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SCIENCE AND TECHNOLOGY

Innovation Activity of Russian Industrial Enterprises during Economic Crisis[1]

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Abstract– The article deals with the problem of the impact of the economic crisis on the innovative behavior of Russian companies. It is shown that the current crisis did not have significant impact on the model of innovative behavior of companies. Some decrease in innovation activity is more likely due to medium-term trends in the development of innovative processes and unfavorable macroeconomic dynamics.

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Innovation activity is the important component of sustainable economic development [1]. Due to innovation labor productivity has significantly increased; resource consumption and environmental damage have decreased [2–6]. Technological changes are viewed as a key factor of economic growth, but innovation activity is characterized by a high level of risk: at the same time. But if, for example, scientific and technical risk: at the same time is objective (negative R&D results are obtained, the parameters of the production technology are worse than expected, etc.), then the changing economic conditions may have a shocking, initially not predictable impact on the parameters of the innovation project (demand volume, the payback period, the amount of costs and revenues, etc.).

The economic crisis has an impact on the economic situation of the country as a whole, and hence on company's motivation to implement innovation projects in virtually all sectors. Negative impact can be manifested in deteriorating conditions for access to financial resources (first of all, for small enterprises), reducing demand and investment, outflow of personnel, deteriorating economic conditions in partner companies, etc. However the economic crisis reducing the opportunities for obtaining rent, stimulates the departure of obviously inefficient companies from the market and optimizing costs, which positively affect the intensity of implementation of process innovations.

In the literature it is often mentioned that the innovation activity of Russian companies is low compared to companies from other countries due to the possibility of obtaining rent [7–9]. This can be true for raw materials sector. And for the manufacturing industry, as shown by the survey of the Association of Managers and Russian Venture Company, the backlog of innovations developed in the Soviet era has been already exhausted for many large companies, so they established research centers, and none of the firms surveyed reduced activity of this unit in the crisis year of 2009 [10]. The current crisis is more prolonged, intensified with effects of sanctions. At the same time many Russian companies have the experience of adapting to economic fluctuations. If we assume that the beginning of a new wave of Russian crisis (after some recovery in 2010–2012) is the beginning of 2014, then we have data on innovation dynamics for three crisis years (2014–2016).

Factors of innovation activity of companies. The impact of the economic crisis on the innovation activity of large corporations is negligible or not at all, as evidenced by the research data. For example in 2009 R&D expenditures of the largest 1400 companies in the world (with research expenditures more than $28 mln.) fell by only 1.9% (despite much larger decline in revenues, profits and investments in fixed assets). At the same time in 2010 there was already an increase of 4% [11, 12]. This suggests that for majority of large companies (especially with a long research cycle) R&D spending is of strategic importance. This is most typical model for companies in India, China and South Korea, where growth of R&D in 2009 was 27.3; 40 and 9.1% respectively [11].

The negative impact of the economic crisis on the innovation activity of medium and small companies may be due to existing institutional barriers in the country that "preserve" the structure of the market, preventing newly created companies from supplanting

[1] The article was translated by the authors.

"old-timers" [13]. According to study of UK firms the crisis of 2008–2009 led to decrease in the relative innovation expenditures, but their concentration has increased significantly [14]. In other words the results of the survey [11] on the more vulnerable condition of small and medium-sized companies are confirmed. Accordingly it makes sense to take into account such parameter as the period of existence of a company, since the majority of small firms were established relatively recently.

Traditionally the scientific literature focuses on the factor of financial constraints as a key factor of a company's innovation activity. Of course the short-term impact of the economic crisis is precisely reflected in the change of the financial resource provision of the company. However in the case of a prolonged recession such determinants as the level of qualifications and sufficiency of staff, access to information, demand for products, etc., can significantly worsen. In this case the reaction of newly established firms and old-timers may differ. As shown in [15] the relationship between the duration of the company's existence and the significance of financial constraints is reverse. At the same time long-standing firms are acutely prone to such obstacles as the volume of demand and the structure of the market.

The industry characteristic of a company does not play a significant role. Firms of both "traditional" and relatively "new" industries can increase (reduce) investment in research and development. For example in 2010 investments in R&D by automotive companies declined by 11.6% in general, while in the oil and chemical sector they increased by 2.7% and 2.6%, respectively. A similar picture was observed in 2009 [11]. The accumulated level of technological knowledge in the industry also can't serve as an explanation. According to a sample of the world's largest companies [11] automotive, engineering, software development are among the most R&D-intensive sectors (4.7, 8.7 and 9.9% of sales, respectively), but in 2009–2010 there was a decline in investment in research in these sectors. At the same time an increase of these expenses was observed in electrical equipment, pharmaceuticals, health care (equipment and services). Industry specificity can determine the sustainability of R&D firms during an economic crisis. The study [14] shows that spending on R&D in the past positively affects the increase of their size during crisis years.

The dynamics of innovation activity during the economic crisis is also influenced by factors of the microeconomic level. For example if a company enters into the foreign market, it stimulates innovative activity. This is due to the diversification of markets and is effective if the diffusion of the economic downturn is not global. Another factor is the company's strategy. If the company initially adhered to the strategy of sustainable growth, i.e. pursued a cautious financial policy, avoiding uncontrolled accumulation of debts, formed a client base, developed competencies, aspiring to acquire some degree of "market power" in the value chain, then the probability of continuing innovation would be higher [16]. It is important not to become dependent on one client: in this case the firm may suffer from the crisis in the country of the company of which it is supplier [17].

The ability to withstand recession is due to differences in national innovation systems of countries [18]. The more developed is the financial sector in the country (region), the more sustainable is the amount of private spending on innovation. This can work along a chain: supporting banks, increasing government subsidies and expanding public-private partnership programs make it possible to keep the terms for financing private innovation projects at an acceptable level. If a country specializes on the production of high-tech products, then the reduction of innovation costs could take place only when demand decreases above the average for the sample of countries [17, 18].

Innovation activity in Russia: basic indicators. It is impossible to single out the most relevant indicator for characterizing the intensity of innovation processes in the economy. This is due to the ambiguity of the category "innovation" itself and the definition that is used in the international practice of statistical observation[2]. The firm determines itself to what extent the product, process, method is new. Evaluation is particularly subjective if it is a question of the market as a whole. Thus it is necessary to consider several indicators.

Key indicators that characterize innovation activity in the Russian economy are presented in Table 1.

If we take 2014 as the reference point for the current crisis, then there is a clear trend for all indicators given: significant growth since the end of the acute phase of the previous economic crisis (2009–2010) almost in all cases and a decrease, although not very significant, for the last two years.

Here it is necessary to make three comments:

1. In Russia the share of companies that carry out marketing and organizational innovations is extremely low (1.9 and 2.9% respectively), while in the EU countries it is ten times higher [21]. This may indicate on a low adaptive capacity of domestic enterprises. At the same time the share of companies that carry out these types of innovation has decreased more significantly than enterprises that implement only technological innovations.

2. Recession in 2015–2016 is not very significant. For example the share of innovation products decreased by 0.2% only; the share of organizations implementing innovations has decreased by 1%. It means that the innovation activity of enterprises is quite resistant to the crisis exacerbated by Western countries, and that innovation activity could significantly decrease in some industries (regions) and significantly increase in others.

3. The first three indicators[3] (see Table 1) are partly subjective. The organization itself decides whether it implements the innovation activity. Adoption of competitors' products and acquisition of technically more advanced

[2] Innovation is the introduction to the use of any new or significantly improved product (product or service) or process, a new marketing method or a new organizational method in business practice, workplace organization or external relations [19, p. 55].

[3] To be short they are called indicators of organizations' innovative activity.

Table 1. Indicators of innovation activity in Russia, %

Indicator	2010	2011	2012	2013	2014	2015	2016
Share of organizations that implemented technological innovation	7.9	8.9	9.1	8.9	8.8	8.3	7.3
Share of organizations that carried out technological, organizational, marketing innovations	9.5	10.4	10.3	10.1	9.9	9.3	8.4
Share of innovation goods, works, services in the total volume of shipped goods, works performed, services	4.8	6.3	8.0	9.2	8.7	8.4	8.5
Share of expenses on technological innovations in the total volume of shipped goods, works performed, services	1.6	2.2	2.5	2.9	2.9	2.6	2.5

Source: [20].

Table 2. Assessment of changes of the indicators of innovation activity during 2013–2016 for 15 regions of Russia, percentage points

Object of analysis	Share of enterprises that carry out technological innovation	Share of innovation products to shipped ones			Share of innovation expenditures in total products
		total	in industry sector	in service sector	
Fifteen leading	–1.5	0.2	0.6	0.3	–0.73
Russian regions, total	–1.6	–0.7	–0.5	0.7	–0.4

Source: author's calculations are based on data [20].

equipment are not always characterized by a significant increase in the company's innovation potential. Measuring the expenditures on innovation, including the cost of acquiring equipment and carrying out R&D (the main components), characterizes both the innovation activity and the companies' readiness for investment projects, which also stimulates innovation.

On the regional level the innovation activity of companies that carried out technological innovations increased in 19 regions (the standard deviation of the sample is 2.96). The indicator decreased significantly in some regions (the Republic of Altai, Kabardino-Balkaria, etc.). To make the indicator more relevant the average value of the indicator was calculated for the 15 largest regions in which a significant part of innovation projects is performed (Table 2)[4]. The obtained value is –1.5 percentage point, which almost coincides with the all-Russian dynamics (–1.6). Assessment of changes of indicators for 2013–2016 is given in Table 2.

In general it can be concluded that large regions are more resistant to the current crisis. However the negative dynamics of the share of innovation products is due, among other things, to a significant decline in certain regions of the Russian Federation. For example, in the Sakhalin Region, the indicator fell from 57.8% to zero; in Arkhangelsk—from 45.8 to 0.9%. However the number of regions in which the share of innovation products increased, amounted to 38 in total, 48—in the service sector. Of course production volumes in real terms are declining, but there is no collapse in the output of innovation products. An outstripping reduction in the ratio of innovation expenditures to the volume of shipped products is a negative prerequisite for the reduction of real innovation activity in the economy. The specified coefficient has increased in 34 regions during the period 2013–2016, but in the context of federal districts a significant increase occurs only in the Central Federal District, namely in Moscow (1.3 percent). Of course for such a large metropolis it is very high growth. If in 2013 the ratio of innovation expenses to the value of shipped products was 3% (which roughly corresponded to the all-Russian level), then in 2016–4.3%.

In the dynamics of the share of innovation-active companies in industry at the sectoral level there is stability, namely: in only eight out of 17 industries the indicator has changed by more than 1%. The decline is observed in the production of petroleum products

[4] Rep. Bashkortostan, Krasnodar Territory, Krasnoyarsk Territory, Moscow, Moscow Region, Nizhny Novgorod Region, Novosibirsk Region, Perm Region, Rostov Region, St. Petersburg, Samara Region, Sverdlovsk Region, Rep. Tatarstan, Tyumen Region., Chelyabinsk Region.

(–7.5 percent), machine construction (–2.3 percent) and the production of vehicles (–3.1 percent), growth is primarily in the textile industry (4.4 percent of the total). If we consider the dynamics of relative costs on innovation by industry, then it should be noted that in the raw materials industries the science intensity of products has increased and in the manufacturing industry has decreased. Some analogies can be drawn with the 2008 crisis but in 2010 the innovation expenditures in the primary sector declined, while at the current time they consistently exceed the level of 2013 [22]. In high and medium-tech industries the situation is mixed. On the one hand there is a strong decline in the chemical industry, oil-refining, on the other hand growth in engineering and, especially, in the production of electrical equipment. It is noteworthy that the share of innovation products in the shipped one is stable by industry relative to pre-crisis indicators.

It means that inertia dominates in the behavior of companies: the dynamics of the output of innovation products largely corresponds to the output as a whole, i.e. the presence of Russian firms in more high-tech segments remains. However they change (or are forced to correct) innovation development strategies, which follows from a sharp change in the dynamics of innovation costs relative to output.

Innovation activity of small enterprises. The share of innovation-active Russian small businesses is much lower than in the economy as a whole, which is confirmed by more detailed surveys [23, 24]. This is reasonable: a large company has much more opportunities for innovation development as well as the need for it as competition on large segments of the market requires innovation. It is necessary to take into account the structure of small business, traditionally focused on trade and services. However in Russia the dynamics of the share of innovation expenditures in the volume of shipped products resembles an inverted parabola [24, p. 77; 25, p. 78]. The current crisis has stimulated the intensity of innovation expenses for small enterprises with a number of employees 50–99 people and for the medium ones in the category of 500–999 people, but in 2016 there was a decrease in the indicator [24, p. 77].

At the regional level the increase occurred only in 27 regions of Russia. Given the negative trend of the indicator for medium and large companies it is necessary to assume a decrease in innovation activity. In other words general economic factors dominate; the effect of "creative destruction", if we follow the terminology of J. Schumpeter, does not yet show itself.

An analysis of the costs of innovation shows their significant decline in the production sector in real terms and in nominal terms compared to 2009. In manufacturing there was also a reduction on 13% in nominal terms, but in a number of medium- and high-tech industries growth continued (in the production of rubber and plastic products, furniture, finished metal products, vehicles). However similar trends are observed in large and medium-sized companies, so again one should point out on the prevalence of factors common to enterprises in their behavior. *Apparently, the crisis does not lead to a structural restructuring of the market space, but rather a large-scale change in the position of small companies in favor of medium and large.*

It should be borne in mind that the amount of expenses, as well as the number of innovation companies is very small, so the actions of even a few companies can lead to a significant distortion. Thus the analysis of the share of innovation products in general repeats the conclusions given above, but the fluctuations are more significant. In a number of cases (production of coking coal and petroleum products), the output of innovation products was not recorded in 2015.

Structure of innovation expenditure and cooperation activity. In itself variance of the key parameters that characterize innovation activity is not absolutely informative. The economic crisis exacerbated by the sanctions of the Western countries certainly should negatively affect the *overall* innovation activity. However in parallel companies can adapt to the new reality. For example devaluation can stimulate exports, therefore the renewal of the product line. Stronger competition can force companies to reduce redundant personnel, upgrade equipment, and optimize production and management processes. However the question arises: does the current economic crisis stimulate the modernization model of import substitution, the essence of which is not the acquisition of foreign licenses (equipment), but the formation of innovation ecosystems around companies?

Traditionally the innovation process in Russia for most industrial enterprises consisted in importing foreign equipment, usually at the expense of its own funds. This method of reducing the economic backlog can't be a key element of the strategy for the development of the national economy. In 2008 the share of equipment accounted for 59% of all innovation expenditures (of course, it includes Russian products too). In 2016 this share was gradually reduced to 53.2%, while R&D spending increased to 23.6 (in 2008 – 15%). The structure of the remaining items of expenditure has not changed significantly, in particular the expenditures on acquiring new technologies is still about 2%; but there was a slight tendency to increase the share of costs for the acquisition of patents and licenses.

At the level of separate industries fluctuations are more significant. For example if the dominant model (see above) is retained in the extraction of the fuel and energy complex, then in the extraction of other minerals the share of R&D increased very significantly: from 19% in 2008 to 50.8% in 2016. Data on the expenditure structure of a sample of processing industry are presented in Table 3.

Table 3. The structure of expenditures for innovation of sample industries of the manufacturing sector in Russia in 2008 and 2016, %

Industry	Share of R&D expenditures		Share of expenditures on equipment		Share of expenditures on new technology	
	2008	2016	2008	2016	2008	2016
Mechanical engineering	27.7	34.2	44.0	44.0	0.4	5.5
Manufacture of rubber and plastic products	2.7	16.2	70.0	62.8	4.4	2.7
Manufacture of coke and refined petroleum products	1.1	13.3	35.4	30.7	4.2	0.8
Manufacture of vehicles	25.6	24.4	35.5	49.8	4.6	4.8
Manufacture of electrical equipment	40.3	28.6	34.3	62.2	0.6	0.4
Chemical production	7.1	13.5	50.7	40.3	2.5	4.0

Source: [20], author's calculations.

De facto in Table 3 two groups of industries are shown: the production of equipment (engineering group) and a group of chemical production. Concerning the second one there is a tendency to reduce the share of spending on fixed assets and increase the share of spending on R&D, but the cost of acquiring new technologies does not follow a clear trend. In the production of coking coal and petroleum products, as well as in the chemical industry the innovation expenditures are steadily declining. But if in the first case the expenses on R&D increased by 2013 then reduced, in the chemical industry against the background of a reduction in the total expenses R&D expenditures remain at a level several times higher than before the crisis, and even grow in 2016 as compared to 2015 (5.5 and 4.1 billion rubles, respectively). In the rubber and plastic products industry the picture is similar: a reduction in total expenditures and an increase in R&D expenses (5.5 times compared to 2008). In high-tech industries there are two types of behavior. In engineering and the production of vehicles inertia dominates: the change in R&D expenditures corresponds to the dynamics of total expenditures. In the production of electrical equipment there is an increase in both overall expenditures and R&D expenditures (at a slower rate). In low-tech industries the growth in R&D expenses is not an end in itself. The company's development strategy under sanctions and devaluation can be aimed at producing analogs rather than developing fundamentally new products. However in virtually all industries except for the chemical industry the share of engineering expenses which include production design, trial production, installation, etc., has declined. Perhaps this is a short-term decline because in 2014 and 2015 in the manufacturing sector as a whole it was consistent with pre-crisis values.

Cooperation is an important indicator of the growth of innovation activity. Interaction of participants allows not only to distribute expenses between companies, to reduce risks, but also to ensure the achievement of economies of scale, to accelerate the development of innovations. Below we consider a number of indicators that allow us to estimate the prevalence of cooperation.

Indirect indicator of cooperation is payment for goods, works and services of outside organizations in the implementation of innovation projects. Unfortunately at present these data are only available for 2015 and 2016, so the comparison of growth was carried out only in the last year. In general for the industries in question the propensity to interact with outside organizations has increased. If in 2015 about 41% of the expenses fell on payment for goods, works, services of outside organizations, then a year later – already 53%. An unambiguous evaluation of this result without additional information is difficult. The growth of this indicator may be due to the emergence of incentives for companies to execute more breakthrough innovations, but at the same time a lack of their own competencies; or by the recognition of non-competitiveness of their own developments. Therefore an assessment should be carried out at the sectoral level if there is a clear tendency in the industry to increase (decrease) innovative expenses. Finally the results can be random, if the amount of expenses is small.[5] A clear trend in the dynamics of innovation expenditures for individual sectors is presented in Table 4.

In all industries there is an increase in the propensity to attract outside organizations for the implementation of innovation projects. However the pace of change in the expenses structure is significant and data for subsequent years are needed to assess the sustainability of the innovation process. There is no clear trend for individual cost items. For example the role of

[5] For example in 2015 only 30 companies were busy with innovative activities in the production of coking coal and chemical products.

Table 4. The share of outside organizations in spending on innovation of innovation-active industrial companies, %

Industry	Expenditures					
	on innovation, it total		on R&D		on engineering	
	2015	2016	2015	2016	2015	2016
Manufacture of electrical equipment	36.0	61.5	18.8	13.4	74.4	15.7
Extraction of fuel and energy minerals	8.7	39.0	12.3	50.0	37.3	22.5
Manufacture of machinery and equipment	11.7	16.9	14.9	12.6	18.7	33.1
Chemical production	44.0	51.1	47.5	32.6	36.6	31.7
Manufacture of coke and refined petroleum products	65.2	77.6	72.1	92.9	75.7	96.1

Source: author's calculations based on [20].

Table 5. Cooperative models of companies' behavior in 2011–2016, %

Industry	Innovation products are created									
	Most of all by other organizations					In cooperation with other organizations				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
Manufacture of electrical equipment	12.2	10.5	10.6	15.7	14.7	23.3	24.6	25.6	25.7	22.9
Mechanical engineering	12.5	14.8	12.8	12.9	15.3	22.6	22.8	23.4	19.2	22.2
Chemical production	20.6	23.9	20.8	20.9	16.5	28.6	30.6	33.1	38.0	35.7
Manufacture of coke and refined petroleum products	38.2	34.4	29.0	33.3	29.0	52.9	50.0	54.8	63.3	58.1
Manufacture of rubber and plastics	23.8	26.3	22.2	19.7	23.8	26.2	18.8	19.8	18.4	16.3
Manufacture of food products, including drinks	20.4	21.6	19.5	19.4	24.3	30.1	28.9	24.3	24.4	23.5
Mining	39.7	50.8	50.8	43.0	45.4	39.7	30.2	33.1	33.9	31.5
Total for industrial enterprises	23.2	25.2	24.7	24.6	25.9	30.4	30.5	29.8	29.6	28.4

Source: author's calculations based on [20].

external organizations in joint R&D can be reduced and in engineering work – to increase. Since 2012 there has been a tendency to reduce the share of industrial companies that participated in joint projects of companies that implemented innovation projects. In general cooperation ties (or their absence) are a stable model of company behavior. If we consider industrial enterprises as a whole, then the amount of shares of the companies that carry out joint development and those who outsource these processes are relatively constant (Table 5).

The crisis caused a certain surge in cooperative activity. In 2015 activity was countercyclical (at the sectoral level), but in 2016 a return to pre-crisis models is observed. For example in the production of electrical equipment and machinery the share of companies that carry out joint development is slightly below the pre-crisis level. In the production of rubber and plastic products, the food industry and the extractive sector the tendency of the decline in cooperative activity is renewed. On the contrary in the chemical industry the economic crisis has strengthened the trend towards cooperation.

Finally, we present the analysis of the involvement of companies in joint research (Table 6). If we consider all industrial companies, then the share of R&D cooperating firms that carry out technological innovations is about one-third with a downward trend. If in 2011 share of such companies was 34.7%, then in 2016 – 28.6%. Among companies that did not implement technological innovations in this year, the involvement in cooperation is less than 1%, so they are not considered.

The main criterion for selection of industries was the sufficiency of the number of companies represented in the sample, so that results did not depend to

Table 6. Participation of firms in performing joint R&D in 2011–2016, %

Industry	2011	2012	2013	2014	2015	2016
Mechanical engineering	37.4	34.8	34.0	33.2	34.0	25.3
Manufacture of electrical equipment	36.2	34.5	32.7	29.4	28.9	30.0
Chemical production	47.2	45.8	42.4	41.0	39.8	29.7
Mining	41.2	41.3	37.9	38.1	38.8	36.6
Manufacture of coke and refined petroleum products	69.7	66.7	58.6	65.4	66.7	60.0
Manufacture of fabricated metal products	29.2	27.2	29.5	18.8	16.9	14.1
Manufacture of food products, including drinks	17.4	16.7	15.8	14.1	10.8	8.6

Source: author's calculations based on [20].

a large extent on the decision of several firms. The conclusion is obvious: in the Russian industry there is a steady trend of reduction of cooperation of companies in the field of R&D. The economic crisis immediately affected the cooperation of enterprises producing finished metal products (a decline in 2014) with an annual lag of food industry companies (a decline in 2015). One of the key reasons for the severance of relations can be the deterioration of the financial condition of partners (suppliers, customers, etc.). Another reason is the shrinking markets for innovation products. The third reason is the financial state of the company. For example mining companies, as a rule, are holding structures. Over half of the firms that carry out technological innovations cooperate within the group of companies. For comparison: in mechanical engineering – this is only a quarter of firms, in the production of electrical equipment – a third. The reason can't be the termination of relations between companies due to geopolitical tensions. If we analyze the number of partners in joint R&D from the EU countries in 2012 there were 349, in 2015 – 408; from the USA and Canada – 86 and 71, respectively.

CONCLUSIONS

The analysis performed at the sectoral and regional levels showed that during four years the economic crisis did not have a significant impact on the innovation model. Key indicators of innovation activity have not undergone significant changes. This indicates on the stability of companies in the markets of innovation products, at least in the medium term. Of course the overall level of innovation activity has declined due to a fall in investment, but some industries are resistant to recession. Perhaps this influence was rendered by state subsidies to individual enterprises. Despite the reduction of competition from foreign companies a slight decrease in the severity of the problem of labor shortage, innovation indicators after some improvement (in individual sectors) return to pre-crisis values [26]. This is a consequence of the lower priority of the task of technological renewal of production in view of the need to solve the problem of survival in the conditions of a reduction in demand and financial resources [27]. The cost structure for innovations in the direction of greater science intensity has not changed significantly, although the positive changes in a number of industries are obvious. The crisis caused an increase in cooperation in the development of new products, but this influence is of a short-term nature. Finally the reduction of cooperative activity in the field of R&D is a medium-term trend and requires separate consideration.

It is worth mentioning the limitations of the study. Analysis at the level of branches and sub-sectors is quite sufficient to detect the basic trends inspired by macroparameters. However consideration at the level of individual companies would allow to reveal the influence of a number of micro-level factors, first of all, resource (financial abililties, firm size), geographical (regional affiliation), institutional (ownership structure, belonging to the group of companies) on the change of the innovation activity model.

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