Forecasting Of Innovative Activity Dynamics Using Industry Competition Indicators Analysis (Evidence From Food Industry Of Russia)

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Abstract

With the current fast pace of time it is crucially important to make reliable and trustworthy forecasts of market trends in order to keep abreast of competition and maintain a long-term competitiveness.

This article explores possibility to make forecasts about innovation activity dynamics in industries based on data concerning changes in competitive structure and intensity. It contains an overview of empirical evidences concerning relationship between dynamics of competition and innovation activity from the food industry of Russian Federation.

In order to provide a complete research of interrelations between abovementioned factors we put forward and empirically test a new approach considering market barriers analysis and estimation of market entry threats. For identifying cause-and-effects relationships between the various factors in this study we use the mathematical statistics methodology.

The concentration overview was performed on the basis of financial statement database. Large industry merger and acquisition dataset over the period 2006-2012 was used to describe industry competition.

The research for food industry through the Russian regions explored relations between factors of industrial competition, such as the size of market barriers and probability of new competitors' entry, and factors of innovative activity, including expenditures on technologies and volumes of innovative goods' production.

Given results make possible using suggested approach to a competition dynamics analysis for purposes of forecasting of innovative activity in industry.

1. Introduction

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One of the key factors for the long-term competitiveness of the company in a market conditions is ability to make trustworthy forecasts of the business environment changes. According to the basic principles of management and the industrial organization theory, one of the top issues is to examine the competitive environment, competition dynamics, and competitive structure of the industry. The innovative activity of companies is an extremely important factor of their competitiveness and competition in industry. The experience of companies, operating in global fast developing markets (primarily, high-tech industries), demonstrates the importance of immediate reaction on technologic trends fluctuations and of the ability to anticipate the trend of innovation dynamics. At the same time, this fact has also theoretic background. Schumpeter (1994), descending the evolutionary approach, marked out that nowadays the traditional price competition is being changed by processes of the creative destruction. It appears, for instance, in new product or technology, threatening competitors not only by lower profits, but a bankruptcy at all.

In order to come up with methods of forecasting of innovative activity in industry it is necessary to determine the influencing factors and to find out cause-and-effect relationships.

The advocates of the dynamic approach to competition analysis suggest case for relation between competition dynamics and innovative activity of companies.

According to the dynamic theory of competition, the industry is developing in accordance with a cyclic pattern in terms of competitive structure changes and innovation activity. Schumpeter (1982) pays extra attention to the significance of new small innovative firms, which are set up on the early stages of the market development and due to low competition can utilize high profit margin. Their success attracts new players to the industry and competition grows rapidly. In terms of innovations these new players have an extra advantage because using Schumpeter's terminology imitate existing successful technologies. Finally, few large companies keep abreast of the competition on the market and strive for a monopoly. On this stage the breaking through type of innovative activity is being replaced by routine one, upgrading of technological processes turns to dominating the creation of new innovative products. Relying on results of empirical tests Mauborgne and Kim (2005) suggest the "blue oceans" theory. They are arguing that on the stage of competition between monopolists new combinations of business patterns are likely to appear. These combinations turn industry to a new level, open new markets. This approach also backs up the ideas of evolutionary theory.

2. Related Literature and Research Results

Concerning interrelations between competition dynamics and innovative activity there should be mentioned an approach of Dinz, Zayzel, and Kryuger (2002). According to this approach, every industry follows the S-type curve for 25 years in average. Based on empirical data these authors made a conclusion that the industrial concentration life-cycle is similar across the industries and all of them go through the same stages of consolidation.

The analysis of given approaches allows to make a suggestion about correlation between the level of competition in industry, which is determined by market barriers size and the concentration ratio, and the innovative activity measures, such like expenditures on R&D expenditures and the volume of innovative production manufactured.

This suggestion finds an empirical background in numerous publications out of Russia. For instance, Abernathy (1978) and Utterback (1994) prove the correlation between life-cycle of innovations, new firms entry and growth, and changes in market structure. Dosi. Marsili, Orsenigo and Salvatore (1995) suggest a model explaining the strong correlation between technological regimes features and levels of concentration and uncertainty. According to these researches the correlation between technological opportunities and concentration depends on who use these opportunities – experienced or new firms.

Malerba and Orsenigo (1995) distinguish two market patterns considering Schumpeterian theory. According to the first pattern, innovations are implemented by new firms in new markets. In the second case

innovations are implemented by experienced firms, which exploit specific technologic technological trajectory by accumulation of unique facilities. Abovementioned technologic regimes were named "entrepreneurial" and "routine" respectively. According to Winter (1984), the success of young innovative firms is higher in first case. For experienced companies the situation is reverse. Empirical studies of Audretsch (1991) and Breschi, Malerba and Orsenigo (2000) also confirm the hypothesis about two market models, explaining the relation between the competitive actions of new firms and the innovative dynamics in industry. Almeida and Kogut (1997), Stuart and Podolny (1996) arguing for the idea that new firms are more inclined to search for new innovative trajectories and empty market niches, while large players pay more attention to developing of the existing technologies.

Thus, conclusions of the given empirical studies provide evidences for cycles of competitive structure dynamics and innovative activity in industries, as well as for the interrelations between these two factors. Fauchart and Keilbach (2002) outline that in early periods of the development of the industry technological paths are not defined clearly, the level of uncertainty is rather high, while the market barriers are low, so new firms turn to be the main innovators and key elements for the evolution of the industry. Subsequently, with the development of the industry, technological progress gets clear trajectories, scale effect, learning curves, market barriers and availability of funds gain the significant role in competition. Finally, market makers with monopolistic power become the leaders of innovative development.

There is a lack of empirical studies on given topic in Russian researching practice. Due to this fact, the development of approaches to analysis of interrelations between competition dynamics and innovative activity in Russian industries seems to be an issue of current interest.

The next step of our research was to find out, whether innovative activity rises after the integration of organizations. Theoretical proves lie in sphere of fundamental motives behind mergers and acquisition: transferring company's technological achievements through newly acquired branches, investing with higher return in industrial less-developed branches, improving and fastening the creation of inner innovations.

Empirical studies usually focus on certain cases, firms or managers, but not deal with average and total industry indicators. Furthermore, both mergers and innovation expenditures are strategically caused, and the effect of innovations or a merger comes in a long-term. The main purpose of our research is to check the applicability of conclusions in foreign studies to Russian practice, and to develop applied methods of analysis and forecasting of innovative activity on data concerning changes in competitive structure and intensity.

Particular problem concerning this purpose is to find evidences of relation between size of market barriers and innovative activity dynamics in Russian industries.

3. Methodology

This empirical study is based on statistical data of Russian State Statistics Committee on subsection "Manufacture of food and beverages" in a breakdown by federal regions of Russian Federation. Food industry is traditionally characterized as rather competitive one; hence the research will be representative.

For calculation of market barriers' size it is suggested to use methodology recently tested by Akhmetzyanov (2011). It is based on comparison of invested capital of experienced firms ROICc and new ones ROICn. This approach is based on the thesis suggested by Porter (1998). According to it, market barriers include all factors, preventing new firms from gaining the same revenues as experienced ones do; increasing operation costs and the initial investments of new firms. Thus, the market barriers size is calculated as follows:

Market barriers size=ROICc-ROICn,   (1)

A positive value of this measure indicates entry barriers on the market.

In case where return on investments of new companies exceeds return on investments of experiences firms, it is supposed, that there are no any entry barriers, because new firms are more successful than experienced ones. As a supplement, in this research will be examined recently suggested indicator of new firms' entry into the market. In calculation of this measurement, apart from barriers size, we also consider attractiveness of the industry for new players NCR. In the basis of this indicator there is a suggestion, that the probability of new players' entry is directly proportional to the return on invested capital of new firms on the market, and in inverse ratio for the market barriers' size, which is calculated as a difference between ROIC of experienced and new firms. In other words, the criteria for the market entry is to maximize the value of the index, calculated as follows:

$$NCR = ROIC_n/(ROIC_c - ROIC_n), \tag{2}$$

This indicator is applicable in cases of cross-industry comparison, or analysis in dynamic. For instance, let's consider two virtual industries. For the first industry $ROIC_{c1}$ 0.3 and $ROIC_{n1}$ 0.2, and for the second one $ROIC_{c2}$ 0.2 and $ROIC_{n2}$ 0.1. Then, in first industry the probability of new companies' entry into the market equals 2, while in second this figure is 1. According to these results, we can make a conclusion, that in case when the size of market barriers in both industries is equal, there is more likely that new players will come to the first industry, due to more attractive level of the return on invested capital of young firms.

4. Result

Due to limited period of market experience in Russia, and the processes of statistics gathering system formation, the statistical data for analysis is available only for the period of 2006-2011 years.

Table 1. Market barriers size and level of probability of new companies' entry into the market

Year Category	2005	2006	2007	2008	2009	2010	2011
Central federal region							
Barriers size	23.59%	21.42%	24.88%	23.56%	22.13%	30.05%	34.28%
NCR	0.35	0.51	0.66	0.98	1.17	0.20	0.11
North-Western federal region							
Barriers size	9.16%	21.60%	8.55%	11.33%	23.61%	15.89%	18.73%
NCR	1.62	0.40	0.67	0.57	0.50	1.20	0.67
Volga federal region							
Barriers size	26.92%	22.85%	16.79%	36.69%	48.68%	32.22%	15.16%
NCR	0.25	0.37	0.52	0.23	0.14	0.19	0.39
Ural federal region							
Barriers size	0.00%	0.00%	20.23%	27.49%	85.07%	43.96%	9.83%
NCR	max	max	0.49	0.61	0.09	0.22	1.83
Siberian federal region							
Barriers size	1.08%	10.46%	0.00%	0.13%	36.35%	10.75%	0.00%
NCR	29.62	1.78	max	189.36	0.58	1.33	max
South federal region							
Barriers size	7.00%	0.00%	29.40%	27.93%	29.18%	20.60%	12.79%
NCR	1.94	max	0.36	0.26	0.33	0.55	1.42
Far Eastern federal region							
Barriers size	21.12%	7.52%	0.00%	44.19%	81.80%	167.86%	118.31%
NCR	0.00	0.00	max	0.30	0.00	0.00	0.00
North-Caucasus federal region							
Barriers size	5.07%	0.00%	0.00%	14.80%	0.00%	0.00%	3.91%
NCR	4.64	max	max	0.00	max	max	1.08

Results of calculation of market barriers size and of level of probability of new companies' entry into the market are given in the Table 1. These results give evidence about market barriers in food industry for new players in all examined regions during almost the whole period with rare exclusions. There were no market barriers in Ural federal region in 2005-2006, as a consequence, new players' entry is very likely.

Table 2. Correlation between factors of competition and innovative activity

Indicators of innovations / Competition measurements	Expenditures on technologies	Expenditures on technologies at constant prices	Production of innovative goods	Production of innovative goods at constant prices	Share of innovative products in total sales
Central federal region					
Without lag					
Barriers size	-0.2041	-0.4840	0.6713	0.3392	-0.0805
NCR	0.2161	0.1128	-0.0591	0.1964	0.2041
1-year lag					
Barriers size	-0.0044	-0.2448	0.3547	-0.0954	-0.8994
NCR	-0.4827	-0.5124	0.3955	0.4389	0.5143
North-Western federal region					
Without lag					
Barriers size	0.0117	-0.1079	0.4124	0.1593	0.1169
NCR	-0.1181	0.0960	-0.1101	0.0989	0.1856
1-year lag					
Barriers size	-0.7944	-0.6785	-0.1688	-0.2361	-0.2578
NCR	0.3277	0.4780	-0.2322	-0.0633	-0.0062
Volga federal region					
Without lag					
Barriers size	-0.5794	-0.3575	-0.3531	-0.5815	-0.5193
NCR	0.5135	0.3472	0.1330	0.3711	0.2702
1-year lag					
Barriers size	-0.2954	-0.4190	0.5836	0.4031	0.5337
NCR	-0.1696	0.0704	-0.7744	-0.7755	-0.8573
Ural federal region					
Without lag					
Barriers size	-0.1841	-0.4693	0.7106	0.7271	0.7025
NCR	0.2422	0.5253	-0.7195	-0.7399	-0.7394
1-year lag					
Barriers size	0.3623	0.0763	0.8122	0.6389	0.6282
NCR	-0.3316	0.0518	-0.5460	-0.3185	-0.2880
Siberian federal region					
Without lag					
Barriers size	-0.3567	-0.7362	0.2201	0.2602	0.2764
NCR	0.1651	0.6530	-0.4007	-0.4392	-0.4635
1-year lag					
Barriers size	0.6596	0.3695	0.6247	0.5654	0.5994
NCR	-0.7313	-0.3541	-0.7419	-0.6713	-0.6825
Far Eastern federal region					
Without lag					
Barriers size	0.8052	0.7820	0.3672	-0.0224	-0.0693
NCR	-0.3797	-0.4067	0.2505	0.5006	0.5312
1-year lag					
Barriers size	0.9543	0.9400	-0.0598	-0.5645	-0.6443
NCR	-0.1649	-0.1318	0.1127	0.1448	0.1365

Taking into account profits of young firms in food industry of this region, market is attractive for new competitors. The similar situation were observed in Siberian federal region in 2007th and 2011th, in South

federal region in 2006th, Far Eastern federal region in 2007th, and North-Caucasus federal region in periods of 2006-2007 and 2009-2010. At the same time, due to losses of young firms in 2005th, 2006th, 2009-2010 in Far Eastern federal region and in 2008th in North-Caucasus federal region, the probability of new rivals' entry was estimated at zero level.

At the second stage of the research we gathered cross-regional statistical information about the innovative activity in food industry in given period of time. There are two main categories are available there, «Expenditures on technologies» and «Production of innovative goods». These figures were calculated at current and constant prices. We also calculated the measure «Share of innovative products in total sales», using data about sales turnover.

In order to explore relations between competition and innovative activity we calculated linear correlation coefficient of considered factors. On this step we came up with a hypothesis that there is a lag in dynamics of competition and innovative activity indicators.

We suppose that new innovative firms react on market barriers size after some period of time. For the purposes of this research we examine correlation of factors without lag, and with 1-year lag. The results of the research are given in the Table 2.

Correlation coefficient less than 0.3 indicates small strength of association, 0.31-0.5 range is for medium one, 0.51-0.7 range is for notable strength, 0.71-0.9 range is for strong association, and 0.91 and above range indicates very strong correlation.

Empirical study of integration is based on ISI Emerging Markets database, that provides us with more than 300 integration deals in food manufacturing (311 NAICS), soft drinks manufacturing and beverage (3121 NAICS) through the period of 2003-2011. We assumed that both inner mergers, acquisitions or privatization deals and cross-border deals with Russian companies as targets can influence innovation activity and stimulate spending on innovations.

5. Conclusion

Our first conclusion supposes that the share of M&A deals with companies of studied industries (in a total amount of deals with Russian companies as targets) was permanently decreasing over the period observed. It shows, that food, soft drinks manufacturing and beverage industry in Russia is passing through «specialization» stage of the S-type industry development curve [4]. Efficiency raising (one of the main integration motive) becomes crucial on this stage. Correlation of the innovative and integration activity indicators doesn't show any considerable tight. But the chain growth rates, calculated on the number of deals and innovative expenditures in studied industry shows us the 0.61 multiple R, which can be assessed as a proof of interdependency. Some forecasting power of integration activity and further innovation expenditures can be found.

Trustworthy interrelations between size of market barriers and measures of innovative goods' production in food industry were observed in three regions of eight examined, including Central, North-Western federal region, and Ural federal regions.

Results of survey for Central federal region have not given trustworthy results. However, due to data testing with 1-year lag, was observed strong (close to very strong) inverse correlation (at -0.9) between factors of market barriers' size and the share of innovative products in total sales. This result may indicate, that in this region large market barriers decline innovation potential, because young innovative firms cannot compete with experienced firms, which are not inclined to product innovations.

Survey for the North-Western federal region without lag had not explored strong correlation. However, by enhancing statistics with lag, we observed notable (close to strong) inverse dependence (correlation coefficient equals -0.68) between size of market barriers and Expenditures on technologies at constant prices. With some degree of probability it allows to conclude that in this region efforts of experienced firms in food industry for preventing new competitors' entry diminish their innovative activity.

Analysis for Volga federal region without lag has not shown correlation above of notable through the whole range of testing samples. Test of dependence between NCR and factors of innovative goods' production with lag provided strong correlation (coefficients -0.77 and -0.86 between the level of probability of new companies' entry into the market and production of innovative goods at constant prices and share of innovative products in total sales respectively). It may justify explanatory quality of this indicator for research on this region. Such result may be interpreted as follows. The less likely entry into the market of new companies, the more innovative goods are produced in industry. It may also prove that threats of intensification of competition in food industry of Volga federal region decline its innovative potential. At the same time expenditures on technologies are not being influenced by the competition dynamics.

Rather convincing results are observed in Ural federal region, where was found out direct strong dependence between the size of market barriers and the production of innovative goods at constant prices (correlation ratio is 0.72), and between the size of market barriers and the share of innovative products in total sales (correlation ratio is 0.70). These results are supported by the strong inverse correlation between the same production measures and the level of probability of new companies' entry into the market (coefficients are -0.74 in both cases). Hence, we may conclude that similar to the situation in Volga federal region, the larger in this region market barriers and less likely new rivals' entry, the greater volume of production of innovative goods. Consequently, threat of competition intensification in industry affects its innovative potential.

The similar results are observed for Siberian federal region in case of test with 1-year lag. Correlation coefficient between the level of probability of new companies' entry into the market and production of innovative goods at constant prices reached -0.67. For the share of innovative products in total sales this ratio equals -0.68. Such figures indicate notable and close to strong dependence between the examined factors.

High correlation observed between market barriers' size and expenditures on technologies at constant prices (coefficient 0.78 without lag and 0.94 with lag) in Far Eastern federal region. Such result points out direct very strong association between considered factors in this region. Thus, we may conclude, that market barriers' rise in food industry of this region is accompanied by the innovative activity of experienced players, probably, competing by technological innovations, while there is no need to prevent start-ups from entry with innovative production.

Surveys on South and North-Caucasus federal regions have not allowed to make clear conclusions about relations between factors of competition and innovative activity.

Consolidated results of research are given in the Table 3.

Table 3. Cross-regional results on notable and strong correlation between factors

Category	Direction of dependence	Expenditures on technologies	Production of innovative goods
Barriers size	Direct	Far-eastern federal region	Ural federal region
	Inverse	North-western and Siberian federal regions	Central federal region
NCR	Direct	-	-
	Inverse	-	Volga and Ural federal regions

Overall, we can make a conclusion, that for major part of regions the hypothesis about the interrelations between factors of competition and innovative activity is approved by trustworthy evidences of correlation between tested variables.

Thus, due to the research for food industry in Russian regions we explored relations between factors of industrial competition, such as the size of market barriers and probability of new competitors' entry, and factors of innovative activity, including expenditures on technologies and volumes of innovative goods' production.

Explored relationships make possible using given approach to a competition dynamics analysis for purposes of forecasting of innovative activity in industry.

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