Impact of economic crisis on innovation behaviour of industrial firms in Russia

Kuznetsov, Boris and Simachev, Yuri

Interdepartmental Analytical Center

December 2010

Impact of Economic Crisis on Innovation Behaviour of Industrial Firms in Russia

Boris Kuznetsov* and Yuri Simachev**

Abstract

The paper focuses on empirical analysis of major factors that determine innovation activities of Russian manufacturing firms during the crisis. We presume that the crisis has ambiguous effects on firms' behaviour, on one hand limiting their financial capabilities to invest into new products and/or technologies, and on the other hand – creating additional incentives to innovate and opportunities to enter new markets. We use micro-level data to reveal major determinants of changes in innovation activity of a firm, including structural characteristics (size, industry, etc.), competitive environment (intensity of competition and type of main competitors) , changes in financial position of a firm, it's pre-crisis performance and innovation activity, the declared strategy of a firm and other factors. The empirical part of our research is based mostly on the results of two surveys of industrial firms conducted in August of 2008 (before the crisis) and in September 2009 (during the crisis). About 600 medium and large firms mostly in manufacturing industries have been surveyed using specially developed survey instruments. We show that while general impact of the crisis on innovation activity was strong and negative different industries have been damaged to different extent. The adjustment to the crisis led to sharp decrease in investment intensive innovations while R&D activity has diminished much less and for some groups of firms has even intensified. The drop in innovations is typical for firms pursuing the strategy of incremental improvements of technology and products or with the strategy of large-scale investments in enhancing the production of traditional goods, rather than for firms focused on the development of new products. We found further that about 30% of manufacturing firms during the crisis still pursued innovation based strategies and this behaviour does not is depend on industry or even financial position.

Keywords: industrial innovation, impact of crisis, innovation policy.

JEL classification: *D22, O31, O38*

This paper is based on the results of several research projects conducted at Interdepartmental Analytical Center in 2005-2009 with the financial support of the Ministry for Education and Science of Russian Federation. The authors are extremely grateful to the Department for Economic Surveying of the Institute for the Economy of Transition and in particular to it's Head Sergei Tsuhlo for help with the survey instruments and for collecting the data.

December 2010

**) Ph.D., Lead researcher at the Institute for Industrial and Market Studies of Higher School of Economic, Moscow. E-mail: bkuz@bk.ru*

***) Ph.D., Deputy Director at Interdepartmental Analytical Center, Moscow. E-mail: simachev@iacenter.ru*

1. Introduction

The Russian manufacturing started to revive from transitional shock after 1998 crisis using the advantages of devaluated national currency, relatively cheap labour and excessive production capacities. For several years this development was mostly extensive – based on growing internal demand and import substitution with little new investments and few technology innovations. By the mid 2000s the most important sources for extensive development originating from the crisis of 1998 were largely depleted. It seemed imminent that Russian manufacturing firms would have to look for a different – intensive - development strategy, involving new market entry, technological upgrade and product innovation. Several studies (Desai, Goldberg eds. 2008, Golikova et al 2008, Simachev et al, 2008) based on the surveys of industrial firms conducted in 2005-2006 demonstrated that obsolete technologies and low investment in introducing new products were the major factors of low competitiveness of industrial enterprises, in particular in manufacturing sector. So, increase in innovations, should be the major source of further development. The Russian government also declared the transition for "knowledge based" economy as a main priority of economic policy (MoED, 2008).

It should be admitted today that those expectations did not come quite true. In fact, in 2005-2008, an exceptionally favorable external environment and terms of trade, rapid expansion of domestic demand and improved access to borrowings helped most industrial enterprises to maintain their market power and, moreover, to increase output without any significant changes in their technologies, innovation risks or entering new, first of all, international markets. It's well known that Russian firms continued to be much less active in innovations, in particular in technology and product innovations, comparing to firms in other countries. Official statistic data reports the share of innovation active firms at less than 10% compared to 25%-80% for OECD group of countries (OECD, 2009). An, what is more important, this gap was not closing up even at the seven-year period of stable economic growth. The reasons for such poor performance of Russian firms were the subject of heated debate among economists, researchers, businessmen. The dispute was mostly about the question of whether the main problems lay at the demand side or on the supply side. To put it roughly – are the firms passive due to lack of incentives to innovate due to weak competition and unfavorable invest climate? Or they are passive because they do not have access to resources (both financial and intellectual) due to inefficient innovation system, low quality of human resources, lack of the adequate state support, etc.?

The current crisis which hit Russia badly and has changed the situation in many ways and should have ambiguous impact on innovation activity of firms. On one hand, the crisis squeezed markets and should have resulted in higher competition and stronger incentives for innovation. On the other hand it made a strong blow to financial performance of firms, made external financing very expensive and thus, limited the ability of firms to spend money on investments and innovate. In this context it would be interesting to see the reaction of firms to the crisis in terms of their innovation activity.

In this paper we'll try to analyze this issue mostly using the data of two surveys: one conducted just before the crisis in August 2008 and another a year later in August-September 2009 when the initial shock was over and most of firms have understood that they will be operating in new environment where growth will be at least moderate and resources (in particular, financial resources) will be less available and quite expensive[1].

2. Data description

Data was collected by Department for Economic Surveying of the Institute for the Economy of Transition using their panel for monthly polls. The polling involves the representative panel of the directors of industrial enterprises throughout the whole territory of Russia. The panel is build upon the principle "one enterprise – one respondent". Among the respondents, directors of enterprises constitute 35%, deputy directors - another 35%, and heads of economic departments - 20%. The panel includes mostly medium and large industrial enterprise and represents about 20% of such firms. The response rate for the posted questionnaires was not very high (about 40%-50%) but the survey provided data for about 600 firms in 2008 and about 500 firms in 2009 representing all the major branches of Russian industry (see Tab. 1). The panel part of two samples (i.e. number of firms that responded to the

[1] It should be noted that Russian economy entered the global crisis somewhat later than most of the countries: the sharp decline started in October 2008 and the acute phase of the crisis continued till the first quarter of 2009.

questionnaire in both years is smaller and consists of 310 firms (actual number of panel observations may be smaller due to missing values for some questions).

Industries	%	
	2008	2009
Energy and fuel industry	0,8	0,9
Metals industry	4,3	5,4
Chemical industry	7,4	7,1
Machinery	41,3	39,5
Wood and pulp industry	7,4	7,5
Stone and clay industry	14,2	14,4
Light industry	11,7	11,6
Food industry	12,9	13,5
Total	*100,0*	*100,0*
Number of respondents	**622**	**534**

Tab. 1 : *Structure of the sample by industries*
Source: Surveys of Innovation Activity of Russian Industrial Firms (2008, 2009)

By size (measured by number of employees) our sample include 30% of SME firms with number of employees of 300 or less 39% of firms with employment in the range of 300-1000 and 31% of large firms with more that 1000 employees. The database includes responses for approximately 50 questions mostly concerned with innovation behavior of the firm. Most of this information is qualitative and reflects respondents' opinions or evaluations. That do not always allow to conduct sophisticated econometric analysis, though even simple analysis reveals some interesting facts and trends.

3. General background: macro-level dynamics of the crisis[2]

The global crisis started in the sectors of Russian economy mostly involved in borrowing money on the World financial markets, namely in the banking sector and in the segment of large industrial groups that were heavily borrowing abroad in previous years not so much for modernization of production capacities as for M&A activity. For some industrial groups additional impact came from the stock markets when the so called "margin calls" (demands for additional collaterals due to sharp decrease of stock prices) started from the foreign banks. Other sectors influenced by the crisis at the early stage were exporting industries such as ferrous metal, chemicals (mainly mineral fertilizers) where both the demand and world market prices fell significantly. Very sharply fell the output of cars and lorries, cement production and some investment goods. It should be noted that the crisis was not "frontal": a lot of industries were not seriously affected – for example, food industry, retail trade, other industries oriented on personal consumption[3].

Still, the overall drop of macroeconomic indicators was impressive. The number of registered unemployed (people receiving unemployment benefits) grew up 44% in the first quarter of 2009 (2.2 mln.) and the total unemployment level (by ILO methodology) reached 9.5%. At the same time households consumption did not experienced a serious decline and that supported retail trade and food industry. It may be partly due to the fact that Russian population in general at the start of the crisis was not heavily indebted to banks comparing to other countries: in spite of the high rates of growth of personal loans in the previous period most of the population did not use bank loans (mostly due to the still underdeveloped system of mortgages in Russia).

The acute phase of crisis and decline was short. In March the negative dynamics of main indicators slowed down significantly and by May 2009 the second phase of the crisis has started. That stage was characterized by very unstable dynamics industrial output (weak growth in some months and small decrease in others), decline in unemployment, by slowing of inflation, significant revaluation of the national currency. At the same time investments continued to fall a s well as export volumes. Statistics for January-August 2009 published by Ministry of Economic Development of Russia (MoED 2009) shows that for this period the GDP stayed more than 10% lower than for the

[2] We are giving here the overview of Russian economy and Russian industry performance for the period our survey data was collected, i.e. till August 2009

[3] The influence of the first phase of crisis on different industries and sub-industries is analyzed in detail in (Bessonov V.A. 2009).

same period last year, industrial output fell 14% and manufacturing industries, construction and investments were at the level about 20% lower. Other economic indicators also show ambiguous dynamics: unemployment level lower than in the first quarter of the year but nevertheless high for Russian standards of previous years - about 8%, stock indexes stay at low levels, export 45% and import 40% lower than in 2008. The relative stabilization in the second and third quarters was driven first of all by stabilization of the World economy and consequent growth of the World market prices for oil and other products of Russian export. State policy, most of all the decision to keep state expenditures high in spite of the drop in state revenues, supported internal consumption. Summarizing macro-level data it may be said that since May 2009 the Russian economy found itself in rather unstable equilibrium, balancing around zero growth (Fig. 1).

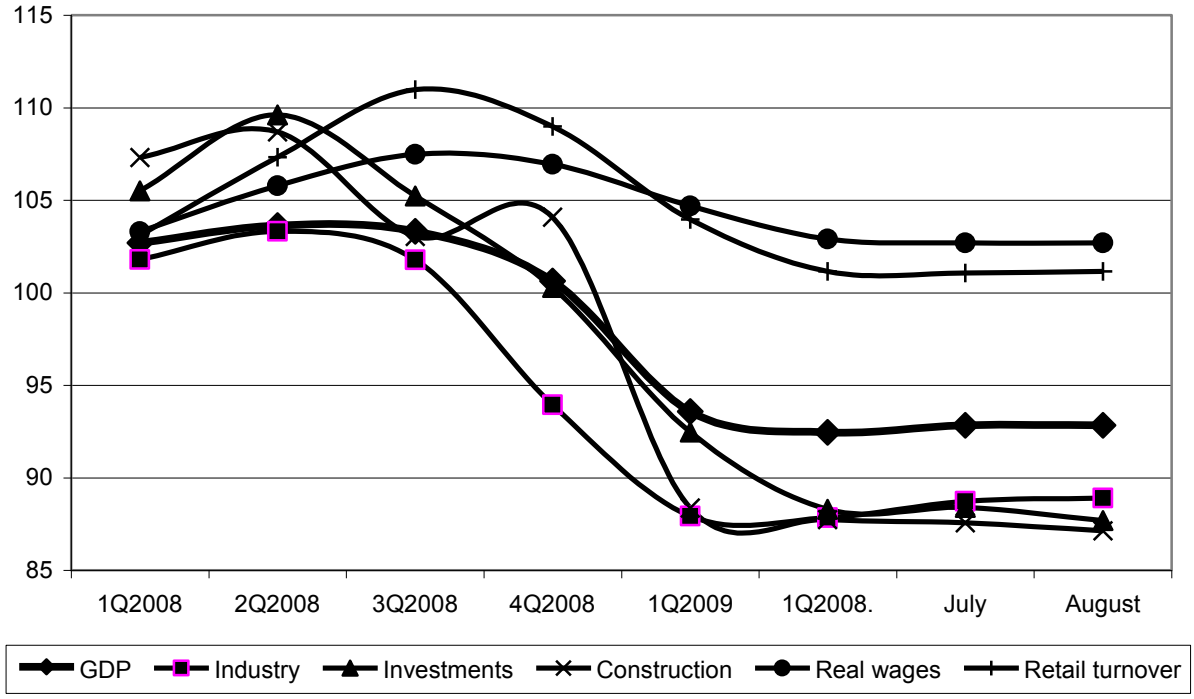

Fig 1. *Quarterly dynamics of main indicators for 2008-2009 (4 quarter 2007==100%)*
Source: calculated from Ministry of economic Development data (MoED 2009)

4. The impact of the crisis on innovation activity of firms

Main Hypothesis to be tested

We believe that the crisis, while damaging the overall innovation activity in industry has a certain "creative destruction" effect, providing new incentives and new opportunities for more active and more successful firms and stimulated higher heterogeneity of firms inside industries, dividing "formal innovators" (those involved in some innovation activity only when they have resources to spare), and firms for which innovation-oriented strategy is a necessity and part of their long-term strategy. In particular, we'll try to test following hypothesis:

1. We presume that in the time of crisis firms tend to cut down expenses, including the expenses for innovations. Although, we presume that the reaction differ pending on how deep the firm was involved in innovation activity prior to the crisis: if innovations are part of the firms strategy it's less inclined to stop those efforts in spite of worsening of financial situation. The reasons for this may be the existence of ongoing innovation projects some of which may be on final stages, the existence inside the actively innovating firms special departments (in particular, R&D) that are difficult and unwise to liquidate even in hard times. The sub-hypothesis is that R&D expenses are less elastic to changes in revenues and demand than innovations linked to investments (i.e. procurement of new equipment).
2. The crisis tends to increase competition and provides incentive for innovations. Thus, firms in competitive environment less often cut down or stop innovations. Firms with low or no competition even if they innovated before actually had little pressure to innovate and are more ready to cut expenses connected with innovations.

3. Innovation activity of relatively smaller firms are more damaged by the crisis as they have less financial reserves and external financing for them becomes unavailable and more expensive comparing to large companies. The result is a concentration of innovation in the group of large companies.

Changes in innovation activity

It should be noted that as we are dealing with medium and large industrial companies the formal indicators of innovation activity are much higher that officially reported level for Russian economy. Different surveys (Kozlov et al, 2004, Golikova et al, 2008) give for the pre-crisis period the share of firms involved in one or another innovation activity[4] at about 60%-80% percent. Though that activity is often rather "shallow", incremental and mostly concerned with imitation of existing technologies or products. In 2008 more than 80% of the firms in our sample reported that they are involved in innovation, but only 45% reported any R&D. But even those who had any R&D spending on the average spent 3.3% of the total sales – much less than the same respondents indicated as "an optimal" value for R&D to sales ratio that averaged 9.9% of sales for the same sample of firms. Still, for several years before the crisis firms increased spending for innovation and for R&D.

The crisis changed the situation dramatically. That the crisis is not the best time to enhance some innovation activities like the replacement of old equipment is quite clear without special research. Our data allows to evaluate the "scale of the catastrophe". More than 50% of firms decreased their spending on innovations in 2009 compared to 2008 (in 2008 only 7% of firms reported such a decrease compared to 2007). If in 2008 about 40% of respondents reported increase in spending on innovations and another 34% reported those expenditures constant, a year later only 10% reported increase and 15% kept financing of innovation at the pre-crisis level (Tab 2). At the same time the share of companies that are not involved in innovations at all (and do not plan to invest in innovation this year) changed insignificantly. Thus we witness not the process of stopping innovations but rather of downsizing of those expenditures.

Change in the level of innovations' financing to the previous year	August 2008	September 2009	Balance
Do not finance and do not plan to finance innovations	19%	23%	**+4 p.p**
Decreased financing of innovation	7%	52%	**+43 p.p**
Kept the level of financing stable	34%	15%	**-19 p.p**
Increased financing of innovation	40%	10%	**- 30 p.p.**

Tab. 2 : *Distribution of companies by the dynamic of innovation activity (% of firms)*
Source: Surveys of Innovation Activity of Russian Industrial Firms (2008, 2009)

To understand what kind of companies were most damaged it's interesting to look at the group of companies that decided not to decrease spending but to totally stop financing innovations. There are 15% of such firms in 2009 data. The first factor is, quite naturally, the size of a firm. In a group of small firms with less than 100 employees 28% had to stop innovation activity while in the group of companies with 5000 employees and more there are no such firms at all. Even before the crisis innovation activity was "biased" for larger companies. The crisis made this trend much more prominent. By industries situation also differ. Better than average look chemical industry and food industries where 19% and 15% of firms during the crisis continued to increase innovation expenditures. Worse than average are wood industry and stone&clay (building materials) industry. The last fact is easily explained if we consider that those two industries demand came to large extent from construction – the sphere that experienced the hardest blow from the crisis.

The total expenditure for technological innovations includes (and are dominated by) purchasing the new technological equipment and, thus, are strongly correlated with investments. If we take into account the fact that more than 50% of new equipment came to Russia via import which became very expensive due to devaluation, it's no wonder that total spending on innovation fell down. The share of companies investing in new equipment fell down from 74% in 2007 to 60% in 2009. And those firms that continued to invest in new equipment significantly decreased the volume.

	2007 (fact)	2009 (estim.)
Share of firms in the sample investing in new equipment (%)	74	60

[4] In this paper we operate only with so-called technological innovations, i.e. innovations connected with new technologies, new products, R&D, while innovations in management ("organizational innovations") we do not consider here.

	2007 (fact)	2009 (estim.)
Investments in new equipment to sales ratio (median value for the group, %)	*4*	*3*
Share of firms in the sample with non-zero expenditures for R&D (%)	39	33
R&D to sales ratio (median value for firms with non-zero R&D, %)	*1*	*2*
Share of firms in the sample investing producing new or updated products (%)	60	59
Share of new/updated products in total sales	*10*	*10*

Tab. 3 : *Comparisons of innovation indicators prior and during the crisis*
Source: Surveys of Innovation Activity of Russian Industrial Firms (2008, 2009)

If we look at other indicators of innovation activity – R&D activity and expenditures – the situation is somewhat different. The share of companies financing R&D also has declined but more moderately: from 39% to 33% of the panel group and for those who continued R&D the ratio of R&D spending to sales grew up (Tab. 3).
The "willingness" of a firm to stop R&D expenditures among other factors (size, industry, etc.) depends on whether the firm is conducting R&D itself or is outsourcing this activity. Though the number of observation is too small to provide statistically correct analysis we see that firms which outsource 50% or more of R&D stop financing this activity during the crisis 1.5 times more often than firms with more than 50% of "in-house" R&D.
Anyway, we see that even at the time of crisis there are certain groups of firms that increase their efforts to innovate and there are firms for whom expenditures on innovation are first item to be cut at hard times. In both rounds of the survey we asked firms if they innovate from time to time (when the need for some change arises) or their spending on innovations are made according to medium or long-term strategy. For our analysis we break firms in our sample in three groups. First one – "passive firms" which are not involved in any innovation activity; second – group of "casual innovators" which do invest in some innovations but from time to time when the needs arises; and the third group – "systematic" or "strategic innovators" which invest innovations regularly and believe them to be a part of their market strategy. In time of the crisis both group of innovators decreased their spending but firms which innovate "from time to time" are much more inclined to stop innovation altogether during the crisis. Thus we can presume that the crisis provides some kind of selection dividing those for whom innovations are imminent for keeping competitiveness and those for whom innovations are something you do when you have financial opportunity. Below we'll discuss what factors determine changes in innovation activities of the firms during the crisis.

5. Impact of the crisis on the firms' performance

In this section we'll look upon some factors which should have been important for firms' innovation decisions during the crisis. The drop of demand was immediate and the most evident consequences of the crisis. The rate of decline was obviously different for different markets and industries but we were more interested in looking how the demand for new and traditional goods behaved. I.e. did the crisis damage the production of new, innovative goods? Initially we presumed that the drop in demand for goods will mostly concern the so-called newly introduced innovative products as they are usually more expensive than the traditional ones. In fact our data shows the opposite trend: 70% of our firms mentioned the drop of demand for their traditional products, while only 37% reported the drop of demand for new products (Fig. 2).

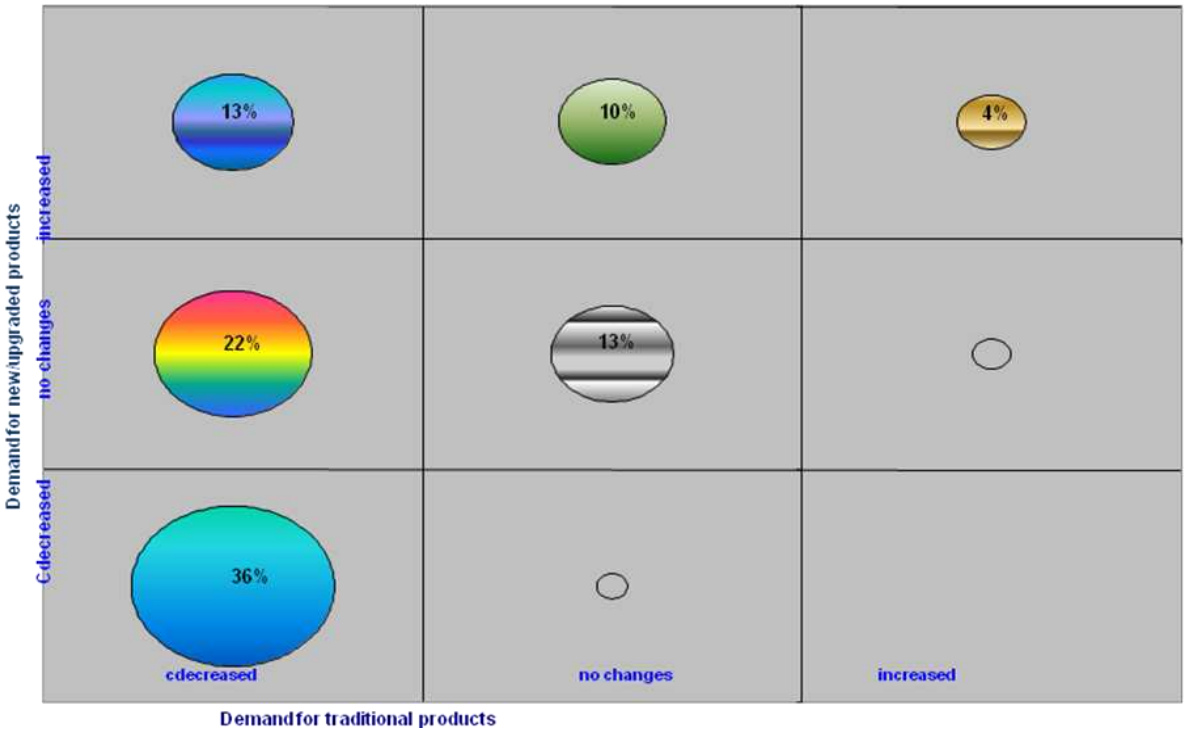

Fig 2. *Share of firms reporting changes in the demand for traditional and/or new/upgraded products in 2009 (%)*
Source: Surveys of Innovation Activity of Russian Industrial Firms (2009)

Only 5% of respondents said that the drop of demand for innovation products during the crisis became an important obstacle for financing innovations. Thus, we can presume that while crisis led to lower demand for both traditional and new products the production of the later were damaged less, creating additional incentives for product innovations and giving some competitive advantages to firms who were active in introducing new products prior to the crisis. A shift to larger share of new products in time of the crisis is most prominent in such industries as chemicals, machinery building and light industry. It should be noted that this shift to new products is due not so much to growth of demand on such products but mostly to the much sharper decrease of demand for traditional products.
The shift to new/upgraded products may indicate that the crisis has changed to some extent the competitive strategies of industrial firms from competing by price to competing by quality. To check this we compare answers of respondents for questions about the priorities of innovations before the crisis, during the crisis and plans for the post-crisis period (Tab.4).

Firms' priorities concerning the innovations	2008	2009	Post-crisis (estim.)
Introducing new products	29	35	51
Upgrading the existing products	34	34	35
Improving energy efficiency	18	50	36
Lowing down material costs	22	42	28
Increasing labour productivity	28	40	47

Tab. 4 : *Comparisons of innovation priorities of firms indicators prior and during the crisis (% of firms)*
Comment: Respondents were allowed to give more than one answer
Source: Surveys of Innovation Activity of Russian Industrial Firms (2008, 2009)

We can see that the crisis did change the firms' opinion about the relative importance of different innovations. During the crisis the importance of technological innovations aimed at lower costs of production grew sharply. This evidently is due to the financial problems. At the same time even in time of the crisis and especially for post-crisis period (when respondents, we presume, expect the growth of demand for their products and improvement of firm's financial situation) the share of firms which believe it necessary to introduce new products also increase. Of cause it is only intentions and we can't be sure that they will result in actual efforts. Still, it looks as the crisis definitely made more managers to realize the importance of more "deep" and serious product innovations. It should be noted that

innovations aimed at upgrading of existing products that were the most often priority mentioned before the crisis became relatively less important.

We expected that the crisis and decline of demand would lead to more vicious competition (and, thus, will create additional incentives to innovate). Nevertheless our data does not confirm the growing competitive pressure. Tab. 5 provides the data on how Russian industrial firms assessed the intensity of competition with other Russian producers, with firms from CIS countries and with firms from so-called "far-abroad countries", i.e. excluding firms from CIS countries. Formally about 90% of firms meet some competition on their market though the competition with foreign firms is not high. Opposite to expectations, the crisis has not influenced competition with other Russian firms and competition with foreign produces became somewhat less intense. The last fact can be explained by devaluation of the national currency and import becoming more expensive.

	With other Russian firms		**With CIS firms**		**With other foreign firms**	
	2008	2009	2008	2009	2008	2009
Strong competition	35.8	34.9	12.0	8.7	20.9	16.2
Moderate competition	53.0	42.3	29.4	24.5	19.9	22.0
Weak competition	4.2	8.4	17.4	19.0	16.2	14.7
No competitors	4.7	6.5	28.8	29.4	27.2	28.8
Difficult to answer	2.3	7.9	12.5	18.5	15.7	18.3

Tab 5.: *Share of firms in a panel sample reporting the level of competitive pressure from different producers (%)*
Source: Surveys of Innovation Activity of Russian Industrial Firms (2008, 2009)

The analysis of correlations between innovation activity and changes in competitive pressure shows that most often stopped innovations firms with weak competition with other Russian producers: the share of firms reporting constant innovative activity as an element of firm's development strategy in this group fell two times – from 52% to 25%. Although that may be due to the fact that those enterprises were hit harder by the crisis and found themselves in hard budget constraints. Alternative explanation is that those firms did not have initially strong incentives to innovate and dropped all the activity at the time of the crisis. The data also indicates that the most important type of competitive pressure for innovation activity is a strong competition with foreign producers. This is not a new tendency: the same results different researchers got for Russian industrial firms for pre-crisis period of 2000-2008 (Yasin ed. 2004, Gonchar, Kuznetsov eds. 2008, HSE 2010).

One of the most important reasons for cutting down innovations during the crisis is the lack of resources, in particular, financial resources. We do not have quantitative data for our firms that could be used to measure financial constraints. Nevertheless, we have responses of top-managers to the question of the financial position for 2008 and for 2009. Tab.6 shows how firms "moved" from category to category when the crisis hit the economy.

2008 financial position	**2009 financial position**			
	Good	Satisfactory	Bad or critical	Total
Good	18.8	62.5	18.8	100
Satisfactory	2.5	63.8	33.7	100
Bad or critical	0.0	37.8	62.2	100
Total	*3.2*	*59.3*	*37.5*	100

Tab 6.: *Share of firms in a panel sample which moved from on financial position category to another (%)*
Source: Surveys of Innovation Activity of Russian Industrial Firms (2008, 2009)

The data shows that less than 20% of firms that assessed its' position as "good" in 2008 stayed in the same category in 2009, while more than 60% evaluated the situation as "satisfactory" and almost 20% dropped down to "bad or critical" category. Only 8% of the total sample managed to improve their position (mostly they moved from critical to satisfactory category). We divide firms into two groups – those which kept or improved financial position and those whose position has changed to worse. First group is 68.5%, second 31.5 percent. Tab.7 shows cross-tab of innovation activity groups described above and groups by changes in financial position.

	2008		2009	
	Stable fin. position in 2009	Deteriorated fin. position in 2009	Stable fin. position in 2009	Deteriorated fin. position in 2009
"Passive" firms	25.3	23.5	27.9	38.2
"Casual innovators"	30.1	35.3	30.6	32.4
"Strategic innovators"	44.5	41.2	41.5	29.4

Tab 7.: *Distribution of firms by type of innovation activity in 2008 and 2009 pending on the impact of the crisis on financial position if the firm (%)*
Source: Surveys of Innovation Activity of Russian Industrial Firms (2008, 2009)

The figures in the table are self-explanatory: in a group with stable financial position the distribution of firms by type of innovation activity changed just slightly, while in a group with deteriorated financial situation the share of "passive" firms increase by 60% and the share of "strategic innovators" fell by 30%. This tendency is supported by other responses. Thus, in the group of firms which kept financial position 12% stopped innovations totally, 48% cut innovation expenditures, 24% kept them on the previous level and 15.5 increased them. In a group of deteriorated financial situation 20% stopped innovations, 61% of firms cut expenditures, and less than 10% kept them stable.
Firms in different industries and of different size may react to worsening of financial situation in a different way. We'll control the relationship for the possible influence those factors by using simple probit regression:

$$Inn\_type\_down_i = \beta_0 + \beta_1 * fin\_down_i + \sum_{k=1}^{8} \beta_{1+k} * ind_k + \sum_{l=1}^{3} \beta_{9+l} * size_l + \varepsilon \qquad (1)$$

Where inn_type_down is 1, for firms which in 2009 "downgraded" their innovation activity, i.e. moved from the status of "strategic innovators" to "casual innovators" or from "casual innovators" to "passive", etc., 0 – if the iinovation status stay the same or is "upgraded";
Fin_down equals 1 if a firm's financial position deteriorated in crisis, 0 – otherwise;
ind и size – dummy variables for industry and size categories; there are 8 industry dummies for industries named in Tab.1 and three size categories: small (<250 employees), medium (251-1000) and large (>1000 employees).
The results in Tab.8 show that the change in financial position significantly increase the probability for a firm to downgrade it's innovation status. Industry dummies are insignificant and the significance of the coefficient before the dummy for medium size category may point out that medium size companies tend to stronger react to financial changes than larger companies.

Probit estimates	Number of obs		=	213[5]
	Wald chi2(10)		=	8.9
	Prob > chi2		=	0.5412
inn_down	Pseudo R2		=	0.0431
	Coef.	**Std. Err.**	**z**	**P>z**
fin_down	-0.43578	0.20426	**-2.13**	0.033
Energy and fuel	0.456639	0.948859	0.48	0.63
Metals	*-0.38273*	*0.512015*	*-0.75*	*0.455*
Chemicals	dropped			
Machinery	-0.20173	0.379254	-0.53	0.595
Wood and pulp	-0.34429	0.494391	-0.7	0.486
Stone and clay	-0.29239	0.449947	-0.65	0.516
Light	-0.37446	0.504351	-0.74	0.458
Food	-0.46633	0.492804	-0.95	0.344
<250 employees	0.343956	0.300102	1.15	0.252
250-1000 employees	0.467952	0.252353	**1.85**	0.064
>1000 employees	dropped			
_cons	-0.47273	0.383806	-1.23	0.218

Tab 8.: *Distribution of firms by type of innovation activity in 2008 and 2009 pending on the impact of the crisis on financial position if the firm (%)*

[5] Number of observations is much lower that the panel sample as not all the firms gave answers for both years.

Source: Surveys of Innovation Activity of Russian Industrial Firms (2008, 2009)

6. Factors of innovation activity during the crisis

So, the crisis did have ambiguous impact on innovation activity. The descriptive analysis of firms' reaction to the crisis provides some evidence on several possible factors that may influence innovations. Not all of them we can measure using the available data. Nevertheless, we can try to include in our model qualitative indicators for some of them. In particular, for changes of financial position of firms, the competitive pressure, the innovation status of a firm previous to crisis and characteristics of a firm such as the firm's size and industry. It should be stressed that the panel part of our survey include a limited number of observations and the results should be treated with caution.

We presume that a firm is involved in innovation activity during the crisis if it was actively innovating before and probably have a lot of ongoing projects costly to be stopped. We also presume that strategic innovators are less probable to stop their activity comparing to firms which were involved in "casual" innovative activity. We include a dummy variable reflecting the fact that a firm was conducting R&D before the crisis as it indicates the serious intentions for strategic innovations. Further, we expect that the change of financial position of a firm to the worse should negatively impact the innovation activity. And finally, we presume that firms in strong competitive environment are less eager to stop innovations.

The general design of regression is like following:

$$Inn\_activity09_i = \beta_0 + \sum_{p=1}^{3} \beta_p * inn\_status08_i + \beta_5 * fin\_position\_down_i + \\ + \beta_6 * compet09_i + \beta_7 * RD08_i + \sum_{k=1}^{8} \beta_{7+k} * ind_k + \sum_{l=1}^{3} \beta_{15+l} * size_l + \varepsilon \quad (2)$$

Inn_activity09 is a variable of value 1 if a firm still continue innovations in 2009;
inn_status08 reflects the previous status of a firm
fin_position_down is the variable described above that is equal 1 if the crisis led to deterioration of financial position (i.e. if a firm's self-assessment of the financial position changed to worse), 0 – if it stay stable or improved;
compet09 is 1 if a firm has a strong competition pressure either with other Russian firms or with foreign producers, zero otherwise;
RD08 – is 1 if a firm was conducting any RD in 2008;
ind and size – dummies described above in equation (1).
The results are shown in Tab.9.

Probit estimates	Number of obs		=	197
	Wald chi2(13)		=	53.98
	Prob > chi2		=	0
	Pseudo R2		=	0.239
Log pseudo-likelihood = -96.10909				
inn_act09	Coef.	Std. Err.	z	P>z
inn_status08_strategic	1.049405	0.32517	3.23***	0.001
inn_status08_casual	0.737905	0.276251	2.67***	0.008
inn_status_passive		dropped		
comp09_strong	0.494902	0.223512	2.21**	0.027
RD08	0.001659	0.250217	0.01	0.995
fin_position_down	-0.41126	0.219124	-1.88*	0.061
lsize1		dropped		
lsize2	0.62641	0.245182	2.55**	0.011
lsize3	0.970356	0.329623	2.94***	0.003
_cons	-1.12019	0.50496	-2.22	0.027

Tab 9.: *Probit regression results for factors of innovations during the crisis*

Comment: (***) indicates 1% significance, (**) - 5%, (*) – 10%; coefficients before industry dummies are not included as none of them is significant

As can be seen from the results of estimation not all of expectations came true. While firms innovating prior to the crisis are less probable to stop innovations (or rather it means that passive firms, obviously, do not start to innovate during the crisis) , we cannot prove that "casual" innovators are significantly more active in stopping innovations that "strategic" innovators. The fact of RD expenditures prior to the crisis has no impact on the probability for firms to innovate in time of the crisis. Other presumptions are more justified: negative changes in financial situation push firms out of innovation activity, while strong competition provides incentives for continuing innovations. And, finally, smaller firms more often drop innovation efforts during the crisis than larger companies.

7. Conclusions

The economic crisis had strong negative impact on innovation activity of Russian industrial firms: the negative impact was mentioned by 70% of respondents, while only 16% said that the crisis had ambiguous effect on innovations. More than half of the surveyed firms decreased expenditures on technological innovations while 10% increased them. The main factor were hard financial constraints: the share of firms in bad or critical financial situation increased from 17% in 2008 to 37% in 2009. In this group of firms about 20% stopped innovation activity totally and 60% cut expenditures. In time of crisis firms are more inclined to cut such items like investments in new equipment and expenditures on incremental innovations than R&D expenditures: the ration of R&D to sales even increased, though to some extent this can be explained by drop of sales volume.

Opposite to expectation the drop in demand did not lead to more intensive competition. It can be partly explained by devaluation of the national currency and weaker pressure from imported goods. Still, strong competitive pressure continues to be a major factor for firms to continue innovating.

An important result is the existence of a quite large group of firms which pursue active innovation policy at the time of the crisis. Those firms are not concentrated in particular sectors but are more or less equally distributed by all sectors of industry. The only exclusion is wood industry where the share of active firms is lee than 20%.

The crisis made management to review firms' development priorities: innovations aimed at energy and material efficiency, labour productivity and at introducing new products are mentioned as a priority much more often than in pre-crisis survey.

An interesting and somewhat unexpected consequence of the crisis is a shift in demand for newer and upgraded products: 70% of firms report lower demand for their traditional products and only 37 for new/upgraded products. This shift in demand has not led yet to changes in the structure of production (the share of new/upgraded products declined at 30% of firms and grew up at 37% of firms) but we may presume that the crisis created additional incentives for product innovations.

On the negative side further concentration of innovation activity in a segment of large companies should be mentioned. Even before the crisis large companies were much more active but in 2009 28% of smaller firms (with less than 100 employees) in the sample had to stop innovation altogether comparing to 15% for the whole sample.

It should be noted that while 605 of respondents do not see any new opportunities in the crisis, there is a significant group of firms whose managers believe that the crisis will be favourable for their firms because it will push out of the market less efficient competitors (17% of respondents), make it easier to find qualified workers and specialists (14%), make their products more competitive comparing to imported goods (12%), will push down prices for raw materials and components (12%). Preliminary analysis shows that larger firms, with higher share of new/upgraded products and more active in innovations see advantages in time of crisis more often. But more correct analysis of those findings needs further research as our data is not large enough to do it.

References

Bessonov V.A (2009), «O tendettsiyah razvitiya rossiiskoy ekonomiki v kontexte mirovogo krizisa». Journal «Economic Policy» №1, 2009 cc.59-68. (in Russian)

Desai, R., Goldberg, I. eds. (2008), "Can Russia Compete? Enhancing Productivity and Innovation in a Globalizing World". Raj M. Desai and Itzhak Goldberg, eds., Brookings Institution Press.

Golikova V, Gonchar K, Kuznetsov B, Yakovlev A. (2008) . “Russian Manufacturing at the Crossroads. What Prevents Firms from Becoming Competitive”, State University —Higher School of Economics. Moscow : Publ. house of SU HSE, http://www.hse.ru/data/700/244/1235/Russian%20Manufacturing....pdf

Gonchar, Kuznetsov eds.(2008) “Rossiiskaya promyshlennost' na etape rosta: faktory konkurentosposobnosti firm. HSE. Moscow :”Vershina”, 2008. 480 pp. (in Russian)

HSE (2010), “ Russian Manufacturing Revisited: Two Rounds of Surveying Russian Enterprises in 2005-2009”, HSE Policy. University Higher School of Economics. 2010

Kozlov K., Sokolov D., Yudaeva K., “Innovacionnaya aktivnost' rossiiskih firm // Ekonomicheskii zhurnal VShE. 2004. T. 8. № 3. S. 399-420.(in Russian)

Kuznetsov B. (2008) , “Russian industry and competitiveness: trends and prospects” in Mizobata S. ed. “ Varieties of Capitalisms and Transformation”. Kyoto. Bunrikaku publisher. 2008

McKinsey (2009) “Lean Russia: Sustaining economic growth through improved productivity“. McKinsey Quarterly 23.09.2009

MoED (2008), “Koncepciya dolgosrochnogo ekonomicheskogo razvitiya Rossiiskoi Federacii” (in Russian). http://www.economy.gov.ru/minec/activity/sections/strategicPlanning/concept/doc1193835322297.

MoED (2009) “Current situation in the Russian Economy in January-August 2009”. Ministry of economic development of Russia. September 2009. Available at www.economy.gov.ru (in Russian)

OECD (2009) “OECD Economic Outlook. No. 85, June 2009

Simachev Yu., Zasimova L., Kuznetsov B., Kuzyk M., Chulok A. (2008), «Problemy perehoda promyshlennosti na put' innovacionnogo razvitiya: mikroekonomicheskii analiz osobennostei povedeniya firm, dinamiki i struktury sprosa na tehnologicheskie innovacii». Moscow Public Science Foundation (MPSF). Research papers N201. (in Russian)

Yasin ed. (2004), “Structural Changes in the Russian Industry” / Ed. by E.G. Yasin. HSE. Moscow, 2004