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INNOVATIVE DEVELOPMENT OF RUSSIAN COASTAL REGIONS: NORTH–SOUTH DIVERGENCE

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Coastal regions are territorial social systems whose socio-economic and innovative development is strongly influenced by the factor of coastalisation. The effect of movement to the sea determines the dynamics of settlement systems as well as their economic and infrastructure development. This holds for transport, logistics, information and communications, industrial, and other infrastructure. Coastal regions are so diverse that it is impossible to construct a development model that will fit all of them. One can speak only of general trends. This study focuses on identifying differences between the innovation systems of northern and southern coastal regions within the same country. The geographical scope of the study is four Russian coastal territories: Murmansk and Arkhangelsk in the Baltic Sea region and Rostov and Krasnodar in the Azov-Black Sea region. Methodologically, this study carries out a comparative assessment of heterogeneity of innovative development at municipal and interregional levels, using four groups of indicators: human capital, economic growth and clustering, innovation and digitalisation, and quality and standards of living. All these components are vital for regional innovative development. A statistical assessment is supplemented by a qualitative analysis of spatial patterns of innovation capital accumulation; the agglomeration factor is taken into account. It is shown that northern and southern coastal regions perform very differently on innovative development, the latter doing better than the former. Three main models of innovation generation, implementation, and accumulation of coastal regions are described. Each is associated with a different way to benefit from proximity to the sea. These are maritime activities, maritime transport, and the economic use of recreational, natural and climatic resources.

Keywords:

coastal region, innovation capital, coastalisation, urban agglomeration, innovation geography, innovation space

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Introduction

Studies of the global and macroregional heterogeneity of regional economic development show two major trends. The first one is that northern countries and regions are often considered more developed in terms of the economy, community life, technology, and innovation. A UN report contains data on cross-country and cross-region differences in the era of unprecedented economic growth and a global increase in the standards of living [1]. The rapid rise of the economies of new industrial powers, particularly China, has changed the north-south asymmetry dramatically [2]. Uneven development is observed not only at a global level. It has been argued [3] that the north-south differences in economic development models are characteristic even of the Eurozone. Moreover, this disparity is expected to grow.

The second trend is closely connected with the coastalisation factor, which leads to the concentration of human, financial, intellectual, and other resources and infrastructure in the coastal zones. The literature has emphasised that economic coastalisation is more important for southern countries and regions than for the northern ones. A comparative study of fifteen European cities and agglomerations carried out by the Joint Research Centre of the European Commission both confirmed the coastalisation effect and identified the Mediterranean region as a hotspot of coastal urbanisation [4]. Most research into the patterns of coastalisation processes is conducted in regions with a warm climate, located on the shores of a warm sea [5–7].

Findings have shown differences in the dynamics and development trajectories of coastal and inland regions [8–14]. Other coastal phenomena described in the literature include greater involvement of coastal areas in global transport, logistics, and industrial networks; stronger urbanisation and agglomeration effects and city clustering; economic diversification ensured by extractive and manufacturing industries; a ramified network of tourism, transport, and financial services; leadership in embracing eco-innovations and renewable energy sources. At the same time, many coastal regions are deep periphery; many towns and smaller cities are single-company communities; many large seaports and coastal agglomerations put enormous pressure on the ecosystem; many maritime borders are in a precarious position susceptible to institutional factors. According to Stephen Fletcher and Hance Smith [13], all the above create the unique social environment of coastal spaces.

Coastalisation and coastal clustering are considered to be a driver of growth and a competitive advantage that translates into socio-economic, innovative, and technological excellence.

This work aims to describe how innovation systems develop in differently located coastal regions. The focus is on how regional potential for innovation is exploited in the north and south. Our primary objective is to distinguish different types of regions within a single country to establish an institutional baseline for the comparison of their innovative development. We hypothesise that, within one country, southern coastal regions are more developed in terms of innovation than their northern counterparts.

Very few countries meet the requirements of our geography-intensive study. Among those that do are the United States with its historical north-south divide, which has affected national administrative geography, and Russia, which has both northern and southern coastal regions on its vast territory. This study concentrates on the coastal regions of European Russia since they have a developed maritime infrastructure, strong maritime industries, and a long history of maritime activity, which created a settlement system with units of different levels.

Theoretical background

Embodied in the concepts of regional divergence, development asymmetries, socio-economic polarisation and inequality, uneven spatial development is increasingly connected with location. Findings obtained in different countries indicate that environmental and climate conditions greatly affect the levels and trajectories of regional development. At a global scale, the southern hemisphere lags behind the northern in economic development [2; 15], and plains outperform mountainous terrains in the same regard [16; 17]. Some studies point to a moderate climate [18] and favourable environmental conditions [19] as major factors in human capital development and innovation.

Location on the banks of navigable rivers or in a coastal zone contributes as much to the unique profile of a spatially based social system as the availability of mineral deposits [20; 21]. When examining the development trajectories of coastal areas, the significance of the maritime economy for the coastal zone is taken into account along with global coastalisation trends [22–24]. Direct access to a sea and/or ocean is a key competitive advantage and the starting point for any strategy [10; 11; 25].

The Organisation for Economic Cooperation and Development (OECD), the World Bank, the United Nations (UN), and other international organisations look for ways to use geographical position to narrow socioeconomic gaps between countries on a global scale [26]. Some academic research teams have considered the ‘place factor’ in the context of individual territories [27] and, less often, in a cross-country context [28]. Earlier findings show that coastal regions are under considerable environmental pressure accounted for by a high immigration rate and economic density [29; 30]. Arctic areas have isolated ‘islands’ of development, whose socio-economic dynamics are more dependent on the situation in the global raw materials market than on national accounts [31].

Although the effects of coastal position have been investigated before, the patterns observed at a global scale are difficult to scale down to a national level. The broadly discussed north-south regional divide in Italy [3; 32] gives little insight into the situation in Russia. In the Mediterranean [33; 34] and South-East Asia [35–37], coastalisation has a pivotal role, whereas, in the coastal regions of the Arctic, different factors are at play. Previous research has paid little attention to the effect of coastal position on the innovative trajectory of regional development. Obviously, there are significant disparities between northern and southern coastal regions with regards to their capacity for innovation.

Methodology

Data on municipalities of four Russian coastal regions – Murmansk, Arkhangelsk, Rostov, and Krasnodar – were used in the study (Fig. 1). All the regions are located in the traditionally better-developed European part of Russia. The Murmansk and Arkhangelsk regions are part of the North-western federal district. Most of their territory lies in the Extreme North. The Murmansk region has access to the White and Barents Sea; the Arkhangelsk region, to both of the above and the Kara Sea. The Rostov and Krasnodar regions are located at the south-western border of Russia. Both belong to the Southern federal district. The Krasnodar region borders the Azov and Black Seas; the Rostov region, Taganrog Bay of the Azov Sea.

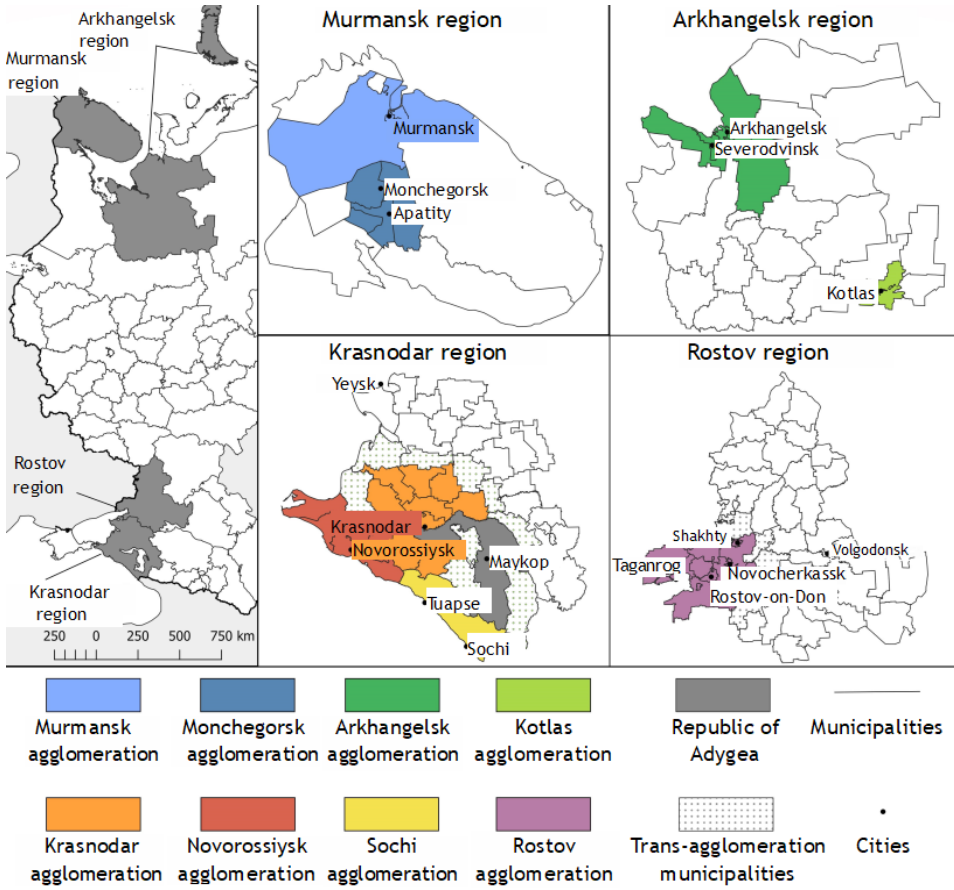


Fig. 1. Geography of Russian coastal region studies

Our research concentrated on the north-south divide in innovative development in European Russia. The region’s potential for economic and innovative development was analysed at a cross-city level; possible hotspots of innovation generation and consumption were identified. The research strategy included analysing the centre-periphery relations within the spatially based social system of the studied regions under the cross-influence of the coastal, agglomeration, and environmental factors. The spatial structure of regional economies, their industrial makeup, gross added value structure, the presence of hi-tech industries, and the tendency for clustering were examined. Particular attention was paid to the inclusion of rural areas into intra-regional economic processes. Quality of rural life was identified as a criterion for human capital preservation and access to utilities and soft infrastructure. Table 1 shows the indicators and data sources used in the study.

Table 1

Measuring the innovative development of coastal regions in European Russia

Group	Indicator	Period/source
Human capital	Population density, people/km ²	2013-2019 / Rosstat
	Urban population, %	2013-2019 / Rosstat
	People holding undergraduate and postgraduate degrees, %	2010 / National census
Economic growth and clustering	Contribution of manufacturing industries to the shipping volume, %	2014-2019 / Rosstat
	Retail sales per capita, 1,000 roubles	2015-2019 / Rosstat
	Companies per 1,000 population	2015-2019 / SPARK
Innovation capacity and digitalization	New agricultural machinery, %	2016 / National agricultural census
	People employed in IT, communications (section J), research, and technology (section M) in the average headcount (except small enterprises), %	2017-2019 / Rosstat
	3G and 4G coverage, % of the area of the municipality	2019 / official websites of telecommunication companies (Beeline, Megafon, MTS, and Tele2)
Life quality and standards of living	New housing stock per capita, m ²	2013-2018 / Rosstat
	Communities without gas supply, %	2013-2018 / Rosstat
	ATMs per 1,000 population	2019 / official websites of Russia's 23 largest banks

The values were calculated for municipalities of the sample regions and aggregated for the agglomeration, trans-agglomeration, and periphery groups (Fig. 1). For the purposes of this study, an agglomeration is the core city and municipalities connected to it by transport, logistics, economy, and community life. Trans-agglomeration municipalities are districts abutting the agglomeration. These were distinguished in the Rostov and Krasnodar regions, which have a large number of municipalities. The periphery includes all other, more remote municipalities.

Results

Murmansk region

Spatial differences in socio-economic development and capacity for innovation are very noticeable in the Murmansk region. There is a clear growth

pole — the city of Murmansk, which accounts for 50% of the regional gross added value [38]. The southern part of the region has its own economic centre, which brings together the cities of Monchegorsk, Olenogorsk, Kovdor, Kirovsk, and Apatity. Our analysis of the the parameters of socio-economic development and capacity for innovation showed that the economic development of the region was very uneven (Table 2).

Table 2

Innovative development indicators for Murmansk municipalities

Indicator	Year	Municipalities		
		Murmansk agglomeration	Monchegorsk agglomeration	Periphery
<i>Human capital</i>				
Population density, people/km ²	2013	11.14	14.58	1.20
	2019	14.42	13.96	1.22
Urban population, %	2013	97.20	91.50	83.60
	2019	95.35	90.18	84.03
People holding undergraduate and postgraduate degrees, %	2010	21.25	20.16	14.46
<i>Economic growth and clustering</i>				
Contribution of manufacturing industries to the shipping volume, %	2014	5.93	31.98	12.52
	2019	9.12	65.72	11.52
Retail sales per capita, 1,000 roubles	2015	70.05	77.08	49.51
	2019	75.52	88.68	65.13
Number of businesses, units per 1,000 population	2015	51.49	13.70	12.07
	2019	25.08	11.03	9.65
<i>Innovatisation and digitalisation</i>				
New agricultural machinery, %	2016	0	0	0
People employed in IT, communications, research, and technology in the average headcount, %	2017	3.83	4.35	1.69
	2019	5.18	5.04	2.66
3G and 4G coverage, %	2019	61.24*	15.95	3.92
<i>Life quality and standards of living</i>				
New housing stock per capita, m ²	2013	0.03	0.06	0.03
	2018	0.07	0.07	0.05
Communities without gas supply, %	2013	19.23	57.89	61.11
	2018	23.08	57.89	63.89
ATMs per 1,000 population	2019	0.77	0.62	0.44

Comment: the Kola municipality, where the Internet coverage is at 7.78%, is not taken into account.

The local economy consists of many industries. The economic specialisation and innovation profile of a municipality is determined by the performance of large local mining and manufacturing companies. The municipalities of the region's secondary economic centre where one large organisation creates most jobs and added value serve as a representative example. In the Kovdor region, the key economic player is the local mining and processing plant, which produces apatite, baddeleyite, and magnetite; in Kirovsk and Apatity, this is the Apatit plant, which produces apatite and nepheline; in Monchegorsk, the Kola Mining and Metallurgy Company producing nonferrous metals; in Olenegorsk, the Olkon mining and processing plant specialising in iron ore.

The Murmansk municipalities that are not home to large companies lack an economic system capable of either generating or consuming innovations. Industry analysis shows that there, gross added value is created by sectors dependent on budgets of all levels [39]. The most budget-dependent municipality in the region is Levozero, where 60% of gross added value is generated this way. Public administration and defence comprise over 25% of the gross added value created in the municipality. The situation is very similar in Tersky where no large companies are registered: budget-financed organisations account for the bulk of the income of its residents. These features of their socio-economic development preclude the rural areas of Murmansk from becoming either generators or consumers of innovation [40]. Nevertheless, there are opportunities for generating innovations in the sectors that are traditional for the Extreme North: deer farming, fishing, hunting, wild-herb harvesting, pedigree livestock breeding, and dairy farming.

Arkhangelsk region

The socio-economic space of the Arkhangelsk region is polarised as well (Table 3), with capacity for research and innovation concentrated in local cities. The primary growth pole is Arkhangelsk, the neighbouring city of Severodvinsk, and their environs. The second most important economic centre, or, more precisely, economic belt, stretches through the south of the region along the railway running from Konosha to Kotlas. The other municipalities are rural communities with a marked tendency towards depopulation caused by out-migration and natural decrease [41].

Table 3

Innovative development indicators for Rostov municipalities

Indicator	Year	Municipalities		
		Arkhangelsk agglomeration	Kotlas agglomeration	Periphery
<i>Human capital</i>				
Population density, people/km ²	2013	16.05	20.63	0.77
	2019	15.66	20.17	0.69
Urban population, %	2013	90.96	91.18	47.24
	2019	91.49	91.80	48.90
People holding undergraduate and postgraduate degrees, %	2010	20.52	17.61	12.44
<i>Economic growth and clustering</i>				
Contribution of manufacturing industries to the shipping volume, %	2013	68.93	76.15	4.69
	2019	39.83	82.35	2.08
Retail sales per capita, 1,000 roubles	2015	69.77	36.21	23.39
	2019	73.87	63.40	44.80
Number of businesses, units per 1,000 population	2015	27.26	16.61	13.68
	2019	22.80	14.95	11.94
<i>Innovatisation and digitalisation</i>				
New agricultural machinery, %	2016	4.08	7.69	7.28
People employed in IT, communications, research, and technology in the average headcount, %	2017	3.24	2.56	2.26
	2019	2.21	1.53	1.81
3G and 4G coverage, %	2019	22.34*	26.57	4.61
<i>Life quality and standards of living</i>				
New housing stock per capita, m ²	2013	0.23	0.43	0.28
	2018	0.30	0.32	0.26
Communities without gas supply, %	2013	22.90	84.24	81.46
	2018	36.49	83.28	87.13
ATMs per 1,000 population	2019	1.00	0.83	0.34

Comment: within the Arkhangelsk agglomeration, 92.8% in Arkhangelsk and 100% in Novodvinsk.

A specific feature of the Arkhangelsk economy is the strong contribution of low-productivity industries: the lumber sector accounts for 60% of the regional output. Workforce productivity in other industries is very low because of an insufficient level of innovation. The number of businesses in the Arkhangelsk region is also low. Even in the largest economic centres (Murmansk, Kotlas), they are as few as 20 per 1,000 population. To compare, there are 35–40 businesses per 1,000 residents in most municipalities of the Leningrad region. Most small and medium enterprises, which are usually first to embrace innovation, specialise in trade and construction. Few of them are engaged in manufacturing. The region's economic structure lacks the critical mass needed to ensure horizontal cooperation and clustering.

The rural population of Arkhangelsk is even less economically active than urban residents. Few jobs and even fewer well-paid ones are created there. Young employable people have to move out to settle in cities. Rural territories urgently need inter-organisation diversity and a developed labour market, which are necessary for retaining human capital. The rate of out-migration is the highest in the northern and north-western districts of the Arkhangelsk region. Another negative factor is poor utility and soft infrastructure. Only about 19% of rural houses are connected to the mains. Social services have become increasingly unreachable because of the enlargement of social services providers, worn-out property and outdated equipment, and a lack of professionals.

In the Arkhangelsk region, capacity for innovation is associated with two industries, which have given rise to shipbuilding and lumber clusters. The first one is sustained by defence procurement contracts, which account for 90–95% of shipbuilding revenues. Military commissions, however, prevent diversification and put the shipbuilding industry, which is not facing any competition, into dependence on government funding. The regional lumber cluster has brought together logging and wood processing companies along with mechanical engineering, transport, logistics, research, and educational organisation meeting the needs of the sector. Further development of the lumber cluster by value-added wood processing can meet the regional need for innovation (see Strategy for the Economic Development of the Arkhangelsk region until 2035¹).

Rostov region

The internal heterogeneity is less pronounced in Russia's southern coastal regions than in northern ones. Yet there is a clear centre-periphery divide. Diversification and structuring of the economic space of the Southern federal district have been affected by several interconnected factors, the most significant of which is 'diverse neighbourhood' (*raznososedstvo*) [42]: the region develops in a multi-cultural and inter-civilizational environment under the influence of geopolitical forces [43]. Most of the potential contacts of the Rostov region are concentrated

¹ URL: <https://www.strategy29.ru> (accessed 15.03.2020).

in the coastal zone. The cross-influence of coastalisation and agglomeration forces has created the large Rostov agglomeration, which links Rostov-on-Don, a major city with a population of over one million, with adjacent towns and villages. The agglomeration consists of three ‘belts’ [44; 45]: the core, which accounts for the region’s capacity for innovation and technological advances; the semi-periphery, which unites secondary industrial poles; and the agrarian periphery. Whereas the Rostov agglomeration continues to establish itself as the coastal centre of innovation, education, technology, and community life, the trends observed over the past decades in the periphery and semi-periphery have been inconsistent (Table 4).

Table 4

Innovative development indicators for Rostov municipalities

Indicator	Year	Municipalities		
		Agglomeration	Trans-agglomeration	Periphery
<i>Human capital</i>				
Population density, people/km ²	2013	153.44	49.83	17.19
	2019	155.56	47.48	16.32
Urban population, %	2013	80.58	68.03	42.59
	2019	80.38	68.29	42.90
People holding undergraduate and postgraduate degrees, %	2010	18.93	13.46	12.27
<i>Economic growth and clustering</i>				
Contribution of manufacturing industries to the shipping volume, %	2014	50.69	69.24	34.40
	2019	56.50	77.41	34.95
Retail sales per capita, 1,000 roubles	2015	75.33	44.36	36.62
	2019	63.16	32.64	25.21
Number of businesses, units per 1,000 population	2015	27.03	7.82	10.65
	2019	25.02	7.28	9.59
<i>Innovatisation and digitalisation</i>				
New agricultural machinery, %	2016	9.90	6.42	7.03
People employed in IT, communications, research, and technology in the average headcount, %	2017	2.50	2.60	1.90
	2019	2.20	1.60	1.80
3G and 4G coverage, %	2019	94.70	98.51	87.82

The end of Table 4

Indicator	Year	Municipalities		
		Agglomeration	Trans-agglomeration	Periphery
New housing stock per capita, m ²	2013	0.69	0.22	0.23
	2018	0.87	0.19	0.26
Communities without gas supply, %	2013	27.23	40.86	57.56
	2018	22.91	39.07	54.58
ATMs per 1,000 population	2019	0.60	0.35	0.40

Periphery districts and towns, which are localised in the north-east and south-east of the Rostov region, are very heterogeneous in terms of companies' technological resources, access to infrastructure, housing quality, internal market situation, and growth rates [46]. The most actively developing municipalities border Rostov-on-Don. These are the Aksay district, Bataysk, and Azov. They attract new residents and experience growth in residential construction. People leave other, mostly agricultural municipalities because of low wages, poor infrastructure, and low quality of life [47]. The central problem of development in the Rostov region, which specialises in low-cost cereal and sunflower crop farming, is the poor condition of the internal market and the low purchasing power of the local population. This precludes the diffusion of innovations in everyday life as well as their generation in production. High cost-effectiveness of agricultural production does not encourage technological change.

The south-eastern periphery districts of the region, which specialise in potato, vegetable, and livestock farming along with the production of cereal and sunflower crops, have better infrastructure. Almost all of them have gas supply. Still, the housing stock in these areas is rather old, and it is very slowly renewed. These factors also contribute to out-migration. For many households, moving to the Rostov agglomeration is a cheaper and more rewarding way to improve living conditions than investment in better technological infrastructure in the hometowns. This is explained by the absence of amenities and zero residential innovations in their region's towns and villages. The situation is better in the central districts of the periphery, which are situated closer to the reaches of the Don navigable by cargo-carrying ships, and those contiguous with the local economic centre, the city of Volgodonsk.

Remarkably, depopulation and 'peripheralisation' occur in semi-periphery industrial centres and adjacent areas at a higher rate than in the periphery and the least developed parts of the region. In effect, the latter are not secondary growth

poles but territories that transfer their functions and population to the core of the Rostov agglomeration and take on few new functions. These areas include the Azov area, the city of Taganrog and its environs, and the districts of the Shakhty conurbation remote from the sea and the river. Along with Volgodonsk, they constitute the tertiary agglomeration belt. These are commuter areas, which have strong educational and technological links. In periphery districts, the negative net migration rate is about 4%; in semi-periphery districts, over 5%. The ratio of average wages in the periphery and semi-periphery to the regional average is 0.8 and 0.7 respectively, whereas the proportion of people employed in finances is 12.1 and 9.3%. Semi-periphery municipalities perform below the regional average in investment, new housing per capita, and the availability of amenities and utility infrastructure [44].

The national policy of import substitution has encouraged innovation both in the core of the Rostov agglomeration and beyond it, particularly in the periphery. Successful projects have been realised by the Taganrog Aviation Research Centre, Rostselmash, Novochoerkassk Electric Locomotive Works, Tagmet, and other manufacturing companies [43]. Some agricultural projects have contributed to the diffusion of innovations in periphery municipalities [48]. Nonetheless, these projects can neither change the region's trajectory of innovative development nor ensure greater engagement in innovation of the semi-periphery, which has capacity for innovation, technology and research and may benefit from its coastal position.

Decentralisation is an essential need of the region, meeting which will accelerate the development of the industrial semi-periphery, agricultural periphery, and potential growth poles². Despite there being a comparatively high transit through towns and villages located at the intersections of transport routes, not all of them have turned into local centres. Nor have they unlocked their transport, logistics, industrial, research, or technological potential. This situation is aggravated by the fact that connections with Ukraine have weakened after 2014. Unlike the north-south transport corridor, the east-west corridor is losing its importance. At the level of growth poles, there is a multidimensional hierarchy. Without sufficient competitive advantages, small potential centres of growth have poor development prospects.

Krasnodar region

The spatial structure of the Krasnodar region is polycentric. Administrative, industrial, logistics, and recreational functions are distributed between several

² These include the villages of Veshenskaya and Matveev-Kurgan, the towns of Semikarakorsk, Zernograd, and Proletarsk [45].

agglomerations — Krasnodar, Sochi, and Tuapse. Although the spatial structure of the regional social system is not hyper-centralised, it has a clear centre-periphery pattern [49], whereas many important facilities are located along the coastline [44]. Eastern and north-eastern municipalities, which are remote from both the sea and the local economic centres, have turned into peripheries with a sparse population and few businesses. Semi-periphery municipalities include the seaports of the Azov basin and high-transit districts located along railways and motorways (Tikhoretsk, Kavkazsky, and Gulkevichi districts and the city of Armavir). Although these areas are neither tourism destinations nor large centres of logistics, they have an important role in the industrial and transport development of the region (Table 5).

Table 5

Innovative development indicators for Krasnodar municipalities

Indicator	Year	Municipalities				
		Krasnodar agglomeration	Novorossiysk agglomeration	Sochi agglomeration	Trans-agglomeration	Periphery
<i>Human capital</i>						
Population density, people/km ²	2013	117.79	111.10	97.54	41.66	49.70
	2019	129.71	122.61	111.14	41.71	48.92
Urban population, %	2013	61.47	57.79	78.75	41.15	38.30
	2019	63.65	58.71	79.94	41.19	38.09
People holding undergraduate and postgraduate degrees, %	2010	21.20	24.38	29.09	16.56	17.13
<i>Economic growth and clustering</i>						
Contribution of manufacturing industries to the shipping volume, %	2014	41.34	26.06	20.00	53.94	42.93
	2019	38.73	25.72	13.15	62.80	35.87
Retail sales per capita, 1,000 roubles	2015	77.38	65.63	87.50	38.04	31.88
	2019	144.39	94.24	126.41	44.38	47.33
Number of businesses, units per 1,000 population	2015	42.62	21.82	41.59	10.40	11.38
	2019	31.83	17.79	32.10	8.89	9.28

The end of Table 5

Indicator	Year	Municipalities				
		Krasnodar agglomeration	Novorossiysk agglomeration	Sochi agglomeration	Trans-agglomeration	Periphery
New agricultural machinery, %	2016	13.48	10.78	10.86	17.04	13.06
People employed in IT, communications, research, and technology in the average headcount, %	2017	2.86	3.57	3.89	2.76	2.80
	2019	2.81	2.95	2.81	2.54	2.75
3G and 4G coverage, %	2019	79.74	72.28	23.63	69.19	93.64
<i>Quality of life and standard of living</i>						
New housing stock per capita, m ²	2013	1.05	0.94	0.70	0.46	0.43
	2018	1.32	0.94	0.68	0.32	0.31
Communities without gas supply, %	2013	35.74	41.44	64.63	46.67	36.14
	2018	29.51	36.50	52.38	42.50	32.66
ATMs per 1,000 population	2019	0.62	0.53	0.87	0.33	0.40

Over the past decade, decentralisation has moved to a new level in the region. This happened thanks to sizeable federal investment in the infrastructure and amenities of Sochi during preparations for the winter Olympics. The construction and putting into operation of the Crimea Bridge has lent new significance to western coastal municipalities. The east-west connection, which is closely linked to the north-south connection, has been activated in the Krasnodar region, which is the opposite of the situation in Rostov. All these processes have stimulated the diffusion of innovations, which has translated into the high rates of innovative development in the region after 2014 [50].

The centre-periphery pattern of the Krasnodar region has a more distributed structure than those of the Rostov, Arkhangelsk, and Murmansk regions. This is explained by a high density of rural population in intra-agglomeration spaces, motorway connections between towns and villages [49], and the advantageous location of secondary centres (the towns of Timashevsk, Korenovsk, and Ust-Labinsk, the village of Dinskaya, and others) at the intersections of major transport corridors within the catchment area

of the agglomeration. These centres are home to agricultural processing facilities that have the potential for technological development. The strategic planning of innovative clustering in the region takes these considerations into account. That is why priority is given to biotechnology and smart value-added processing. These two industries can contribute to the diffusion of innovations from the centre of technology to the manufacturing links of the agglomeration space and beyond.

Discussion and conclusions

The innovative development of coastal regions has distinguishing characteristics. This is confirmed by this and earlier studies [22; 52; 53]. These characteristics are the product of the accumulation of knowledge, competencies, technology, and innovation in regional maritime industries (fishery, aquaculture, recreation and tourism, shipbuilding and ship repair, etc.). A significant contribution is made by maritime and river transport and infrastructure. Major trends in innovative development are set at the national level. Later, they are adapted to a regional and municipal level. Along with the economy, social situation, politics, and geopolitics, environmental and climate factors have a considerable effect on the innovative trajectory of coastal regions. Among these factors are a year-round ice-free port located at the intersection of major transport corridor, offshore and onshore mineral deposits, a mild climate, and tourist attractions. Differences between the innovation systems of northern and southern coastal regions of European Russia were analysed in view of the above.

Our findings show that there are three major innovative development models for a coastal zone.

The first model focuses on the generation, use, and accumulation of innovations in maritime industries: fishery, port and logistics, shipbuilding, coastal tourism, etc.

The second model places emphasis on attracting human capital and developing intelligent businesses in regions with a mild climate and social and institutional innovations, which translate into a higher quality of life and living standards and good conditions for technology-intensive industries.

The third model concentrates on the generation, use, and accumulation of technological innovations in deposit development, onshore and offshore mineral extraction, processing and transporting minerals to the sea, as well as providing housing for people living in the area. This model can be applied to traditional industries such as wood processing and agriculture, whose product is cheaper to transport by sea.

Real coastal regions either combine elements of the above models or lack conditions for implementing any of them. The first and third innovative models are apt for Russian northern coastal regions, where living conditions are

less favourable than in southern ones. In the Murmansk region, capacity for innovation and technological advances is associated with the mining industry; in the Arkhangelsk region, with wood processing. Government support is conducive to the development of maritime industries: shipbuilding, port services, and logistics. Non-technological innovations are few in northern coastal regions; this is accounted for by a sparse population and a small internal market. As a result, people leave poorly developed districts for better-developed cities, thus contributing to the hyper-centralisation of the settlement and administrative systems. Top experts come to northern coastal regions of Russia primarily to cater to the needs of leading industrial organisations. Their arrival usually requires additional investment, and regional mechanisms for *retaining* human capital are frequently absent.

Southern coastal regions of European Russia have a higher innovative development level than their northern counterparts, which proves the hypothesis proposed at the beginning of the article: the agglomeration factor does play a key role in attaining this result. The largest cities of the Rostov and Krasnodar regions have become strong agglomerations, which attract intellectual, financial, human, industrial, and other resources, while periphery and semi-periphery municipalities lag in economic and innovative development.

In the Rostov region, the diffusion of innovations from the central agglomeration to the regional periphery can occur by a partial transfer of production facilities to rural areas and smaller towns, whereas Rostov-on-Don remains the regional centre of research and technology. This will attract investment in the transport, logistics, and communications infrastructure as well as encourage the creation of centres of industry-oriented education and thus contribute to a better quality of human capital in the periphery. Developing the semi-periphery of the Rostov region demands an independent regional policy providing a comprehensive solution to the problems of low competitiveness and depreciation of town-forming companies. It is also important to unlock competitive advantages of the region, including those associated with its maritime position, and to take local infrastructure and amenities to another level. The socio-economic and innovative dynamics in semi-periphery municipalities can be improved by strengthening the positions of Taganrog, Novochoerkassk, and neighbouring areas, as well as by increasing agglomeration attraction forces.

The Krasnodar region has developed more evenly than the other regions studied. Today, the growth of regional agglomerations is sustained through the inertia of urbanisation, and a transition to suburbanisation has not taken place yet. This complicates the diffusion of innovations because the gap in the intensity of territorial development is growing. Neither periphery nor semi-periphery can compete for population and new production facilities. Nevertheless, the Krasnodar region has demonstrated that large federal in-

vestment projects aimed at improving urban infrastructure and delivering innovations ensure returns on investment and create a more even innovative landscape in a region.

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