | 4,355       | 1,428         | 9,795                | 21,666     | 14,573         |
| Altai Krai                                  | 1,566    | 17,228         | 18,814      | 18,816        | 650                  | 43         | 12,980         |
| Yamalo-Nenets Autonomous District           | 481      | 2,102          | 257         | 178           | 9,433                | 1,909      | 10,948         |
| Khabarovsk Krai                             | 2,144    | 3,746          | 5,908       | 1,073         | 5,400                | 14,050     | 10,478         |
| Khanty-Mansi Autonomous District            | 1,084    | 5,315          | 578         | 1,173         | 5,608                | 4,424      | 9,293          |
| Amur Region                                 | 2,920    | 4,332          | 8,117       | 4,018         | 2,600                | 1,355      | 8,761          |
| Zabaikalsky Krai                            | 2,398    | 5,398          | 9,311       | 6,954         | 2,200                | 1,652      | 8,535          |
| Tyumen Region (without Autonomous Districts)| 877      | 10,490         | 3,591       | 5,155         | 2,209                | 935        | 8,420          |
| Primorsky Krai                              | 1,559    | 6,503          | 8,446       | 1,867         | 2,122                | 2,183      | 7,947          |
| Tomsk Region                                | 344      | 3,634          | 4,033       | 3,429         | 5,195                | 2,012      | 7,864          |
| Omsk Region                                 | 735      | 12,358         | 1,574       | 9,965         | 1,132                | 14         | 7,764          |
| Novosibirsk Region                          | 1,506    | 8,974          | 10,924      | 8,286         | 383                  | 87         | 7,651          |
| Kemerovo Region - Kuzbass                   | 1,678    | 8,358          | 8,630       | 3,455         | 184                  | 125        | 6,955          |
| Republic of Buryatia                        | 1,227    | 4,627          | 4,571       | 5,566         | 2,325                | 1,569      | 6,415          |
| Sakhalin Region                             | 835      | 1,559          | 764         | 2,662         | 4,700                | 949        | 6,401          |
| Chukotka Autonomous District                | 0        | 54             | 788         | 1,306         | 4,788                | 3,529      | 5,032          |
| Kamchatka Krai                              | 0        | 689            | 1,392       | 121           | 4,000                | 3,512      | 4,608          |
| Magadan Region                              | 0        | 498            | 2,097       | 117           | 3,696                | 1,681      | 4,278          |
| Republic of Khakassia                       | 667      | 2,758          | 2,941       | 1,890         | 390                  | 0          | 2,758          |
| Altai Republic                              | 0        | 1,541          | 3,045       | 1,670         | 688                  | 37         | 1,856          |
| Republic of Tyva                            | 0        | 1,613          | 1,932       | 5,018         | 285                  | 517        | 1,364          |
| Jewish Autonomous Region                    | 512      | 1,055          | 1,388       | 421           | 584                  | 10         | 1,784          |

As a result, we get the integration potential of the economic and geographical position:

$$I = T \cdot D \cdot K$$ (6)

where: $T$ – the potential of the neighbouring position; $D$ – the indicator of the permeability of the boundaries; $K$ – the relative value of the Engel coefficient.

Data on the integration potential of the EGP are summarized in Table 4.
Table 4. Integration potential of the EGP.

| Subjects of AR | Potential of the neighbouring position | Indicator of the permeability of the boundaries | Number of residents | Engel coefficient | Relative value of Engel coefficient | Integration potential of the EGP |
|----------------|----------------------------------------|-----------------------------------------------|---------------------|------------------|-------------------------------------|--------------------------------|
| Kemerovo Region - Kuzbass | 11.50 | 8.50 | 2633 | 0.44 | 1.05 | 102.7 |
| Altai Krai | 7.88 | 6.69 | 2296 | 0.66 | 1.66 | 87.7 |
| Republic of Khakassia | 10.25 | 5.26 | 532 | 0.48 | 1.6 | 86.0 |
| Tyumen Region (without Autonomous Districts) | 7.50 | 6.10 | 1537 | 0.54 | 1.33 | 60.8 |
| Omsk Region | 7.50 | 6.83 | 1904 | 0.47 | 1.09 | 55.6 |
| Novosibirsk Region | 8.50 | 8.60 | 2786 | 0.34 | 0.69 | 50.2 |
| Irkutsk Region | 12.00 | 2.63 | 2375 | 0.40 | 1.22 | 38.5 |
| Jewish Autonomous Region | 6.81 | 2.81 | 157 | 0.75 | 1.77 | 33.8 |
| Tomsk Region | 11.50 | 2.59 | 1070 | 0.43 | 1.13 | 33.6 |
| Republic of Buryatia | 8.50 | 3.50 | 985 | 0.34 | 1.06 | 31.4 |
| Sakhalin Region | 6.94 | 1.46 | 486 | 0.98 | 2.77 | 28.0 |
| Altai Republic | 8.75 | 3.31 | 221 | 0.41 | 0.93 | 26.9 |
| Zabaykalsky Krai | 9.75 | 3.00 | 1053 | 0.40 | 0.90 | 26.3 |
| Primorsky Krai | 5.94 | 2.92 | 1878 | 0.45 | 1.38 | 23.9 |
| Amur Region | 9.88 | 2.24 | 782 | 0.52 | 1.04 | 23.0 |
| Republic of Sakha (Yakutia) | 13.75 | 1.13 | 982 | 0.52 | 1.14 | 17.8 |
| Republic of Tyva | 10.75 | 3.07 | 330 | 0.18 | 0.50 | 16.7 |
| Yamalo-Nenets Autonomous District | 8.50 | 1.19 | 547 | 0.53 | 1.50 | 15.1 |
| Krasnoyarsk Krai | 14.50 | 2.26 | 2856 | 0.18 | 0.43 | 14.1 |
| Khanty-Mansi Autonomous District-Yugra | 10.00 | 1.89 | 1688 | 0.31 | 0.74 | 14.0 |
| Khabarovsk Krai | 10.88 | 1.77 | 1301 | 0.33 | 0.52 | 10.1 |
| Chukotka Autonomous District | 8.88 | 0.31 | 50 | 0.84 | 1.75 | 4.8 |
| Magadan Region | 9.88 | 0.41 | 139 | 0.53 | 1.03 | 4.2 |
| Kamchatka Krai | 6.69 | 0.29 | 312 | 0.38 | 0.49 | 0.9 |

As can be seen from the table, the highest indicators of the integration potential of the EGP are characteristic of the Kemerovo Region - Kuzbass, the Altai Krai and the Republic of Khakassia. The Kamchatka Krai, the Magadan Region and the Chukotka Autonomous District are characterized by the smallest values of such a potential.

4. Conclusion
The concept of EGP is a key category of socio-economic geography. EGP are characterized by the relation of the region with its external environment. This is very important with regard to further diversification of the region’s economy to increase its investment rating and ensure positive dynamics of the level and quality of life of the population. All spatial objects in socio-economic geography have
to be compared with similar ones, linked to the territories surrounding them, and their interaction is revealed according to the principle of hierarchy.

A simplified descriptive approach to the EGP, in which only basic information about the location of the object under consideration, its boundaries and so on is articulated, seems unproductive from the point of view of knowing the true problems, dynamics and prospects for the development of an object of any territorial rank.

Thus, the EGP of the regions is ambiguous and varies from very convenient to very inconvenient. Territories with a more favourable EGP are developing better and faster. The use of the region’s EGP data facilitates its assessment and allows us to determine negative and positive aspects of the socio-economic development of the region, to make a forecast for the further development of a particular region.

References
[1] Sokolov S N 2015 Economic and geographical position as a socio-economic resource of the regions of the Russian Federation In the World of Scientific Discoveries 9-4(69) pp 1528-38
[2] Druzhinin A G 2009 Global Positioning of the South of Russia: Factors, Features, Strategies (Rostov-on-Don: Southern Federal University Press) p 288
[3] Golubchik M M 2004 Economic and geographical position of Saransk: characteristic features and problems of using the potential Regional Studies 2(4) pp 99-102
[4] Baklanov P Ya and Romanov M G 2009 Economic, Geographical and Geopolitical Position of Pacific Russia (Vladivostok: Dalnauka) p 168
[5] Leyzerovich E E 2006 Basic components of the economic and geographical position of countries and regions Izvestia of the Russian Academy of Sciences. Geographical series 1 pp 9-14
[6] Bezruckov L A 2005 Transport and geographical continentality of Russia: transport capacity of the economy and adaptive consequences Izvestia of the Russian Academy of Sciences. Geographical series 3 pp 48-55
[7] Treivish A I 2009 City, District, Country and the World. The Development of Russia through the Eyes of a Country Scientist (Moscow: New chronograph) p 372
[8] Zemtsov S P and Baburin V L 2016 Assessment of the potential of the economic and geographical position of the regions of Russia Economy of the Region vol 12(1) pp 117-38
[9] Smirnyagin L V 1998 Russian Federalism: Paradoxes, Contradictions, Prejudices (Moscow: MONF) p 72
[10] Moskalkov S P 2004 Spatial and temporal aspects of the economic and geographical position of industrial territorial systems Regional Studies 2(4) pp 90-8
[11] Baransky N N 1980 Selected Works. The Formation of Soviet Economic Geography (Moscow: Mysl) pp 128-59
[12] Maergoiz I M 1986 Territorial Structure of the Economy (Novosibirsk: Nauka, Siberian Branch) p 303
[13] Sabitov R K 1997 On the assessment of the transport and geographical location of the regions of Russia Regional Policy and Regional Economy (Yekaterinburg) pp 73-80
[14] Tkachenko G G 2014 Economic and geographical position as a factor of integration of the subjects of the Russian Far East with the countries of Northeast Asia Regional Studies 3(45) pp 42-50
[15] Blanutsa V I 2016 Deployment of the Information and Communication Network as a Geographical Process (on the Example of the Formation of the Network Structure of the Siberian Post) (Moscow: INFRA-M) p 246
[16] Blanutsa V I 2015 Economic and geographical position: generalization of conceptual attitudes and generation of new meanings Geography and Natural Resources 4 pp 7-16
[17] Sokolov S N and Kuznetsova E A 2019 The permeability of borders and the transport and geographical position of the territory Geography and Natural Resources S5(159) pp 133-8