INNOVATION– AN INFLUENCE FACTOR OF CYCLICAL FLUCTUATIONS. STUDY CASE FOR ROMANIA, BETWEEN 1995 AND 2009

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The study of influence factors of cyclical fluctuations is of major importance for a country’s economy. In the present context, of the new economy, where the emphasis is on new technologies, and information is the main product and resource of the economy, innovation is one of the most important factors among the ones which influence the economic activity fluctuations.

As part of a larger paper, this study is set to emphasize and explain the influence of innovation on the cyclical fluctuations in Romania between 1995 and 2009.

The following analysis indicators were used: the ‘innovation’ factor is represented by Research & Development expenses and by the number of people with internet access, whereas the economic activity fluctuations are represented by the fluctuations in the real GDP.

The research starts with the conceptual boundaries regarding innovation, with an emphasis on Joseph Schumpeter’s theory, then, the influence of innovation on economic activity fluctuations is underlined through a quantitative analysis of the three indicators mentioned above and through an econometric model.

The results of the research underline Romania’s economic status, the scale on which new technologies have entered the Romanian market and the way in which the fluctuations of the economic activity are closely linked to innovation.

Key words: cyclical fluctuations, innovation, Schumpeter, GDP, internet
JEL codes: E32, O31

1. Introduction

The impact of technological changes on the economy represents one of the current and representative subjects in economic research. Information and communications, including scientific and technological information have become a primordial component of the production forces.

The reduction of physical consumption is accelerated in favor of using information and knowledge, while investments in human capital are intensified, compared to investments in fixed assets. Moreover, the respective technologies have contributed to the improvement in productivity of the capital and work factors, which lead to a rise and diversification in production. Thus, they make up an important source for the creation of new products, services and jobs, first within their own sector, and then, through the expansion of production and exchanges, in other economic activities as well.

New technologies feature increasing efficiency (many products have a very high initial development cost, and then the respective products are sold at very low marginal prices; for example, the initial development of a computer program might be very expensive, but the cost of its copies is very low – in the case of the medium cost on which the software is recorded: CD, DVD, or sometimes zero – in the case of the internet), and this efficiency represents the engine of economic growth.

For all these reasons, the goal of the paper is to underline these innovations and the way in which they influenced the fluctuations in economic activity in Romania, between 1995 and 2009.
In the first part of the paper it is presented the importance of studying this influence factor and in the second part it is made a short theoretical review, with an emphasis on Schumpeter’s theory of innovation, and identified the five Kondratieff cycles, with their great innovations. In the third part it is presented the work methodology and the descriptions of the data series, creating a multifactorial model that shows the influence of the studied factors on the real GDP.

2. Innovation – Conceptual Boundaries

J. Schumpeter considers that innovation is the fundamental factor that explains the evolution of economic life, it is at the basis of cyclical fluctuations, and without it the economy would work as a simple circular flow. A new idea inserted into the economy gives extra efficacy and progress and economic growth. Its curve peaks when the technical progress is mass spread, a point in which the technological mode of production based on past innovations has exhausted its capacity to create progress. This moment of tension is the descending phase of a cycle. The moment of crisis imposes the identification of new technological, economic and organizational possibilities. (Cismaș, 2000)

Innovation must be funded before the entrepreneur can benefit from its results, and funding is ensured, usually, through loans given by banks. Its effect spreads from field to field and one innovation generates another, influencing each other. Another feature is unpredictability, which means that not all the anticipated innovations will be successful and there will be a time when loans will have to be paid: if the companies will not be able to pay them, a wave of pessimism and chain bankruptcies will be created and there will be a recession which will effect a great number of sectors of the economy. (Schumpeter, 1939)

Schumpeter continues the ideas of the Russian economist Nikolai Kondratieff concerning long waves, according to which each cycle corresponds to a major innovation and thus the following cycles can be identified: (Valery, 1999)

- the first Kondratieff cycle (1785-1845) would correspond to the first industrial revolution, marked by hydraulic energy, the textile industry and the iron industry;
- the second Kondratieff cycle (1845-1900) would correspond to the innovations in the steam, railways and steel industries;
- the third Kondratieff cycle (1900-1950) would encompass the chemical industry and the internal combustion engine;
- the fourth Kondratieff cycle (1950-1990) would encompass the petrochemical and electronics industries and aviation;
- the fifth Kondratieff cycle (1990-2020) corresponds to digital networks, software applications and new means of communications.

As we can see, the Kondratieff cycles become shorter as they succeed one another. The first one lasted for 60 years, then the following ones for less and less: 55, 50, 40 and 30 years respectively. This ‘acceleration’ effect can be explained in three ways:

- we are experiencing a ‘learning effect’: companies and consumers pay attention to new innovations and adopt them immediately;
- the most recent innovations are network innovations, these have a tendency to develop exponentially, affecting all fields and causing a drop in unit costs due to scale economies;
- the nature of innovations is mostly immaterial, they spread rapidly, irrelevant of distance; in a global economy, innovation has no borders.

Innovations are accompanied by that which Schumpeter called ‘creative destruction’, a sort of ‘economic storm’ that engages the brutal disappearance of many jobs, while simultaneously creating an equal or greater number of jobs in other fields. This phenomenon is present in an economy with a high degree of flexibility. (Schumpeter, 1939)

Currently, the phenomenon of globalization, of Earth flattening under the influence of these new innovations is predominant. Thomas Friedman (Friedman, 2007) identifies ten forces which lead
to flattening: (1) the fall of the Berlin Wall, the birth of computers and the development of the
Windows operating system, (2) the birth and development of the internet, through the concept of
World Wide Web and the Netscape platform, (3) the development of workflow automation
software, (4) the development of uploading, through blogs and open-source programs, (5) the
birth of the outsourcing phenomenon, (6) off shoring, market liberalization, (7) the development
of supply chains, (8) internalization, (9) getting information, through the more and more
pronounced development of the internet, especially in the case of the Google, Yahoo and MSN
platforms and (10) the development of the rural environment, of mobile phones, the birth of the
iPad and the inclusion of new technologies into these devices.

3. Analysis on the influence of innovation on the economic activity fluctuations in Romania
In this paper, the period between 1995 and 2009 was chosen in order to ensure the compatibility
of data, taking into consideration the change in the Romanian GDP calculation method, which
was set to 'ESA 1995' in 1995. The data series used are taken from the websites of the National
Indicators: the gross domestic product and the research & development expenses are expressed in
millions of lei and a conversion was made from current prices to constant prices (with the aid of
the GDP deflator and the CPI - Consumer Price Index), and the number of internet users is
expressed in millions of people.

<table>
<thead>
<tr>
<th>Year</th>
<th>Real GDP (mil lei)</th>
<th>R&amp;D expenses (mil lei, constant prices)</th>
<th>Internet users (mil people)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>5781.5</td>
<td>4336.11</td>
<td>0.02</td>
</tr>
<tr>
<td>1996</td>
<td>6199.5</td>
<td>4215.63</td>
<td>0.05</td>
</tr>
<tr>
<td>1997</td>
<td>5456.3</td>
<td>3110.09</td>
<td>0.1</td>
</tr>
<tr>
<td>1998</td>
<td>4977.7</td>
<td>2439.08</td>
<td>0.5</td>
</tr>
<tr>
<td>1999</td>
<td>5085</td>
<td>2034.02</td>
<td>0.6</td>
</tr>
<tr>
<td>2000</td>
<td>5121.1</td>
<td>1894.82</td>
<td>0.8</td>
</tr>
<tr>
<td>2001</td>
<td>5545.3</td>
<td>2162.66</td>
<td>1.02</td>
</tr>
<tr>
<td>2002</td>
<td>5834.4</td>
<td>2217.08</td>
<td>1.45</td>
</tr>
<tr>
<td>2003</td>
<td>6571.8</td>
<td>2563</td>
<td>1.95</td>
</tr>
<tr>
<td>2004</td>
<td>7358.5</td>
<td>2869.82</td>
<td>3.27</td>
</tr>
<tr>
<td>2005</td>
<td>7885.9</td>
<td>3233.2</td>
<td>4.68</td>
</tr>
<tr>
<td>2006</td>
<td>8826.8</td>
<td>3972.07</td>
<td>5.35</td>
</tr>
<tr>
<td>2007</td>
<td>10162.5</td>
<td>5284.48</td>
<td>6.12</td>
</tr>
<tr>
<td>2008</td>
<td>11658.2</td>
<td>6761.77</td>
<td>7</td>
</tr>
<tr>
<td>2009</td>
<td>10683</td>
<td>5020.99</td>
<td>7.88</td>
</tr>
</tbody>
</table>

Source: drawn-up by the authors on the basis of data of the INS (www.insse.ro), and of the World Bank
(www.worldbank.org)

In Table 1 we can see that the real GDP reaches its lowest level in 1998 (4977.7 million lei), after
which it registers a slow increase, a recovery towards the value that it had before the drop,
recorded in 1996. This happens only in 2003, after which the real GDP starts to rise, until it
reaches its peak in 2008. The Romanian economy entered recession in the third quarter of 2008,
along with the drop of the Gross Domestic Product and keeps registering falls in 2009.
The highest level of Research & Development expenses was recorded in 2008 (6761.77 million
lei), and the lowest in 2000 (1894.82 million lei). Between 1995 and 2000 we can see a
decreasing expense trend, and after 2000, an increasing one. Also it can be seen the boom of the
internet; the number of people with internet access rose exponentially since 1999, when only 20,000 inhabitants had access, to 7.88 million people in 2009. Further on, we calculated the GDP Index, in order to emphasize the change of the indicator compared to the previous year. We performed the same operation for the R&D expenses and for the number of internet users.

Table nr.2. The dynamics of the real GDP and its influence factors (previous year=100)

<table>
<thead>
<tr>
<th>Year</th>
<th>Real GDP Index</th>
<th>R&amp;D Index</th>
<th>Internet Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1996</td>
<td>107.23</td>
<td>97.22</td>
<td>250.00</td>
</tr>
<tr>
<td>1997</td>
<td>88.01</td>
<td>73.78</td>
<td>200.00</td>
</tr>
<tr>
<td>1998</td>
<td>91.23</td>
<td>78.42</td>
<td>500.00</td>
</tr>
<tr>
<td>1999</td>
<td>102.16</td>
<td>83.39</td>
<td>120.00</td>
</tr>
<tr>
<td>2000</td>
<td>100.71</td>
<td>93.16</td>
<td>133.33</td>
</tr>
<tr>
<td>2001</td>
<td>108.28</td>
<td>114.14</td>
<td>127.50</td>
</tr>
<tr>
<td>2002</td>
<td>105.21</td>
<td>102.52</td>
<td>142.16</td>
</tr>
<tr>
<td>2003</td>
<td>112.64</td>
<td>115.60</td>
<td>134.48</td>
</tr>
<tr>
<td>2004</td>
<td>111.97</td>
<td>111.97</td>
<td>167.69</td>
</tr>
<tr>
<td>2005</td>
<td>107.17</td>
<td>112.66</td>
<td>143.12</td>
</tr>
<tr>
<td>2006</td>
<td>111.93</td>
<td>122.85</td>
<td>114.32</td>
</tr>
<tr>
<td>2007</td>
<td>115.13</td>
<td>133.04</td>
<td>114.39</td>
</tr>
<tr>
<td>2008</td>
<td>114.72</td>
<td>127.96</td>
<td>114.38</td>
</tr>
<tr>
<td>2009</td>
<td>91.64</td>
<td>74.26</td>
<td>112.57</td>
</tr>
</tbody>
</table>

Source: according to Table nr.1

A decreasing trend in the research & development expenses can also be seen (R&D Index < 100). From 1996 to 2001, the highest drop was recorded in 1997, 16.22% compared to the previous year. Similarly, in the same year, the real GDP registers the highest drop, of 12%.

Source: according to Table 2

**Fig. nr. 1. The dynamics of the real GDP and its influence factors**
The internet index has an ascending trend throughout the analyzed period, which can be seen in Table nr.2 and Figure nr.1. The highest rise was recorded in 1998, 400% compared to 1997. Afterwards, the rises were not as high, but they were constant, averaging 50% each year. After each influence factor was interpreted separately, we will create a model that will show the influence of both factors on the real gross domestic product.

The way in which the economic activity fluctuations are influenced by research and development expenses and by the number of people with internet access, between 1995 and 2009 were calculated with the aid of a regression, through a multifactorial econometric model with the following form:

\[
GDP = \alpha + \beta_1 * \text{R&D Expenses} + \beta * \text{Internet Users} + \varepsilon
\]  

(1)

In the econometric model we can see that:
- Multiple R is 0.99, which shows a very strong link between the GDP and the research & development expenses and the number of people with internet access;
- R Square is 0.99, meaning that 99% of the GDP variation can be explained by the influence of research & development expenses and of the number of people with internet access;
- the resulting F value is 628.7, much higher than the critical F value (2.483), which means that the econometric model is correct;
- the estimated value of \(\alpha\) is 3638.9, the estimated value of \(\beta_1\) is 0.56 and of \(\beta\) is 567.38;
- the t Stat value associated with \(\alpha\) is 20.85, higher than the critical t value of 2.144, the t Stat associated with \(\beta_1\) is 9.29 and of \(\beta\) is 18.15; all the values are higher than the critical t value, which means that all the mentioned factors are in the model.

This model shows a strong link between the real GDP and the factors taken into consideration. Thus, the multifactorial econometric model in the case of Romania between 1995 and 2009 has the following form:

\[
GDP = 3638.91 + 0.564\times\text{R&D Expenses} + 567.382\times\text{Internet Users} + \varepsilon
\]  

(2)
4. Conclusions
The internet plays an important role in the spread of knowledge in economy (Choi, 2009) and as an indicator of innovations it has an effect on economic activity fluctuations.
This research was made for the period between 1995 and 2009, during which the Gross Domestic Product was analyzed in correlation with the innovation influence factor, represented by the following indicators: Research and Development expenses and the number of people with internet access in Romania.
The main results were: (1) identifying the economic activity fluctuations by studying the real GDP in relation to the other factors, thus two periods during which the GDP dropped were noticed: 7% and 9% in 2009 and 1998 respectively; (2) interpreting the influence factor ‘innovation’ through internet users, noticing that in 1998 their number recorded the highest increase, of 400% and that throughout the studied period it had a rising trend, and through Research & Development expenses, which had an decreasing trend until 2000, then started to rise and (3) the correlation of the real GDP with the two studied indicators in an econometric multifactorial model, having as a result a strong link (0.99), thus an influence of innovation on cyclical fluctuations.

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