Book of proceedings

VŠE

FAKULTA
PODNIKOHOSPODÁŘSKÁ

INNOVATION MANAGEMENT, ENTREPRENEURSHIP AND SUSTAINABILITY 2019

Proceedings of the 7th International Conference

PATH DEPENDENCE AND REGIONAL PATHS OF PROCESS CHANGES IN THE RUSSIAN INDUSTRY

Svetlana Rastvortseva

Abstract

Purpose: The regional economy depends on the structure of industrial production which has been established earlier. This study makes it possible to determine the hi-tech spheres in which the entrepreneurship is going to develop more successfully. The purpose of the investigation is to determine the technological proximity of the industrial production branches with the high-tech economy sector for further defining the egress from the previous development path.

Design/methodology/approach: In order to determine possible egress of the region from the previous development trajectory there has been proposed a method of proximity evaluation between the high-tech sector and the existing structure of industrial production in the region. The characteristics of high technologies relatedness to other industry branches in the Russian regions have been defined.

Findings: For the Russian regions it was determined that less than 30% of sub-branches can be considered as connected with the high technology sector - 25%. The regions having the comparative advantages in the high-tech types of industry and sectors related thereto have been revealed. We have demonstrated that individual regions can progress through investment into interregional connections and entrepreneurship domestic innovations.

Research/practical implications: Considered as the investigatory contribution of the paper can be the alternative proposed to the comparative advantage index in the form of a localization coefficient to be used at evaluation of the technological proximity of industrial branches. The results of this study can be of benefit to representatives of the regional managerial bodies in the course of the economic policy development in the sphere of entrepreneurship.

Originality/value: Proposed in the article is a method for evaluation of technological proximity of industry branches which differs from the traditional use of the localization coefficient. The calculated proximity indexes make it possible to determine such high-tech industries to the development of which there are the necessary prerequisites in the region, i.e. the technologically similar industrial production is under development.

Keywords: Evolutionary Economic Theory, Path Dependence and Breaking, Technological Relatedness, Proximity Index, The Regions of Russia

JEL Codes: O18, O33, R11

Introduction

The regional economy depends on the structure of industrial production which has been established earlier. Transition from the previous development trajectory through innovations cannot take place without the necessary prerequisites and shall be formed on the basis of the industrial structures, labour market and institutes already established in the region (Neffke et al., 2011). If conditions for high-tech industries development already exist in the region, the transition from the traditional path to the innovative one will be harmonic.

The purpose of the investigation is to determine the technological proximity of the industrial production branches with the high-tech economy sector for further defining the egress from the previous development trajectory.

The paper is organized as follows. Section 1 gives us a short overview of the theoretical literature on the subject. After description of the methodology in the second part of the paper and disclosure of data in the third part, the obtained results are described (section 4), the prerequisites for move-away from the previous development trajectory for the Russian regions (section 5) and summarizing and drawing conclusions are determined.

1 Theoretical background and bibliography

Over the last years a number of investigations increases which show that the economy in the countries and regions is not only developing the most rational way, but depends largely on factors which have importance far back in the past. For example, (Acemoglu et al., 2001) have considered the institutional factors of economic growth; at that, many of them have appeared or even taken place hundreds of years ago. Such authors as (Engerman & Sokoloff, 2002), (La Porta et al., 1997) have focused their investigations on establishment of institutes depending on the country colonization character.

The *path dependence* concept development was started more than thirty years ago by Paul David (works since 1985) and Brian Arthur (works since 1988). The previous development theory was used to explain why non-efficient standards and technologies prevail when predominance of market efficiency is forecast theoretically (Liebowitz & Margolis, 1995). At the present time, in the total scope of works concerning *path dependence* it is possible to define a tendency which draws special attention to some unforeseen events considered as insignificant at the moment of their appearance. They influence the process of social-economic development mainly through the institutional structures or chains of events (Mahoney, 2000). Such events pose a challenge to political scientific theories ascribing major impacts to significant reasons. Noted particularly is the importance

of critical stages in formation of dependence paths that create stable institutes and minimize possible alternatives for further development.

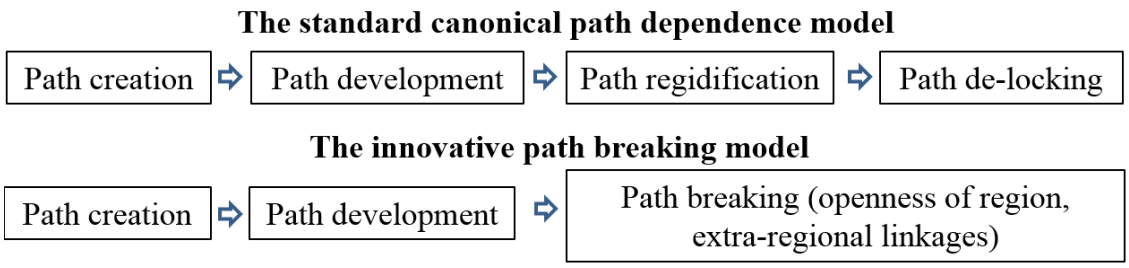
Held in the Russian economical literature were discussions in the field of the innovative management as a possibility to shift away from the existing development path. It was shown that such transition depends not only on the institutional reforms but also on social and cultural characteristics of the country or individual region (Yasin, 2007; Auzan et al., 2011). "New industrialization components" can be promotive of a change in the development path at a regional level (Silin et al., 2017). The regions developing new industries shoot ahead of those which "close" with better established industries in regard to the economic growth rates. Old industrial regions which are distinguished by high salaries, functioning trade unions, density of population and transport loads become victims of past success (Uskova & Lukin, 2016).

1.1 Economic evolution of regions

The example of regional movement along the development trajectories from creation of one industry to the other, interesting to our opinion, was proposed by (Zhu et al., 2017). They have illustrated the regional specialization on the example of tropical forest where the trees represent individual industries, and the forest represents the world production environment. The regions are monkeys that jump from a tree to the other tree looking for the best fruits (specialization area). The range of their jump is limited by physical preparedness and acquired skills (historical development). Just as in the given comparison, the strong regions haves more possibilities to diversify the industrial production. So, rightful seems a question on whether the regions with a low level of economic development can catch up the regions with a high level thereof using the benefits created thanks to the interregional specialization, and what mechanisms are necessary for this process.

Let us consider possible paths of regional development - traditional and innovative (Fig. 1).

Fig. 1: Possible paths of regional development



Source: Prepared by the author by (Zhu et al., 2017)

We see that moving along the ***traditional development path*** provides for passing four stages. The first stage – *path creation:* creation of technological, industry-specific and institutional structure of a region. The second stage – *path development:* development consisting in the growth of revenues of industrial enterprises in a region. The third stage – *path rigidification:* loss of flexibility characterized by obsolescence of knowledge and relations due to absence of new technological solutions. Weak interaction between regions in this case is accompanied by the absence of knowledge and technologies exchange mechanism. The period of the region stay in this stage depends on economic policy, since waiting for independent transition to a whole new level, in this case, is self-defeating. The fourth stage allows for transformation only (*path de-locking*), i.e. regional restructuring as a result of exogenous shocks (Martin & Sunley, 2006). The initiative for transformation can come from the main stakeholders of the region - companies, state and private sectors.

The innovative theory of development is based upon the "creative destruction" concept (Schumpeter, 1947) – creation of new industries as a result of supplementation and alteration of the existing technologies with innovative solutions, which makes it possible for the regions to carry out expansion to the new production spheres. So, the region comes through the first stages by the same path as the traditional version, but thanks to initial set of more successful industries such region demonstrates flexibility of production, ability to come to terms with the external innovative processes. This is provided by openness of the structure for external technological solutions (Boschma & Iammarino, 2009), implementation of modern technologies and exchange of knowledge.

Transition from the traditional path to the innovative one is complicated. If the region initially specializes in peripheral industries, it loses the opportunity for growth by the accelerated innovative direction. Move-away of the regional economy from the previous development path and creation of "new path" does not originate from ground zero, but appear from the already created industrial structures, institutes and standards, labor resources and capital in the region, which determine what new prospective directions in the region can appear (Neffke et al., 2011). If there are many opportunities for creation of new industries in the region, then its move to a new development path will be quicker and easier.

2 Methodology

In order to assess a possibility of the region transition to a new development path it is necessary to determine an index reflecting the technological proximity between new and existing industries. The so called "indicators of relatedness" or "proximity" have been represented in some other papers (Yeats, 1985).

The indicator of technological proximity between the industries is based on the indicator reflecting a level of their development in the region. To this end, some papers offer using a comparative advantage index based on the export of industrial commodity groups (*RCA*) (Yeats, 1985; Ivanova et al., 2017). To our opinion, such approach has some disadvantages. This is due to imperfection of records of the international trade indicators, firstly. So, at *RCA* calculation the equality of the alternative suppliers of similar commodities would be desirable, which is impossible upon the availability of trade barriers. The *RCA* value is significantly distorted in recent decades under the influence of institutional factors which start playing the leading role in the international trade. *RCA* does not reflect different measures on stimulation of export, subsidy assistance of individual industries.

Secondly, the use of *RCA* index is complicated during the analysis of industries within one and the same country. For example, if index values for a specific industry compared to other countries are highly concentrated in the range slightly exceeding or below a figure of one, the country with the most comparative advantage in the industry can have relatively low value of *RCA* index.

Thirdly, statistical errors are possible, which are connected with accounting of enterprises and their export by physical or legal registration address. For example, for the Russian regions the data of the Federal Customs Service are accumulated by the company legal address.

Let us consider the grounds on which export cannot always reflect the comparative advantages of regions, using the example of Russia. Mineral fuel, oil and their distillation products have taken 59% of export in 2017. Food products, agricultural, mineral raw materials and fuel - 66% of export. If commodity groups are selected which can be attributed to a high-tech category, then their share in the Russian export is 2.4%. Previous studies have shown that the development of innovations and their impact on economic growth in the Russian regions has its own specifics (Rastvortseva, 2015).

The comparative advantage index based on the export indicator is inadvisable to be used if the commodity composition in the country has homogeneous character, as well in the countries with a receptive internal market.

A small-scale contribution of high-tech sector products to export is not yet an evidence of that it is not represented in the country regions. We believe that in order to determine the geographic concentration of this segment, and to assess the industries proximity degree in the future, it is advisable to use the localization coefficient (*LQ*) – an indicator proposed by (Porter, 2003):

$$LQ = \frac{Emp_{ig}}{Emp_g} \Big/ \frac{Emp_i}{Emp} = \frac{Emp_{ig}}{Emp_i} \Big/ \frac{Emp_g}{Emp}, \qquad (1)$$

where Emp_{ig} – a number of the employed in the economy sector *i* in the region *g*; Emp_g – total number of the employed in the region *g*; Emp_i – a number of the employed in the economy sector *i*; *Emp* – total number of the employed in the country.

The co-occurrence analysis method is used by us to determine the interconnection through assessment of that in how many regions these two industries occur together. Following the paper (Hidalgo et al., 2007), we will consider such coincidences only when the regions possess the comparative advantage (have a localization coefficient more than 1) in the industry being analyzed.

The index of proximity between two industrial sectors ($\phi_{i,j}$) is calculated as follows:

$$\phi_{i,j} = \min\left\{P(LQ_{c,i} > 1 \middle| LQ_{c,j} > 1), P(LQ_{c,j} > 1 \middle| LQ_{c,i} > 1)\right\}, \quad (2)$$

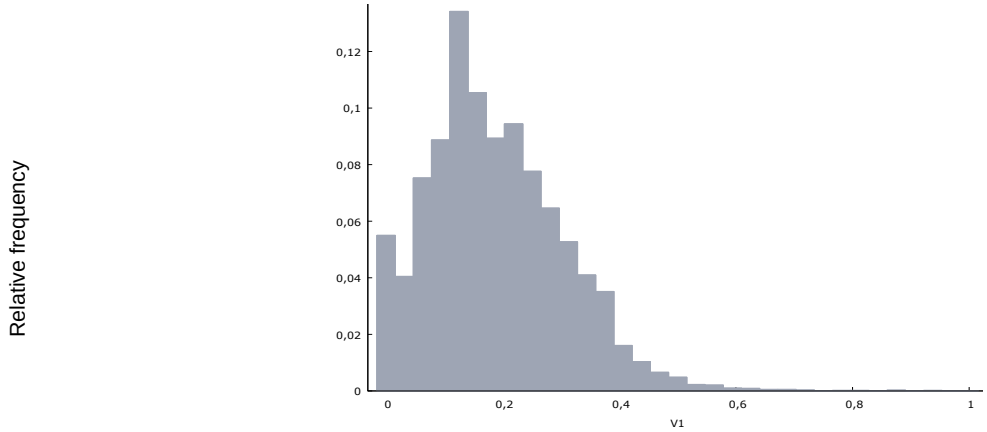
The index of proximity between the industrial sectors *i* and *j* is calculated as a minimum between the conditional probability of the comparative advantage availability in sector *i*, taking into account that the region *c* has the comparative advantage in sector *j* (i.e. $P(LQ_{c,i}>1|LQ_{c,j}>1)$) and the conditional probability of the comparative advantage availability in sector *j*, taking into account the revealed comparative advantage in sector *i* (i.e. $P(LQ_{c,j}>1|LQ_{c,i}>1)$). The substantiation of this proximity indicator consists in that if two economy sectors are closely related to each other, they, probably, require creation of similar institutes, infrastructure, factors, and technologies. The potential of that they will occur jointly and develop successfully in the same region is high. The indicator used by us, unlike the others, for example, classification methods or cluster analysis, makes it possible to take into account all combinations of industries, even overlapping ones, which significantly enriches the obtained results.

3 Data

We have calculated the indicator of proximity between the industry branches by a number of the employed in 2016 according to the data of the Federal State Statistics Service. Samples in this paper have counted to 198 industrial sub-branches (section D) for 85 regions of the Russian Federation. The proximity index in this investigation was calculated on the basis of single country data. We can reason this by that Russia is a country of large territory with a high regional inequality. This means that calculation on the basis of data in such great economy must be sufficient. The calculation of indicators of the regional employment by industries, but not by export data, can make it possible for us to better take into account the unique national economic conditions of Russia.

We have created a matrix of indicators in the industrial branches 198 x 198, which makes it possible to determine the spatial connections in the branch. Figure 2 gives a bar chart of proximity indicators. We can see that the technological proximity index is characterized by a truncated normal distribution.

Fig. 2: Bar chart of proximity index



Source: Calculated by author

A slight deviation from the norm is detected in a number of pairs of industries not having the connection (proximity index is equal to zero). There are 1072 or 5.5% of such pairs in the total sample. The most number of industry pairs have proximity indexes in the range of 0.11-0.14 – these are 2616 pairs or 13.41% of a sample. It is traditionally considered that two economy sectors can be characterized as connected if the proximity index is equal to or exceeds 0.25. In the obtained sample, such condition is met by 5690 industry pairs or 29.2% of all combinations.

4 Results

According to OECD standard, the high-tech industrial branches include five sub-branches, namely: production of pharmaceutical products, airplanes and space crafts, electronic and telecommunication equipment, computers and office appliances, medical equipment and measurement devices.

We have determined that when attributing the industrial branches to high-tech ones, 14 branches from the obtained matrix of proximity indexes (198x198) can be attributed to high technologies. With regard to the current territorial distribution of high technologies in Russia, the most number of regions are distinguished by the comparative advantage in production of electric machines and electric equipment (32 regions); ships, airplanes and space crafts and other transport means (28 regions); electronic components, equipment for radio, television and communication (28 regions), and devices and equipment for measurements, monitoring, tests, navigation, control and

other purposes (28 regions). The least number of regions have the comparative advantage in production of optical devices, photo and cine equipment (9 regions), and clocks and other time instruments (10 regions).

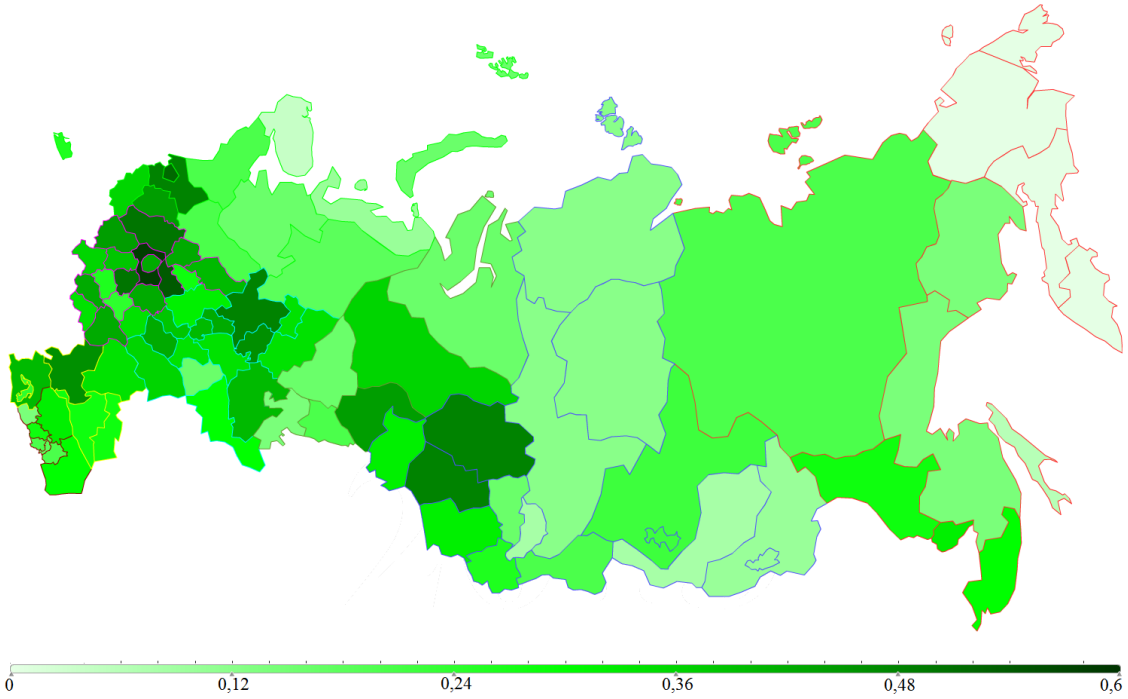
It is considered that two branches are connected if their proximity is equal to or exceeds 0.25. However, having analyzed the obtained proximity indexes we have come to a conclusion that only 25 sectors of 198 have no connection with high technologies (the index is less than 0.25). That is why we made the condition more rigorous and consider a case as connection of branches if the proximity index is more than 0.40. As regards to the high-technological production branches there are 51 of them.

Having calculated the proximity indexes by branches and having determined those most related to high-technological sectors of industry, we can make some conclusions. Firstly, the high-tech branches are connected between each other. Secondly, arrangement of high-tech production in the regions is often accompanied by the logically connected branches not related to high-tech category. For example, the pharmaceutical industry is accompanied by chemical production, Office equipment and computing machines have the comparative advantage in the same regions where electronic lamps and lighting equipment have the comparative advantage. Thirdly, we can distinguish some branches which are difficult to be logically connected to new technologies, but they have high index of proximity with some of them. So, one of the branches most closely connected to high-tech industry sectors is production of suit-cases, bags and similar articles of leather and other materials, production of saddlery and other articles of leather; production of leather, leather articles and shoes.

5 Determination of prerequisites for move-away from the previous development path for the Russian regions

Figure 3 shows a degree of regions participation in industrial sectors connected with high technologies. We see that some other picture is observed here. For example, concentration of "proximal" branches takes place to a greater extent not in Moscow, but in the Moscow region. On the whole, more than 40% of "proximal" branches in 25 regions differ in the comparative advantage. And in two regions only (the Kamchatka Region and the Chukotka Autonomous District) no connected branches are observed at all.

Fig. 3: Degree of the Russian regions participation in the industrial production sectors connected with high technologies



Source: Russian Federal State Statistics Service and own elaboration

The high participation degree in the high-tech sectors and those close to them is observed in Moscow, St.Petersburg, Novosibirsk region, Vladimir region, Penza region, Yaroslavl region and Omsk region, the Republic of Tatarstan, Udmurtia. The high participation degree in the allied industries is observed in Tver region, Tula region, Leningrad region, Kirov region, Tomsk region and Rostov region. We can suppose that these regions have prerequisites for development of the high-tech industrial sectors, and therefore for move-away from the previous development path.

Conclusion

Thus, we see that understanding of connections in the current industrial structure of regions with certain high-tech sectors must be integrated into the economic strategy of the region development. The scientifically grounded approach to determination of a new development path and specialization of the region economy makes it possible to avoid implementation of standard policy for labor resources preparation or investment in the popular scientific-technological fields. Instead, the regional governments will facilitate creation of the human capital for new demands in knowledge of traditional industries which will adapt and use these new skills and knowledge. The supportive infrastructure in the regions should be more focused on the strong cooperation among

the research centers, universities, science parks, business incubators and governmental institutions (Dvouletý, 2017).

Acknowledgment

Preparation of this paper was supported by the grant of the President of Russian Federation, project No. NSc-3175.2018.6

References

Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *American economic review*, *91*(5), 1369-1401.

Auzan, A. A., Arkhangelsky, A. N., Lungin, P. S., & Naishul, V. A. (2011). *Cultural factors of modernization*. SPb: Fund - Strategy.

Boschma, R., & Iammarino, S. (2009). Related variety, trade linkages, and regional growth in Italy. *Economic geography*, *85*(3), 289-311

Dvouletý, O. (2017). Determinants of Nordic entrepreneurship. *Journal of Small Business and Enterprise Development*, *24*(1), 12-33

Engerman, S. L., & Sokoloff, K. L. (2002). *Factor endowments, inequality, and paths of development among new world economics* (No. w9259). National Bureau of Economic Research

Hidalgo, C. A., Klinger, B., Barabási, A. L., & Hausmann, R. (2007). The product space conditions the development of nations. *Science*, *317*(5837), 482-487

Ivanova, I., Strand, Ø., Kushnir, D., & Leydesdorff, L. (2017). Economic and technological complexity: A model study of indicators of knowledge-based innovation systems. *Technological Forecasting and Social Change*, *120*, 77-89. https://doi.org/10.1016/j.techfore.2017.04.007

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W. (1997). Legal determinants of external finance. *The journal of finance*, *52*(3), 1131-1150.

Liebowitz, S. J., & Margolis, S. E. (1995). Path dependence, lock-in, and history. *Journal of Law, Economics, & Organization*, 205-226.

Mahoney, J. (2000). Path dependence in historical sociology. *Theory and society*, *29*(4), 507-548

Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of economic geography*, *6*(4), 395-437

Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography*, *87*(3), 237-265.

Porter, M. (2003). The economic performance of regions. *Regional studies*, *37*(6-7), 549-578

Rastvortseva, S. (2015). Innovation as a factor of regional economic growth: evidence from Russia. *Innovation Management and Corporate Sustainability (IMACS 2015)*, 251-262.

Schumpeter, J. A. (1947). The creative response in economic history. *The journal of economic history*, *7*(2), 149-159

Silin, Ya. P., Animitsa, E. G., & Novikova, N. V. (2017). Regional aspects of new industrialization. *Regional economy*, 13(3), 684-696. doi 10.17059/2017-3-4

Uskova, T. V., & Lukin, E. V. (2016) About the prospects for development of the region on the basis of interregional cooperation. *Economic and Social Changes: Facts, Trends, Forecast*, 3(45), 60-81. doi: 10.15838/esc/2016.3.45.3

Yasin, E. (2007). Modernization and Society. *Economic Matters*, 5, 4-29

Yeats, A. J. (1985). On the appropriate interpretation of the revealed comparative advantage index: Implications of a methodology based on industry sector analysis. *Weltwirtschaftliches Archiv*, 121(1), 61-73. doi:10.1007/bf02705840

Zhu, S., He, C., & Zhou, Y. (2017). How to jump further and catch up? Path-breaking in an uneven industry space. *Journal of Economic Geography*, *17*(3), 521-545

Contact

Svetlana Rastvortseva

National Research University Higher School of Economics

ul. B.Pereayaslavskaya, 10, 136, 129 110 Moscow, Russian Federation

SRastvortseva@gmail.com