

RESEARCH AND DEVELOPMENT: BASE OF THE COMPANIES PROGRESS IN KNOWLEDGE SOCIETY

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Abstract

The current framework of the society is the result of the actions that were taken in the direction of development by all the organizations that have activities in a business environment that is constantly changing. The complexity of the factors that influence the way of doing business has led to the appearance of new resources, which will support the evolution of the economic organizations, namely the knowledge. Therefore it is created a new context whose base is represented by the information and the human capital. In order to achieve a certain level of the economic performance, the business organization must identify measures and strategies that can insure obtaining competitive advantages. Research and development has become the main method that helps companies and states in order to evolve and find new solutions for the current and future challenges. The increasing interest for activities that have as result innovation seems to be the best option for each participant at the productive actions on the market. The knowledge based economies have as base innovation, research, education, but most of all human capital. Taking into consideration these aspects, the economic entities will initiate action that need to be performant according to the requirements of the current level of development of the society, but also will plan strategically the future directions, in order to face the change.

Key words: *research and development; knowledge economy; innovation; business organization; competitiveness*

JEL Classification: *M16, M21, O30*

I. INTRODUCTION

Research and development have become the primary elements for growth and progress taking into consideration the fact that the result of these activity is the innovation, but most of all it supports finding some efficient alternatives for the economic activities. It is well known the fact that there are certain domains where the research and development work is defined better. We can mention the IT sector, the pharmaceutical industry, the electronics and computing branch and the automotive. In these domains there is a significant interest for innovation because it represents a major advantage in increasing the competitiveness.

Therefore, it is obvious that the foundation of innovation is research and development and the knowledge, fact that highlights the place of the investment in this specific areas in the knowledge economy. Assigning resources in these directions guarantees obtaining new knowledge which emphasizes the motivation of high investments in order to contribute to the future development.

The influence of the ongoing is significant at all the levels, no matter if there is a microeconomic analyses or macroeconomic one or the type of these resources allocation. Most of the times, in the economic practice, there can be noticed that making an investment assumes a lower risk than making no investment at all, which highlights their importance that concerns the capital owner and also the recipient of the results that are obtained.

Innovation is the main objective of each business organization regardless their operating activities. Innovation can also be analyzed as a factor that brings change. (Schumpeter, 1939) The knowledge and the technology concurs with the innovation at growth and economic development. Surely the investments in research and development can be measured by the specific activity of research, but taking into consideration the human capital involved, who has an outstanding role.

An analyses that concerns the situation at the national level shows that the most developed countries have a high level of opening regarding the activities with other states and other particularity is given by the increased volume of research and development investments and also the other sorts of investments. Therefore an important variable in the economic progress of a state is represented by the investments in activities with high added value and also the abroad partnerships, given the fact that the economic growth of a state is the base of people wellbeing and increased power (Friedman and Mandelbaum, 2012). It also needs to be remembered that the innovation policies are focused on the development of high-tech technology and also on research and development investments (Cappellin and Wink, 2009) because they have a great impact on progress.

Nakauchi (2011) highlighted that the education has a major impact in transforming Japan in a knowledge society, but we consider that this is the purpose of education regardless the state we refer to. The level of

education of a country defines its level of development. The solid education strategies contributes to the increasing of the attractiveness in the relations with the large organizations.

Knowledge based innovation is the foundation of the economic entity progress in the knowledge economy, fact that emphasizes that in the current framework has appeared a new type of management, the knowledge management. Therefore there are certain connections between different levels of development of the knowledge that is presented in the below figure:



Figure 4 The knowledge level of development

Source: Processed by the author using Bures, V. „Knowledge Management: The Czech Situation and Approach”, Proceedings of the International Conference and Exhibition KMICE06, Sintok, Kedah, Malaysia, 2006 pp. 621-627

Thus the results reached by the companies in the area of knowledge has a major influence on the entire economy, taking into consideration the fact that these entities experiment different ways in order to face today’s challenges (Daft, 2010).The purpose of this research is to highlight the fact that the most developed business organizations have activity in economies that have similar objectives regarding the performance and innovation. The companies will choose the territories that ensure access to human capital which is the result of the interest of the states on education. Thereby in the following pages we will emphasize that the most innovative companies have the headquarters in countries with high level of the research and development investments.

II. THE IMPACT OF RESEARCH AND DEVELOPMENT ON THE GROWTH OF INNOVATION AT NATIONAL LEVEL

The governmental investments in research and development are directed on different domains, but in developed countries like USA, Japan, Sweden, Holland and Canada the industry benefits of the highest budgets. The domains where is invested regarding the research and development are: the automotive, software and internet sector, computing and electronics and pharmaceuticals. These trends are available for the companies also especially for the multinational companies which have the financial means to support these sort of investments. In the table below we have synthesized some information that offer an appropriate image on the interest that the developed countries give to research and development, interest pointed by the share of these expanses in the GDP.

Table 2 The R&D governmental investments

No	Country	The R&D investments									
		% in GDP					USD billion				
		2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
1	Austria	2.8	2.77	2.84	2.8	2.83	10.91	11.89	11.58	11.99	12.35
2	Canada	1.86	1.79	1.73	1.9	1.96	30.02	32.02	31.51	34.71	35.02
3	China	1.76	1.84	2.02	1.9	2.02	106.30	137.86	166.24	175.56	209.27
4	South Korea	3.74	4.04	3.6	3.6	4.15	40.93	48.58	44.02	46.96	58.53
5	Denmark	3	2.98	2.98	3	3.02	9.59	10.18	9.60	10.08	10.33
6	Finland	3.9	3.8	3.55	3.6	3.43	9.66	10.40	9.08	9.62	9.28
7	France	2.24	2.25	2.26	2.3	2.22	59.29	64.41	60.72	64.55	62.81
8	Germany	2.8	2.89	2.92	2.8	2.87	95.54	108.43	103.17	104.45	110.57
9	Israel	3.97	3.97	3.93	4.2	4.2	9.25	10.26	10.11	12.20	12.78
10	Japan	3.29	3.39	3.4	3.4	3.35	180.80	200.34	202.45	167.27	154.15
11	Great Britain	1.77	1.78	1.72	1.8	1.71	42.62	46.14	44.98	48.21	50.31
12	Holland	1.86	2.03	1.97	1.98	1.62	15.56	18.14	16.22	16.90	14.09
13	Romania	0.46	0.43	0.49	0.1	0.48	0.76	0.79	0.83	0.19	0.96
14	USA	2.74	2.76	2.79	2.8	2.8	410.02	428.29	450.95	469.51	487.73

Source: Processed by the author using data from: după www.data.worldbank.org, www.ec.europa.eu, <http://www.tradingeconomics.com/>

According to the data presented to the table 1 regarding to the public resources for R&D it is obviously the USA maintain their top position, being followed in the ranking by Japan; the European countries register some major gaps compared to the first positions, however Germany, France and Great Britain manage to stand out. An interesting example is China which has significantly increased the R&D investments in the latest years, managing to overtake Japan in 2013. As respects Romania, the budget for R&D is modest, fact that has visible consequences on several economy sectors.

The analyze of the R&D investments intensity (the share of the R&D expenses in GDP) emphases some changes in the ranking in favor of some small countries; the highest share is noticed in the case of Israel in 2013 which is followed by Finland and South Korea. The values presented highlight that these countries invest major financial resources in research and development and innovation because they are aware of the importance in their own growth and their economic wellbeing. Romania is the only one country, in the presented ranking, that has registered a sudden decrease of R&D investments.

The R&D Rankins haven't changed a lot in the last 5-10 years, but the differences has reduced the differences between the states in this direction. For example, China had a constant growth and has even doubled its investments in R&D. Until the 2007 financial crisis, the Asian states have registered important increases regarding the R&D sector, but eventually the budgets for R&D has decreased; despite of this situation this state continue to have a good position in the world economy. The Asian companies, most of them have activity in IT and electronics and telecommunication sector, had a significant role in keeping this place, but furthermore the states have understood that the IT domain is quit important for the growth on long term. At the same time, for USA, Japan and Europe the trend is decreasing, in these states being located the headquarters of many corporation: pharmaceutical companies (Johnson & Johnson, Merck, GlaxoSmithKline, AstraZeneca), energy companies (Enel, General Electric), oil companies (Chevron, Agip, Exxon Mobile) and auto companies (Volkswagen, Ford, Volvo, BMW).

Therefore the developed countries have large budgets for R&D which highlights the fact that the level of GDP of a country has impact on its investments and on the R&D investments too. Starting from this premise we have tested the hypothesis of the existence of a correlation between the GDP of the analyzed states (independent variable) and their budgets for research and development (dependent variable) using SPSS for Windows. There were analyzed the states which allocate the highest share of the GDP in research and development, but also have the largest GDP. It was analyzed the level of the correlation between the GDP and the investment in R&D and then it was established the degree of the R&D investments influenced by the GDP. After testing the precedent hypothesis there were obtained the following data:

Table 3 The analysis of the correlation coefficient and the determination correlation between the R&D investments (dependent variable) and the GDP (independent variable)

No.	Country	Pearson Coefficient	The determination coefficient
1	Austria	0.976	0.953
2	Canada	0.66	0.43
3	China	0.99	0.98
4	Coreea de Sud	0.89	0.79
5	Danemarca	0.987	0.975
7	Franța	0.93	0.87
8	Germania	0.94	0.89
9	Israel	0.993	0.987
10	Japonia	0.99	0.99
11	Marea Britanie	0.95	0.91
14	SUA	1.00	1.00
15	Suedia	0.97	0.94

Source: Processed by the author using data from: după www.data.worldbank.org, www.ec.europa.eu, <http://www.tradingeconomics.com/>

The value of the Pearson coefficient in the case of all the analyzed states straightens us to conclude that the hypothesis formulated is verified. Even more, the determination coefficient emphasize the fact the interest in research and development is influenced more than 80% in most of the cases by the GDP. In the case of correlation coefficient the values are much closed to 1 which shows a strong connection between the GDP and the expenses with research and development.

In the same time, innovation is possible just by allocating funds for certain activities that not always guarantee fine results, fact that highlights the incertitude in reaching the established level of innovation. Given the fact that there is a connection between the R&D and economic growth it is necessary a constant allocation of the resources in order to identify new methods of satisfying the needs of the consumers that are permanently changing.

Innovation has an important role, as we mentioned, in ensuring economic growth and the wellbeing of the people. Therefore it is essential to measure the level of innovation at national level by highlighting their place in each economy. In these purpose we can use the Global Innovation Index.

The annual reports regarding this index gives us a world ranking in matters of innovation at national level. In the below table we have presented the values registered by the Global Innovation Index from 2009 to 2014, in the states that have the largest budgets for research and development.

Table 4 The evolution of the Global Innovation Index

No.	Country	Global Innovation Index					
		2009	2010	2011	2012	2013	2014
1	Austria	44.6	42.1	50.7	53.1	51.9	53.4
2	Canada	46.3	45.5	56.3	56.9	57.6	56.1
3	China	35.9	36.4	46.4	45.4	44.7	46.6
4	South Korea	47.3	42.4	53.6	53.9	53.3	55.3
5	Denmark	46.9	47.2	56.9	59.9	58.3	57.5
6	Swiss	47.3	48.2	63.8	68.2	66.6	64.5
7	Finland	45.7	46.6	57.5	61.8	59.5	60.7
8	France	43.5	42	49.2	51.8	52.8	52.2
9	Germany	49.9	43.2	54.9	56.1	55.8	56
10	Israel	41.7	41.1	54.1	56	56	55.5
11	Japan	46.5	45	50.3	51.7	52.2	52.4
12	Great Britain	48.2	44.2	55.9	61.2	61.2	62.4
13	Hollande	46.4	46.2	56.3	60.5	61.1	60.6
14	Romania	29.2	32.2	36.8	37.8	40.3	38.1
15	USA	52.8	45.7	56.7	57.7	60.3	60.1
16	Sweden	48.4	48.5	62.2	64.8	61.4	62.3

Source: Processed by the author using the Global Innovation Index Reports during 2010-2014, www.globalinnovationindex.org

The data in the table above highlights that the highest scores are registered by the USA, Sweden, Finland, Germany, France, Swiss, Israel and Great Britain. For these states the analyzed index has a value over 50 in 2014. However in the analyzed period the Global Innovation Index has been increasing continuously, the scores have registered significant changes.

Other aspect that can be emphasized concerns the fact that the countries that have the highest budgets for R&D have the highest scores for the studied index. Taking into consideration this aspects we have tested the hypothesis of a correlation between the budgets for research and development (independent variable) and the scores registered by the Global Innovation Index using SPSS for Windows.

Regarding the motivation of chosen the analyzed states, it was given by the intensity of the research and development, because the selected countries represent the group of those who show a significant attention to this aspect. It was taken into consideration the fact that these have registered economic growth, but also these states represent the place where have headquarter many multinational companies. This fact highlights the particularity of the national level activities; so if at the level of central administration there is a sustainable investment policy, this trend will be reflected on the other participants in the business environment.

After testing the precedent hypothesis there were obtained some data that is presented in the below table. Initially we have identified the level of correlation between the R&D expenses and the GII and then was established the level of GII influenced by the GDP.

Table 5 The analysis of the correlation coefficient and the determination correlation between the R&D investments (independent variable) and the GII (dependent variable)

No.	Country	Pearson coefficient	The determination coefficient
1	Austria	0.865	0.749
2	Canada	0.69	0.48
3	China	0.76	0.57
4	South Korea	0.67	0.45
5	France	0.66	0.43
6	Germany	0.84	0.71
7	Israel	0.653	0.426
8	Great Britain	0.80	0.64
9	USA	0.85	0.72
10	Sweden	0.85	0.723

Source: Processed by the author using www.data.worldbank.org, www.ec.europa.eu, <http://www.tradingeconomics.com/>, The Global Innovation Index Reports during 2010-2014, www.globalinnovationindex.org

The value of the Pearson coefficient in all the cases straightens us to admit that the hypothesis is verified. Even more, the determination coefficients highlight the fact that the degree of innovation is affected more than 50% by the budgets for research and development in all the analyzed countries.

Taking into consideration the fact the GDP is an indicator based on which are established the investments and the consumption expenses of one country it is obvious that any changing of its value will affect the share of each activity that requires funding. The GDP is also an indicator that is used to analyze the economic situation of a country, fact that emphasizes that developed states have a high level of the GDP, which shows that it has a large budget for research and development.

III. THE ROLE OF THE RESEARCH AND DEVELOPMENT IN INCREASING THE COMPETITIVENESS

The result of R&D is measured in innovative products and services, so in the innovation itself. As we have mentioned before a high degree of the innovation leads to a high level of the competitiveness. Therefore innovation becomes a competitive advantage of a state. An important aspect of a competitive business environment is given by acknowledgement of the importance of technological innovation on economic development. The technology provides to business organization a competitive advantage, knowing that the companies are highly oriented in discovering new technologies. It must be taken into consideration the fact that in the current framework the multinational companies have an important role in the technology transfer by the worldwide activities. The utility of a new technology can be estimated taking into consideration the level of the invested capital in the sector that it will be used; the demand for a technology will influence its price and the price will establish the resources for research. (Keely, 2002)

According to the World Economic Forum, Global Competitiveness Index is formed of 12 components which represent the competitiveness pillars of a state. When this index is calculated there are analyzed the state's institutions, the infrastructure, the microeconomic environment, the health and primary education, the higher education and lifelong learning, the efficiency of goods market, the efficiency of labor market, the level of development of the financial market, the technological progress, the dimension of the national market, and the last but not the least the innovation. (Schwab K. 2014)

In the current context, in matters of competitiveness, the world market is ruled by the following countries:

Table 6 The evolution of the Global Competitiveness Index

No.	Country	Global Competitiveness Index					
		2009	2010	2011	2012	2013	2014
1	Austria	51.3	50.9	51.4	52.2	51.5	51.6
2	Canada	53.3	53	53.3	52.7	52	52.4
3	China	47.4	48.4	49	48.3	48.7	48.9
4	South Korea	50	49.3	50.2	51.2	50.1	49.6
5	Denmark	54.6	53.2	54	52.9	51.8	52.9
6	Swiss	56	56.3	57.4	57.2	56.7	57
7	Finland	54.3	53.7	54.7	55.5	55.4	55
8	France	51.3	51.3	51.4	51.1	50.5	50.8
9	Germany	53.7	53.9	54.1	54.8	55.1	54.9
10	Israel	48	49.1	50.7	50.2	49.4	49.5
11	Japan	53.7	53.7	54	54	54	54.7
12	Great Britain	51.9	52.5	53.9	54.5	53.7	54.1
13	Holland	53.2	53.3	54.1	55	54.2	54.5
14	Romania	41.1	41.6	40.8	40.7	41.3	43
15	Sweden	55.1	55.6	56.1	55.3	54.8	54.1
16	USA	55.9	54.3	54.3	54.7	54.8	55.4

Source: Processed by the author using The Global Competitiveness Index Reports, <http://www.weforum.org/>

In the above table it was highlighted the evolution of the Global Competitiveness Index during 2009-2014 for the states that have the highest budgets for research and development and which register high GDP. Taking into consideration this characteristics we can assume that these states (excepting Romania, because the data have an informative purpose in order to present China's position given its amazing evolution over the last passed years) are developed countries which manifest an intense interest for knowledge and technology.

While studying the competitiveness pillars mentioned by the World Economic Forum we can admit that the states mentioned in the table have an infrastructure and a complex of institutions that ensure a favorable environment for business development and also there are established some policies at the microeconomic level

which can encourage the progress of the private sector. In the knowledge economy an important role has the human capital which induces the interest on financing the education and continuous training for the people. The individual's proper preparation ensures the human capital needed by the companies, fact that can be noticed on the rising number of business organizations that are opening subsidiaries abroad in the states where exist more opportunities.

Innovation is another aspect that is taken into consideration where the analyzed index is calculated. It is also necessary to mention that the states that have a high level of the innovation have also a high level of the competitiveness index which emphasizes the impact of innovation on increasing competitiveness. In a more specific analyze, we can state that the countries that have a large value of the index of innovation have large budgets for research and development.

Besides all these we can also observe that all the named factors influence the degree of opening regarding the relations with the world economic actors but most of all it is affecting the business environment by providing the certain conditions in order to develop the productive activity. Therefore, the states are influencing by their investments in education, infrastructure and their institution, the decision a multinational company regarding the expanding on those territories.

The competitiveness index can be the base of a company decision regarding the relocation of the production but also regarding the research and development activity which is the major concern of any company independent of its activity and the sector where it is included. Taking into consideration that the innovation may become a competitive advantage that is obtained throw the activity of research and development, we have tested the hypothesis of a correlation between the research and development expenses (independent variable) and the competitiveness index (dependent variable) using SPSS for Windows.

Table 7 The analyze of the correlation coefficient and the determination coefficient between the R&D expenses (independent variable) and the competitiveness index (dependent variable)

No.	Country	Pearson coefficient	The determination coefficient
1	Canada	0.762	0.58
2	Japan	0.606	0.367
3	Great Britain	0.55	0.303
4	USA	0.941	0.886

Source: Processed by the author using Global Competitiveness Index Reports, <http://www.weforum.org/>, www.data.worldbank.org, www.ec.europa.eu, <http://www.tradingeconomics.com/>

The value of the Pearson coefficient for all the cases that were studied allows us to conclude that our hypothesis is verified. As respects the determination coefficient we may affirm that it highlights the fact that the level of competitiveness of the states is influenced over 50% by the investments in research and development. Regarding the values registered by the correlation index we have noticed that it reached more than 0.5 which shows a significant connection between the R&D expenses and the GCI.

According to the information from the table we may argue that the research and development activity should be an essential activity at state level but also at business organization level. Therefore it was observed that that the degree of development of a country and the degree of competitiveness is influenced by the investment that are done in research and other domain with high added value. It is absolutely necessary to mention that the level of the performances are not the result of a single activity, but of a multitude of elements and actions. The study on creativity index shows that the performance and the economic development can be measured using certain indices that refer to technology, talent and tolerance, which also show the creativity of a society.

IV. THE INVESTMENTS IN RESEARCH AND DEVELOPMENT THE PIONEER OF THE PROGRESS OF BUSINESS ORGANIZATION

The vectors of the knowledge society are the human capital and the information, resources that contribute considerable in companies' evolution. These two type of means are used adequately in business organizations are represent an efficient way of reaching success.

The role of the multinational companies has increased significantly in latest years because of their human and financial resources. Thereby, companies most advanced objectives have been focused on research and development investments. In order to highlight the budgets for this activity, in the below table there are presented the companies that invest the most in this area:

Table 8 The evolution of the highest budgets for R&D on multinational companies level

No.	Company	Domain of activity	Country of origin	R&D budgets (USD billion)					
				2010	2011	2012	2013	2014	2015
1	Volkswagen	Automotive	Germany	7.6	9.1	10.1	11.4	13.5	15.3
2	Samsung	Computing and electronics	South Korea	6	7.9	9	10.4	13.4	14.1
3	Intel	Computing and electronics	USA	5.7	6.6	8.4	10.1	10.6	11.5
4	Microsoft	Software și internet	USA	9	8.7	9	9.8	10.4	11.4
5	Roche	Pharmaceuticals	Swiss	9.1	9.6	9.4	10.2	10	10.8
6	Toyota	Automotive	Japan	7.8	8.5	9.9	9.8	9.1	9.2
7	Novartis	Pharmaceuticals	Swiss	7.5	8.1	9.6	9.3	9.9	9.1
8	Johnson&Johnson	Pharmaceuticals	USA	7	6.8	7.5	7.7	8.2	8.5
9	Pfizer	Pharmaceuticals	USA	7.8	9.4	9.1	7.9	6.7	8.4
10	Daimler	Automotive	Germany	4.9	5.6	7	6.6	7	7.6
11	Merck	Pharmaceuticals	USA	5.8	8.6	8.5	8.2	7.5	7.2
12	Sanofi-Aventis	Pharmaceuticals	France	6.4	5.8	6.7	6.3	6.3	6.4

Source: Processed by the authors using <http://www.strategyand.pwc.com/global/home/what-we-think/innovation1000/top-innovators-spenders>

According to the presented data we can notice that the most developed business organization have the headquarters in states like Germany, South Korea, USA, Swiss, Japan and France, countries that can be found in the table presented in the first part of the paper where were analyzed the governmental research and development investments. Therefore we affirm that there is a correlation between the trend on microeconomic level and the one on macroeconomic level given the fact that the states ensure the framework for companies' activity.

In order to emphasize the influence of the general context of doing business on companies' decisions of investing in one region or another, we have decided to complete the given information with some data regarding the level of innovation. We underline the fact the innovation is a result of research and development activity.

Table 9 The most innovative companies

Position	Company	The headquarter	Domain of activity	The R&D expenses USD billion
1	Apple	United States	Computing and electronics	6
2	Google	United States	Software and internet	9.8
3	Tesla Motors	United States	Automotive	0.5
4	Samsung	South Korea	Computing and electronics	14.1
5	Amazon	United States	Software and internet	9.3
6	3M	United States	Industrials	1.8
7	General Electric	United States	Industrials	4.2
8	Microsoft	United States	Software and internet	11.4
9	IBM	United States	Computing and electronics	5.4
10	Toyota	Japan	Automotive	9.2

Source: Processed by the author using: <http://www.strategyand.pwc.com/global/home/what-we-think/innovation1000/top-innovators-spenders#/tab-2015>

Given the above table, can be noticed that the most innovative companies are the one that invest large amounts of money in research and development, fact that straightens our affirmation regarding to the innovation. Regardless the type of business and the level of development of an economy, the progress depends on investments in education and research. Even more, we consider that a state that focuses its attention on this direction will attract many companies that produce goods with high added value.

The research and development becomes o new source of knowledge (Latham and Le Bas, 2006) which will influence the future performance and will contribute in increasing the wellbeing of the people. Taking into consideration these fact, any economic actor should maintain its attention on finding new sources of innovation and developing the human capital. Certainly, an entity that doesn't invest in research and development is an entity that doesn't innovate.

V. CONCLUSIONS

The changes that occur on the world market emphasizes that is very difficult to find the best way of doing business. Certainly, every economic entity will be focused on increasing its profit and also improving its market position by settling subsidiaries in the countries that ensure the most favorable condition. Despite of these aspects, the development of the society has meant some modifications in the needs of the people and also a new context for the economic activities. Therefore, the main tool that can be used by those involved on the market in order to become more competitive is to invest in research and development. Research and development has become a specific feature of the knowledge society.

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