Search for “transforming innovations” for Russian regions and barriers to their implementation

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Abstract. The paper reviews the approaches to defining “Resource regions” and substantiates the authors’ own definition of “transforming innovations”. Patent work activities of Kemerovo region’s mining companies were analyzed to identify the transforming innovations.

1. Introduction
In the present-day economic studies resource regions are increasingly seen not as the “curse” of the Russian economy, but rather as its potential growth points. This trend was particularly evident in the stages of development of the approaches to defining resource regions in the economic literature. Traditionally, resource regions have been studied as areas with significant reserves of mineral resources, land, forest and other natural resources. A region was classified as a “resource region” based on the evaluation of the features, quality and amount of reserves, while the efficiency and comprehensive use of the available resources were not taken into account. This approach was most widespread in the Soviet era. Further development of approaches to understanding resource regions is associated with the beginning of the formation of the market approach to the use of natural resources in Russia and an attempt to assess the resource potential (resource reserves and the extent of their involvement in public production). Within the framework of this approach, the key characteristics are the structure of the GRP of the region and the share of raw materials in it, and the level and features of the development of material infrastructure that supports extraction, transportation and processing of natural resources. The strength of this approach is the quantitative assessment of the involvement of natural resources in public production while the weak point is its inability to explain the sources of formation and mechanisms of development of resource regions.

2. Data and methods
The key point in the search for tools of resource regions’ development is to determine the “resource-type” of Russian regions. Let us turn to the method proposed by E.S. Kagan and E.V. Goosen, based on the approach of V.P. Orlov [1], who determined the “resource-type” of Russian regions basing on the share of the value added in the “Resource extraction” section in the GRP [2]. E.S. Kagan and E.V. Goosen calculated the degree of the regions’ resource dependence using the K-rate (the ratio of the value of the share of extractive industries in the region’s GRP (Kreg) to the value of the share of extractive industries in the Russian Federation’s GDP (Krus), which allowed comparing the regions’ “resource-type”. If K>1, it means that the region is a resource region. Table 1 presents 35 Russian
resource regions with varying degrees of resource dependence. Thus, in Russia more than a quarter of the regions are classified as resource regions.

Significant reserves of mineral resources are concentrated in resource regions, and their export is a source of growth of the regions’ welfare, but at the same time it can cause the formation of the “enclave economy”. Therefore, it is necessary to find the sources and mechanisms of transition to a new balanced development path. “Transforming innovations” play a critical role to play in this process. The authors of this paper suggest their own approach to the concept of “transforming innovations” basing on the microeconomic model of the replication of “dual enclave economy” (based on the theory of value chains) proposed by S.M. Nikitenko, E.V. Goosen, and K.S. Sablin [4,5].

By “transforming innovations” we mean the innovations that contribute to the change of the region’s development path towards its balance. “Transformative innovations” possess the following distinguishing features: they are available to medium-sized businesses (innovation is a competitive advantage of medium-sized businesses); they contribute to the formation of branched horizontal descending value chains in resource extraction and related industries; they create conditions for the localization of manufacturing industries in the region, which are the basis for the development of the regional market on the basis of inter-firm interaction and diversification of the economy; they never emerge on by themselves and always have an organizational or institutional component; they also form another market environment and other market relations.

The aim of this study is to identify the “transforming innovations” in resource regions based on the analysis of patent activity of large mining companies localized in their territory. The study focuses on Kemerovo Region (also known as Kuzbass – after ‘Kuznetsk Coal Basin’), Russia’s largest coal mining region. Kemerovo Region is a resource region, and its economy is based on the extraction of minerals, which amounted 29.7% of the GRP in 2016, according to Kemerovo Region’s Office of Federal State Statistic Service. We selected the two largest coal mining companies: Public company “EVRAZ” and Joint-stock company “Siberian coal energy company” (JSC “SUEK”). The data sources were the patent database "Contour focus" and the companies’ websites.

In 2017, Russia produced 408.9 million tons of coal (+23 million tons (+5.6%) compared to 2016), of which 22% were coking grades: 88.6 million tons (-4 million tons (-4%) compared to 2016) [3]. In Kuzbass, coal production amounted to 241.51 million tons (+13.5 million tons (+5.5%) compared to 2016) [3], which is 59% of the total Russian production, including 75% of the Russian production of coking grades. Kuzbass accounts for 70% of the total investment in the coal industry [6,7]. The largest coal companies are SUEK (whose market share is 26%), UMMC (13%), SDS-Coal (7%), Mechel (5%) and EVRAZ (5%) [8].

### Table 1. Dynamics of the structure of the regions’ resource dependence in 2005-2014 [3].

| Region                              | 2005 | 2010 | 2011 | 2012 | 2013 | 2014 |
|-------------------------------------|------|------|------|------|------|------|
| 1. Nenets Autonomous Okrug          | 5.80 | 7.56 | 6.60 | 6.73 | 7.03 | 7.01 |
| 2. Khanty-Mansiysk Autonomous Okrug – Yugra | 5.85 | 6.06 | 5.98 | 6.06 | 6.07 | 6.31 |
| 3. Sakhalin Region                  | 1.73 | 5.70 | 5.41 | 5.49 | 5.66 | 6.20 |
| 4. Tyumen Region                    | 4.68 | 4.80 | 4.63 | 4.87 | 4.86 | 5.11 |
| 5. Yamalo-Nenets Autonomous Okrug   | 4.80 | 4.61 | 4.29 | 4.64 | 4.87 | 4.74 |
At the first stage of our study, based on the analysis of the information contained in the database “Contour focus”, detailed supply chains of both companies (SUEK and EVRAZ) were built, the most innovative and active organizations in their structures were identified, their role and place were shown.

Public company “EVRAZ” [9] is a vertically integrated steel and mining company with assets in Russia, the USA, Canada, the Czech Republic, Italy and Kazakhstan. Its own base of iron ore and coking coal almost completely meets the internal needs of Eurasia. In total, the PC “EVRAZ” has 23 units, three of which are engaged in coal mining: JSC “Yuzhkuzbassugol” (Kemerovo region), PJSC “Raspadskaya” (Kemerovo region), and Mezhegeyugol (the Republic of Tyva.) In total, the company owns 9 mines and open pits, and 3 processing plants. Coal production volumes in 2016 amounted to 22.1 million – 6 % of the Russian total (ranking 5th in Russia), of which 22.5 million tons was

|    | Republic of Sakha (Yakutia) |    | 3.09 | 3.86 | 3.88 | 3.82 | 3.98 | 4.20 |
|----|-----------------------------|----|------|------|------|------|------|------|
| 6. | Chukotka Autonomous Okrug   |    | 0.59 | 3.67 | 3.71 | 3.38 | 2.90 | 4.05 |
| 7. | Orenburg Region             |    | 2.89 | 3.45 | 3.16 | 3.30 | 3.80 | 3.40 |
| 8. | Komi Republic               |    | 2.68 | 3.22 | 2.98 | 2.88 | 3.00 | 3.17 |
| 9. | Tomsk Region                |    | 2.77 | 2.30 | 2.69 | 2.79 | 2.69 | 2.69 |
| 10.| Republic of Udmurtia        |    | 2.09 | 2.25 | 2.30 | 2.29 | 2.33 | 2.28 |
| 11.| Republic of Sakha (Yakutia) |    | 2.12 | 3.02 | 3.09 | 2.39 | 2.06 | 2.04 |
| 12.| Chukotka Autonomous Okrug   |    | 0.21 | 0.34 | 1.56 | 1.74 | 1.97 | 2.03 |
| 13.| Irkutsk Region              |    | 0.30 | 0.72 | 1.16 | 1.40 | 1.56 | 1.88 |
| 14.| Tatarstan Republic          |    | 2.41 | 2.08 | 1.98 | 1.95 | 1.90 | 1.87 |
| 15.| Magadan Region              |    | 2.12 | 1.98 | 2.24 | 1.63 | 1.61 | 1.62 |
| 16.| Krasnoyarsk Kray            |    | 2.12 | 3.02 | 3.09 | 2.39 | 2.06 | 2.04 |
| 17.| Perm Kray                   |    | 1.23 | 1.30 | 1.39 | 1.62 | 1.58 | 1.46 |
| 18.| Samara Region               |    | 0.84 | 1.14 | 1.25 | 1.31 | 1.24 | 1.34 |
| 19.| Belgorod Region             |    | 1.70 | 1.62 | 1.87 | 1.43 | 1.40 | 1.17 |
| 20.| Murmansk Region             |    | 0.84 | 1.46 | 1.66 | 1.44 | 1.67 | 1.15 |
| 21.| Republic of Karelia         |    | 1.51 | 1.23 | 1.27 | 1.21 | 1.15 | 1.13 |
| 22.| Amur Region                 |    | 0.41 | 0.98 | 1.40 | 1.33 | 1.07 | 1.06 |
| 23.| Republic of Khakassia       |    | 0.57 | 1.48 | 1.40 | 1.06 | 1.10 | 1.03 |
| 24.| Kursk Region                |    | 1.41 | 1.16 | 1.33 | 1.13 | 1.09 | 0.88 |
| 25.| Transbaikal Kray            |    | 0.59 | 1.23 | 0.71 | 0.81 | 0.93 | 0.73 |
| 26.| Republic of Tyva            |    | 0.40 | 0.66 | 0.55 | 0.54 | 0.43 | 0.61 |
| 27.| Volgograd Region            |    | 0.53 | 0.54 | 0.55 | 0.53 | 0.55 | 0.43 |
| 28.| Khabarovsk Kray             |    | 0.37 | 0.43 | 0.49 | 0.58 | 0.53 | 0.42 |
| 29.| Kaliningrad Region          |    | 1.15 | 0.57 | 0.51 | 0.43 | 0.40 | 0.33 |
| 30.| Republic of Buryatia        |    | 0.35 | 0.47 | 0.54 | 0.45 | 0.38 | 0.33 |
| 31.| Bashkortostan Republic      |    | 0.99 | 0.85 | 0.43 | 0.26 | 0.26 | 0.30 |
| 32.| Republic of Ingushetia      |    | 0.80 | 0.18 | 0.17 | 0.17 | 0.19 | 0.16 |
| 33.| Chechen Republic            |    | 0.79 | 0.26 | 0.21 | 0.17 | 0.18 | 0.16 |
| 34.| Republic of Kalmykia        |    | 0.51 | 0.33 | 0.26 | 0.27 | 0.27 | 0.13 |
produced in Kemerovo Region. In 2017, EVRAZ produced a quarter of the Russian coking coal (22.4 million tons) became its largest producer [9].

EVRAZ is a vertically integrated company which produces iron ore and coal further used for producing metal. A large part of the extracted coal is used for the own needs of EVRAZ. A smaller part of the coal goes to the housing and utilities sector (see figure 1).

Joint stock company “Siberian coal energy company” (JSC “SUEK”) [10] is one of the largest coal mining companies in the world (ranking 5th in terms of coal exports in 2016 – 51.9 million tons) and a leading coal producer in Russia (ranking 1st in terms of coal production in 2016 – 105.4 million tons, which exceeds the 2015 amount by 7.77%). Of these, 37.7 million tons were produced in 2016 in Kemerovo Region (ranking 1st place among the other regions of presence). The company owns 27 mines and open pits, 9 enrichment plants and systems, and 3 ports. JSC “SUEK” has 55 units, 36 of which are involved in coal production.

SUEK is the main supplier of thermal coal to the Russian market, its share is 40%. The delivery of coal to the leading energy companies which supply electricity and heat to industrial enterprises and homes across the country is facilitated by proximity to major consumers and the company’s large car fleet.

SUEK is a vertically integrated company that controls the entire operational cycle – from coal mining, processing and transportation to sales of products to consumers around the world through a network of sales offices. The company produces coal in large open-cuts and mines of Siberia and the Far East, and its enrichment plants and systems allow improving the quality of products. SUEK has ports and railway infrastructure, which helps deliver products effectively to consumers in Russia and to foreign countries in the Atlantic and the Asia-Pacific regions (see figure 2).

At the second stage of the study, the search and analysis of patents owned by the organizations included in the supply chain, taking into account affiliated companies, was carried out.

Only 2 of 23 structural units of PC EVRAZ (8.7 %) are involved patent activity: they are JSC “United Coal Company “Yuzhkuzbassugol” and PJSC “Raspadskaya”. As of 01.01.2018, EVRAZ has received four patents, none of which are justified in force (see table 2).
Figure 2. Supply chain of JSC “SUEK”.

Table 2. Patents of PC “EVRAZ”.

| Name of company                                         | The company’s position in the added value chain                                      | Number of useful model patents |
|--------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------|
| JSC “United coal company “Yuzhkuzbassugol” (Novokuznetsk, Kemerovo Region) | R&D, exploration, extraction, enrichment, transportation, maintenance and technological support | 2                              |
| PJSC “Raspadskaya”, LTD “Montazhnik Raspadskoy” (Mezhdurechensk District, Kemerovo Region) | Development and production of mining equipment, maintenance and technological support | 2                              |
| Total number of patents                                  |                                                                                      | 4                              |

Seven out of the 55 structural units of JSC “SUEK” (12.7%) show patent activity. In JSC “SUEK” the R&D strategy is concentrated within one specialized scientific institute – “Sibmiugleobogashchenie”, which owns 70% of the patents in the coal industry, and 30% of the mining divisions’ patents (see table 3). As of 01.01.2018, only 10 out of 13 patents (76.9%) are justified in force.

3. Results and discussion

The analysis of the companies’ selected patents showed that the main direction of their research and technological activity is the development of technologies and equipment related to the enrichment of coal.

At the same time, these patents were registered over the past three years, and the lifetime of the technology is 8 years, therefore, the companies are constantly improving their own developments. Moreover, the patents are valid, i.e. justified in force, which proves that they are used in coal production.

At the third stage of our study, the existing patents were evaluated in terms of their “breakthrough character”. The studied patents cannot be attributed to “transforming innovations”. According to experts, the patents refer to the obsolete technology, and match the level of the 1970s – so, they cannot be attributed to “transforming innovations” nor can they shape the value chain.
To create and implement “transforming innovations” in the coal industry, firstly, it is necessary to cooperate with coal companies from related industries, which will increase the added value of the final product. The closest to the coal industry in Kemerovo Region are the enterprises of mechanical engineering, small chemical production, energy industry, and developers of automated control algorithms. Secondly, new forms of cooperation are needed, for example, innovative enterprises in related industries to form value chains with the region’s largest coal companies which will develop new technologies taking into account the identified strategies for conducting research activities. Thirdly, measures are needed to encourage companies to form and use “transforming innovations”.

4. Conclusion
Thus, the barriers to the formation of “transforming innovations” in resource regions are as follows. The first one is the focus on the place based approach, as it makes no sense to introduce the latest technologies where the level of technological development is low. To overcome it, it is necessary to modernize the entire complex of equipment of coal mining enterprises, the qualifications of their staff, etc. Secondly, the strategy of patent activity showed that large vertical companies are not interested in the development of R&D. A possible solution will be to use smart specialization in the companies’ strategies [11]. The third barrier is the lack of a clear policy for the resource regions’ development strategy. On the one hand, in the regions where the rent allows solving social issues, the federal authorities do not see a threat to the socio-economic development of the regions; on the other hand, the example of Kemerovo Region clearly demonstrates the need to change the resource region’s development path.

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Table 3. Patents of JSC “SUEK”.

| Name of company                        | The company’s position in the added value chain | Number of patents for invention | Number of useful model patents |
|----------------------------------------|-----------------------------------------------|--------------------------------|--------------------------------|
| LTD “Siberian research institution for coal enrichment” (LTD “Sibniiugleobogashchenie”) (Moscow) | R&D                                           | 1                              | 0                             |
| Prokopyevsk branch of LTD “Sibniiugleobogashchenie” (Prokopyevsk, Kemerovo Region) | R&D                                           | 7                              | 0                             |
| JSC “Tugnuisky Open Pit” (Sagan-Nur, Republic of Buryatia) | Extraction                                    | 1                              | 0                             |
| JSC “Berezovsky Open Pit” (Rodniki, Sharypovo District, Krasnoyarsk Kray) | Extraction                                    | 1                              | 0                             |
| JSC “SUEK-Kuzbass” (Leninsk-Kuznetsky, Kemerovo Region) | Transportation                               | 0                              | 2                             |
| JSC “United Production and Transport Department of Kuzbass” (Leninsk-Kuznetsky, Kemerovo Region) | Transportation                               | 0                              | 0                             |
| Murmansk Commercial Seaport (Murmansk, Murmansk Region) | Transportation                               | 0                              | 1                             |
| Total number of patents                |                                               | 13                             |                                |
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