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Competitiveness of national pharmaceutical industry: The Russian case

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ABSTRACT

A National Pharmaceutical Industry Profile is a key indicator for innovation-driven growth of any national economy and its level of social assistance. Competitiveness of the pharmaceutical industry is determined by many factors such as innovation, production quality, the number of large producers, export position, etc. Innovation in pharmaceutical industry is associated with branded pharmaceutical companies that make a great deal of investments in Research and Development (R&D). Factor, cluster, and regression analyses were implemented to estimate the level of competitiveness of national pharmaceutical industries. According to the factors influencing competitiveness, we provide a rating of countries in the field of their pharmaceutical industry and define the place of Russia. As the level of competitiveness of the Russian pharmaceutical industry turns out very low, we analyze the causes of such a failure. Although development of the national pharmaceutical industry is one of the priorities for the government, there are some factors listed that determine the low position of the Russian pharmaceutical industry.

Key words*:* pharmaceutical industry, competitiveness, innovation.

INTRODUCTION

Competitiveness aspects of different national industries have been widely analyzed and the results are available in literature. Given numerous approaches to assess the industry competitiveness, our research is mainly based on the ideas of Michael Porter [1].

Nowadays development of the pharmaceutical market has some peculiarities. The most important features include consumption rate acceleration in developing economies, expiration of patent protection for a lot of branded pharmaceutical goods and growth of generic production [2, 3]. All these trends cause increase in competition on the pharmaceutical market. In this particular industry, interests of many economic subjects such as government, different types of companies, investors, and customers overlap. Investments in Research and Development (R&D) need government protection as drug development is time-consuming and the structure of manufacturers' expenses is complex. Growth of generic production may lead to groups of population with different level of welfare using a wider variety of drugs. Every year developed economies spend a lot of money to provide support for people with poor health and the low-income elderly population. Taking all of the above into consideration, it is very important to protect innovative pharmaceutical business as well as introduce more competition on the market.

We believe that the analysis of industry competitiveness should be based on such indicators as a country's industry share in the world industry export and the share of this industry in the country's export. As for the pharmaceutical industry, it is important to take into account its strong connection with the chemical and medical production, a big number of production types, and the innovation segment connected with R&D investment. From demand side, we should analyze such important indicators as consumer expenditure and government expenditure on pharmaceutical products as well as the government support of national pharmaceutical companies. Some countries have their own programs to support the industry, which include a reduced price on vitally important medicines for different social

groups, procurement of medicines for hospitals and advantages for national companies on the local market.

EXPERIMENTAL SECTION

Indicators

We considered net export of pharmaceutical production as the main criterion of competitiveness in this market. Taking into account the pharmaceutical industry peculiarities, we added other indexes to evaluate its competitiveness level, such as some indexes of the market which reflect its supply and demand sides including government expenditures on the health care. Totally, we used nine factors for our analysis. They are as follows: "Protecting investors rating", "Global competitiveness index", "Total patent applications", "Biotechnology patent grants", "Business enterprise funds expenditures on R&D", "Net export of medicinal and pharmaceutical products", "Total health expenditure per capita", "Consumer expenditure on pharmaceutical products and medical appliances", "Production of pharmaceuticals and medicinal chemicals".

Data

Forty countries have been regarded in our research. They are situated all over the world and have different degrees of prosperity of their pharmaceutical industry. Among them there are economically developed countries and countries with emerging markets.

The statistical data were taken from the Euro monitor International Corporation. The statistics covered nine indicators mentioned above for forty countries under consideration. The period of the investigation was 2013.

Methods of investigation

Using factor, cluster, and regression analyses we compiled a ranking of these countries by their level of competitiveness in the field of pharmaceutical industry. We also try to explain the position of Russia and find some factors influencing the level of its competitiveness.

Our first research milestone was factor analysis. Factorization is the instrument of reducing the dimension of model and, thus, it allows eliminating extra values of indicators which have similar meaning in term of our analysis. Using factorization provides a correct result for cluster analysis.

The second stage of our research was cluster analysis. The countries observed were assembled in particular clusters according to the principal components determined during the previous stage of the research. Clusterization was based on the K-means algorithm. It uses the iterative refinement technique, which first assigns each observation to the cluster with the number stated initially, whose mean yields the least within-cluster sum of squares; then it calculates the new means as the new centroids of the clusters. The algorithm converges when the assignments no longer change. This method fully depicts the scheme of clusterization, since the possibility for differently allocated observations to appear in one cluster is minimal.

Then, regression analysis was conducted including the indexes that were previously used for clusterization and factorization. For more adequate data outcome, all indexes were normalized before constructing the regression function. For this type of analysis we used the stepwise inclusion method.

Our original hypothesis based on analytical data and scientific articles was that the chosen criterion variable "Net export of pharmaceutical products" was somehow influenced by all the indicators except "Total health expenditure" and "Consumer health expenditure". We supposed that the variable directly depends on the "Total patent applications", "Biotechnology patent grants", "Business enterprise funds expenditure" and "Production of pharmaceuticals and medicinal chemicals". The hypothesis stated that "Production of pharmaceuticals" and "Business funds spending" were the key variables in the regression model proposed. We anticipated that "Investors protecting rating" and "Global competitiveness index" had inverse interdependence with the variable under investigation.

We calculated three regression models in the software package for statistical analysis, which used the stepwise inclusion method. Before each new step of constructing our model, F and T-statistic tests were automatically conducted in order to determine whether a new suggested variable was of statistical value in the model. The third model is the final one and includes all the three regressors significant (with 95% confidence interval).

The final stage of our research comprised the ranking of the national pharmaceutical branch competitiveness. In order to compile the competitiveness ranking, we used the results of all the research stages, namely factorization, clusterization and function construction. Clusters are ranged according to the value of the indicators that characterize

the national pharmaceutical industries. To range countries inside clusters the most important indicator determined by regression analysis was used.

RESULTS AND DISCUSSION

With the help of factor analysis nine primary variables were aggregated in three principal components. The first component is connected with protection of patent holders and production of pharmaceutical goods (Table 1). The second component includes variables of consumer expenditures on pharmaceutical goods and competitive rating of the countries. The third component deals with the rating of protecting investors, which is caused bythe assessment peculiarities of the variable. The most arguable indicator is the net export of pharmaceutical goods and services. The Rotated component matrix table below shows that this indicator has the minimal differences of correlation among the principal components, and thus it can be treated as the most valuable in the analysis or one that more or less correlates with each index taken for research. However, the biggest values are included in the second principal component.

Table1.Rotated component matrix

Indicator	Component		
	1	2	3
Protecting investors rating	0,031	0,015	**0,931**
Global competitiveness index	-0,23	**-0,801**	0,278
Total patent applications	**0,95**	-0,094	0,024
Biotechnology patent grants	**0,816**	0,245	-0,255
Business enterprise funds expenditures on R&D	**0,975**	0,091	-0,139
Net export of medicinal and pharmaceutical products	-0,399	**0,431**	0,366
Total health expenditure per capita	0,21	**0,879**	0,015
Consumer expenditure on pharmaceutical products and medical appliances	0,128	**-0,667**	-0,219
Production of pharmaceuticals and medicinal chemicals	**0,891**	0,068	0,183

Equations made by implementation of IBM SPSS 21

With the help of cluster analysis we identified four main clusters of which the first group consists of China alone, so this case can be treated as a statistical outlier. It accounts for the fact that China's economy is unique within the framework of the statistical data observed. The country is ranked relatively low in the protecting investors rating and has a low indicator of the public health spending "Total health expenditure per capita" because of the number of population. Nevertheless, production of pharmaceuticals and medicinal chemicals in China is the highest among the selected countries. In 2013 it was two times higher than that in the USA, which follows China according to this indicator. Business enterprise funds are spent mostly on R&D here, and this spending is even higher than that in Japan, but still lower than in the USA.

The next cluster includes the USA and Japan. These countries feature a great volume of patent applications, business enterprise funds spending on R&D and mass production of pharmaceuticals and medicinal chemicals. One of their common features is negative net export of pharmaceuticals. Despite the fact that lots of indicators have close values for these countries, they are different in the indexes of total health expenditure per capita. Its value in the USA is much above while in Japan it is below the median level.

The third cluster has its own peculiarities. It includes such features as the high level of consumer expenditure on pharmaceutical goods and total health expenditure per capita. Nevertheless, this cluster is marked by comparatively low (to the previous group) production of pharmaceuticals and business enterprise funds expenditure on R&D. These key indicators, doubtless for the pharmaceutical branch, do not obstruct almost each observed country from the positive net export of pharmaceutical goods. This cluster includes countries of Western Europe, as well as Canada and Australia. Despite the fact that Germany, Switzerland, Belgium and Ireland are the first-string exporters of pharmaceutical goods and thus outstrip the other countries of the given group, they do not form a separate cluster. It happened due to the similarities with the other countries of the group in such indexes as total health expenditure per capita and protecting investors rating.

Latin American countries, some Central and Eastern European countries and also Israel, Jordan and Russia compose the fourth group. This cluster can be described by low total health expenditure and a relatively big amount of private consumer expenditure on pharmaceutical products (40 – 60%), which can indicate scarcity of resources in healthcare or feeble social policies of the national governments. Moreover, this cluster features low business enterprise funds spending on R&D. Hence, there are outliners in stated indexes, e.g., South Korea. It has a rather substantial amount of pharmaceutical production and a great level of business enterprise funds expenditure on R&D, which could have resulted in this country belonging to the previous cluster; however, it has total health expenditure no higher than an

average of emerging countries. Also, Korea is a net importer of pharmaceuticals as the majority of this group. Only four out of twenty three countries in this cluster are net exporters – India, Singapore, Israel and Jordan. Noteworthy is the fact that general tendencies are negative solely for this cluster, which validates our computer estimations.

With the help of regression analysis we identified the most valuable factors that influence the key indicator of the industry competitiveness "Net export of medical and pharmaceutical products". The result of regression analysis is provided in Table 2 below.

Table 2. Parameters of regression function

Final model	Unstandardized coefficient estimates	Standard error	Standardized coefficients β_i estimates	T-test	F-test	95% confidence interval	
Constant	3632,516	2190,747		1,658	0,106	-810,525	8075,557
X_1	-0,13	0,016	-1,948	-8,101	0	-0,162	-0,097
X_2	0,318	0,045	1,701	7,015	0	0,226	0,41
X_3	-215,491	85,852	-0,244	-2,51	0,017	-389,607	-41,375

Equations made by implementation of IBM SPSS 21
Calculated regression function:

$Y=3632,516 – 1,984X_1 + 1,701X_2 – 0,224X_3$
with
Y – Net export of medicinal and pharmaceutical products (mn. USD);
X_1 – Total patent applications (number);
X_2 – Production of pharmaceuticals and medicinal chemicals (mn. USD);
X_3 – Global competitiveness index (ranking).

The coefficients show that the two most valuable ones are the "Total patent applications" and "Production of pharmaceuticals and medicinal products". However, the first coefficient in our regression(β_1) is negative, which contradicts our original hypothesis. A common assumption is that the more patents applications are submitted, the more the effect of such intellectual property protection should be. Nevertheless, the whole process from the very beginning of inventing a pharmaceutical product to its implementation and return on investment is troublesome. Considering that the patent application predominantly falls on the first stage of research, we can conclude how few of the patents are ultimately successful and reach their aim. According to statistical data, the leaders in the number of total patent applications are China, the USA and Japan. However, they all have negative net export of pharmaceuticals. In contrast, Switzerland is the leader in pharmaceutical net export with a relatively miserable number of patent applications: 569 667 in USA against2039 in Switzerland. This incoherence and low patent application number with high "yield" of each one in Switzerland can be explained by several factors starting with the quality of national research, due to the reach experience of national companies in pharmaceutical industry, and ending with structural shifts in company costs in Switzerland as opposed to their US competitors. It can also refer to the quality of data available.

The positive second regression coefficient (β_2) supports our original hypothesis. The more national producers manufacture, the more competitiveness the national pharmaceutical branch enjoys in the world pharmaceutical market.

The last standardized regression coefficient (β_3) has the least value in the equation above and is negative. It is explained by the way this variable is calculated as in ranking the least number refers to the best position in the list.

We should note that our function describes only 65% of dependent variable distribution, which asserts some statistical error. This upholds the idea of an incomplete list of the variables taken into account, or that it is necessary to choose another or a completely new criterion as the key variable.

The outcome of clusterization is shown in Table 3, which also contains the final rating of the competitiveness level of the countries' national pharmaceutical branches. The clusters were ranged on the basis of the share of the total production of pharmaceuticals and medicinal products that each cluster contributes to the world production, i.e. the sum of the corresponding indexes of all the countries in each cluster. As it was already noticed, the total patent application number is a rather controversial indicator and does not determine the country's position on the pharmaceutical market. That is why it was considered negligible in order to avoid confusion. The value of the global competitiveness index is also relatively inconspicuous. Thus, the ranking of countries within the clusters depended on their net export of pharmaceuticals.

Table 3. National Pharmaceutical Branch Competitiveness Ranking, 2013

Competitiveness Rank of National Pharmaceutical Branch	Country	Cluster	Distance from a Centroid	Net Export of Pharmaceuticals (bn. USD)	Total patent applications (number)	Production of pharmaceuticals and medicinal products (bn. USD)	Global Competitiveness Index (Rank)
1	Switzerland	2	2,690	36,049	2039	69,761	1
2	Ireland	2	0,370	25,148	443	60,851	28
3	Germany	2	1,103	24,459	58832	50,185	4
4	Belgium	2	0,629	11,143	795	18,542	17
5	Great Britain	2	0,761	9,835	20553	34,185	10
6	France	2	0,705	6,196	16270	59,270	23
7	Netherlands	2	1,010	3,825	2881	7,601	8
8	Swiss	2	0,704	3,748	2230	10,809	6
9	Denmark	2	0,678	2,236	1730	12,201	15
10	Austria	2	0,637	1,545	2455	4,586	16
11	Finland	2	0,419	-0,900	1672	2,029	3
12	Norway	2	0,939	-1,267	1606	1,403	11
13	Australia	2	0,635	-5,580	26691	11,210	21
14	Canada	2	1,440	-7,623	34297	12,083	14
15	China	1 (outl)	0,000	-2,236	767083	304,389	29
16	Japan	3	1,318	-18,128	327193	73,622	9
17	USA	3	1,318	-21,750	569667	175,538	5
18	India	4	0,788	8,932	45706	26,555	60
19	Singapore	4	1,454	6,903	9047	20,347	2
20	Israel	4	1,154	4,414	6076	7,376	27
21	Jordan	4	1,529	0,067	298	1,203	68
22	Bulgaria	4	0,418	-0,269	275	0,607	57
23	Indonesia	4	0,825	-0,407	6757	6,672	38
24	Peru	4	0,659	-0,608	1534	1,048	61
25	Honk-Kong	4	1,395	-0,756	13278	0,335	7
26	Chile	4	0,662	-0,914	4810	1,228	34
27	Malaysia	4	1,217	-1,283	8221	1,169	24
28	Spain	4	1,101	-1,311	3587	20,245	35
29	Kazakhstan	4	0,759	-1,432	1892	0,215	50
30	Italy	4	0,808	-1,439	9590	41,860	49
31	Columbia	4	0,499	-1,832	2024	2,591	69
32	Portugal	4	0,321	-1,978	643	1,392	51
33	Czech Rep.	4	1,122	-2,155	824	1,591	46
34	Greece	4	2,332	-2,531	558	1,494	91
35	Poland	4	0,382	-2,852	3715	3,888	42
36	S. Korea	4	0,828	-3,067	182064	17,828	25
37	Mexico	4	0,430	-3,573	14911	13,194	55
38	Turkey	4	0,398	-3,802	6680	4,938	44
39	Brazil	4	0,601	-6,619	24742	27,093	56
40	Russia	4	1,264	-14,232	44631	8,334	64

Statistical data source: Euro monitor International.www.euromonitor.com
Clusterization made by implementation of IBM SPSS 21

Thus, top performers of the world pharmaceutical branch in-sample by the competitiveness in the branch ranking are: Switzerland, Ireland and Germany, all of which belong to the cluster of developed countries. Russia is at the bottom of the ranking. Analyzing the causes of such a low position, we notice that it is the most vulnerable country in-sample according to the quantity of the pharmaceutical goods imported and has the least tangible contribution to the world pharmaceutical market. From our point of view, Russian pharmaceutical industry faces a number of following challenges which put brakes on its development:

- no support mechanism for delivering Russian innovation pharmaceutical products on the local market;
- insufficient government subsidies for the national producers to provide innovation strategies for the whole industry;
- certain bias among Russian physicians about the low quality of Russian innovative medicines;
- baseless understating of traditional Russian quality standards applied to the pharmaceutical production and attempts to arrange new demand according to the foreign standards;
- absence of an independent expert association that could help national producers overcome corruption and oppose those Russian medical officials who lobby foreign producers' business interests.

We should mention that the Russian government has paid some attention to the problems in the pharmaceutical industry, but the official documents adopted [4, 5] do not encourage the national producers.

CONCLUSION

Pharmaceutical markets vary by region, their volume and growth rate, main tendencies and the level of patent protection. In order to assess their competitiveness index, economists use indicators reflecting the country's export capacity in the world market. Our results were obtained by means of factor, cluster and regression analyses; the model used encourages further development by introducing additional factors and indicators that can influence the competitiveness of the pharmaceutical branch. Gathering a wider statistical database and adding the indicators complement to the net export index are to make the analysis even more accurate.

Russia's last place in our selection of the national pharmaceutical industries accounts for its heavy reliance on imported pharmaceuticals, feeble facilities and lack of government support for the industry, which prevents Russia from competing equally in the world pharmaceutical market.

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