DOI: 10.15838/esc.2017.3.51.8
UDC 339.9, LBC 65.5

Potential for Asia-Pacific Countries Innovative Development*

Natalia Victorovna
KUZNETSOVA
Far Eastern Federal University
Vladivostok, Russian Federation, 8, Sukhanov Street, 690950
E-mail: ipatovanat@mail.ru

Ekaterina Victorovna
KOCHEVA
Far Eastern Federal University
Vladivostok, Russian Federation, 8, Sukhanov Street, 690950
E-mail: kochevaev@mail.ru

Abstract. The relevance of the chosen topic is determined by the new geo-economic situation. Since the end of the 20th century, the vector of global economic development has shifted towards the Asia-Pacific region. Russia's economic entry to the Asia Pacific region is a necessary condition for its internal sustainability and competitiveness on the international stage. The purpose for the research is to assess the level of innovative and technological development in Asia-Pacific countries with further clustering. Integrated assessment remains understudied, in particular, in the context of Asia-Pacific market. The authors estimate innovative activity of 42 Asia-Pacific countries during 2008–2013 (252 observations), built regression models, use their own methodology for clustering Asia-Pacific countries

* The research results were obtained in the framework of the state order of the Ministry of Education of the Russian Federation in science, Order no. 26.1478.2014/K "Structural transformations of the Russian economy through integration into Asia-Pacific markets".

For citation: Kuznetsova N.V., Kocheva E.V. Potential for Asia-Pacific countries innovative development. *Economic and Social Changes: Facts, Trends, Forecast,* 2017, vol. 10, no. 3, pp. 150-170. DOI: 10.15838/esc/2017.3.51.8

by level of innovation development in 2008–2013 according to indicators of innovative activity. The study identifies the most significant factors the changes in which have a positive impact on innovative development of a country: "human potential factor", "factor of innovative development", "factors facilitating (impeding) the development of human abilities". The research proves the role of human potential as the most meaningful factor in assessing the level of innovative-technological development of countries measured by indicators such as: per capita GDP, higher education enrolment rates, costs of R&D, engineers and researchers in R&D, demographic burden on the working-age population and life expectancy, investments and internet users. An increase in the above indicators in a particular country will lead to its efficient innovative development. The main area of state policy in terms of increasing economic potential is primarily stable growth of industrial production and significant annual GDP growth as a basis for increasing the level of financial self-sufficiency and economic independence. The use of the proposed set of indicators implies the study of factors which have the greatest impact on the integrated assessment of the level of innovative development of a country. The built regression models help use the identified factors with a positive impact on the outcome indicator, which will significantly influence the level of innovative development of a country in the long run.

Key words: innovative development, Asia-Pacific Region, regression analysis, patents, clustering, human potential.

Nowadays researchers consider the Asia-Pacific region as one of the most promising regions for future integration. The relevance of this study is determined, firstly, by the necessity of Russia's transition to innovative development as the only way to make its economy competitive and to enter the global community on equal terms. Secondly, such a transition requires the use of comparative advantages of the domestic economy related to the Eastern area of its foreign economic relations, especially in terms of economic and political issues.

Issues of theoretical and methodological justification of industrial market estimation and forecasting in Asia-Pacific countries are currently poorly researches, especially in terms of determining the properties and variables influencing economic performance. International economy is going through "tectonic" transformations which change its configuration. Previously, the term "developing countries" was used as a synonym for "backwardness", but now this concept is replaced by a new definition – emerging – "rising" economies. In light of this, there is a need for Russia's further critical reflection on opportunities related to the recovery of these economies.

The scientific significance of addressing the issue at this research stage is to develop theoretical and methodological foundations of the research, assess the dynamics of sectoral markets of Asia-Pacific countries with regard to potential of the Russian economy.

Modern strategy of Russia's development is based on the principles of protecting national interests in the long term. In this context, the issue of new quality of economic development of the Russian economy from the point of view of achieving strategic goals and reducing the gap between the developed countries has been discussed for many years. In fact, the only result of this controversy to date is the recognition that to address the issues Russia is facing in the medium and long term, a high level of economic development must be ensured. As for opportunities and ways of achieving this goal, the need for fundamental restructuring of the management system and finding new mechanisms of the country's competitiveness through effective collaboration with Asia-Pacific countries. A lot remains to be done, primarily, in the context of studying the issues of integration of the Russian economy into sectoral markets of Asia-Pacific countries. However, these opportunities have not yet been fully comprehended, the mechanism for their implementation has not been developed. *Comprehensive analysis of these issues has not yet been conducted.*

New, breakthrough scientific results are possible after defining the specific features of the Russian economy – relatively high natural resource security. In this regard, there are discussions which oppose resource-based economy to innovative economy and estimate potential location of innovation development institutions in territorial and sectoral aspects.

The most popular view is that innovative development will break the resource deadlock of the Russian economy. This view is supported by most economists and politicians.

The opposite point of view, based on the Heckscher–Ohlin theorem, is sharply criticized. The theorem determines that a relatively high resource security of the Russian economy should be taken into account in innovative development. In other words, innovation in the Russian economy will pay off only in primary industries.

The presented points of view, despite their mutually exclusive nature, can be reduced to a common denominator. It is related to integration of the Russian economy into sectoral markets of Asia-Pacific countries and development of structural transformation of the Russian economy which would take into account the possibility of using innovation development impulse from this integration.

It should be comprehended that the economic prospects of the Asia-Pacific Region are not unique, so they are discussed by many authors. Some authors write that the East Asian community is acting against in the interests of creating a common East Asian identity and pursue the aims of particular states [21]. In different periods, the authors point to the low level of economic integration in the Asia-Pacific Region due to lack of highly developed regional institutionalization processes. Asia-Pacific Economic Cooperation (APEC) is described as the most successful regional association among the others [9, 10, 20]. For many observers, the Asia-Pacific Region is the epitome of Asian regionalism where integration is inefficient. Various authors note the possibility of replacing formal processes of regional economic integration institutionalization [17, 18], both inside and outside the region [15].

The history of institutionalization of integration processes shows that significant efforts have been made to build a strong institutional environment for the development of regional economic relations in post-war East Asia, but these efforts were not successful [12]. The fact that integration in the Asia Pacific Region will increase the potential benefits for the country due to conserving on the scale by expanding export industries [10, 14, 29], reduce transaction costs between contracting parties and reduce the importance of political negotiations [30], is the subject of many economic discussions. A number of authors note that cross-border banking operations in the Asia-Pacific Region, which began to increase in the past decade, could be considered a sign of major integration processes in the region. But it is represented in the form of dollar flow from the US to Europe and then to the Asia-Pacific region and back to the US through major mediators —European banks [8]. However, after the crisis, European banks are openly hampering the banks of Asia-Pacific countries [11, 13, 28, 31].

The ambiguous interpretation of integration processes in the Asia-Pacific region was the impetus which results in the need to evaluate the potential and the actual state of integration processes in the region based on innovative potential.

The above presented studies largely cover the issues of evaluating market production capacity; however, the issues of integrated assessment of potential remain underdeveloped, in particular, a set of market in the Asia-Pacific region.

The often used thesis that Russia is already present in the Asia-Pacific region has determined the authors' scientific interest to test this statement. As a result of studying the possibilities of Russia's integration into Asia-Pacific markets, the authors identified very low trade exchange among Asia-Pacific countries. Judging by trade relations, the authors exclude South Asia, TLA countries, Oceania, Indochina, Russia, Mongolia, and North Korea from the Asia-Pacific region. The remaining are: the US, Northeast Asia (without Russia, North Korea and Mongolia), ASEAN countries, Canada, Australia and New Zealand, i.e. 15 countries [22]. The differences and similarities in the sectoral GDP structure do not affect the increase in the volume of mutual trade between partner countries. Empirical analysis of Asia-Pacific countries confirmed that in this case, formation of trade blocks does not entail the increase in mutual trade flows. This proves that many of the trading blocks are formed as a result of a political decision, rather than an objective economic process. The success of the currently existing organizations can be put under question. Analysis showed that the stated objectives of any organization were not fully achieved. Moreover, social, political and cultural spheres were largely involved; however, the economic sphere demonstrates less cooperation. Statistics confirm the thesis that most Asia-Pacific countries are not of any trade value neither to each other, nor to other Asia-Pacific sub-regions. Their integration potential is not mentioned in the present paper. Some of the economic trends can only be applied to two sub-regions: Northeast Asia and ASEAN region, including, of course, the United States which, due to their global impact are the most important economic factor in all parts of the globe, including the specified sub-regions [23, 24].

Assessment of the current state of integration processes in the Asia-Pacific region by country and sector showed that there are differences in the level of economic potential, natural resource security, population, cultural, religious and other traditions. A lot of time will pass before the Asia-Pacific region is identified as a region according to similarity of all characteristics. Cluster analysis of Asia-Pacific countries has shown that these countries cannot be considered a single organized community. The Asia-Pacific region is demonstrating extreme fragmentation in development [25, 26]. The country areas of developing promising partnership for Russian business of greatest interest are Chinese, Korean, Japanese, Vietnamese, and Australian destinations.

Further research in this area should be focused on detecting the gap between the absolute and the current market potential taking into account both quantitative and qualitative indicators, which will ensure the understanding of directions of cross-country market integration from the perspective of innovative development.

There is no consensus on defining the list of Asia-Pacific countries; there is only a conditional classification of its member economies, so the authors include the following countries in Asia-Pacific region: Australia, Brunei, Vanuatu, East Timor, Vietnam, Guatemala, Honduras, Hong Kong, Indonesia, Cambodia, Canada, China, Colombia, Costa Rica, Macau, Malaysia, the Marshall Islands, Mexico, Micronesia, Nauru, Nicaragua, New Zealand, Palau, Panama, Papua New Guinea, Peru, Russia, Taiwan, South Korea, El Salvador, Samoa, Singapore, Solomon Islands, Thailand, Tonga, Tuvalu, the USA, Fiji, the Philippines, Chile, Ecuador, Japan, Myanmar, Mongolia, Nepal, India, Sri Lanka, Bangladesh, North Korea, and French Polynesia.

Nowadays there are different approaches to assessing the level of innovative-technological development of the country and its regions in domestic and international practice. Amid the establishment of innovative economy the main factors in socio-economic development include technological development, innovation creation and use, intellectual property. In order to identify potential opportunities and growth areas of the economic system it is necessary to find and use the methods of complex estimation of innovative potential of the country. Domestic and foreign science uses different methods of estimating innovative potential of the country (region).

The issue of measuring and evaluating innovative potential is covered by researchers of various international schools and scientific organizations. In particular, these include the Organization for Economic Cooperation and Development (OECD), the European Commission on Innovation, research units of the World Economic Forum and the World Bank, the UN Industrial Development Organization (UNIDO), etc. Methods and approaches to assessing innovative potential developed by these organizations are widely used for various purposes (*Tab. 1*).

Table 1. Methods of assessing country's innovative development

Indicator	Description
Technological capacity index *(World Economic Forum – WEF)*	Integrated index of assessing the level of the country's competitiveness depending on three categories of variables: macro-economic environment, public institutions and technology.
Integrated index of innovative development *(Organization for Economic Cooperation and Development – OECD)*	Applied to analyze the level and development dynamics of innovative economy of developed and developing countries. The OECD methodology presents the following indicators: the share of high-tech economic sector in manufacturing and services; innovative activity; investment in the knowledge sector (public and private); development and production of information and communication equipment, software products and services; number of employed in science and high tech, etc.
System of indicators to measure *Eurocomission* innovative activity	The technique is used for comparative analysis of the level of innovative activity development in the European Union (EU), as well as for its comparison with indicators of the US and Japan. The system includes 16 indicators divided into four groups: human resources; knowledge generation; knowledge transfer and use; innovation financing, innovative activity results.
European Innovation Scoreboard (EIS) Index	The index is based on three blocks: opportunities, business activity and results.
Knowledge Economy Index (World Bank methodology *in the framework of Knowledge for Development (K4D)* program	It represents the mean value of four indicators: economic incentive and institutional regime, education and human resources, innovation system, information and telecommunication technology.
Index of Russian regions' innovativeness *(Independent Institute for Social Policy project)*	The calculation of the index is based on a set of five factors expressed by relative indicators: share of employees engaged in research and development in the total number of employed in economy; number of university students per 10 thousand people; number of registered patents per 1,000 people employed in economy; costs of technological innovation per 1 person; level of IT development.
Level of scientific development and introduction of technological advances in the region *(Expert RA rating Agency)*	The indicators used for analysis: share of innovation-focused enterprises, share of innovative products in the total production volume, costs of research.
Source: [1, 2, 5, 16, 19, 27, 32, 34, 35].	

The whole range of techniques for assessing the country's innovative development is not limited to this set of indicators. However, the used techniques for assessing the country's innovative development have certain disadvantages limiting their practical use. These include imperfect regional statistics as a number of indicators at the regional level are not calculated; therefore the differentiation factor is not taken into account. National indices take into account the country's specific characteristics. Indices of international organizations are largely comparable as they are based on common techniques.

It is worth noting that the assessment of the country's innovative development does not focus on people's level and quality of education and their wealth necessary to meet their need for benefits and socio-economic conditions affecting human potential in all its diversity. Given the current trends, nowadays it is advisable to use the integrated approach to studying the country's innovative development and defining the role of a human in it. Thus, from the point of view of innovative development, the contribution of human potential is determined by its influence as a source of new ideas and innovations.

In our study, we propose an approach to determining the actual areas of innovative development taking into account human development in countries with different levels of socio-economic development. Special attention is paid to the system of indicators giving information on the country's level of innovative development. The practical use of the proposed set of indicators involves the study of factors having the greatest impact on the integrated assessment of the country's level of innovative development.

Quantitative assessment of the volume and efficiency of innovative development is quite difficult because of the limited statistical information in terms of regional and country aspects. The main measure of innovative activity in foreign economic literature is the number of patent applications; for comparison: some Russian studies use the indicator "number of innovation-focused enterprises" [3, 6, 7]. Thus, the choice of a measure indicator is up to the researcher.

We agree with the opinion of foreign researchers that patents more accurately reflect the state of the scientific research sector as the main source of new knowledge and innovations than the number of innovation-focused enterprises. It is the number of patent applications that reflects the effectiveness of innovation-focused enterprises. Of course, their innovative activity has an impact on the country's and regions' innovative development and is determined by a large number of factors.

The choice of factors influencing the country's innovative development was made by using regression analysis techniques. The number of residents' and nonresidents' patent

Table 2. Indicators of country's innovative activity

Legend	Indicator
GDPpc	GDP per capita, by Purchasing Power Parity (PPP) in current international dollars
EDU_GDP	Public expenditure on education, % of GDP
EDU_H	Gross higher education enrollment rate, in %
RgD	Expenditures on R&D, in % of GDP
IMP_HT	Imports of high-tech goods, in % of the total amount of imports
EX_HT	Exports of high-tech goods, in % of industrial exports
IT_SERV	Information and communication services. Protected Internet servers, per 1 million people
SAJ	Articles in scientific and technical journals, number
IT_US	Internet users, per 100 people
TECH_RgD	Engineers in R&D, per 1 million people
RES_RgD	Researchers in R&D, per 1 million people
HEALTH_GDP	Public and private expenditures on healthcare, in % of GDP
TDR	Dependency rate, number of people aged 0–14 and those aged 65 and over per 100 people aged 15–64
LEB	Life expectancy at birth, years
INV_OUT	Foreign direct investment, net outflow, in % of GDP
INV_IN	Foreign direct investment, net inflow, in % of GDP
U_EMPL	Unemployment rate, in %
Source: compiled by the author.	

applications per 100 thousand people (Patent) serves as a dependent variable characterizing the country's innovative activity.

The regressors are the following (*Tab. 2*).

The regression equation was estimated by 42 countries in the Asia-Pacific region in 2008–2013 (252 observations). The rest of the countries were not sampled due to lack of data on certain key indicators. The information base for the research is World Bank statistics [4; 33].

It is obvious that in Asia-Pacific countries there is a sufficiently high differentiation both by indicators of socio-economic development and indicators of innovation and technological development. ***In the present study, Asia-Pacific countries are classified into homogeneous groups using cluster analysis.*** During cluster analysis, each Asia-Pacific country was represented by a vector in a 17-dimensional space of factors (*Tab. 3*). In general, similar territorial zones called clusters have been identified by using the system of indicators characterizing the country's level of innovative activity.

Cluster *A* in 2013 included 8 Asia-Pacific countries (19% of the total number of countries). This cluster is formed by countries

Table 3. Grouping of Asia-Pacific countries by level of innovative and technological development in 2008 and 2013

Results of clustering at the beginning of the period under review (2008)	Results of clustering at the end of the period under review (2013)
Cluster A	
Australia, Canada, New Zealand, South Korea, Japan, Singapore, Hong Kong, the USA	Australia, Canada, New Zealand, South Korea, Japan, Singapore, Hong Kong, the USA
Cluster B	
Brunei, China, Russia, Macau, Malaysia, Mexico, Thailand, Chile, Panama	China, Costa Rica, Macau, Malaysia, Mexico, Russia, Thailand, Chile, Mongolia
Cluster C	
Costa Rica, Vietnam, India, Indonesia, Colombia, Mongolia, Peru, Fiji, Ecuador, the Philippines	Brunei, India, Indonesia, Colombia, Panama, Peru, El Salvador, Fiji, the Philippines, Vietnam, Ecuador
Cluster D	
Vanuatu, Guatemala, Honduras, Cambodia, Micronesia, Papua New Guinea, Samoa, Solomon Islands, East Timor, El Salvador, Nicaragua, Tonga, Nepal, Sri Lanka, Bangladesh	Vanuatu, Guatemala, Honduras, Cambodia, Micronesia, Nicaragua, Papua New Guinea, Samoa, Solomon Islands, East Timor, Sri Lanka, Bangladesh, Nepal, Tonga
Source: compiled by the author.	

leading in indicators of innovative development. GDP per capita of these countries is 48054,53 international dollars by PPP, indicating a fairly high level of socio-economic development. Indicators intellectual potential are also at a high level: the countries' average higher education enrollment rate is 68% with an average of 819 and 4946 engineers and researchers in R&D per 1 million people respectively. The number of publications in scientific journals by the end of 2013 averaged 43233,6. These countries had an average of 192 patent applications patents per 100 thousand people. All this, of course, indicates high innovative activity of the countries included in the cluster. During the period under review the group has not changed.

Cluster *B* at the end of 2013 included 9 Asia-Pacific countries (21% of the total number of countries). These countries are in the "middle" position regarding countries from other clusters. Cluster *B* countries demonstrate rather high GDP per capita: the average of 26465,91 USD by PPP (in current international dollars), which characterizes them as countries with prosperous standard of living and quality of life. As for the values of key indicators of innovative development, these countries have the average of 20.8 patent applications per 100 thousand people. In cluster *B* countries in 2013 there was a high share of imports of high-tech products – an average of 13.5% of the total amount of goods. At the same time there was a high share of high-tech exports – an average of

20.1% of industrial exports, mainly due to Costa Rica (43.3%) and Malaysia (43.6%). In 2013, these countries were allocated an average of 4.6 and 0.8% of GDP respectively for education and R&D. The average higher education enrollment rate was approximately 53.5%. During 2008–2013, the quantitative composition of the cluster slightly changed: Brunei left Cluster *B* and moved to Cluster *C*; while Costa Rica improved its position became part of Cluster *B*. Thus, countries of Cluster *B* rank second by innovative development and intellectual capacity compared to other homogeneous groups of Asia-Pacific countries.

Cluster *C* in 2013 included 11 Asia-Pacific countries (26% of the total number of countries under study). The main characteristic of these countries is that their level of innovative development is below average. This is evidenced by a small number of patent applications – 2.4 per 100 thousand people, and the number of articles in scientific journals – 2226, as well as a small number of engineers and researchers in R&D – 106 per 1 million people. In countries of this cluster high-technology exports exceed their imports, the average increase amounted to 20% (except Colombia, Peru, Panama and Ecuador). Public expenditures on education in the countries of this group averaged 3.7% of GDP, but it is worth noting that Vietnam is the leader the value of which is 6.6% of GDP. Public expenditures on R&D are more stable and range on average around 0.2% of GDP. By level of socio-economic development these countries differ from other clusters: they are characterized as more or less sustainable. The value of GDP per capita is on average 16330.4. USD by PPP (current international dollars), which is almost 2 times lower than the average value in Cluster *B*. The average gross higher education enrollment rate is 32.1% along with the small number of Internet users – 40 per 100 people.

During 2008–2013 cluster *C* underwent some changes: in 2008, the cluster consisted of 10 countries; during the period under review Costa Rica and Mongolia improved their ratings by some indicators of innovative development and moved to cluster *B*. The negative trend of declining indicators of innovation activity was observed in Brunei (the number of patent applications during the period under review decreased from 19.7 to 2.6 per 100 thousand people); there was also a decline in publication activity. Thus, the level of innovative development of cluster *C* countries can be described as below average.

In 2013, cluster *D* consisted of 14 Asia-Pacific countries (34%). These countries differ considerably from the countries of all other clusters in terms of innovation development, as well as by indicators of human potential. This cluster demonstrates lowest indicators of innovative activity (number of patent applications amounted to an average of 0.980 per 100 thousand people; the number of publications in scientific journals is also at the lowest level compared to other clusters – 10 units). This group is also characterized by the lowest higher education enrollment rate – an average of 12.9%, and the lowest number of researchers and engineers in R&D. Cluster *D* countries have highest unemployment rates (on average, 11.3%) compared to other clusters, and the lowest rate of GDP per capita – 4729.1 international dollars by PPP. During the period under review, the cluster has slightly changed due to the fact that El Salvador moved to the group of countries with better indicators of innovative development. Thus, cluster *D* countries are characterized as countries with the lowest level of innovation and human development in the Asia-Pacific region.

The results of clustering show high differentiation among Asia-Pacific countries in terms of innovation development; this is due to several factors: geographical position, climate, economic and labor market development, demographic and social characteristics. In this regard, it seems appropriate to introduce a dummy variable which will take into account the specific features of each country. Let us present the countries' specification (country's belonging to a particular cluster) with binary features (*Tab. 4*).

Through correlation analysis we determine the correlation between the outcome indicator and factor features. To exclude the effect of multicollinearity and reduce the dimension of initial indices the current study implements factor analysis through principle component analysis.

Table 5 shows that eigenvalues of the first three principal components are more than one, so they are preserved for further analysis. They explain 75.7% of initial feature variance. *Figure 1* shows the composition of each component.

Conventionally, the first component *(F_1)* can be called "human potential factor": GDP per capita – reflects the level of material well-being; gross higher professional education enrollment rate – the literacy rate; life expectancy at birth – the level of social welfare. It should be noted that these indicators are

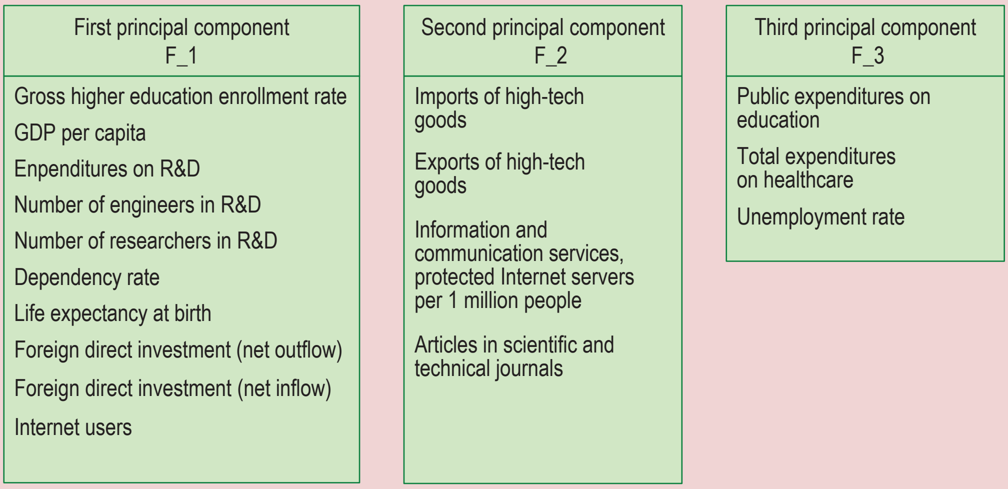
Table 4. Replacement of qualitative parameters of a regression model with binary features

Binary variables			Belonging to a cluster
Cluster *A*	Cluster *B*	Cluster *C*	
1	0	0	Cluster *A*
0	1	0	Cluster *B*
0	0	1	Cluster *C*
0	0	0	Cluster *D*
Source: compiled by the authors.			

Table 5. Value of principal components and the share of explained variance of features

No. of component	Principal component symbol	Principal component eigenvalue	Explained variance, %	Cumulative fraction explained variance, %
1	*F_1*	6.003	42.343	42.343
2	*F_2*	3.256	19.991	62.334
3	*F_3*	1.789	12.855	75.189
Source: compiled by the authors.				

Figure 1. Composition of principal components



included in the integrated index – Human Development Index, according to the UN methodology. Moreover, the index includes indicators characterizing the number of specialists in R&D. The dependency rate reflects the level of population ageing and the number of people of working age with accumulated potential. Direct foreign investment is also important for the formation of human capital as targeted capital investment in different sectors and industries contribute to the improvement of the population's welfare. Most indicators are related to the first principal component by direct correlation, i.e. if values of these indicators are increased, according to the calculations, the component value is increased, except for dependency rate, which indicates the decreasing component value amid the increasing indicator. Variance of the first principle component is 42.3%.

The second main component *(F_2)*, the variance of which is 19.991%, includes indicators of country's innovative development; it is conventionally called "factor in innovative potential". The indicators included in the second principal component are directly correlated indicating an increasing *F_2* amid the growth of the underlying factors.

The variance of *F_3* amounts to 12.855% of the total variation. Indicators of the third principal component can mostly be described as factors in development of human capacity. Public expenditures on education and healthcare have a positive correlation with the component; the unemployment rate – negative. Measures to reduce unemployment and tensions on the labor market carried out by the government in any country will definitely affect the economic growth, which will result in the increasing quality of life and the standard of living and, of course, will have a positive impact on the development of human capacity and innovative thinking. All of the above will also have a major impact on the level of the country's long-term innovative development.

Next we build a regression dependence model based on the outcome indicator of the selected factors (*Formula 1*). The regression model includes dummy variables which help take into account the country's belonging to a certain cluster:

$$y = 143{,}98 + 12{,}83F\_1 + 8{,}86F\_2 + \\ + 1{,}32F\_3 - 142{,}68Cl\_A - \\ - 132{,}08Cl\_B - 124{,}63Cl\_C \qquad (1)$$

The dependence of the number of patent applications from the factors for countries in each cluster will be described by the following equations:

For the countries of cluster *A*:

$$y = 143{,}98 + 12{,}83F\_1 + 8{,}86F\_2 + 1{,}32F\_3 - 142{,}68Cl\_A;$$

For the countries of cluster *B*:

$$y = 143{,}98 + 12{,}83F\_1 + 8{,}86F\_2 + 1{,}32F\_3 - 132{,}08Cl\_B;$$

For the countries of cluster *C*:

$$y = 143{,}98 + 12{,}83F\_1 + 8{,}86F\_2 + 1{,}32F\_3 - 124{,}63Cl\_C;$$

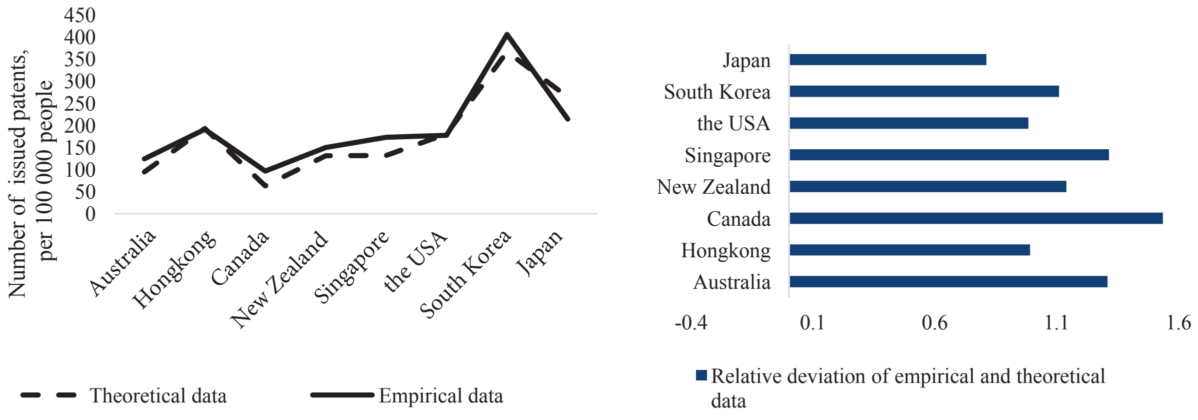
For the countries of cluster *D*:

$$y = 143{,}98 + 12{,}83F\_1 + 8{,}86F\_2 + 1{,}32F\_3.$$

Figures 2–5 present empirical and simulated values of the number of patent applications in the countries of clusters *A, B, C, D* at the end of 2013. The graphs also present the relative deviation of the simulated values of the outcome indicator from empirical data. The models can be used for predicting key performance indicators and identifying the main trends in the outcome indicator.

To identify priority areas of innovative development for the countries of cluster *A* we rate the main factors included in the first principal component *F_1* and contributing to the change in the outcome indicator for the countries in this group. Through stepwise regression for the countries of cluster *A* we have identified four important factors: R&D expenditures *(RgD)*; public and private expenditures on healthcare *(HEALTH_GDP)*; public expenditures on education

Figure 2. Number of patent applications in the countries of cluster *A* at the end of 2013



Source: calculated by the authors.

Table 6. Evaluation of factors contributing to the change in the outcome indicator for the countries of cluster *A*

Model	Non-standardized index	Standardized index	Indicator importance
	B	*Beta*	*P-level*
Constant	44.770352	–	0.01120
RgD	73.700571	0.930890	0.00000
HEALTH_GDP	14.224475	0.805795	0.00000
EDU_GDP	0.692993	0.248387	0.00600
TECH_RgD	0.039370	0.246965	0.00100
Source: compiled by the authors.			

(EDU_GDP); engineers in R&D *(TECH_RgD)*. These factors explain 72% of the total variance of the value of the number of patent applications. Factor estimates are presented in *Table 6*.

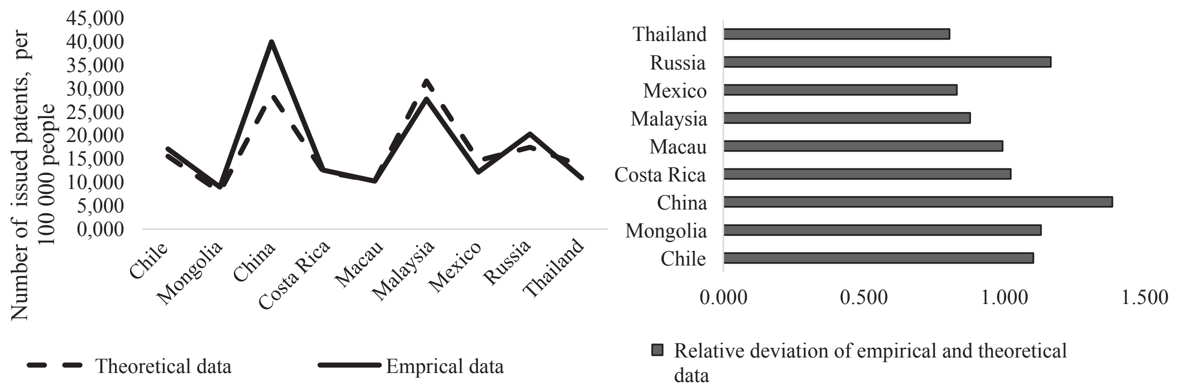
Table 6 shows that ***the amounts of investment in R&D and public expenditures on healthcare have the greatest impact on the results of innovative activities in the countries from cluster A.*** This cluster includes leading countries of the Asia-Pacific region in terms of economic, innovative and human potential development. Ultimately, if the results of economic development in the countries of this cluster are forwarded to maintaining the achieved results in innovation, as well as to maintaining an adequate standard of living and quality of life, it will lead to building innovative potential and economic growth.

The regression model for the countries from cluster *B* is as follows (*Fig. 3*).

As a result of decomposition of "human potential factor" *(F_1)* the most significant indicators are highlighted: net inflow of foreign direct investment *(INV_IN)*, researchers in R&D *(RES_RgD)* and the number of articles in scientific and technical journals *(SAJ)*. These factors explain 79% of the total variance in the outcome indicator. Parameter estimates are presented in *Table 7*.

The table shows that ***the researchers' publication activity and the number of researchers in R&D have the greatest impact on the results of innovative activities in the countries from cluster B.*** These countries can be described as effectively-oriented since their competitiveness is achieved through market efficiency and ability to benefit from the existing technology. ***These countries experience the need to stimulate scientific potential and innovative activity of research and scientific organizations. Attention should also be paid to***

Figure 3. Number of patent applications in the countries of cluster *B* at the end of 2013



Source: calculated by the authors.

Table 7. Evaluations of factors contributing to the change effective indicator for the countries of the cluster In

Model	Non-standardized index	Standardized index	Indicator importance
	B	*Beta*	*P-level*
Constant	2.589210	–	0.00711
SAJ	0.000519	0.889209	0.00000
RES_RgD	0.003984	0.599207	0.00000
INV_IN	0.907935	0.111984	0.00000
Source: calculated by the authors.			

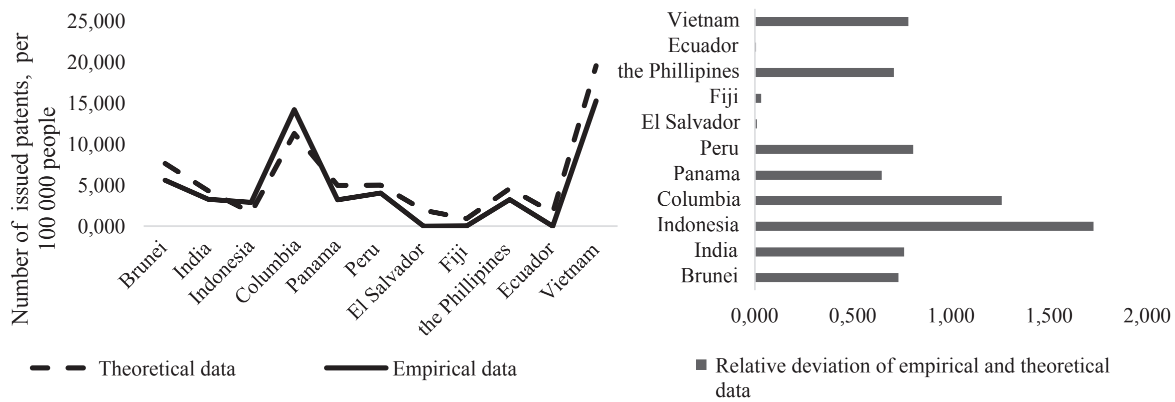
attracting investment in science and education for increasing innovative potential of the countries in this cluster.

For the countries of cluster *C*, the simulation results of the number of patent applications are shown in *Figure 4*.

The figure shows that the theoretical model does not contradict empirical data given the trend of innovative development of the countries in this cluster. We also define priority areas by highlighting the main factors contributing to the change in the outcome indicator in the countries of this cluster.

Through stepwise regression for the countries of cluster C we have identified four important factors: researchers in R&D (RES_RgD); GDP per capita (GDPpc); dependency rate (TDR); higher education enrollment rate (EDU_H). These factors explain 66% of the total variance of the number of patent applications (*Tab. 8*).

Figure 4. Number of patent applications in the countries of cluster *C* at the end of 2013



Source: calculated by the authors.

Table 8. Evaluation of factors contributing to the change in outcome indicator for the countries of cluster *C*

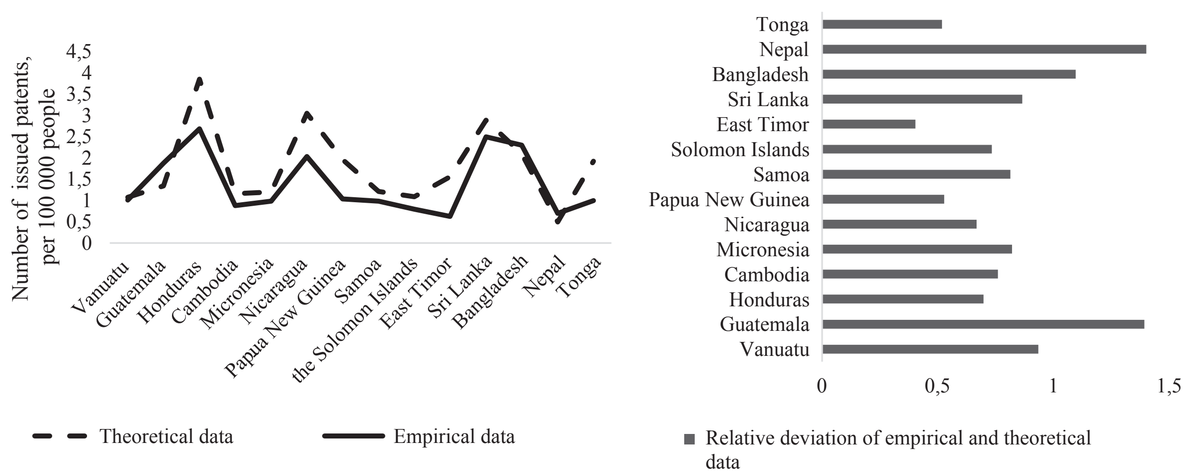
Model	Non-standardized index	Standardized index	Indicator importance
	B	*Beta*	*P-level*
Constant	8.907542	–	0.00000
TDR	0.106871	0.607524	0.00401
GDPpc	0.000029	0.298712	0.00900
EDU_H	0.097125	0.222901	0.00153
RES_RgD	0.035971	0.200181	0.00120
Source: calculated by the authors.			

As can be seen from the data, in terms of standardized equation indices, **dependency rate have the greatest impact on the number of patent applications in the countries from cluster C;** *the remaining parameters are sufficiently equivalent. These countries can be characterized as more or less sustainable in terms of socio-economic development.* ***Thus, if the results of economic development in these countries are forwarded to improving demographic indices and developing educational potential, it will lead to significant innovative development.***

The simulation results of the number of patent applications in the total amount of determining factors for the countries of cluster D are shown in *Figure 5*.

Let us outline factors which have the greatest impact on the results of innovation activity by using stepwise regression (*Tab. 9*).

Figure 5. Number of patent applications in the countries of cluster D at the end of 2013



Source: calculated by the authors.

Table 9. Evaluations of factors contributing to the change in the outcome indicator for the countries of cluster *D*

Model	Non-standardized index	Standardized index	Indicator importance
	B	*Beta*	*P-level*
Constant	1.777298	–	0.00013
RES_RgD	0.049981	0.552987	0.00030
TDR	0.125871	0.378120	0.00013
RgD	8.001578	0.232487	0.01500
Source: calculated by the authors.			

The table shows that the number of researchers in R&D, dependency ration and investment in R&D have the greatest impact on the number of patent applications in the countries from cluster D. **The priority area of economic development in these countries is building educational and scientific potential.** Countries in this cluster may be classified as resource-based (focus on natural resources and low-skilled labor). These countries do not have a developed system of education, and high-skilled workers are available due to migration processes. These countries are experiencing acute problems of migration outflow which affects demographic indicators. **Thus, these countries need to implement programs aimed at social development, reduction of unemployment and improvement of the quality of educational and scientific potential.**

The study identified the most significant factors the changes in which are beneficial for the country's innovative development: "human potential factor" which characterizes human development in terms of demographic indicators, reflects the population's satisfaction with material benefits and determines its level of self-sufficiency; "innovative development factor" which characterizes the level of innovative and technological development and the country's intellectual potential; "factors facilitating (impeding) the development of human capacity" which accumulate various economic conditions to implement people's potential.

In general, we can conclude that the constructed models provide a visual representation of groups of factors influencing the level of innovative and technological development in a particular country. **The study proved the role of human potential as the most significant factor in assessing the level of countries' innovative and technological development measured by indicators such as: GDP per capita, higher education enrollment rate, expenditures on R&D, number of engineers and researchers in R&D, dependency rate and life expectancy at birth, investment and Internet users.** Therefore, the increase in the above indicators in a particular country will lead to effective innovative development.

With the help of the developed system of indicators it is also possible to develop the priority areas of the countries' innovative development. We also point to the necessity of implementing a set of measures for developing innovative potential of the society, stimulating economic activity, which is reflected in the incomes of different population groups for meeting their needs and developing creativity ultimately leading to innovative achievements. The main area of the state policy in terms of increasing economic potential is primarily stable growth of industrial production and significant annual growth of GDP as the basis for increasing the level of budgetary self-sufficiency and economic independence.

References

1. Gritsenko S.V. Regional'nyi indeks innovatsii kak instrument izucheniya innovatsionnoi aktivnosti oblastei Tsentral'nogo federal'nogo okruga / S.V. Gritsenko [Regional index of innovations as an instrument of studying of an innovative activity of the areas of the Central Federal district]. *Vestnik VGU. Seriya: Ekonomika i upravlenie* [Proceedings of Voronezh State University. Series: Economics and management], 2015, no. 4, pp. 75-85. (In Russian).

2. Kuznetsova Yu. A. Issledovanie podkhodov k opredeleniyu ponyatiya "innovatsionnyi potentsial regiona" [Studying approaches to the definition of "region's innovation potential"]. *Mezhdunarodnyi nauchno-issledovatel'skii zhurnal* [International research journal], 2014, no. 5 (24), part 2, pp. 28-30. (In Russian).

3. Osipova K.V., Savel'eva I.P. Metodicheskie aspekty otsenki innovatsionnogo potentsiala regiona [Methodological aspects of evaluating region's innovation potential]. *Vestnik YuUrGU. Seriya: Ekonomika i menedzhment* [Bulletin of the South Ural State University. Series: Economics and management], 2013, volume 7, no. 3, pp. 182-184. (In Russian).

4. *Ofitsial'nyi sait Vsemirnogo banka* [World Bank official website]. Available at: http://www.worldbank.org. (In Russian).

5. *Ofitsial'nyi sait Agentstva po innovatsiyam i razvitiyu* [Official website of Agency for Innovation and Development]. Available at: http://www.innoros.ru/publications/analytics/12/termin–innovatsiya. (In Russian).

6. Sterzer T.A. Determinanty innovatsionnoi aktivnosti na regional'nom urovne (empiricheskii analiz) [Determinants of innovative activity at the regional level (empirical analysis)]. *Statisticheskie izmereniya i ekonometricheskii analiz* [Statistical measurement and econometric analysis]. Available at: http://www.nsu.ru/exp/ref/Media:4ef1a2788846c8c01300028210. (In Russian).

7. Eminov N.O. Innovatsionnyi aspekt ekonomicheskogo rosta Azerbaidzhanskoi Respubliki [Innovation aspect of economy growth of the Republic of Azerbaijan]. *Kreativnaya ekonomika* [Creative economy], 2012, no. 4(64), pp. 119-124. (In Russian).

8. Avdjiev S., McCauley R., Shin H.S. Breaking free of the triple coincidence in international finance. *BIS Working Papers*, forthcoming. 2015.

9. Aggarwal V.K., Yamazawa I. APEC as an International Institution. *APEC: Its Challenges and Tasks in the 21st Century.* New York: Routledge, 2000. Pp. 298-324.

10. Aggarwal V.K., Ravenhill J. Undermining the WTO: The Case against Open Sectoralism. *Asia–Pacific Issues,* 2001, no. 50. Available at: http://www.eastwestcenter.org/sites/default/files/private/api050.pdf (Accessed: 13.12.2013)

11. Bruno V., Shim I., Shin H.S. Comparative assessment of macroprudential policies. *BIS Working Papers*, 2015, vol. 502.

12. Calder K., Ye M. Regionalism and Critical Junctures: Explaining the «Organization Gap» in Northeast Asia. *The Journal of East Asian Studies,* 2004, vol. 4, no. 2, pp. 191-226.

13. Chantapacdepong P., Shim I. Correlations across Asia–Pacific bond markets and the impact of capital flow management measures. *Pacific–Basin Finance Journal,* 2015, vol. 34, pp. 71-101.

14. Chase K. A. Economic interests and regional trading arrangements: the case of NAFTA. *International Organization,* 2003, vol. 57, no. 1, pp. 137-174.

15. Dent C. Networking the Region? The Emergence and Impact of Asia–Pacific Bilateral Free Trade Agreements. *The Pacific Review*, 2003, vol. 16, no. 1, pp. 1-28.

16. Disruptive Innovation in Financial Services: a blueprint for digital. 2016. *World Economic Forum. Committed to Improving the State of the World,* 2016. 108 p.

17. Ernst D. *Partners for the China Circle? The Asian Production Networks of Japanese Electronics Firms*. Berkeley: BRIE Working Paper 91, 1997. Available at: http://brie.berkeley.edu/publications/wp%20 91.pdf (Accessed: 12.12.2014)

18. Encarnation D.J. Asia and the Global Operations of Multinational Corporations. *Japanese Multinationals in Asia: Regional Operations in Comparative Perspective*. New York: Oxford University Press, 1999. Pp. 3-13.

19. European Innovation Scoreboard. 2016. Methodology Report. *European Innovation Scoreboards (EIS) project for the European Commission*, 2016. 30 p. Available at: http://ec.europa.eu/DocsRoom/ documents/17821.

20. Higgott R. The Pacific and Beyond: APEC, ASEM and Regional Economic Management. *Economic Dynamism in the Asia–Pacific: The Growth of Integration and Competitiveness.* Thompson G. London: Routledge, 1998. Pp. 335-355.

21. Jones D.M., Smith M.L.R. Making process, not progress: ASEAN and the evolving East Asian regional order. *International Security*, 2007, vol. 32, no. 1, pp. 148-184.

22. Kuznetsova N.V. Cluster Analysis of Asian–Pacific Region Countries. *Actual Problems of Economics*, 2015, no. 6(168), pp. 74-83.

23. Kuznetsova N.V. Economic Integration of Northeast Asia. *World Applied Sciences Journal*, 2013, no. 25 (5), pp. 768-773.

24. Kuznetsova N.V. Economic Integration of Russia to the Northeast Asia. *World Applied Sciences Journal*, 2013, no. 27, pp. 180-185.

25. Kuznetsova N.V., Kocheva E.V., Matev N.A. The Analysis of Foreign Trade Activities of Russia and Asia–pacific Region. *International Journal of Economics and Financial Issues*, 2016, no. 6(2), pp. 736-744.

26. Kuznetsova N.V., Kocheva E.V., Matev N.A. Balance of Economic Development of APR Countries. *Journal of Advanced Research in Law and Economics*, 2015, vol. VI, no. 3(13), pp. 584-605.

27. Klowledge for Development (K4D). *The World Bank Institute's program on bulding Economies*. World Bank Institute. 2016. 30 p.

28. McCauley R. De-internationalising global banking? *Comparative Economic Studies*, 2014, pp. 1-14.

29. Milner H. Industries, Governments, and Regional Trade Blocs. *The Political Economy of Regionalism.* Mansfield E., Milner H. New York: Columbia University Press, 1997.

30. Pempel T.J. Restructuring Regional Ties. *Crisis as Catalyst: Asia's Dynamic Political Economy*. Macintyre A., Pempel T.J., Ravenhill J. Ithaca: Cornell University Press, 2008.

31. Remolona E., Shim I. The rise of regional banking in Asia and the Pacific. *BIS Quarterly Review*, 2015, September, pp. 119-134.

32. *The Global Innovation Index 2016. The Global Innovation*. Cornell University, INSEAD, WIPO. 2016. 420 p.

33. *The Global Competitiveness Report 2013–2014*. Geneva: World Economic Forum, 2013. 166 p.

34. Vertesy D. *The Innovation Output Indicator 2016: Methodology update*. European Commission. 2016. DG JRC, COIN.

35. *World Bank Official Web-Site*. KI and KEI Indexes. Available at: http://web.worldbank.org

Information about the Authors

Natalia Victorovna Kuznetsova – Doctor of Economics, Professor, School of Economics and Management, Far Eastern Federal University (8, Sukhanov Street, Vladivostok, 690950, Russian Federation; e-mail: ipatovanat@mail.ru)

Ekaterina Victorovna Kocheva – Ph.D. in Economics, School of Economics and Management, Far Eastern Federal University (8, Sukhanov Street, Vladivostok, 690950, Russian Federation; e-mail: kochevaev@mail.ru)

Received October 07, 2016.