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## Original Paper

doi [10.15826/recon.2018.4.2.006](https://doi.org/10.15826/recon.2018.4.2.006)**Regional inflation in Russia and ways of controlling it****Polina S. Kiseleva***Ural Federal University, Ekaterinburg, Russia; e-mail: p.s.kiseleva@urfu.ru***ABSTRACT**

The article focuses on regional inflation in Russia, showing that there are independent regional factors shaping inflation and that there are considerable discrepancies between the levels of regional and national inflation. There is a need for more effective anti-inflationary policy to ensure stable social and economic development of the country and its regions. The problem, however, is that the instruments of anti-inflationary policy targeted at one type of inflation may act as triggers for another type of inflation. Therefore, for a successful anti-inflationary policy we must first identify the factors that contribute to the development of inflation. Otherwise, the anti-inflation measures may cause a rise in prices rather than help the government maintain them at a lower level. We carried out correlation analysis of the interrelation between the consumer price index and inflation rates over the past few years and found that the cost-related factors play a key role in the inflationary processes in Russia and its regions. Therefore, a conclusion was made that monetary methods alone are ineffective to control inflation and recommendations were given for improving regional anti-inflationary policies.

**KEYWORDS**

inflation, regional inflation, cost factors, natural monopoly, anti-inflationary policy

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Kiseleva, P. S. (2018) Regional inflation in Russia and ways of controlling it. *R-economy*, 4(2), 41–45. doi: 10.15826/recon.2018.4.2.006

**Инфляция в регионах России и пути её контроля****П. С. Киселёва***Уральский федеральный университет, Екатеринбург, Россия; e-mail: p.s.kiseleva@urfu.ru***РЕЗЮМЕ**

Статья фокусируется на региональной инфляции в России и демонстрирует, что существуют независимые региональные факторы, формирующие инфляцию, и что существуют значительные расхождения между уровнями региональной и общенациональной инфляции. Существует необходимость в более эффективной антиинфляционной политике для обеспечения стабильного социально-экономического развития страны и ее регионов. Политика усложняется тем, что инструменты антиинфляционной политики, ориентированные на один тип инфляции, могут вызывать другой тип инфляции. Поэтому для успешной антиинфляционной политики вначале необходимо определить факторы, которые способствуют развитию инфляции. Иначе антиинфляционные меры могут привести к росту цен, а не к их удержанию на низком уровне. В статье был проведен корреляционный анализ взаимосвязи между индексом потребительских цен и темпами инфляции за последние несколько лет и было обнаружено, что факторы, связанные с затратами, играют ключевую роль в инфляционных процессах в России и ее регионах. Поэтому был сделан вывод о том, что одни лишь денежные методы неэффективны для борьбы с инфляцией, и были даны рекомендации по совершенствованию региональной антиинфляционной политики.

**КЛЮЧЕВЫЕ СЛОВА**

инфляция, региональная инфляция, факторы издержек, естественная монополия, антиинфляционная политика

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**Introduction**

Inflation is one of the most acute problems in Russia as it affects the national economy as a whole and individual economic entities. The level of inflation, therefore, is one of the key macroeconomic indicators since it has a direct impact on the cost and quality of life in the country.

Inflation makes calculations more complex and, therefore, leads to mistakes and inaccuracies in financial planning of households and business entities [1]. Even a moderate 5% annual inflation is likely to result in doubling of prices in about 14 years. With the creeping inflation of 11.35%, typical of Russia in 2014, the overall price level

will increase more than 4.5 times in the same period while the inflation which reached the level of 13% in 2015 will lead to a six-time increase in the general price level<sup>1</sup>. The above-described situation makes saving and implementing long-term investment projects particularly difficult.

The study of regional inflation reveals discrepancies in the rates of inflation across Russian regions. We need to identify those regional factors that affect inflation in order to avoid inflationary outbursts in regions and develop an efficient anti-inflationary policy.

### Types and characteristics of regional inflation in Russia

Social and economic development of Russian regions is increasingly uneven and there are considerable discrepancies between inflation rates in different regions [2]. In particular, in 2017, the highest level of inflation was recorded in the Republic of Sakha (Yakutia) – 4.44%, and the lowest – in Dagestan, 1.12%. In 2016, the highest inflation was in the Khanty-Mansiysk Autonomous District (Yugra) – 8.52%, and the lowest, in Ingushetia – 2.6%<sup>2</sup>.

Even more significant differentiation of inflation rates was observed in 2015.

At the end of 2015, the highest inflation was found in the Republic of Crimea – 27.64% (26.4% in the Crimean Federal District), which is more than twice as high as the federal inflation rate (12.91%)<sup>3</sup>. It should be noted that in the case of the Crimea, high inflation stems from the fundamental changes in the region's economy, in particular, its integration into the larger economic space. As a result, the Crimea turned into another subsidized region of Russia. In 2016, the Crimea project was allocated over 40 billion rubles worth of gratuitous revenue from the federal budget, including the subsidies exceeding 20 billion rubles intended to *equalize the budgetary security*<sup>4</sup>. Regarding the amount of gratuitous payments, the Crimea ranks fourth among

other Russian regions, following Dagestan, Sakha (Yakutia) and Kamchatka<sup>5</sup>.

The lowest level of inflation in 2015 was recorded in Khakassia (10.33%), the highest (excluding the Crimean Federal District), in Ingushetia (17.54%). Such statistics show significant discrepancies in the rates of price growth across different regions. Similarly, a significant differentiation of inflation rates was observed in the previous period. In particular, in 2014, the inflation rates ranged from 7.46% in the Yamalo-Nenets Autonomous District to 15.6% in Kaliningrad region<sup>6</sup>.

Regional inflation requires the government to adjust its social and economic policies on the federal and regional levels, including the anti-inflationary policies. Our analysis shows that the cost factors play a key role in inflation processes [3]. If we take a closer look at the dynamics of consumer inflation and price indices (tariffs) of natural monopolies, we will find that these indicators are closely connected and, consequently, that non-monetary factors shape inflation in the entire country as well as in specific regions.

The dynamics of quarterly indicators is especially remarkable in this respect because it allows us to take into consideration the time lag of the impact that various factors have on consumer inflation. Moreover, the analysis of quarterly indicators over the past decade has revealed the following pattern: the highest level of inflation is observed in the quarter characterized by an increase in tariffs of natural monopolies. For example, until 2012, the increase in electricity and heating tariffs as well as utility tariffs occurred in the first quarter (in January), and the highest rate of inflation was also observed in this quarter (Table 1). Since 2012, however, there has been an increase in tariffs in the third quarter, which was also characterized by the highest inflation.

The above-described pattern characterizes only national economy but also specific regions, for example, Sverdlovsk region [4].

In order to ensure long-term price stability, in addition to looking at the regional inflation factors, we should address the problem of the disproportional development of the country's economic space. At present, there are considerable differences in the development of Russian regions in the main macroeconomic indicators.

<sup>5</sup> Official website of the Ministry of Finance of the Russian Federation. Retrieved from <http://minfin.ru>.

<sup>6</sup> Our calculations are based on the data provided by the official website of the Federal State Statistics Service. Retrieved from <http://www.gks.ru>.

<sup>1</sup> Our calculations are based on the data provided by the official website of the Federal State Statistics Service. Retrieved from <http://www.gks.ru>.

<sup>2</sup> Our calculations are based on the data provided by the official website of the Federal State Statistics Service. Retrieved from <http://www.gks.ru>.

<sup>3</sup> Our calculations are based on the data provided by the official website of the Federal State Statistics Service. Retrieved from <http://www.gks.ru>.

<sup>4</sup> Official website of the Ministry of Finance of the Russian Federation. Retrieved from <http://minfin.ru>; Official website of the Ministry of Finance of the Republic of Crimea. Retrieved from <http://minfin.rk.gov.ru>.

Table 1

**Consumer price index in the Russian Federation in 2005–2015, % of the previous period**

| Quarter | 2005   | 2006   | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| I       | 105.27 | 104.98 | 103.42 | 104.78 | 105.42 | 103.16 | 103.81 | 101.46 | 101.89 | 102.32 | 107.44 |
| II      | 102.72 | 101.18 | 102.24 | 103.96 | 101.98 | 101.23 | 101.19 | 101.75 | 101.63 | 102.50 | 101.08 |
| III     | 100.62 | 101.01 | 101.86 | 101.82 | 100.65 | 101.84 | 99.70  | 101.95 | 101.22 | 101.45 | 101.88 |
| IV      | 102.31 | 101.83 | 104.35 | 102.72 | 100.75 | 102.55 | 101.40 | 101.41 | 101.73 | 105.08 | 102.51 |

*Source:* Calculations were based on the data from the official website of the Federal State Statistics Service. Retrieved from <http://www.gks.ru>.

Therefore, it is advisable to adjust regional policies in order to make the socio-economic development more balanced.

The growing tariffs on the products of natural monopolies serve as the main catalyst for regional inflation and affect the consumer price index [4]. At the same time, in combination with high freight rates and monopolistically inflated fuel prices, tariffs influence the cost of regional production, increase production cost inflation and are detrimental for local businesses. Therefore, monopolistically inflated prices cause a rise in the general price level, thus exacerbating imbalance in industry as certain sectors by virtue of their monopolistic positions get super-profits while others have to make zero profits or even suffer losses.

### **Anti-inflationary policy in Russia: methods and approaches**

Discrepancies in regional economies are caused by the deviation of regional inflation rates from the national rate. The problem of regional imbalances regarding tariffs for housing and communal services needs to be addressed through state policies that would enable federal bodies to create their own territorial bodies to regulate tariffs. These territorial bodies should be authorized to conduct operational analysis of regional companies' activities.

It is also necessary to create a single executive body responsible for the development and implementation of the pricing policy as well as vertical agencies regulating tariffs and monitoring companies' compliance with the established pricing procedure. Moreover, we recommend to introduce a unified network system of price monitoring.

Since Russian economy is characterized by substantial unloaded production capacities and the declining production, the aggregate demand should be stimulated by increasing investment through tax cuts and the key interest rate. The current tax policy is unstable and does not contribute to the country's innovative development.

It is possible to make the country's economy more efficient by reducing the tax burden on producers' incomes, including taxes on wages, profits and added value. Furthermore, it is necessary to exempt from taxation the profit that enterprises direct for real investment. Taking into account the peculiarities of national economy, such policy may reduce the average production costs and increase the aggregate demand without a significant increase in the general price level. Decreasing average production costs can be effective in the conditions of cost inflation, which prevails in national and regional economy and should be distinguished from demand inflation.

Fears of a rise in the general price level due to the increase of the aggregate demand are unjustified in the current economic conditions. First, as we have noted above, the development of inflationary processes in national and regional economy is mostly caused by cost factors, and therefore, we can conclude that cost inflation prevails in the country. Secondly, national economy at the current stage of its development is characterized by incomplete employment, unloaded production capacities and declining production.

Consequently, an increase in the aggregate demand in the current economic conditions will not have negative consequences, but, on the contrary, will be beneficial for economy. In addition, there is evidence that an increase in wages entails an increase in the average annual GDP while inflation remains at the same level [5, pp. 144–156]. GDP growth is associated with an increase in labor productivity, which has a greater impact on the volume of production of goods and services, which, in turn, leads to lower prices. Therefore, in Russian economy, inflation does not increase with the growth of the population's income [5, pp. 155].

To address the problem of cost inflation and stimulate business activity, another effective method is to reduce tax rates, which will reduce the overall prices level. This measure is favoured by

the proponents of the theory of supply economics. V. V. Roshchupkin points out that excessive tax burden can stem from the inefficiency of the tax system [6, pp. 140]. Thus, mitigation of the tax burden, for example, a partial tax relief will allow enterprises to use their profits for real investment, which will contribute to the growth of economic activity. By increase the aggregate supply, this measure will help the government deal with cost inflation, which is a dominant type of inflation in Russian economy.

From the diversity of anti-inflationary policy models, we should choose only those that are aimed at combating the underlying causes of inflation in the economy of a given country. Different economic schools propose different approaches to the interpretation of the phenomenon of inflation and the assessment of economic conditions, which creates a great diversity of views on what course an anti-inflationary policy should take.

Recently, the need to introduce inflation targeting in Russia has been actively discussed. However, in the conditions of the current economic recession and high unemployment, this method will not be effective, since keeping inflation at bay should not be an end in itself of the economic policy. In addition, there is no evidence that inflation targeting has a positive impact on the dynamics of production output, neither in the short-term nor in the long-term [7, pp. 107–128]. The same study shows that in developing countries inflation targeting might negatively affect the production output. It should be noted that there is still no clear understanding of how to safely and effectively apply the instruments of inflation targeting [8].

Empirical studies on different countries show that in recent years the effect of exchange rate transfer on inflation has subsided [9, pp. 924–947]. Nevertheless, in Russian economy there is a reverse trend: fluctuations in the ruble exchange rate have a strong negative effect on the dynamics of consumer prices, especially in the food sector. In Russia, in the recent years, consumer prices have become more responsive to changes in exchange rates [10].

D. Mihaljec and M. Klau also demonstrate that in developing countries, the impact of the national currency on the development of inflationary processes is stronger than in developed countries [11]. Therefore, it is required, on the one hand, to take measures aimed at strengthening the ruble,

and on the other hand, to mitigate the influence of the exchange rate dynamics on inflation. It should be noted that the latter effect is strengthened by inflationary expectations.

According to B. P. Bosworth, cost factors play the main role in regional inflation, which means that it is necessary to take into account its non-monetary nature and to reduce the inflation of costs [12].

Thus, to maximize the effect of an anti-inflationary policy it is necessary to apply an integrated approach: stimulate national production and business activities, which will contribute to the growth of the aggregate supply, and at the same time control the increase in the aggregate demand as a factor of economic growth. It is necessary to strengthen control over natural monopolies' tariffs, which requires some serious institutional changes. In addition to controlling pricing at the federal level, tariffs should also be regulated on the regional level.

More balanced economic development across the regions will enhance the development of the national market and strengthen the unity of the Russian state. Increasing interregional differentiation, on the contrary, makes it difficult to implement a comprehensive social and economic policy successfully, including an anti-inflationary policy.

A number of theoretical models prove that inflation can have a negative impact on the market structure, long-term relationships and their efficiency. R. Benabou and M. Tommasi describe the mechanisms of inflation that may lead to considerable expenses [13; 14]. The extreme cases of lower inflation are the disastrous consequences of hyperinflation. Furthermore, there is a negative interrelation between inflation and investment [15; 16].

## Conclusion

A successful anti-inflationary policy requires the government to adopt an integrated approach to the problem. Given the prevailing type of inflation and the current economic conditions, the government's priority should be the stimulation of domestic production and those business activities that contribute to the growth of aggregate supply. It is also necessary to maintain control over the increase in the aggregate demand as a factor of economic growth. We need serious institutional changes in the sphere of natural monopolies in order to establish more rigorous control over their tariffs.



Based on our analysis of the characteristics of the country's economic development and the predominant type of inflation, we would recommend to apply the Keynesian theory and the theory of economic proposals to develop a national economic policy. It would, however, be difficult to

combine these two approaches as the former seeks to regulate the aggregate demand while the latter, the aggregate supply. Nevertheless, taking into consideration the current state of Russian economy, we have reasons to expect these measures to be quite efficient.

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## Original Paper

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## Cultural indicators of sustainable regional development (the case of Serbian national park)

Dobrila Lukić<sup>a</sup>, Marko D. Petrović<sup>b</sup>, Stefan Denda<sup>b</sup><sup>a</sup> Alfa BK University, Belgrade, Serbia; e-mail: [dobriladjerdap@gmail.com](mailto:dobriladjerdap@gmail.com) ✉<sup>b</sup> Geographical Institute Jovan Cvijić SASA, Belgrade, Serbia; e-mail: [m.petrovic@gi.sanu.ac.rs](mailto:m.petrovic@gi.sanu.ac.rs); e-mail: [s.denda@gi.sanu.ac.rs](mailto:s.denda@gi.sanu.ac.rs)**ABSTRACT**

This study discusses tourism as a means of regional development by focusing on specific cultural indicators. In this paper, we are dealing with the case of the Djerdap National Park – the largest national park in Serbia and one of the most popular of the country's destinations. This area has an extraordinary diversity of geomorphological forms, it is rich in cultural and historical monuments. At the same time this area is sparsely populated and is demonstrating an insufficient economic growth. For our analysis, we apply comparative indicators to measure sustainable regional tourism development that were proposed by the European Union's experts. This set of indicators consists of five groups and includes the ratio of accommodation capacities to the number of local inhabitants and the intensity of tourism. Our calculations are based on the statistical data on accommodation capacities and the tourist traffic provided in several municipalities. These data are provided by the Statistical Office of Serbia (2015). We also use the 2011 census data on the number of local inhabitants. We have found that the ratio of accommodation capacities to the number of local inhabitants in Djerdap is in the so-called *green zone*, which shows the sustainability of tourism in this region and an insignificant impact that tourism has on the cultural identity of the local community. The intensity of tourism in Djerdap is in the *red zone*, however, which demonstrates an alarming trend and requires further analysis, especially regarding the carrying capacity of the area. Thus, the conclusion is made that the development of tourism in Djerdap should be balanced with the protection of natural resources.

**KEYWORDS**

cultural indicators, criteria of the European Union, sustainable regional development, tourism, Djerdap National Park

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## Культурные индикаторы устойчивого регионального развития

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В истраживању разматра се туризам као средство регионалног развоја с упором на одређене културне показатеље. Ауторима разматран случај Националног парка Дјердап – највећег националног парка у Србији и једног од најпопуларнијих туристичких прављења државе. Ова област има необичајно разнообразне геоморфолошке облике, она је богата културним и историјским споменицима. У исто време овај регион је малонасељен и демонстрира недовољан економски раст. За нашу анализу ми примењујемо упоређивајуће показатеље устойчивог развоја регионалног туризма, које су предложени експертима Европског савеза. Овај скуп показатеља састоји се од пет група; он укључује однос гостиничких простора према броју становника и интензивност туризма. Наши прорачуни засновани су на статистичким подацима, достављеним Статистичким управљем Србије, о гостиничким просторима и туристичком саобраћају у неколико општина. Такође се користе подаци пописа из 2011. године о броју становника. Ауторима је откривено да однос гостиничких простора према броју становника у Дјердапу налази се у такозваној «зеленој» зони, што сведочи о стабилности туризма у овом региону и о незначителном утицају туризма на културну самобитност локалног друштва. Интензивност туризма у Дјердапу налази се у «црвеној» зони, што демонстрира забринујућу тенденцију и захтева даље истраживање, посебно у односу на пропусну способност региона. На тај начин, изводи се закључак да развој туризма у Дјердапу мора бити сбалансирани са очувањем природних ресурса.

**КЛЮЧЕВЕ СЛОВА**

културни показатељи, критерији Европског савеза, устойчиво регионално развојење, туризам, Национални парк Дјердап

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## Introduction

Sustainable tourism development requires careful planning and management, which would ensure that tourism contributes to improving the quality of life of the local population and that its negative effects on the local cultural and natural environment should be reduced or mitigated. The concept of sustainable development was defined in 1987 by the World Commission on Environment and Development in the Brundtland Report, also known as *Our Common Future*. Sustainable development is understood as “development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs”. Sustainable development requires us to set certain boundaries, which are not absolute but are defined by the current state of technology and social organization in relation to the environment as well as the ability of the biosphere to absorb the effects of human activities. According to the Brundtland Commission, sustainable development does not mean a fixed state of harmony, but a process in which a harmony of exploitation of resources, direction of investments, directions of technological development and institutional changes with present and future needs are created. The application of the concept of sustainable regional tourism development thus implies minimizing negative and maximizing the positive impacts of tourism on the environment and the available resources. For this reason, it is necessary to identify, monitor, assess and manage the economic, socio-cultural and environmental effects of tourism. At the core of sustainability lies the balance between the development of tourism and tourism areas, on the one hand, and protection and preservation of the environment, resources and the value of the local community, on the other [1].

## Theoretical framework

By analyzing and processing statistical data, many international, national and local institutions have tried to develop a set of indicators of sustainable regional tourism development. The World Tourism Organization has published guidelines on sustainable regional tourism development, which included two sets of indicators: basic indicators and indicators for each type of tourist value [2–4]. Indicators of sustainable regional tourism development were also set by the European Environment Agency (EEA). Recently, a growing number of studies have been focusing

on socio-cultural influence of tourism in such areas as Spain, Great Britain, Bali, Florida, and Norway. This research primarily refers to the methodology of estimating the ratio of inhabitants in these areas to the number of tourists, the negative impact of tourism on local communities, and the development of tourism as a whole. G. Miller discusses the indicators of sustainable regional tourism development related to environmental protection, employment, finances and visitor aspects [5]. T. G. Ko describes several quantitative and qualitative indicators in relation to eight different dimensions such as political, economic, socio-cultural, and industrial [6].

Different studies have dealt with indicators of sustainable regional tourism development in Serbia by comparing them with those of tourist destinations in other countries. According to B. Stojanović, indicators of sustainable tourism provide the most modern method of measuring the effects of tourism development and usually reflect all the principles of sustainable development [7, p. 264]. M. Maksin et al. define these indicators as measurements of the state of the given environment and process in a certain area and in a certain period. Thus, the indicators enable researchers not only to determine the current state but also to monitor any changes, primarily in terms of goal achievement [8, p. 284]. D. Jovičić, T. Ilić maintains that, according to the World Tourism Organization, since 1996, “indicators measure or evaluate certain information, which helps decision-makers (administrative bodies) minimize the possibility of bad business decisions” [9, p. 277].

## The case of the Djerdap National Park

The Djerdap gorge is located in the northeastern part of Serbia, on the border with Romania, in the center of the northern part of the Balkan Peninsula. It stretches in the west-eastern direction. According to D. Dukić, the Djerdap gorge begins with the underwater rock Germania, which is located on the 1,039.5th kilometer of the Danube. At that point, the riverbank narrows from 2,000 m wide to 350 m. Dukić believes that the Romanian village of Guravoj on the 941th kilometer marks the end of the gorge. Here the river bed becomes wider again, the fall rapidly decreases and the deposit accumulation begins. In this settlement, the islands of the Danube deposits were formed: Serbian Guravoj, Banacansko, Karatas and Dudas. In this part, Djerdap is 98.5 km long [10]. The largest

part of the Djerdap gorge has a typical V-shaped valley, with steep, even vertical sides, which are rising on average 260–300 m and sometimes over 500 m above the river bed. However, Djerdap is a compound river valley comprising four gorges separated by basins: Golubac gorge, Ljupkovska basin, gorge Gospodjin Vir, Donjomilanovačka basin, gorges Great and Small Kazan, Oršavska basin and Sipska gorge.

The Djerdap gorge is an essential part of the National Park Djerdap. This area, which covers about 65,000 ha, was given the status of a national park in 1974. It is located on the territory of municipalities Golubac, Kladovo and Majdanpek; it extends about 100 km along the right bank of the Danube, from Golubac to Karataš; and it is 2 to 8 km wide. The National Park Djerdap is rich in geomorphological forms, cultural and historical monuments, fauna and flora, especially beech and oakwoods (over 64% of the territory). The factors contributing to the preservation of the natural environment of the Djerdap National Park are the low population density, absence of large industrial plants and a fairly sparse transport infrastructure [11].

## Methodology

Experts of the European Commission have designed a set of core indicators in order to evaluate and determine the degree of sustainability of tourism development in a certain area. These indicators provide a starting point for policy-making in this sphere depending on how they assess the condition of tourism: as critical, tolerable or sustainable. Therefore, the three zones are identified: *red* (critical condition; urgent measures are required); *yellow* (tolerable; preventive measures are recommended); and the *green zone* (sustainable). The factors that help us evaluate the current state of development of tourism are divided into five groups:

- *the economic indicators* show the economic effects of tourism on the local area;
- *the satisfaction of tourists* is expressed through their opinion on the attractiveness of the area, the socio-cultural characteristics of the environment as well as on the quality of tourist capacities and services provided;
- *social indicators* reflect the social integrity of the local community in terms of local inhabitants' subjective well-being;
- *cultural indicators* correspond to the degree of preservation of the cultural identity of the local

community under the influence of tourists of different cultural backgrounds;

- *environmental indicators* should reflect the state of the environment and the impacts of tourism on water resources, air, biodiversity, and land [7; 12].

In this paper, the cultural indicators of sustainable regional tourism development in Djerdap are analyzed. They show us the effect of tourism on the local cultural identity.

Table 1

### Cultural indicators of sustainable regional tourism development

|                     |  |   |
|---------------------|--|---|
| Cultural indicators | Ratio of accommodation capacities to the number of local inhabitants | < 1.1:1 <i>green zone</i><br>1.1–0.5: 1 <i>yellow zone</i><br>> 1.6:1 <i>red zone</i> |
|                     | Intensity of tourism   | < 1.1:1 <i>green zone</i><br>1.1–1.5: 1 <i>yellow zone</i><br>> 1.6:1 <i>red zone</i> |

Source: [7].

Cultural indicators of sustainable regional tourism development include the following:

1. *The ratio of accommodation capacities to the number of local inhabitants.* This indicator reveals an alarming trend if the number of beds exceeds the number of inhabitants over 1.6 times, because the local community is affected by the intensive construction of tourist accommodation. If this ratio is less than 1.5, then the situation is more favorable for the local community. Natural characteristics of space, the type of accommodation, intensity and type of tourist traffic also influence the above-described mentioned correlations.

2. *Intensity of tourism.* This indicator is the ratio of the number of overnight stays during the year expressed in thousands to the number of local inhabitants expressed in hundreds. This indicator shows the degree of cultural saturation in the area: if it exceeds 1.6, it is characterized as unfavorable for the sustainability of tourism [7].

## Results and Discussion

In our analysis of cultural indicators of sustainable regional tourism development in Djerdap, we used the data on the accommodation capacities and tourist traffic in Golubac, Majdanpek and Kladovo provided by the Statistical Office of the Republic of Serbia for 2015. The data on the number of inhabitants in the municipalities of Djerdap were also obtained from

the Statistical Office of the Republic of Serbia and are based on the results of the latest 2011 census.

In the municipality of Golubac in 2015, there were recorded one two-star hotel and one overnight stay in the category of basic accommodation capacities. The total number of available rooms was 59 with 172 beds in them. In the category of complementary accommodation capacities, in 2015, there were 21 one-star private rooms with 51 beds. Thus, the total number of available rooms in Golubac in 2015 was 80, with 223 beds.

In Majdanpek, there were two three-star hotels in the category of basic accommodation capacities with the total number of 300 rooms with 580 beds. In the category of complementary accommodation capacities in the municipality of Majdanpek in 2015 there were 70 two-star private rooms with 182 beds. This means that the total number of available rooms was 370 with the total of 762 beds.

In Kladovo, there were two hotels (one four-star and one two-star) and one youth hostel registered in the category of basic accommodation capacities. The complementary accommodation capacities included 25 three-star private homes and apartments and 77 private rooms. The total number of available rooms was 561, with 1160 beds.

Table 2  
Ratio of accommodation capacities to the number of local inhabitants in Djerdap

| Municipality    | Population (2011 census) | Number of beds in 2015 | Ratio of accommodation capacities to the number of local inhabitants |
|-----------------|--------------------------|------------------------|--|
| Golubac         | 8,654                    | 223                    | 0.02:1 <i>green zone</i>   |
| Majdanpek       | 19,854                   | 762                    | 0.04:1 <i>green zone</i>   |
| Kladovo         | 21,142                   | 1,160                  | 0.05:1 <i>green zone</i>   |
| Djerdap (Total) | 49,650                   | 2,145                  | 0.04:1 <i>green zone</i>   |

Source: [13; 14].

Djerdap has seven business units in the category of basic accommodation capacities. The total number of rooms in 2015 was 1,011, with 2,145 beds. The same year in Djerdap, a total of 46,773 tourists were recorded: 37,620 domestic and 9,153 foreign tourists. Overall, they spent in Djerdap 94,934 nights.

The ratio of accommodation capacities to the number of local inhabitants demonstrates that tourism in Djerdap is in the *green zone*, given that this ratio for Djerdap is 0.04, according

to the data of 2015. Therefore, we can conclude that this indicator demonstrates the sustainability of tourism and an insignificant influence that it has on the local culture. However, if we consider the data from other sources, they are likely to show that the cultural influence is more pronounced.

Table 3

#### Intensity of tourism in Djerdap

| Municipality | Population (2011 census) | Number of nights in 2015 | Intensity of tourism     |
|--------------|--------------------------|--------------------------|--------------------------|
| Golubac      | 8,654                    | 3,857                    | 0.45:1 <i>green zone</i> |
| Majdanpek    | 19,854                   | 41,751                   | 2.10:1 <i>red zone</i>   |
| Kladovo      | 21,142                   | 49,326                   | 2.33:1 <i>red zone</i>   |
| Djerdap      | 49,650                   | 94,934                   | 1.91:1 <i>red zone</i>   |

Source: [13; 14].

The intensity of tourism in Djerdap is 1.91 (*red zone*), which means that tourism development is not sustainable and that the identity of the local community is under the increasing pressure on the part of tourists coming from places with different cultural characteristics. The reason for this is the decreasing number of local population in Djerdap municipalities. However, in the municipalities of Djerdap, the level of the cultural saturation of the area is not too high, because the newly built facilities for tourism do not significantly affect the local community. In the analysis of the future development of tourism in Djerdap, the carrying capacity of the space should be determined: "Carrying capacity is the number of users that a certain space can take within a certain period of time, without irreversible biological and physical degradation, the ability of space to satisfy recreational needs and without significant endangerment of the quality of the recreational experience" [15].

#### Conclusion

Our analysis of cultural indicators of sustainable regional development in Djerdap has shown that the criteria put forward by the EU experts are mostly met, especially when it comes to the ratio of accommodation capacities to the number of local inhabitants. As for the intensity of tourism, the situation is alarming, since only in Golubac municipality this indicator is in the *green zone*. In Majdanpek and Kladovo, however, the number of tourist overnight stays throughout the year is more than two times higher than the number of inhabitants. In order to harmo-

nize the development of tourism in Djerdap with the area's capacity and capabilities, it is necessary to ensure that all tourists and other stakeholders of tourism development should preserve the natural environment and culture of this destination, abide by the standards of ethical behaviour and be aware of the needs of future generations.

Therefore, there should be a balance between tourism development in Djerdap and the protection of its natural environment. This can be achieved through careful resource analysis, co-ordination of environmental protection and tourist activities to prevent any negative impact of tourism on the environment.

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## Original Paper

doi: [10.15826/recon.2018.4.2.008](https://doi.org/10.15826/recon.2018.4.2.008)**Drone technology for last-mile delivery in Russia:  
a tool to develop local markets****Haula Kitonsa***Ural Federal University, Ekaterinburg, Russia; email: kitsxauxkissule@gmail.com***ABSTRACT**

As the popularity of online shopping increases, last-mile delivery is gaining more and more attention of e-commerce companies. One of the viable solutions to maximizing the benefits of such delivery and cutting its costs is the usage of the rapidly developing drone technology. However, drone delivery is associated with a number of safety and privacy, which makes legislators uneasy about permitting the commercial use of drones. In this paper, we compare the drone regulations applied in various countries with those of Russia and analyze the criteria used to develop such regulations. Six general approaches are thus outlined: officially banning commercial drone operation; making it virtually impossible for drone operators to acquire the necessary registration and license; allowing to fly drones in exceptional cases over restricted areas; prohibiting to fly drones beyond the pilot's line of visual sight; allowing to fly drones if standard requirements are met; and, finally, following the substantial precedent principle. This analysis shows us the possible strategies Russia could adopt to regulate commercial drone usage. It is thus suggested that Russia should follow the example of Rwanda and China and allow to experiment with drone delivery in rural areas, where the risk to people's lives and property in case of drone malfunction are lower than in urban areas.

**KEYWORDS**

drone technology, last-mile delivery, drone delivery, e-commerce, legal framework

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**Использование дронов на последнем этапе доставки:  
инструмент для развития местных рынков****Х. Китонса***Уральский федеральный университет, Екатеринбург, Россия; email: kitsxauxkissule@gmail.com***РЕЗЮМЕ**

По мере роста популярности онлайн-покупок, проблема заключительного этапа доставки привлекает всё больше внимания компаний, занимающихся электронной коммерцией. Одним из наиболее перспективных и наименее затратных решений является использование быстро развивающейся технологии беспилотных летательных аппаратов. Тем не менее, доставка с помощью дронов связана с рядом вопросов безопасности и конфиденциальности, что мешает законодателям свободно разрешить коммерческое использование беспилотных летательных аппаратов. В этой статье сравниваются нормы, применяемые в разных странах, и анализируются критерии, используемые для разработки таких правил. Таким образом, излагаются шесть общих подходов: официальное запрещение коммерческой эксплуатации беспилотных летательных аппаратов; практически полная невозможность получения необходимой регистрации и лицензии; разрешение на полеты лишь в исключительных случаях и по специальным зонам; запрет полётов вне поля зрения пилота; разрешение полетов при исполнении стандартных требований; и, наконец, следование прецедентам. Этот анализ показывает нам возможные стратегии, которые Россия могла бы принять для регулирования использования коммерческих дронов. В результате предлагается, чтобы Россия следовала примеру Руанды и Китая и позволила экспериментировать с доставкой беспилотных летательных аппаратов в сельских районах, где риск жизни людей и имущества в случае неисправности дрона ниже, чем в городских районах.

**КЛЮЧЕВЫЕ СЛОВА**

дроны, заключительный этап доставки, доставка с помощью дронов, электронная коммерция, правовые вопросы

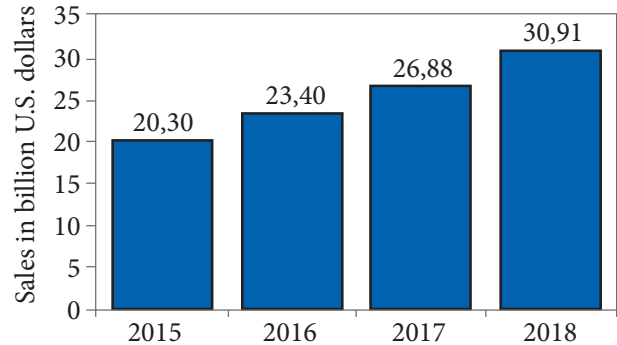
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**Introduction**

In 2016, the on-line expenditure on physical goods on the Russian e-commerce market amounted to approximately \$16.3 billion, including estimated \$4.3 billion of foreign e-commerce sales, with 80% of parcels and small packages coming from China [1]. The market estimates were speculated to top \$17.1 billion in 2017, according to (AKIT) Association of Online Retail Companies. In total, 360 million shipments (both domestic and cross-border) resulted in average spending of 2,500 rbs per e-shopper [2]. Online purchases and home delivery have become widely spread because they are less detrimental for the environment and require less effort on the part of the customer [3]. Together with the growing Internet sales, the growing demand in the delivery industry is also growing. The majority of online shopping companies in Russia currently rely on third parties (private carriers). The leading company is the Russian Post, which accounts for 99% of deliveries in the country due to its large postal network. There are also such services as DPD, SDEK, SPSR-Express, Pony Express and IML Courier [2] whereas some companies offer their own delivery to the customer’s location without any third-parties involved.

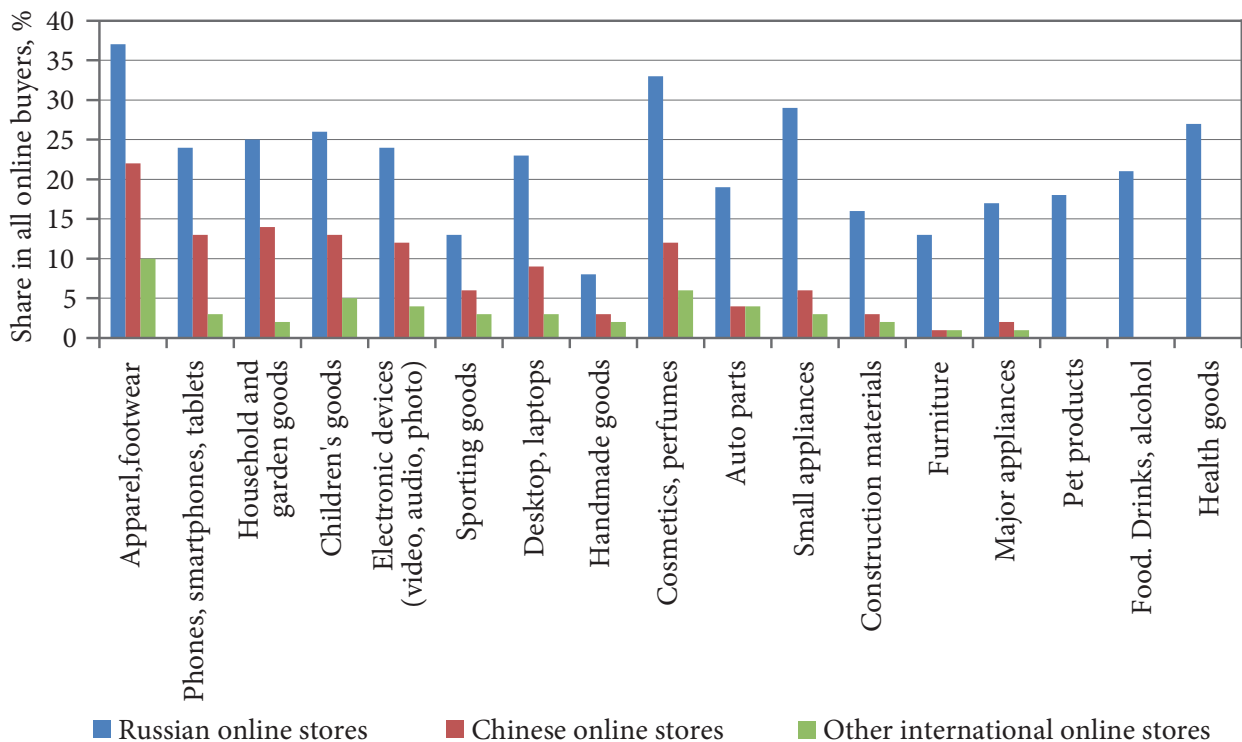
Figure 1 shows a forecast for retail e-commerce sales in Russia for the period from 2015 to 2018. There is a gradual increase in sales, which are expected to reach 30.91 billion U.S. dollars by the end of 2018.



**Figure 1.** Forecast retail e-commerce sales in Russia from 2015 to 2018

Source: e-Marketer, Statistic 2017

Figure 2 demonstrates various types of goods purchased from different online stores in 2016. It is evident that Russian online stores, like Ulmart.ru, Wildberries.ru, Mvideo.ru, AliExpress.ru and Avito.ru, surpassed their counterparts with a share of over 35% as a result of Russian customers’ preference of Chinese and foreign online stores. Most of the goods were compara-



**Figure 2.** Types of goods purchased from different online stores in 2016 in Russia

Source: GFK RUS and Yandex market data, 2016



tively light and, therefore, could be effectively delivered by a drone. As a rule, carriers serving on-line shopping web-sites have to deliver one or several small packages to the customer's address [4]. The new, increasingly popular strategy is to ship products directly from the seller to the customer by skipping drop-offs at retail stores [5]. Comparison between online and conventional shopping has been the core focus of most previous papers concentrating on the grocery retail sector [6]. In the traditional shopping supply chain, goods are delivered to a store for customers to pick them up. Typically, the process of online shopping consists of three stages: placing an order, processing the order and delivery. Each of these stages is vital for ensuring effective customer services at the expense of potential customers [7]. Considering all the phases, starting from the order being placed to home delivery by the seller, logistics providers and transportation companies have found that last-mile delivery to be not only complicated but also expensive [8]. Concerns have been expressed about the rapid growth of home deliveries and their efficiency, which might diminish the net benefits from on-line shopping [9]. In this study, we are going to focus on the third stage, order delivery.

### Last-mile delivery

In logistics, last-mile delivery refers to delivering a customer's order to his or her doorstep [10]. Logistics providers [11] face different challenges, including the following:

- traffic congestions in downtown areas;
- environmental issues caused by inefficient routes in rural areas;
- increased delivery costs;
- as customers are now more prone to purchasing small quantities of goods, cases of failed deliveries (orders are delivered when no one is at home) have become more frequent as well as the return of unwanted goods [12].

In the traditional shopping system, customers are responsible for picking up their orders and bringing them home, whereas in online shopping, most of the work is done by retailers, who deliver customers' orders to their respective addresses sometimes within relatively short time slots [4].

Trying to address the above-described issues, carriers may resort to such options as collaborative delivery, like Colis-voiturage for heavy shipments. Moreover, Amazon is preparing to launch

an Uber-style system<sup>1</sup> for road transport. There has recently been an increase in the usage of self-employed couriers [4]. The major online retailers now rely on third-party courier networks such as the Russian Post [2]. Other alternatives include drones (JD.com<sup>2</sup>), autonomous robots (Swiss Post), green deliveries by boat, e-bikes<sup>3</sup> or on foot deliveries and electric buses (wholesale brand Métro). Sainsbury is planning to switch to electric vans for its on-line shopping delivery by 2010 [13].

The drone technology, which is able to traverse difficult terrains, reduce labour costs and replace fleets of vehicles, proves to be a viable option [14]. It is recommended as one of the best possible solutions to the challenges faced by the companies providing last-mile delivery. The drone technology has the potential to significantly reduce the delivery costs and save time required to deliver packages. Moreover, drones are less expensive to maintain, they are not limited by the established infrastructure, such as roads, and generally involve less complex obstacle avoidance scenarios as compared to the traditional delivery vehicles such as trucks [15]. There is an opinion that since drones do not need to make frequent stops on the way, they will provide an even faster direct service [16; 17]. This way, packages will no longer have to be individually delivered to customers by couriers. This idea is so alluring that large companies have embarked on developing and testing delivery models considering all the safety precautions in order to obtain permits to use drones for last-mile delivery.

### International experience of drone delivery

The twenty-first century has witnessed an advancement of drone technology and a number of major companies have engaged in drone testing [18]. In 2012, Silicon Valley startup Tacobot [19] made headlines when it publicly announced its plans to launch a delivery service of tacos within the city of San Francisco via unmanned aerial vehicles (UAVs). In 2013, Amazon [20] claimed that it was designing a drone delivery program called *Prime Air* to deliver packages within just thirty minutes. In September 2016, an Ameri-

<sup>1</sup> Postal Record (2017). Delivery by Uber?

<sup>2</sup> Josh Gartner (2017). Drone Delivery program Fact Sheet.

<sup>3</sup> Somit Sen (2017). Maharashtra to push for e-bikes for delivery of food, goods.

can based logistics company UPS [19] tested a medical supply drop to an island off the coast of Massachusetts; the same month, as a part of Alphabet Inc’s drone delivery initiative, burritos were sent to students of Virginia Tech. In 2013, Deutsche Post DHL [22], a logistics company in Germany, also started its Parcelcopter project. In March 2016, the largest convenience chain 7-Eleven [23] and a drone startup Flirtey made a drone delivery in Reno, Nevada, which was the first such delivery to be approved by the aviation authorities (FAA). In April 2016, a Japanese e-commerce giant Rakuten<sup>4</sup> tested its drone on the golf course where players were able to use their phones to request new golf balls or refreshments to be delivered to them.

samples between two Ticino hospitals. In Russia, in June 2014, Dodo Pizza<sup>6</sup> became the first company to make a trial deployment of a drone in last-mile delivery. In June 2017, one of Russia’s major banks Sberbank<sup>7</sup>, successfully tested cash delivery from their cash handling center to a cash-in-transit van.

The Table 1 above shows that the drone technology has a wide range of applications, some of which are still waiting to be realized.

**Legalization of drone delivery in Russia**

Despite the struggle to develop the drone technology models for commercial use, companies cannot proceed without permission from the corresponding regulatory bodies [23]. The questions to be addressed in this respect are as follows: should the technology be permitted at all? Should society permit the development of such a technology, which is likely to threaten people’s privacy? If the development of this technology is unstoppable, should there be a regulatory framework so that only authorized individuals or legal entities could use it for socially acceptable purposes? [25]. Let us now compare the existing legal framework in Russia with those of other countries.

In order to decide on the legal framework to regulate drone use we need to consider the fact that drones can be used for criminal ends, for example, to smuggle weapons and drugs or as a weapon. Moreover, there is a number of privacy issues associated with drones as they can carry video equipment and thus can be used for illegal surveillance. It is also essential to decide who should be authorized to operate drones as it requires certain skill and experience while drones can be dangerous to people and objects in their vicinity.

Commercial drone regulations are different in various countries, which either choose to benefit from the development of this technology or to restrict it for safety reasons [25]. Legal regulators around the world are toiling to keep up with the rapidly evolving technology with unlimited capabilities which may be perceived as threatening the traditional norms and values [27].

Table 1

**Applications of the drone technology by market category**

| Asset management         | Aerial surveying    | Cinematography  | Video marketing      | Other                      |
|--------------------------|---------------------|-----------------|----------------------|----------------------------|
| Power line inspections   | Forestry management | Films           | Real estate          | Fire scene inspections     |
| Railway line inspections | Geophysical surveys | Documentaries   | Tourism destinations | Insurance claims           |
| Oil pipeline inspections | Land use planning   | News            | Property development | Crash scene inspections    |
| Wind turbine inspections | Mapping             | Sporting events | Commercials          | Monitoring marine wildlife |
|                          |                     |                 |                      | Agriculture                |
|                          |                     |                 |                      | Anti-piracy operations     |
|                          |                     |                 |                      | Border controls            |
|                          |                     |                 |                      | Flood documentation        |
|                          |                     |                 |                      | Research                   |

Source: Rich, C. (2015).

In November 2016, Flirtey and Domino’s Pizza Enterprises Ltd<sup>5</sup> delivered pizzas from Domino’s stores to customer homes in New Zealand as a part of Enterprise’s ongoing drone delivery testing. Since mid-March 2017, Swiss Post [24] has successfully been conducting drone flights in Lugano, testing the transportation of laboratory

<sup>4</sup> Reuters (April 26, 2016). Japan’s Rakuten Demonstrates “First Commercial Drone Delivery Service in the World”. Retrieved from <http://toyokeizai.net/articles/-/115632>.

<sup>5</sup> Flirtey (Nov 15, 2016). Flirtey Launches World’s First Pizza-By-Drone Commercial Trials, Delivers Domino’s Pizza to Customer Homes.

<sup>6</sup> LENTA.RU (June 25, 2014). Dial-a-drone! Syktyvkar pizzeria begins unmanned deliveries.

<sup>7</sup> Sputnik news. (June 16, 2017). Retrieved from <https://sputniknews.com/science/201706161054695960-russia-sberbank-drone/>.

Table 2

**Laws regulating the use of commercial drones in different countries**

| Features                         | Australia <sup>1)</sup>   | Canada <sup>2)</sup>  | UK <sup>3)</sup>   | China <sup>4)</sup>   | New Zealand <sup>5)</sup>   | USA <sup>6)</sup>   | Russia <sup>7)</sup>   |
|----------------------------------|---|---|--|---|---|---|--|
| Regulatory body                  | Civil Aviation Safety Authority (CASA)  | Transport Canada (TC)   | Civil Aviation Authority (CAA)   | Civil Aviation Administration of China (CAAC)   | Civil Aviation Authority of New Zealand (NZCAA)   | Federal Aviation Administration (FAA)   | The Federal Air Transport Agency (FATA)  |
| Maximum altitude                 | Controlled airspace – 120m / 400ft – Outside – No limit   | Max 300ft   | Max 120m / 400ft > 120m / 400ft approval required  | Max 120m / 400ft > 120m / 400ft approval (CAAC)   | Max 120m / 400ft > 120m / 400ft approval required   | 121m / 400ft  | Not specified  |
| Maximum take-off weight          | < 2kg / 4.4lbs > 2kg / 4.4lbs   | < 25kg / 55lbs > 25kg / 55lbs permission required   | Not specified  | 0 ≤ 1.5kg, 1.5 ≤ 4kg, 1.5 ≤ 7kg, 7 ≤ 25kg, 15 ≤ 116kg, 25 ≤ 150kg >5,700kg (agricultural)   | 25kg / 55lbs  | < 25kg / 55lbs > 25kg / 55lbs permission required   | 30kg / 66lbs   |
| BVLOS flights                    | Not allowed   | –   | Not allowed  | Not allowed   | Not allowed   | Not allowed   | Not allowed  |
| Competence statement / license   | < 2kg / 4.4 lbs = Registration required > 2kg / 4.4lbs = Operators certificate + RPA required Commercial flight – 5 days notice   | > 1kg ≤ 25kg Re-quired (Urban)  | > 20kg ≤ 150kg CAA license required  | < 250 g/.55lbs – Real name registration > 7kg/15lbs – <116kg (CAAC) license   | Not required  | > 0.55lbs Re-quired   | < 30kg – Not required > 30kg – Re-quired   |
| Night time and bad weather       | Special approval  | Not allowed   | Special approval   | Special approval  | Special approval  | Special approval  | Not allowed and a watcher required   |
| Labeling requirements            | Not required but recommended  | Not required  | Not required but recommended   | Not required  | Not required  | Required  | Required   |
| Air traffic control notification | Required in controlled airspace   | >4lbs – Re-quired   | > 15lbs – Re-quired in controlled airspace   | Required  | Required in controlled airspace   | –   | Required   |
| Drone liability insurance        | Not required but recommended  | Required, \$100,000   | Not required but highly recommended  | Not required  | Not required  | Not required but recommended  | Required   |
| Pilot certification              | < 4lbs None > 4lbs Requires manufacturer conducted training course  | Above 18 years of age – Ground school   | Training (commercial)/ basic certificate for UAS and ground school   | < 116kg, re-quired  | Knowledge of airspace restrictions  | Above 16 years of age   | Required   |
| Drone ban zones                  | State institutes; Federal authority constructions; Regional authority constructions; Airport control zones (CTR); Vehicles, Boats, Buildings, People Hospitals; Operation sites of police, military, search and rescue forces | State institutes; Federal authority constructions; Regional authority constructions; 9 km from Airport control zones (CTR); Minimum 150m/500ft from crowds and 90m from built up areas hospitals; Operation sites of police, military, search and rescue forces | State institutes; Federal authority constructions; Regional authority constructions; Airport control zones (CTR); Minimum 150m/500ft from crowds and built up areas hospitals; Operation sites of police, military, search and rescue forces | State institutes; Federal authority constructions; Regional authority constructions; Airport control zones (CTR); Crowds of people Hospitals; Operation sites of police, military, search- and rescue forces *DJI drones-programmed not to take off in No-fly zones | State institutes; Federal authority constructions; Regional authority constructions; Airport control zones (CTR); National Parks; Crowds; Private Property (only with permission of the owner); Hospitals; Operation sites of police, military, search- and rescue forces | State institutes; Washington; Federal authority constructions; Regional authority constructions; Airport control zones (CTR); Crowds of people (not specified); Hospitals; Operation sites of police, military, search- and rescue forces | State institutes; Moscow kremenlin, Red Square; Federal authority constructions; Regional authority constructions; Airport control zones (CTR); Crowds of people; Military installations, power plants |

Source: <sup>1)</sup> Australia UAV. Retrieved from [https://www.casa.gov.au/operations/standard-page/how-become-safe-rpa-operator?w-cms%3astandard%3a%3apc=pc\\_101985](https://www.casa.gov.au/operations/standard-page/how-become-safe-rpa-operator?w-cms%3astandard%3a%3apc=pc_101985); <sup>2)</sup> Transport Canada – drone safety. Retrieved from [http://www.tc.gc.ca/eng/civilaviation/standards/general-recavi-uav-2265.htm?wt.mc\\_id=1zfhj#safety](http://www.tc.gc.ca/eng/civilaviation/standards/general-recavi-uav-2265.htm?wt.mc_id=1zfhj#safety); <sup>3)</sup> Civil Aviation Authority – cap393. Retrieved from [http://publicapps.caa.co.uk/docs/33/cap%20393\\_aug2016.pdf](http://publicapps.caa.co.uk/docs/33/cap%20393_aug2016.pdf); <sup>4)</sup> China's new drone regulations. Retrieved from <http://www.caac.gov.cn/index.html>; <sup>5)</sup> CAA of New Zealand. Retrieved from [https://www.caa.govt.nz/rules/rule\\_consolidations/part\\_101\\_consolidation.pdf](https://www.caa.govt.nz/rules/rule_consolidations/part_101_consolidation.pdf); <sup>6)</sup> FAA drone regulations. Retrieved from [http://www.faa.gov/uas/media/part\\_107\\_summary.pdf](http://www.faa.gov/uas/media/part_107_summary.pdf); <sup>7)</sup> Federal Air Transport Authority. Retrieved from <http://www.favt.ru>.

There are six main parameters commonly used as standards for drone regulation at the national level: maximum altitude; VLOS and BVLOS flights; licensing; flying drones at night time or in bad weather; pilot certification; and drone banned zones.

As we can see, all countries have bodies regulating drone operation. The requirements differ depending on drone capability, payload, mass, altitude, application, operator's license level and flight area. Operation of drones beyond the visual line of sight (BVLOS flights) is not allowed in most countries and it is accompanied by a set of requirements concerning the maximum altitude and the restricted distance from a crowd of people. Labeling is an optional requirement in many countries but it is obligatory in Russia.

To use recreational drones no license, insurance, registration or certification is required. The rules are much stricter regarding commercial drone applications: for example, the air traffic control notification is required in all countries; flights are either banned or highly restricted in certain areas, for example, airport control zones, state institutions, power plants and so on. Flying drones at night or in bad weather conditions also usually requires a special permission whereas in Russia it is prohibited and requires presence of a watcher.

Thus, Russian drone laws are very much in line with those of other countries, with only a few exceptions:

- drone operators must have a watcher at all times to monitor the flight and drones must not be operated beyond the visual line of sight;
- the air traffic control must be notified prior to the flight with a detailed flight plan to be provided (in other countries, it is only required in controlled airspace);
- a drone has to be labeled for the purpose of identification;
- at the moment, no maximum flight altitude is specified but this issue will undoubtedly soon be addressed and limits will be set.

There are six general approaches [27] to national commercial drone regulation varying across countries:

1. Outright ban: countries that prohibit any commercial drone operation (for example, Morocco, Argentina, and Cuba).

2. Effective ban: countries that officially allow commercial drone application but the licensing and registration procedures make it virtually im-

possible to obtain a legal permission (for example, Algeria, Belarus, and Egypt).

3. Drones must not be operated beyond the visual line of sight, which limits the potential of drone usage (for example, Belgium, Croatia, and Thailand).

4. Permission can be given in exceptional cases to carry out drone testing within restricted areas (for example, Brazil, Canada, and Germany).

5. Commercial drone operation is permitted as long as the standard requirements (registration, licensing, and insurance) are met (for example, Sweden, Norway, and Iceland).

6. Substantial precedents: these countries follow the substantial precedent principle regarding drone regulations and monitor the results of the strategies adopted by other countries.

## Conclusion

As we have shown above, the development of last-mile delivery is currently facing a series of challenges, which can be met with the help of drones. However, in many countries, including Russia, drone delivery is prohibited. In Russia, a drone must not be operated beyond the visual line of sight, which considerably limits the possibilities of using drones for last-minute delivery. Moreover, the air traffic control must be notified prior to any flight.

A more productive approach would be to develop regulations to enable society benefit from the drone technology and at the same time to ensure safe usage of drones and protect people's privacy. In such countries as Rwanda and China, drone operation is permitted beyond the pilot's visual line of sight, which enhances the development of drone delivery (Rwanda was the first country to permit commercial drone delivery in the world). Although legal regulators in both countries have issued a green pass to drone delivery, there are still strict restrictions to be met, for example, deliveries must only be carried out in rural, not densely populated areas. This is done to reduce the risk level in case of any drone malfunction. Drone laws in Russia and other countries are being constantly amended and, in general, the governments seek to broaden the specter of opportunities for commercial drone delivery. The approach adopted in Rwanda and China, that is, the usage of drones for delivery in rural areas, might prove to be quite effective in Russia as well. What Russian legislators could start with is, for instance, permitting experiments with drone delivery in the countryside since the risk level in such areas is low.

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## Original Paper

doi: [10.15826/recon.2018.4.2.009](https://doi.org/10.15826/recon.2018.4.2.009)**Competitiveness in rural tourism between Serbia and Hungary**Dunja Demirović<sup>a</sup>, Kristina Košić<sup>b</sup>, Stefan Stjepanović<sup>c</sup><sup>a</sup> *Geographical Institute Jovan Cvijić, Serbian Academy of Science and Art, Belgrade, Serbia; e-mail: d.demirovic@gi.sanu.ac.rs*<sup>b</sup> *University of Novi Sad, Novi Sad, Serbia; e-mail: tinicaus@yahoo.com*<sup>c</sup> *University of East Sarajevo, Vlasenica, Bosnia and Herzegovina; e-mail: stefan.stjepanovicuis@gmail.com***ABSTRACT**

Competition between tourist destinations and products has recently become very intense. While the market of rural tourism is on the rise, the future of many rural areas is uncertain due to the changes in agricultural production and the growing attractiveness of cities. In this paper, we are going to identify the factors that may influence the competitiveness of rural tourism in Serbia compared with Hungary, which is Serbia's main competitor. We examined the views of the key stakeholders involved in the development of rural tourism in Serbia and Hungary. Our findings have led us to the conclusion that the level of rural tourism in Hungary is considerably higher than in Serbia as we found a statistically significant difference in the assessment of all the factors, except for *Safety and Security*. Hungarian experts do not see Serbia as their country's competitor, which means that tourism policy makers should consider Hungary as a market that requires greater investment and greater efforts to meet the demands of their sophisticated rural tourists, which is impossible to achieve in a short period of time. In the following period, Hungary should be seen as Serbia's partner and Serbian stakeholders should develop joint projects with their Hungarian counterparts, which will improve the quality of rural tourism in Serbia. At the moment, the Hungarian market of rural tourism presents an example of good practice.

**KEYWORDS**

competitiveness, tourism destination, rural tourism, Serbia, Hungary

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**Конкуренция на рынке сельского туризма между Венгрией и Сербией**Д. Демирович<sup>а</sup>, К. Кошич<sup>б</sup>, С. Степанович<sup>с</sup><sup>а</sup> *Географический институт «Йован Цвиич» Сербской академии наук, Белград, Сербия; e-mail: d.demirovic@gi.sanu.ac.rs*<sup>б</sup> *Нови-Садский университет, Нови-Сад, Сербия; e-mail: tinicaus@yahoo.com*<sup>с</sup> *Восточно-Сараевский университет, Лукавица, Босния и Герцеговина; e-mail: stefan.stjepanovicuis@gmail.com***РЕЗЮМЕ**

В последнее время конкуренция между туристическими направлениями и продуктами стала очень интенсивной. В то время как рынок сельского туризма растет, будущее многих сельских районов является неопределенным из-за изменений в сельскохозяйственном производстве и растущей привлекательности городов. В данной статье определены факторы, которые могут повлиять на конкурентоспособность сельского туризма в Сербии по сравнению с Венгрией, которая является главным конкурентом Сербии. Мы рассмотрели мнения ключевых заинтересованных сторон, участвующих в развитии сельского туризма в Сербии и Венгрии. Наши выводы привели нас к выводу, что уровень сельского туризма в Венгрии значительно выше, чем в Сербии, поскольку мы обнаружили статистически значимую разницу в оценке всех факторов, за исключением фактора безопасности. Венгерские эксперты не считают Сербию конкурентом, а это означает, что разработчики политики в области туризма должны рассматривать Венгрию как рынок, который требует большего числа инвестиций и больших усилий для удовлетворения потребностей своих искушенных сельских туристов, чего невозможно достичь за короткий период. В ближайшее время Венгрия должна рассматриваться как партнер Сербии, а Сербия должна разрабатывать совместные проекты со своими венгерскими коллегами, что улучшит качество сельского туризма в Сербии. В настоящий момент венгерский рынок сельского туризма может считаться образцовым.

**КЛЮЧЕВЫЕ СЛОВА**

конкурентоспособность, туризм, сельский туризм, Сербия, Венгрия

**БЛАГОДАРНОСТИ**

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## Introduction

In many studies, the concept of competitiveness was applied to study tourist destinations [1–3], and the research focused on how to maintain or increase the existing level of competitiveness. In research literature, competitiveness of a tourist destination is defined as “the ability of a destination to maintain its position on the market and/or to improve it over time” [2, p. 239] and “to deliver products and services that are better than in other destinations, especially with regard to those aspects of tourist experience that are important to tourists” [4, p. 374]. According to Ritchie and Crouch [5], the most competitive destinations are the ones that provide their residents with benefits of sustainable development. Thus, it can be concluded that competitiveness implies the application of sustainability principles.

In the tourism industry, the competition between tourist destinations and products has become very intense, which has contributed to greater market transparency of prices and other elements of products and services [6]. Global competition in tourism has become a challenge for many countries that compete to become a desirable tourist destination, and understanding the factors that contribute to the competitiveness of a destination is essential for maintaining the current level of development of a tourist destination, its growth and vitality [5]. Therefore, measuring competitiveness can be considered as a key factor in ensuring the success of tourist destinations.

Rural tourism is one of the priorities in the tourist development of many European countries. The rural tourism market is on the rise, while at the same time the future of many rural areas is uncertain, due to changes in agricultural production or the attractiveness of urban areas due to a higher standard of living. Rural tourism is considered as one of the most effective instruments for revitalization of rural areas and ensuring their sustainable future through job retention or job creation, support for agricultural holdings, nature preservation, or keeping alive traditional rural crafts. Destinations of rural tourism are a complex product consisting of several components (accommodation, transport, food, shops, attractions, and so on) [7–9]. These tourist companies are interdependent and interconnected, and they are usually small and medium-sized businesses. Problems in rural tourism that are detrimental for the competitiveness of the destinations stem from the fact that local providers of tourism products and services are com-

peting rather than cooperating with each other. To make rural destinations more competitive, it is essential to determine the factors that affect their position on the market [10].

In this paper, we are trying to identify and determine the impact of certain factors on competitiveness of rural tourism in Serbia. Analyzing tourist attractions, supporting factors and resources, indicators of market participation and others, we will determine how competitive Serbia is as a destination of rural tourism, that is, its ability to increase tourist spending, attract more tourists, satisfy their needs, and ensure sustainable development of all the regions. We will also examine the views of the stakeholders involved in the development of rural tourism in Serbia and Hungary (direct providers of services in rural tourism, employees in tourist organizations and tourist agencies, employees in municipal and provincial services, ministry officials, and university faculty).

## Methodology

In the existing literature, there is no universally accepted set of indicators for measuring competitiveness which will be applicable to all tourist destinations at any time [11]. The model used in this study was based on models developed by Ritchie and Crouch [5], Dwyer-Kim [4] and Enright-Newton [12]. The final questionnaire for determining the competitiveness of Serbia as a destination of rural tourism has two parts: the first refers to the socio-demographic profile of the respondents (gender, age, education, workplace and work experience), while the second part consists of 17 factors that reflect specific characteristics of rural tourism, and have an impact on the competitiveness of the rural tourist destination. Since in tourism, Hungary is Serbia’s most significant competitor, the same questionnaire was professionally translated into Hungarian and sent to tourism experts to assess the current state of rural tourism in Hungary and to compare results with Serbia. Our Serbian and Hungarian experts were asked to evaluate the current state of all 17 factors that affect or can affect the competitiveness of rural tourism destinations in their countries. The research used the Likert scale.

Since one of the aims of this study is to measure the relative importance of tourist attractions and business functions, it was necessary to conduct a survey among those individuals who have knowledge of both factors. The common characteristic of research in the field of management, in-



cluding competitiveness research, is that the target groups of respondents are managers and other tourism experts, since it is assumed that they have the greatest knowledge of management and competitiveness. Apart from the fact that managers and tourism experts know the specific destination they are working in, the majority can be also informed about the situation in the main competitive locations.

The need to evaluate the competitiveness of a tourist destination by tourism experts was supported by Gearing and associates [13], who argued that tourism experts have a significant experience in working with tourists and that their opinion can reflect the opinion of large groups of tourists. Similarly, B. Faulkner, M. Oppermann and E. Fredline [14] pointed out that tourism experts can reflect the views of the tourism market as they are in constant contact with buyers (tourists) who are in the process of making travel decisions. S. Hudson, J. R. B. Ritchie, and S. Timur [15] noted that the input from a larger sample of tourism experts is desirable and identified six major stakeholders whose attitudes can best characterize the situation on the tourism market. These are the following: transport companies; tourist associations or destination management organization; owners of accommodation facilities; tour operators; commercial companies, and *specific* groups, such as ecological groups or tourist consultants. For our study, we have chosen the tourism experts who possess knowledge and/or experience relevant to this topic or whose field of research and activities are related to rural tourism and competitiveness of tourist destinations.

The following tourism experts were interviewed in Serbia: the faculty of higher education institutions that educate future tourism professionals; employees of the Tourist Organization of Vojvodina and Serbia; employees in local tourist organizations and those employed in national and provincial institutions for development of tourism (Tourism Department of the Ministry of Trade, Tourism and Telecommunications, the Rural Development Department of the Ministry of Agriculture and Environmental Protection, Provincial Secretariat for Economy, Local Self-Government and Inter-Municipal Cooperation, Development Agency Bačka, Regional Development Agency Srem, Chamber of Commerce of Vojvodina); tourist companies and agencies; owners of tourist companies in rural areas (farms, agricultural households, restaurants, ethnographic houses,

museums, wineries, souvenir shops, organizers of village festivals); and so on. In Hungary, the following tourism experts were interviewed: the faculty of higher education institutions; employees of the Tourism Organization of Hungary; employees of nine local tourism organizations; those employed in national institutions for development of tourism (the Department of Tourism and Catering of the Ministry of Economy; the Ministry of Rural Development; and the Ministry of National Development); managers of tourist agencies and tour operators; owners of tourist companies in rural areas of Hungary (restaurants, ethnographic houses, museums, wineries, souvenir shops, organizers of events and others); and representatives of the Association of Hungarian Tourist Guides, the Association for Hungarian Rural Tourism and Agritourism and the Center for Rural Tourism.

In Serbia, the survey was conducted in two ways: we used personal interviews (face-to-face technique) and questionnaires, which we sent via e-mail. In Hungary, the survey was conducted only electronically (using an on-line questionnaire in the form of a web page). The tourism experts in Serbia were surveyed in the period from April to June 2017, while the survey in Hungary was conducted from May to July 2017. The response rate in both countries was about 50%. Statistical analysis of collected data was done in the software statistical program SPSS 21.

## Results

The differences between the Hungarian and Serbian respondents were analyzed by using the T-test for dependent samples. Statistically significant differences were obtained on almost all characteristics, that is, the factors of the competitiveness model. In almost all categories, Hungary got higher scores.

Table 1 shows the differences on the first scale for factors belonging to the determinant *Key Resources and Attractions* (arithmetic mean, standard deviation, value and significance). At the significance level  $p < 0.01$ , statistically significant differences were achieved with the factor *Geographic Environment, Accommodation Capacities and their Authenticity* and *General Infrastructure and Tourist Suprastructure*. Hungary is better rated on items (factors) where the difference is statistically significant.

The obtained results for factors in which there is a statistically significant difference show that the use of rivers, lakes and canals in rural tourism in

Hungary is much more intensive and better organized than in Serbia. Protected natural areas and nature parks are important for rural tourism and in Hungary, there is a larger number of organized programs and activities involving natural areas than in Serbia. Moreover, there is a significant difference for the factor *Accommodation Capacities and their Authenticity*. In particular, there is a difference in the average ratings of Hungary and Serbia when it comes to the authenticity of accommodation units. The owners of accommodation facilities in Hungary make sure that the appearance of the buildings and their interiors enhance the attractiveness of the facilities. The quality of basic infrastructure in Hungarian villages is better than in Serbia while the differences between the quality of basic infrastructure in agrotourism are not so significant.

Figure 1 illustrates that Serbia is the closest to Hungary when it comes to gastronomy, opportunities for sports, leisure and recreation and cultural heritage. It is interesting that the only factor that has a higher average rating in Serbia than in Hungary is *Safety and Security*. In further research, it is necessary to examine why safety and security in Hungary are lower than in Serbia, while managers should use this advantage of the Hungarian rural market for attracting tourists. The smallest differences in the assessment of competitiveness factors between Serbia and Hungary are found for the determinant *Key Resources and Attractions*, while the other two determinants are much more pronounced.

In addition to the key resources and attractions, respondents from Hungary and Serbia assessed the factors within the determinant *Strategy*

Table 1

T-test for dependent samples – determinant *Key Resources and Attractions*

| Factor   | Country | Arithmetic mean | Standard Deviation | T      | Significance |
|--|---------|-----------------|--------------------|--------|--------------|
| Geographic environment                             | Serbia  | 3.5000          | .55830             | -7.422 | .000         |
|  | Hungary | 4.0058          | .56773             |        |              |
| Cultural heritage                                  | Serbia  | 3.5257          | .66477             | -2.184 | .030         |
|  | Hungary | 3.7099          | .72649             |        |              |
| Opportunities for sports, leisure and recreation   | Serbia  | 3.7426          | .73783             | -2.535 | .012         |
|  | Hungary | 3.9562          | .65157             |        |              |
| Accommodation capacities and their authenticity    | Serbia  | 3.0931          | .65256             | -7.602 | .000         |
|  | Hungary | 3.6788          | .62021             |        |              |
| Gastronomy   | Serbia  | 3.9669          | .83267             | -.002  | .998         |
|  | Hungary | 3.9672          | .90180             |        |              |
| General infrastructure and tourist supra-structure | Serbia  | 2.9326          | .70196             | -9.736 | .000         |
|  | Hungary | 3.7117          | .61785             |        |              |
| Safety and security                                | Serbia  | 4.0478          | .75738             | 1.342  | .181         |
|  | Hungary | 3.9197          | .81852             |        |              |

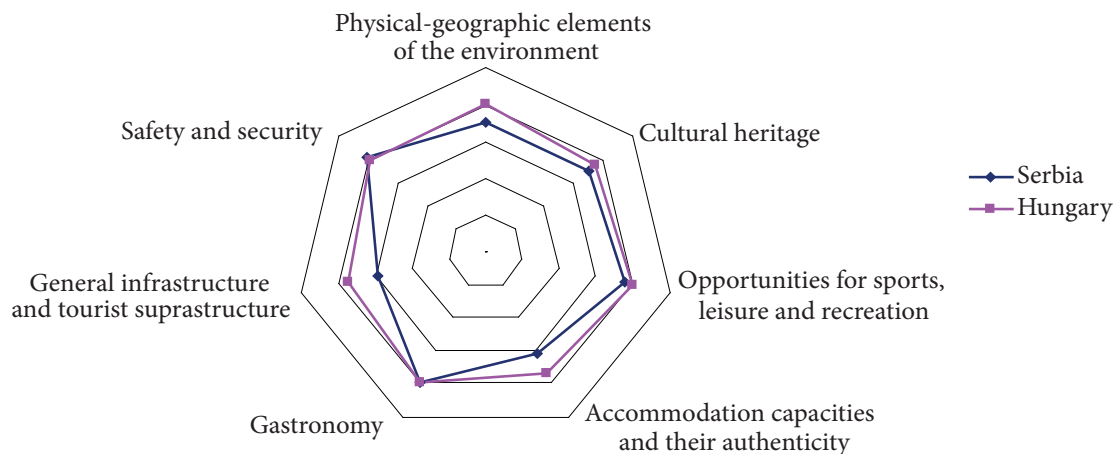


Figure 1. Performance of Serbia and Hungary for factors within the determinant *Key Resources and Attractions*

of the *Tourist Destination*. For each of the five factors, a statistically significant difference at the level of  $p < 0.01$  (Table 2) is observed. As in the previous case, the factors of the competitiveness model for Serbian rural regions are lower than in Hungary.

There are considerable differences for factors within the determinant *Tourist Destination Strategies* between Serbia and Hungary, which again demonstrates that this determinant is the weakest in the competitiveness model and that the policies applied in the sphere of tourism in Serbia have been inefficient so far. Therefore, it is necessary to improve the quality of rural tourism in Serbia in order to boost the demand.

Significant differences in the assessment of the factor *Marketing* show that Hungarian rural tourism is better organized. The emphasis is made on promoting the tourist offer through business entities and especially through tourist organizations and organizations for rural and agritourism. There is also organized distribution of tourist products through several travel agencies, which

make this type of tourism more popular in Hungary. Hungarian policy-makers are aware of the importance of well-trained staff for successful development of rural tourism, and provide multiple opportunities for learning such as seminars and courses. There are also compulsory courses that owners of tourist facilities in rural areas should take. The policy for the development of tourist destinations has a better average rating in Hungary due to the improved availability of the relevant data for local authorities since 1998.

Figure 2 shows that as for the determinant *Strategy of the Tourist Destination*, there are significant differences between Serbia and Hungary. The only sphere in which Serbia's competitiveness is closer to that of Hungary is the *Quality Management of Services*. However, when it comes to this factor, the differences in the profitability of rural tourism enterprises are not so obvious, which suggests that tourism companies in Hungary are struggling to ensure continued profitability of their business.

Table 2

T-test for dependent samples – determinant *Strategy of the Tourist Destination*

| Factors  | Country | Arithmetic mean | Standard Deviation | T       | Significance |
|--|---------|-----------------|--------------------|---------|--------------|
| Marketing  | Serbia  | 2.9779          | .58514             | -10.166 | .000         |
|  | Hungary | 3.6616          | .52452             |         |              |
| Employees in the tourist sector and rural tourist facilities | Serbia  | 2.7623          | .62711             | -6.562  | .000         |
|  | Hungary | 3.2920          | .70415             |         |              |
| Policy of planning and destination development               | Serbia  | 2.4540          | .67165             | -9.631  | .000         |
|  | Hungary | 3.3084          | .78898             |         |              |
| Quality management services                                  | Serbia  | 2.7960          | .62153             | -4.878  | .000         |
|  | Hungary | 3.1734          | .65625             |         |              |
| Environmental Management                                     | Serbia  | 2.5404          | .77949             | -9.308  | .000         |
|  | Hungary | 3.4489          | .83200             |         |              |

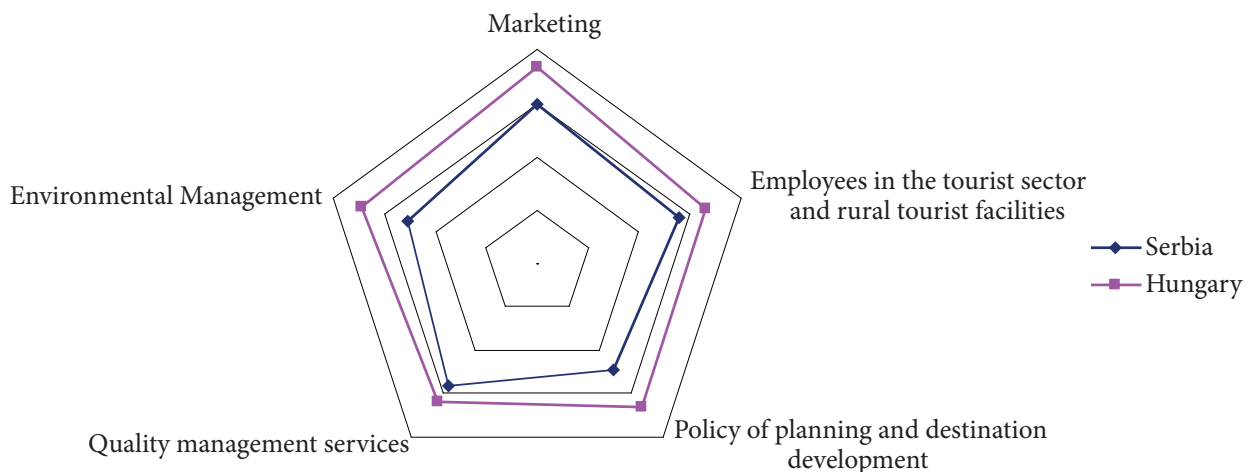


Figure 2. Performance of Serbia and Hungary for the factors within the determinant *Strategy of the Tourist Destination*

Within the third determinant of the competitiveness model, determinant *Tourist Destination* almost all factors achieved statistical significance at  $p < 0.01$  level, except for the factor *Local Community Participation and their Attitudes*. In this case, Hungarian rural areas scored higher (Table 3).

Regarding economic stability, which is an important factor, tourists in Hungary have a greater part of their income available for traveling to rural areas for leisure and entertainment, while the economic differences between the two countries are not significant. In Hungary, many people tend to take shorter tourist trips throughout the year rather than one long vacation, which can result from better living standards and higher awareness of travel opportunities. Tourists who visit rural areas are more aware of the importance of a healthy lifestyle and choose the destinations suitable for active leisure such as hiking, hiking, swimming, and jogging. These tourists are also environmentally conscious and choose protected natural areas and eco-friendly hotels. What rural tourism in Serbia and Hungary have in common is that tourists visiting rural areas belong to all age categories and

that domestic tourists prevail. Hungarian experts assessed cooperation between stakeholders more highly, which means that they are aware of the importance between the stakeholders involved in the development of rural tourism. Moreover, the development of rural tourism in Hungary receives greater and more efficient financial support. This support is provided not only by state institutions but also by other stakeholders, who are trained to apply for European funds to improve all aspects of the tourist offer.

Figure 3 shows that the performance of the determinant *The Environment of the Tourist Destination* for both countries is closest for the factor *Local Community Participation and their Attitudes*, which means that the differences in the average estimates for this factor are not statistically significant. In both countries, the local population is hospitable and the local community is willing to support the development of rural tourism. The problem shared by both countries is the demographic structure of the population in rural areas due to the ageing of the population and their migration to cities in search for better living conditions.

Table 3

T-test for dependent samples – determinant *Tourist Destination Environment*

| Factors   | Country | Arithmetic mean | Standard Deviation | T      | Significance |
|---|---------|-----------------|--------------------|--------|--------------|
| Economic stability  | Serbia  | 2.3051          | .74826             | -7.856 | .000         |
|   | Hungary | 3.0912          | .89775             |        |              |
| Characteristics of demand and socio-cultural change   | Serbia  | 3.3544          | .63338             | -5.857 | .000         |
|   | Hungary | 3.7912          | .59846             |        |              |
| Local community participation and their attitudes   | Serbia  | 3.3431          | .62320             | -.880  | .380         |
|   | Hungary | 3.4112          | .65463             |        |              |
| Cooperation between stakeholders in tourism   | Serbia  | 2.4877          | .78453             | -6.271 | .000         |
|   | Hungary | 3.1290          | .90048             |        |              |
| Incentives and financial support for the development of tourism by the government and local authorities | Serbia  | 2.5423          | .77433             | -3.896 | .000         |
|   | Hungary | 2.9599          | .98343             |        |              |

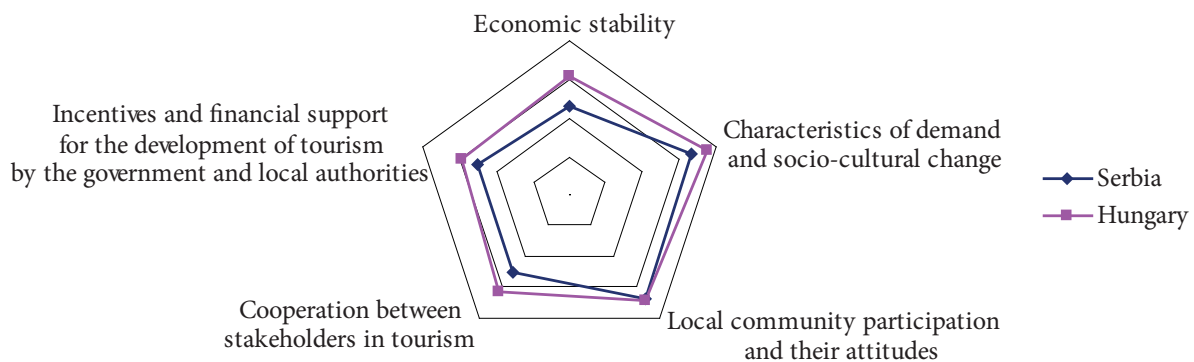


Figure 3. Performance of Serbia and Hungary for factors within the determinant *The Environment of the Tourist Destination*

## Conclusion

The key competitors of Serbia in rural tourism are Hungary, Croatia and Slovenia (and increasingly Romania). Our analysis has shown that the level of rural tourism in Hungary is much higher than in Serbia, since there is a statistically significant difference in the assessment of all the factors (except for *Safety and Security*). Experts in Hungarian tourism do not see Serbia as their competitor, which leads us to the conclusion that tourism policy makers should consider Hungary as a market that requires greater investment and significant efforts to meet the demands of sophisticated rural tourists, which cannot be achieved in a short period of time. In the following period, Hungary should be seen as Serbia's partner and Serbian stakeholders should develop joint projects with their Hungarian counterparts in order to improve the quality of rural tourism in Serbia. At the moment, the Hungarian market of rural tourism presents an example of good practice. In the meantime, more attention and effort should be directed towards foreign tourist markets, especially the countries that Serbia has good traditional connections with such as Montenegro, Bosnia and Herzegovina, Greece, and Russia.

State and local authorities should work together to ensure Serbia's competitiveness as a destination of rural tourism by addressing the two groups of tasks: general and more specific. General tasks are those related to leadership and innovation in product development and market-

ing, research on travel patterns, tourist behavior and satisfaction, and efforts to help businesses and other members of the sector in accordance with laws and regulations. Specific administrative tasks are those that target certain characteristics of the sector, including, for example, creation and maintenance of a database of rural tourism destinations.

It is important to distinguish between the roles that the government and individual businesses play in ensuring the competitiveness of the destination. The government is responsible for realizing systematic tasks and for adopting policies and decisions on the macro-level. In contrast, managerial tasks of the economy sector are carried out on the micro-level, that is, the level of individual owners of rural tourism facilities. These enterprises strive to become more cost-effective and more competitive on the market.

It can be concluded that competitiveness of Serbia as a destination of rural tourism depends significantly on the ability of each business entity to maintain its competitive position on the market, which will also strengthen the overall regional competitiveness. The support of the government is important for creating a healthy environment for business and for providing clear guidelines that will enable the rural tourism sector to grow. Moreover, since a large number of service companies are involved in the provision of services to rural tourists, each section of the sector must make sure to provide high-quality experience for visitors (*good value for money*).

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## Original Paper

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## The role of industrial factors in socio-economic development of Sichuan province in the context of *one belt, one road* initiative

Oksana O. Akhmetzianova<sup>a</sup>, Irina D. Turgel<sup>b</sup><sup>a</sup> Harbin Institute of Technology, Harbin, China; email: oksanochka-star@mail.ru ✉<sup>b</sup> Ural Federal University, Ekaterinburg, Russia; email: i.d.turgel@urfu.ru**ABSTRACT**

Sichuan Province is an important junction area connecting south-western, north-western and central regions of China. For decades, the socio-economic development of this region has been the focus of major effort on the part of the Chinese government. At the moment, the regional authorities of Sichuan seek to maximize the region's potential within the framework of the *One Belt, One Road* Initiative. However, despite the abundance of mineral and other natural resources, modern transport infrastructure, and significant GDP growth, the province faces a number of challenges, primarily in the sphere of domestic and international economic cooperation. Sichuan is also suffering from the massive outflow of workforce to other regions and countries. In this article, we discuss the key industrial factors that determine the socio-economic development of Sichuan. Our analysis of the available statistical data has shown that the region's participation in *One Belt, One Road* Initiative would allow it to strengthen its position on the national and international arena, attract new investors and improve its competitive advantage in comparison with the coastal regions of China. Another viable option for the regional government would be to establish a special economic zone, which means building an appropriate infrastructure or reconstructing the already existing facilities, offering tax-and-tariff incentives, and introducing simplified bureaucratic procedures.

**KEYWORDS**development, industrial factors, transportation, special economic zone, *One Belt, One Road* Initiative**FOR CITATION**

Akhmetzianova, O. O. & Turgel, I. D. (2018) The role of industrial factors in socio-economic development of Sichuan province in the context of *one belt, one road* initiative. *R-economy*, 4(2), 67–71. doi: 10.15826/recon.2018.4.2.010

## Роль индустриальных факторов в социально-экономическом развитии провинции Сычуань в контексте инициативы «Один пояс – один путь»

О. О. Ахметзянова<sup>a</sup>, И. Д. Тургель<sup>b</sup><sup>a</sup> Харбинский политехнический университет, Харбин, Китай; email: oksanochka-star@mail.ru ✉<sup>b</sup> Уральский федеральный университет, Екатеринбург, Россия; email: i.d.turgel@urfu.ru**РЕЗЮМЕ**

Провинция Сычуань является важным районом, соединяющим юго-западные, северо-западные и центральные районы Китая. На протяжении десятилетий социально-экономическое развитие этого региона было в центре внимания китайского правительства. В настоящий момент, региональные власти провинции Сычуань стремятся максимально использовать потенциал региона в рамках инициативы «Один пояс, один путь». Однако, несмотря на обилие минеральных и других природных ресурсов, современную транспортную инфраструктуру и значительный рост ВРП, перед областью стоит ряд проблем, прежде всего в сфере внутреннего и международного экономического сотрудничества. Сычуань также страдает от массового оттока рабочей силы в другие регионы и страны. В этой статье обсуждаются ключевые промышленные факторы, определяющие социально-экономическое развитие провинции Сычуань. Наш анализ статистических данных показал, что участие региона в инициативе «Один пояс, один путь» позволит ему укрепить свои позиции на национальной и международной арене, привлечь новых инвесторов и улучшить свои конкурентные преимущества по сравнению с прибрежными регионами Китая. Другим жизнеспособным вариантом для регионального правительства было бы создание особой экономической зоны, которая заключается в создании соответствующей инфраструктуры или реконструкции уже существующих объектов, предоставлении налоговых и тарифных стимулов и введении упрощенных бюрократических процедур.

**КЛЮЧЕВЫЕ СЛОВА**

развитие регионов, промышленные факторы, транспорт, особая экономическая зона, инициатива «Один пояс, один путь»

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## Introduction

Sichuan Province, located in Western China, consists of two separate regions. In the east, there is a large Sichuan basin, covering about 40% of Sichuan's total land area of 48,500 square kilometers. Sichuan Province is a significant junction area between south-western, north-western, and central regions of China. In addition, it provides an important traffic corridor between southern and central China, its south-western and north-western parts. In a more general sense, this province may be seen as a bridge between Central, Southern and South-Eastern Asia [1]. Sichuan Province serves as an important strategic point that connects the so-called Economic Belts of the *Silk Road Initiative* and the *Maritime Silk Road*. This province has a large population and is rich in various resources.

In the recent years, the province's economic strength has increased significantly and Sichuan ranks high among other Chinese regions by GDP. It is virtually an economic powerhouse of western China. Technological industries and emerging pilot-type service industries enhance agricultural modernization, scientific and technological innovation [2].

In terms of its transport infrastructure, Sichuan has managed to accomplish a major breakthrough: twenty road channels have already been completed, while the other thirteen are currently under construction. Shuangliu International Airport has turned Chengdu into the *Fourth Aviation City in China*. In 2013, thirteen airports were built with the passenger turnover over 37 million. The expressway mileage has reached 5,046 km while the total road mileage exceeded 300,000 km. Chengdu European high-speed rail accounts for 40% of China's total volume of railway freight towards Europe [3].

One of the serious challenges that Sichuan Province has to address nowadays is that it is lacking in domestic and international cooperation. This situation stems from the lingering negative effect of the international financial crisis and the poor business environment.

The data we use in this research is provided by *Input-Output Manuals of Chinese Provinces*. This reference book consists of matrices which provide data on the production volume for each province. In addition, it includes world and domestic commercial activity output for 21 tradable and 10 non-tradable industries in 1982–2015. We also obtained the data on Sichuan Province by analyzing the *Industrial Statistical Yearbook (SSB)*.

The province's development problems were investigated by Christopher A. McNally in his paper *Sichuan: Driving Capitalist Development Westward*. He argues that the Chinese government's *Open Up the West* campaign has failed to achieve one of its primary goals in this province: to decrease the huge development gap between resource-poor and resource-abundant areas. Simultaneously, Sichuan's physical infrastructure is growing intensively, accelerating the national consolidation of the province's economy and society.

David S. G. Goodman points out that "as a result of these different emphases, the campaign encompasses a wide range of development policies, ranging from mainstream efforts to ameliorate physical infrastructure to endeavours to manage human resources better and improve the rule of law" [3].

## The role of industrial factors in the socio-economic development of Sichuan Province

Regional development is a complex, multi-level process, which can be approached from different social and economic perspectives. Effective and efficient economic development depends on such industrial factors as government policy, transport network, raw materials, geography, labor, and industrial inertia [4].

For example, the increased concentration of the transport system and highly connected networks are usually associated with a high degree of development. If transport infrastructure is efficient, it provides the area with multiple economic and social opportunities, which, in turn, enhance employment, investment and availability of markets. Inefficiency of the region's transport system can lead to missed opportunities and lower living standards. At the aggregate level, an efficient transport system decreases the costs in many economic sectors, while inefficient transport network increases these costs.

Many government programs have been implemented in the province in the recent years, in particular the *Western Development Strategy*, which comprises objectives for the development of telecommunications, transport, energy and hydropower plants; attraction of foreign investment, reforestation, promotion of education, and measures to retain qualified workforce and prevent *brain drain*. By 2006, 1 trillion yuan had been spent on infrastructural construction in Western China [6].



It is worth noting that the Chinese government, following in the footsteps of Deng Xiaoping, injected massive funds to boost Sichuan's development. Deng Xiaoping started market reforms in Sichuan in 1978 as an effort to alleviate poverty in the province. The government in a similar way reorganized Sichuan Province in 1997. Chongqing municipality was separated from the rest of the province to create a new political and administrative entity that could transition to market economy, [7]. At the moment, Sichuan Province is involved into the thirteenth national Five-Year Plan (2016–2020) aimed at building a moderately prosperous society while promoting sustainable economic and social development [3].

When the Chinese government put forward "One Belt, One Road" Initiative, Sichuan Province joined this project. The regional authorities have also been implementing policies that focus on interprovincial investment as well as specific industries such as transportation infrastructure and software.

The improvement of the transportation system in Sichuan was largely achieved through large-scale state funding. A comprehensive transport network involving air, rail, road, and water transportations connects all parts of the province with Chengdu, the capital city and hub. Thus, Sichuan Province has a state-of-the-art transport system and is now a major transport juncture in the south-west of China. One of the four largest airports in China is Shuangliu International Airport located in Chengdu. In total, Sichuan Province has thirteen airports. Railway plays a vital role in Sichuan's transport network: there are currently five major railways connecting the region's towns and cities with other provinces. The region also benefits from its well-developed network of expressways and inland water network.

An abundant supply of local raw materials and the high quality of water in the province are important input factors for food and beverage production. Only 4.7% of raw materials used in Sichuan's chemical industry are imported. Sichuan ranks high in the country in terms of guaranteed reserves of solid minerals such as vanadium, titanium, sandstone, clay, and so on.

Rich deposits of minerals are used as sources of raw materials in power, metallurgical and chemical industries, production of building materials and in other important fields, which makes Sichuan Province an important industrial centre

[1]. The province is also known for its coal production [8]. Sichuan's deposits of rare and rare-earth metals are bountiful. Lithium and strontium, both of which are extracted in Sichuan, play an important role in Chinese economy. Moreover, Sichuan is famous for its gold and silver.

Sichuan Province is located in the tropical zone and has abundant biological resources. The region is characterized by the diversity of landscapes (upland, mountains, hills, plains, etc) and climatic conditions, animal and plant life. Sichuan is considered the second-large forest area in the country with its 7.46 million hectares of forests [2]. The variety of soil types make the region's area suitable for cultivation of diverse crops.

There are more than 1,400 rivers in Sichuan, with the majority of rivers flowing through gorges, which turns them into massive sources of hydraulic power. The area of the basin of 343 rivers exceeds 500 sq. km. The total amount of water consumption in the rivers is about 300 billion cubic meters [3].

Human capital in the region is to a great extent determined by the quality of education provided there. At the moment, the education system in the province comprises primary, secondary and higher education. There are also advanced training and retraining opportunities for adult learners. At the end of 2015, in Sichuan there were 43 general higher education institutions with 180 thousand students and 10 thousand graduate students. There are 209 specialized high schools with 257 students; 4,375, general high schools with about 3 million students; 45 thousand elementary schools with 8 million pupils. Compulsory education in Sichuan includes nine years of training, which has allowed the region to eliminate illiteracy among its population [11]. Higher education institutions are, for example, Sichuan University, Southwest Scientific and Technical University. Five of the region's higher education institutions participate in the state *211 Project* [1]. Thus, a conclusion can be made that Sichuan Province has a significant potential regarding skilled labour.

Since 1982, there has been a considerable outflow of workforce from Sichuan province to western regions of the country (see Table 1). Even though the rate of emigration varied at different times, the general trend persisted [8]. Sichuan traditionally is the largest supplier of labor abroad. In 2000, the volume of signed contracts for contract works and labor services abroad was 345 million

US dollars. 10 million workers annually leave the Province of Sichuan. Therefore, *brain drain* is one of the most serious problems that the province faces nowadays [1].

Table 1

**Distribution of emigrants from China by province, %**

| Province          | 1982 | 1990 | 1995 | 2000 | 2015 |
|-------------------|------|------|------|------|------|
| Central and South |      |      |      |      |      |
| Henan             | 2.82 | 0.25 | 2.42 | 1.12 | 2.28 |
| Hubei             | 4.65 | 0.66 | 0.89 | 0.89 | 0.86 |
| Hunan             | 4.16 | 1.11 | 0.72 | 0.66 | 0.57 |
| Guangdong         | 5.18 | 6.73 | 3.05 | 3.37 | 3.20 |
| Guangxi           | 1.01 | 0.37 | 0.64 | 0.47 | 0.36 |
| Hainan            |      |      | 0.25 | 0.10 | 0.10 |
| South-West        |      |      |      |      |      |
| Sichuan           | 8.04 | 1.44 | 2.46 | 1.50 | 1.13 |
| Guizhou           | 2.76 | 0.21 | 0.13 | 0.09 | 0.04 |
| Yunnan            | 1.39 | 0.78 | 0.25 | 29.0 | 3.00 |
| Tibet             |      | 0.04 | 0.13 | 0.02 | 0.02 |

Industrial inertia is ascribed to the persistent residence of an industry in a location, after the initial locational factors have ceased to exist. Sichuan Province’s market size and its position in China, its amplexness of resources, the accessibility and modest labor cost, academic and production infrastructure create favourable conditions for the development of a number of diverse industries. Sichuan Province is ideally placed in the market, itself being a practicable substitute for coastal places as an enticing low expenses contribution site [9]. Although the province’s functional setting can be defined as conducive regarding such factors as conditions for depositors, there is a need for further improvements in this respect that would boost its attractiveness and stimulate the inflow of FDI. The past experience has shown that most foreign investors opt for the establishment of manufacturing enterprises in economic development zones that offer clear and precise rights to use the land and opportunities for more productive handling of operational threats. In the development of many Sichuan’s economic development zones, a number of problems arise such as the lack of land suitable for construction and Chinese land use/ownership laws, creating difficulties for operation of individual investors [2]. Moreover, while Sichuan is often described as a tempting market in the west of China, it has quite a long way to go in becoming one of the major economic centres to be able to compete with coastal provinces and enter world markets.

In 2017, the volume of investment was nearly 2 trillion yuan. Such rapid industrial development, undoubtedly, increases the number of jobs in the region [11].

As Table 2 shows, Sichuan has abundant natural resources and an advanced production sector. Chengdu, the capital city of Sichuan Province, is a vibrant commercial center. The province is one of China’s main agricultural regions growing rice, wheat, rapeseed, citrus fruit, peach, sugar cane, sweet potato and herbs.

Table 2

**SWOT Analysis of Industrial Factors**

| Strengths   | Weaknesses  |
|---|---|
| Well-functioning transportation system (railways, highways, roads, waterways, air lines)<br>Sichuan has a complex and varied topography with mountains and plateaus<br>Human capital  | Socio-economic problems<br>Geographical location: no access to the ocean<br><i>Brain drain</i> to the eastern part of China   |
| Opportunities   | Threats   |
| Diversity of national economic policies.<br>Developed transportation system<br>The province processes its own resources instead of selling them to other regions.<br>Sichuan is located at the crossroads of the Silk Road and the Yangtze River Economic Belt<br>Attraction of highly qualified staff back to the province | Possible deterioration of transport system due to its inefficient use<br>Non-renewable resources<br>Impeded market access to Eastern China<br><i>Brain drain</i> to other regions |

**Conclusion**

Our analysis of the key industrial factors that determine the socio-economic development of Sichuan Province has shown that in the current conditions, the region would benefit from the establishment of a special economic zone, which would allow it to attract new investors and increase the share of tax revenues to the regional budget. Moreover, a special economic zone would ensure more balanced development of the region, enhance its competitiveness and business infrastructure, create new jobs and thus raise the living standards of the regional population [12]. To establish a special economic zone, the regional authorities need to build and/or reconstruct appropriate engineering, transport and social infrastructure; lower administrative barriers; simplify the bureaucratic procedures, creating single window clearance mechanisms; offer tax-and-tariff incentives and a flexible system of loans [1; 12].

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## Original Paper

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## Inframarginal models of spatially allocated economic structures and the analysis of production processes

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**ABSTRACT**

The article discusses designing of labor division networks. Designing of the economic structure of labor division constitutes the main part of inframarginal analysis. Inframarginal analysis normally uses predefined economic structures, which means that in certain cases some economic structures may be neglected. Such inaccuracies may be not important in the analysis of small enterprises but in the analysis of spatially allocated economic structures, some important aspects may be left unnoticed, which will lead to wrong decisions regarding labor allocation. To make an enterprise competitive it is essential to understand what is the optimal economic organization and the form of labor division in the given region. If some economic structures are not taken into account in the analysis, the general equilibrium will be incorrect, which will negatively affect the decision-making. If we use inframarginal models to analyze the production process, it will allow us to take a fresh perspective on the problem. All possible structures of the division of labor are designed by using production factors and goods to reduce the risk of errors in the process of decision-making, which will make the production process of the enterprise more efficient.

**KEYWORDS**

inframarginal analysis, technology, division of labor, network effects, economic structures, regional economy

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## Инфрамаргические модели пространственно разнесенных экономических структур и анализ производственных процессов

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**РЕЗЮМЕ**

В статье обсуждается проектирование сетей разделения труда. Проектирование экономической структуры разделения труда составляет основную часть инфрамагинального анализа. Инфрамагинальный анализ обычно использует predetermined экономические структуры, а это означает, что в некоторых случаях некоторыми экономическими структурами можно пренебречь. Такие неточности могут быть не важны при анализе малых предприятий, но при анализе пространственно распределенных экономических структур некоторые важные аспекты могут остаться неучтенными, что приведет к неправильным решениям относительно распределения рабочей силы. Чтобы сделать предприятие конкурентоспособным, важно понять, что является оптимальной экономической организацией и формой разделения труда в данном регионе. Если в анализе не учитываются некоторые экономические структуры, общее равновесие будет неверным, что негативно скажется на процессе принятия решений. Если мы используем инфрамаргинальные модели для анализа производственного процесса, это позволяет нам взглянуть на проблему с новой точки зрения. Все возможные структуры разделения труда разработаны с использованием факторов производства и товаров для снижения риска ошибок в процессе принятия решений, что сделает производственный процесс предприятия более эффективным.

**КЛЮЧЕВЫЕ СЛОВА**

инфрамаргинальный анализ, технологии, разделение труда, сетевые эффекты, экономические структуры, региональная экономика

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## Introduction

There are two types of business decisions: decisions associated with the choice of activity and decisions of resource allocation. Decisions of the first type can be illustrated by the choice of majors students make when entering the university. These are inframarginal decisions. Then students choose the courses they want to study and decide on the time they want to spend on each of the learning courses. These are decisions of the second type – marginal decisions of time allocation. In the context of the division of labor, inframarginal decisions are more important than marginal decisions.

In most cases of inframarginal analysis, a set of economic activities which can be chosen by individuals is set exogenously and inframarginalists are concerned with the problem of mathematical optimization of utility functions [4, p. 14]. The set of economic activities which can be used in the division of labor is usually limited and well known. In real life, however, managers have enough practical experience to determine the optimality of particular structures of the division of labor in various cases. Complex and specific results of inframarginal articles are not practically useful for the decision-making process, which leads to a situation when “inframarginalists write papers mainly for inframarginalists” [6, pp. 177].

The technology-oriented theory of production can be divided into *function analysis* and *activity analysis* depending on the object of analysis [1, p. 1055]. Inframarginal analysis is based on activity analysis, proposed by Koopmans. Function analysis was introduced by Fandel [7, p. 41] to find the types of possible economic structures in the process of inframarginal analysis. *Activity* was defined by Koopmans as “the combination of certain qualitatively defined commodities in fixed quantitative ratios as ‘inputs’ to produce as ‘outputs’ certain other commodities in fixed quantitative ratios to the inputs” [9].

## Method and model

Let us now consider the asymmetric model with trading activities and heterogeneous parameters introduced by Yang [13, pp. 111]. In the model of specialization, there are three types of goods  $x$ ,  $y$ , and  $z$ . The number of goods which are sold on the market have index  $s$ . The number of goods which are purchased on the market have index  $d$ . The self-provided goods have index  $c$ .

The transaction cost coefficient is  $1 - k$ ,  $k$  is viewed as a transaction service and depends on the quantity of labor used in transactions. As a service, it can be self-provided or purchased on the market:

$$k = r_c + r_d$$

In this case,  $r_c$  and  $r_d$  as transaction services relate to the distance between a pair of trade partners and their location problems. All individuals are evenly spaced and the distance between each pair of neighbors is a constant. The distance between a pair of trade partners may differ from the distance between a pair of neighbors. For example, they can be engaged in rural or urban relations.

The utility function is identical for all individuals and has a form of the Cobb-Douglas utility function [5, p. 337]:

$$u = [x_c + (r_c + r_d)x_d]^\alpha [y_c + (r_c + r_d)y_d]^\beta \times [z_c + (r_c + r_d)z_d]^\gamma.$$

The set of activities known to an enterprise describes the technical opportunities of this enterprise. This set is called *technology* and is designated by symbol  $T$  [7, p. 43].

Therefore, technology can be written the following way:

$$T = \left\{ \begin{array}{l} -l \\ x \\ y \mid l = 1, x, y, z \geq 0 \\ z \\ r \end{array} \right\}.$$

Labor restrictions are equal for all economic agents and can be written as:

$$\begin{aligned} l_x + l_y + l_z + l_r &= 1, \\ l_i &\in [0, 1], \\ i &= x, y, z, r. \end{aligned}$$

Using the theorem of optimum configuration ‘the optimum decision does not involve selling more than one good, does not involve selling and buying the same good, and does not involve buying and producing the same good’ [11], we can find vectors of activities for technology  $T$ .

The producer-consumer uses only one production factor  $l$  (*labor*) in the production processes. The economic agent can produce a good only for their own consumption  $x_c$  or produce an additional part of the good for sale in order

to purchase other types of goods that the economic agent does not produce on their own  $x_s$ . If the economic agent does not produce a good and purchases the good on the market, we put 0 (zero) in the activity vector.

All the possible activities vectors can be written the following way:

$$T' = \left( \begin{array}{cccccc} \begin{pmatrix} -1 \\ x_c + x_s \\ 0 \\ z_c \\ r_c \end{pmatrix} & \begin{pmatrix} -1 \\ x_c + x_s \\ y_c \\ 0 \\ r_c \end{pmatrix} & \begin{pmatrix} -1 \\ x_c + x_s \\ y_c \\ z_c \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ y_c + y_s \\ z_c \\ r_c \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ y_c + y_s \\ 0 \\ r_c \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ y_c + y_s \\ z_c \\ 0 \end{pmatrix} \\ \begin{pmatrix} -1 \\ 0 \\ y_c \\ z_c + z_s \\ r_c \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ 0 \\ z_c + z_s \\ r_c \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ y_c \\ z_c + z_s \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ y_c \\ z_c \\ r_c + r_s \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ 0 \\ z_c \\ r_c + r_s \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ y_c \\ 0 \\ r_c + r_s \end{pmatrix} \\ \begin{pmatrix} -1 \\ x_c + x_s \\ 0 \\ 0 \\ r_c \end{pmatrix} & \begin{pmatrix} -1 \\ x_c + x_s \\ y_c \\ 0 \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ x_c + x_s \\ 0 \\ z_c \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ y_c + y_s \\ 0 \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ y_c + y_s \\ z_c \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ y_c + y_s \\ z_c \\ r_c \end{pmatrix} \\ \begin{pmatrix} -1 \\ x_c \\ 0 \\ z_c + z_s \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ y_c \\ z_c + z_s \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ 0 \\ z_c + z_s \\ r_c \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ 0 \\ 0 \\ r_c + r_s \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ y_c \\ 0 \\ r_c + r_s \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ 0 \\ z_c \\ r_c + r_s \end{pmatrix} \\ \begin{pmatrix} -1 \\ x_c + x_s \\ 0 \\ 0 \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ x_c + x_s \\ y_c + y_s \\ 0 \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ y_c + y_s \\ z_c + z_s \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ 0 \\ 0 \\ z_c + z_s \\ 0 \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ y_c \\ 0 \\ r_c + r_s \end{pmatrix} & \begin{pmatrix} -1 \\ x_c \\ y_c \\ 0 \\ r_c + r_s \end{pmatrix} \end{array} \right)$$

Each element in matrix  $T$  represents the production function of an economic agent. The economic agent can choose any production function. The agent's choice represents their production process, and it will be an inframarginal choice. For each activities vector in matrix  $T$  we will find cases in which the utility functions of the economic agent will be positive. Combinations of activities vectors will give different types of economic structures.

Some of these were reviewed earlier [13, p. 115] and we will use them to show the method of construction of economic structures from technology matrix  $T$ .

### Results

The simplest case is *autarky*: an individual self-provides three goods. Therefore, the number of goods sold and purchased and the number of transaction services are 0. The technology has only one activity vector

$$T = \left\{ \begin{pmatrix} -1 \\ x_c \\ y_c \\ z_c \\ 0 \end{pmatrix} \right\}$$

The utility function can be written as:

$$u = x_c^\alpha y_c^\beta z_c^\gamma > 0.$$

In this case only one activity vector is sufficient to achieve a positive value of the utility function and there is no network of labor division. The pattern of labor division is shown as a graph [2] in Figure 1.

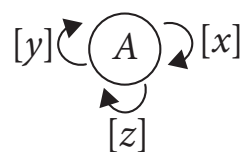


Figure 1. Autarky

#### Activities

$$\left\{ \begin{pmatrix} -1 \\ x_c + x_s \\ 0 \\ z_c \\ r_c \end{pmatrix}, \begin{pmatrix} -1 \\ x_c + x_s \\ y_c \\ 0 \\ r_c \end{pmatrix}, \begin{pmatrix} -1 \\ 0 \\ y_c + y_s \\ z_c \\ r_c \end{pmatrix}, \begin{pmatrix} -1 \\ x_c \\ y_c + y_s \\ 0 \\ r_c \end{pmatrix}, \begin{pmatrix} -1 \\ 0 \\ y_c \\ z_c + z_s \\ r_c \end{pmatrix}, \begin{pmatrix} -1 \\ x_c \\ 0 \\ z_c + z_s \\ r_c \end{pmatrix} \right\}$$

exist in cases of partial division of labor. In this case an individual sells one of the produced goods and purchases one of the goods for consumption. The utility function should be positive. For an individual with the activity vector

$$\begin{pmatrix} -1 \\ x_c + x_s \\ 0 \\ z_c \\ r_c \end{pmatrix}$$

there should exist an individual with the activity vector

$$\begin{pmatrix} -1 \\ 0 \\ y_c + y_s \\ z_c \\ r_c \end{pmatrix}$$

and so on for activities

$$\begin{pmatrix} -l \\ x_c + x_s \\ y_c \\ 0 \\ r_c \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ y_c + y_s \\ z_c \\ r_c \end{pmatrix}.$$

Individuals form an economic structure with production processes described by technology

$$T = \left\{ \begin{pmatrix} -l \\ x_c + x_s \\ 0 \\ z_c \\ r_c \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ y_c + y_s \\ z_c \\ r_c \end{pmatrix} \right\} \text{ (see Figure 2).}$$

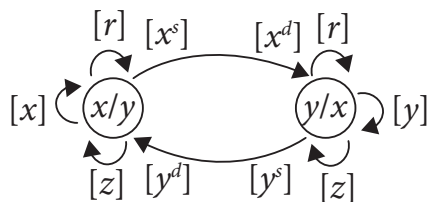


Figure 2. Partial division of labor

The complete division of labor (Figure 3) is represented by technology

$$T = \left\{ \begin{pmatrix} -l \\ x_c + x_s \\ 0 \\ 0 \\ r_c \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ y_c + y_s \\ 0 \\ r_c \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ 0 \\ z_c + z_s \\ r_c \end{pmatrix} \right\}$$

with three activities vectors. In this case, individuals produce only one of the goods and purchase two on the market. The transaction service is self-provided.

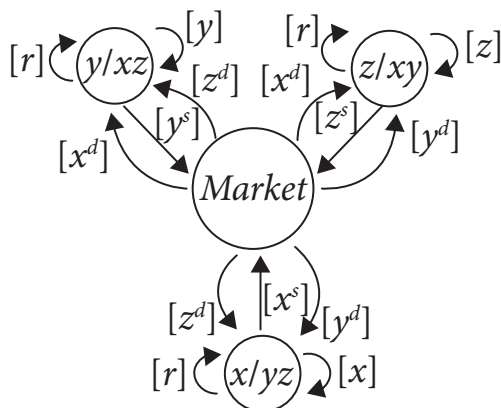


Figure 3. Complete division of labor

For a complete production process, an individual with the activity vector

$$\begin{pmatrix} -l \\ x_c + x_s \\ 0 \\ 0 \\ r_c \end{pmatrix}$$

needs two other activities:

$$\begin{pmatrix} -l \\ 0 \\ y_c + y_s \\ 0 \\ r_c \end{pmatrix} \text{ and } \begin{pmatrix} -l \\ 0 \\ 0 \\ z_c + z_s \\ r_c \end{pmatrix}.$$

If all of these activities vectors are present, the utility functions for all individuals are positive and there is division of labor.

Partial division of labor and transaction services can be represented by the combination of the following activities vectors:

$$T = \left\{ \begin{pmatrix} -l \\ x_c + x_s \\ 0 \\ z_c \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ y_c + y_s \\ z_c \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ 0 \\ z_c \\ r_c + r_s \end{pmatrix} \right\};$$

$$T = \left\{ \begin{pmatrix} -l \\ x_c + x_s \\ y_c \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ y_c \\ z_c + z_s \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ y_c \\ 0 \\ r_c + r_s \end{pmatrix} \right\};$$

$$T = \left\{ \begin{pmatrix} -l \\ x_c \\ y_c + y_s \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ x_c \\ 0 \\ z_c + z_s \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ x_c \\ 0 \\ 0 \\ r_c + r_s \end{pmatrix} \right\}.$$

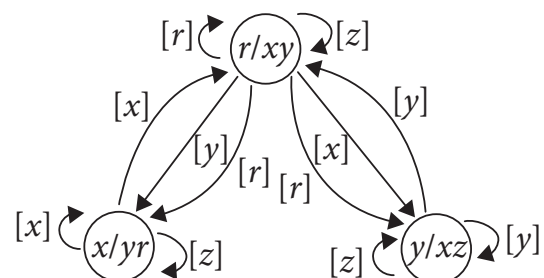


Figure 4. Partial division of labor

The complete division of labor and transaction services can be represented by the combination of the following activities vectors:

$$T = \left\{ \begin{pmatrix} -l \\ x_c + x_s \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ y_c + y_s \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ 0 \\ z_c + z_s \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ 0 \\ 0 \\ r_c + r_s \end{pmatrix} \right\}.$$

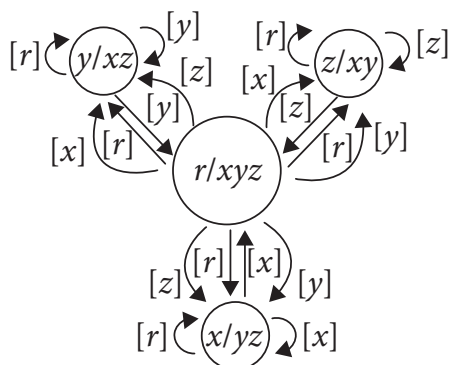


Figure 5. Complete division of labor and transaction service

**Discussion**

In the case of a complete production process, there should be four individuals who produce one type of goods or transactional service.

It is easy to show that the following activity vectors

$$\left\{ \begin{pmatrix} -l \\ x_c + x_s \\ y_c \\ z_c \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ x_c \\ y_c + y_s \\ z_c \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ x_c \\ y_c \\ z_c + z_s \\ 0 \end{pmatrix} \right\}$$

cannot be a part of the production process and a part of labor division because it is impossible to find individuals with the corresponding activity vectors with the positive utility function for these cases.

These four basic forms of the division of labor (autarky, partial division of labor, complete division of labor, and complete division of labor and transaction service) were discussed by X. Yang and Wai-Man Liu [13, p. 115], but the following activities vectors

$$\left\{ \begin{pmatrix} -l \\ 0 \\ y_c \\ z_c \\ r_c + r_s \end{pmatrix}, \begin{pmatrix} -l \\ x_c \\ 0 \\ z_c \\ r_c + r_s \end{pmatrix}, \begin{pmatrix} -l \\ x_c \\ y_c \\ 0 \\ r_c + r_s \end{pmatrix} \right\}$$

were not considered.

Activity vector

$$\begin{pmatrix} -l \\ 0 \\ y_c \\ z_c \\ r_c + r_s \end{pmatrix}$$

can exist in the following production process:

$$T_{xp} = \left\{ \begin{pmatrix} -l \\ 0 \\ y_c \\ z_c \\ r_c + r_s \end{pmatrix}, \begin{pmatrix} -l \\ x_c + x_s \\ 0 \\ z_c \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ y_c + y_s \\ z_c \\ 0 \end{pmatrix} \right\}.$$

The economic structure for this technology is showed in Figure 6. Technology  $T_{xp}$  is characterized by the production process with an intermediate product. We can see that  $y$  is the intermediate product and  $x$  is the final product because all individuals consume  $x$  and  $y$  is used for production  $x$ .

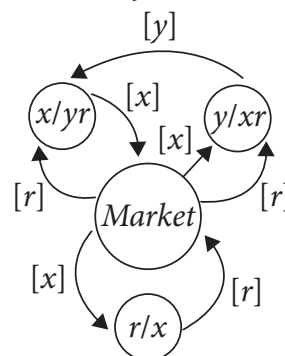


Figure 6. Division of labor with the intermediate product

The utility function for configuration  $x/yr$  can be written as:

$$u_{x/yr} = x_c^\alpha (r_d y_d)^\beta z_c^\gamma.$$

The utility function for configuration  $y/xr$  can be written as:

$$u_{y/xr} = (r_d x_d)^\alpha y_c^\beta z_c^\gamma.$$

The utility function for configuration  $r/x$  can be written as:

$$u = (r_c x_d)^\alpha y_c^\beta z_c^\gamma.$$

Another production process with activity vector

$$\begin{pmatrix} -l \\ 0 \\ y_c \\ z_c \\ r_c + r_s \end{pmatrix}$$



can be written the following way:

$$T_{x_F} = \left\{ \begin{pmatrix} -l \\ 0 \\ y_c \\ z_c \\ r_c + r_s \end{pmatrix}, \begin{pmatrix} -l \\ x_c + x_s \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ y_c + y_s \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} -l \\ 0 \\ 0 \\ z_c + z_s \\ 0 \end{pmatrix} \right\}.$$

In this case, all individuals decide to specialize in production of final goods. An individual who provided a transactional service makes a decision of partial specialization and purchases final product  $x$ .

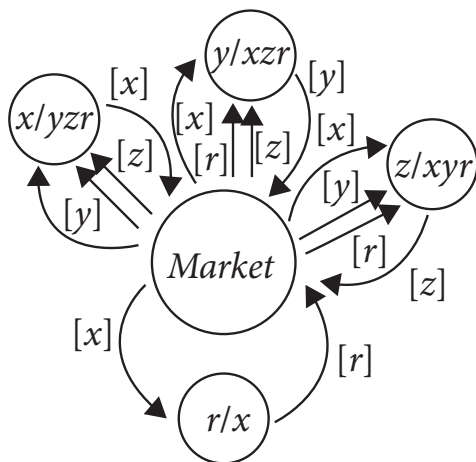


Figure 7. Division of labor

This economic structure can exist if the transaction service is different for other types of goods.

**Conclusion**

Analysis of the technological matrix makes it possible to find all economic structures for a given set of production factors and goods. We can see that all types of predefined economic structures can be found with the help of the technology matrix. We have also considered two economic structures with nonsymmetrical abilities, which were not considered in the initial formulation of the problem.

In the proposed approach, the objective of inframarginal analysis is not just to solve optimization problems for certain economic structures, but to find the economic structures that cannot be determined by experience, and determine their optimality parameters in general equilibrium.

The above-described matrix approach allows us to find and investigate spatially allocated economic structures. We can study the influence of agents who provide logistical support for the decisions that trade partners make in their choice of activities and resource allocation. Modern machine-learning computer methods are applicable for this approach.

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