The Relationship between Profit and Productivity in the IT Sector in Romania. Analysis by Panel Method

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** A B S T R A C T
Within the context of process of globalization and economic integration, the objective of economic politics of every country is strengthening of national competitiveness. To stay competitive in global markets, countries are forced to search for factors, new alternatives stimulating economic development. Productivity is among quantities reflecting the level of competitiveness. This paper has three parts. The first part consists of introduction and literature review. In the second part is found analyzing the relationship of dependence between net income and labor productivity and the last part is an analysis of the IT services sector.

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1. Introduction
In the mid-1990s, the revolution of ICT (Information and communications technology) entered quickly into the level of countries and transformed the modality in which people communicate, work, as well as their way of life. The driving force of this transformation is the progress registered by national economies given by speed, purpose, intensity, as well as quality of access to information, by the spread of knowledge and by the level of communication. These powerful effects are expected to have been translated into economic performance. Innovation leads to economic competitiveness and sustainable economic development over the long term. Especially the emergence and the intensive use of information and communication technologies (ICT), which gave birth to the beginning of the digital economy two decades ago, strongly affects the opportunities and effectiveness of the way in which companies produce and supply goods and services. In the globalization era in which companies, consumers and economies are more interconnected, the services sector, the information technology and their level of efficiency became more debated and discussed topics. Maroto-Sanchez and Cuadrado-Roura (2009) demonstrate in their studies that the relationship between the growth of services and general increase of productivity of a country is positive and statistically significant. The countries that were initially more specialized into services are those that demonstrate a positive dynamics of their productivity increase. Quah (2002) insists in his studies that the revolution in information and communications technology sector leads to employee’s skills development, consumption sophistication and increase of the level of education. This thing leads to the increase of the degree of utilization of technology and increase the work productivity, therefore leads to economic growth (Quah, 2002). Jalava and Pohjola (2007) concluded in their study on the relationship between ICT and work productivity for Finland that ICT capital services contributed 0.50 percentage points to economic growth. The contribution of total capital services was 1,07 percentage points so that the information and communications technology was almost half of contribution. Khuong M. Vu (2011) makes a study of ICT sector as source of economic growth in the information era and concludes that the marginal effect of ICT penetration is higher when ICT level is lower for a national economy.

Cardona, Kretschmer and Strobel (2013) examine empirically the relationship between productivity and the ICT sector and concluded that the effect of productivity is not only significant and positive, but also increases over time. Of course that all these, having a significant effect, do not mean that those who have low productivity can be increased simply by increasing the investments in ICT domain. ICT has to be integrated in complementary organization investments, abilities and industrial structures. The services depending on Information technology (IT) refer to delivery and support of opportunities and IT activities in order to satisfy the business requirement and manage the IT infrastructure for organizations.

As part of business services with intensive knowledge degree, the IT services offer a result used by other sectors and play an increasingly important role in the service-based economy. Based on the theories of production, innovation and competition, we will analyze the relationship between profit-productivity, the

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evolution of this sector's productivity as well as the aspects of the sector itself. The motivation for our study on the IT services sector is based on two observations. Firstly, IT services represent an important part of the economy of services, being inputs to other services. Secondly, the existing literature focused mainly on capital goods from the IT sector, but never paid much attention to the services part.

2. Analysis of the relationship between profit - medium-sized labour productivity for the sector of activities of the information technology services

For the study of profit-productivity relationship, we used in the following model annual data of net income for the period 2004-2013. We analysed the sector of Services activities in information technology, Code NACE 620 being studied a number of 1258 companies. The series of data aggregates a period of 10 years, being a small time-horizon in order to maximize the number of observations we chose to use data analysis of panel type. We used Eviews 7 programme.

The dependent variable is the net income that we obtained from statistical data base of ORBIS, containing complete information about the companies all over the world focusing on the company's private information. More specifically we have associated to the dependent variable the independent variable of labour productivity and we tested the possibility of a link between these.

The equation based on this model is the following:

\[ NI_{it} = \beta + \alpha_i X_{it} + \delta_{it} + \gamma_{it} + \epsilon_{it}, \]

Where

- \( NI_{it} \) is the dependent variable and shows the net income of company to the given moment of time;
- \( \beta \) is the coefficient of free term;
- \( X_{it} \) is the vector of model explicative variable;
- \( \alpha_i \) is the coefficient of explicative variable (WL);
- \( \epsilon_{it} \) are the errors of terms, random variables;
- \( \delta_{it} \) \( \gamma_{it} \) are cross-section values or the effects of the specific period (random or fixed);
- \( i \) indicates the company on the basis of which the regression is made;
- \( t \) indicates the year (2004-2013)

Firstly, we tested if the model is valid by using T or F test. Then we resorted by testing in terms of chosen method: the method of fixed and random effects. The coefficients of regression equation could be tested by a T-test that is used to test the significance of variables in model. If the value of the test is greater than the critical value, then the null hypothesis is rejected. Econometric software programs test with T test, for each coefficient, the null hypothesis which is that the coefficient has zero value. There are reported both the values of t test and probabilities, \( p \), associated. If the associated probability is lower than the relevance level of work (1, 5 or 10 percent), then the null hypothesis is rejected and the coefficient is considered significant from statistic point of view. Where the probability \( p \) is higher than the relevance level then the null hypothesis is accepted and the coefficient is considered as having zero value from statistic point of view.

In order to make further tests for the model, we used the Hausman test checking if the orthogonality hypothesis is violated in the first, namely the case of fixed effects. If the regressors are correlated with the error term, then the estimation by fixed effects method is consistent while the estimation by the method of random effects is not. Using the fixed effects method, the term could vary between countries but do not vary over time, while the slope coefficients are supposed to be constant across countries. This method supposes that the free term is deterministic, namely correlated with covariates (the vector of regressors) and is based on the inner estimation, namely every observation is inside the "i" country throughout the whole period of time. Instead, the random effects method implies that the free term is stochastic (random), namely not related to the variables and included in the error term. In other words, the random effects method is consistent only if the free term is independent or unrelated with regressors or with the error term. The central assumption in case of random effects is that these are not correlated with explicative variables. In order to determine which of the two methods is better in the studied model, we appeal to Hausman test (1998). This test compares the estimations in case of fixed and random effects. In case of fixed effects, the Hausman test checks \( H_0 \) hypothesis: the method of fixed effects would be consistent and efficient versus \( H_1 \): the random effects method would be inconsistent. The result of the test is a \( k \) size vector that would be chi-squared (k) distributed. If the statistics of the test is higher, then it has to be chosen the method of fixed effects and if the statistics of the test is lower, then it has to be chosen the random effects method. Another indicator that shows if the regression model is well specified is \( R^2 \). This shows how much per cent of total variation of dependent variable is due to independent variables. \( R^2 \) takes values between 0 and 1, as its value is closer to 1, the regression is well specified.
### Table 1. Equation NI (net income) as a function of WL (labor productivity)

<table>
<thead>
<tr>
<th>Variable</th>
<th>OLS fixed effects for companies</th>
<th>OLS fixed effects for time</th>
<th>OLS fixed effects for companies and time</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>$15,27204^*_{(11,745)}$</td>
<td>$7,154676^*_{(5,188)}$</td>
<td>$15,40192^*_{(11,829)}$</td>
</tr>
<tr>
<td>WL</td>
<td>$0,466727^*_{(29,312)}$</td>
<td>$0,647557^*_{(49,763)}$</td>
<td>$0,463833^*_{(28,975)}$</td>
</tr>
</tbody>
</table>

**Specifications**

- **R²**: 0.432, 0.166, 0.433
- **F-statistic**: 6,839, 250,453, 6,809
- **Number of observations**: 12542, 12542, 12542
- **Number of firms**: 1258, 1258, 1258

*Source: own processing*

*Note: *significant for 1%

Every time when it is introduced in regression a new independent variable that is as little as correlated with the dependent variable, $R^2$ increases, but in the same time loses a degree of freedom. The chosen method for estimation was the smallest squares (OLS). Taking into account that the sample contains data for 1258 companies for 10 years, it is necessary to use fixed effect in order to isolate the heterogeneity specific to every company. This approach is supported by the results of Hausman test that confirms the correctness of fixed effects utilization. Also, due to the fact that this industry is sensitive to technological progress and new technologies affect the market to a great extent, it is suitable to use fixed effects also for the periods of time. It could be observed that there are significant differences between coefficients in function of the used fixed effects (for companies or for evolution over time), but when the fixed effects are used both surprise the specific of the companies and isolate the evolution in time, the results shows minor differences concerning the comparison with the model that uses fixed effects only for companies. This thing could suggest that the heterogeneity has a higher impact at the level of the company than the evolution in time of the companies. As it shows on the table no. 1, WL representing the labour productivity entered into regression as expected and moreover, the statistical significance has very high levels. WL has a positive effect over the net income of the companies from this sector and the results of T test show that it has a significance degree under the threshold of 1%, demonstrating that between the two variables is a very important connection.

The value of $R^2$ is 0.43 and suggests that the informational relevance of the independent variable for the dynamic description of the dependent variable is a good one. The model has the following form:

$$NI = 15.4019 + 0.4638^*WL + [CX=F, PER=F]$$

where:

- $NI$ – are net income
- $WL$ – average labor productivity per employee
- $CX=F$ – fixed effects for companies
- $PER=F$ - fixed effects for time

The model shows that when productivity increases by 0.46 units, the net profit increases by one unit in IT services sector in Romania. In order to have a better knowledge of the evolution of this sector according to the available data, we went ahead with the sectoral analysis.

### 3. Analysis of the sector Activities of information technology services

Computers, mobile communications devices and the Internet are integrated into daily life and therefore lead to the change of the business way and make the markets to operate in multiple ways. It is important to know and analyze Romania evolution of services sector efficiency in information technology. For this we have focused our attention on the study of productivity as the main indicator of efficiency. We used the calculation of labour productivity (WL) for the sector concerning the Activities of services in information technology, code NACE 620 for each year and it was determined by the ratio of total operating revenues (OR close to net turnover) and the total number of employees ($L$):

$$WL = \frac{\sum_{i=1}^{n} OR_i}{\sum_{i=1}^{n} L_i}$$

where $n$ represents the number of companies

It can be seen from the table below that the labour productivity expressed in value for the sector having the code NACE 620 has a downtrend until the year 2008 registering this year the maximum value of 25.8 dollars per hour per employee. Starting with this year, it has slight decreases, reaching now the value of 21, 35 dollars per hour per employee.
Compared to 2004, in 2013, this registered an increase of 44.64% while in 2008 it decreased with 17.24% and in 2012 it decreased with 8.8%. This thing shows that this sector did not reach the maximum potential and that there are ways for efficiency increasing. Trasca, D. L. (2014) study demonstrates that the crisis had negative effects on the small and medium enterprises in 2009 as 11 times that in 2008 many companies have suspended operations. These negative effects are manifested in the profit and the level of employment. Chou and Shao (2014) studied the total productivity increase of the factors from IT services sector and concluded that there are increases of 1.9% for this sector between 1995-2007 being higher than other sectors and remarked that the noticed productivity increase is mainly determined by the technological process given by the production processes innovation of IT services industry. The technological innovations introduced in the manufacturing process are strong enough to offset the negative effects of the changes in efficiency.

There are significant differences if we report the evolution of this sector in terms of efficiency with the average labour productivity in Romania. Seeing the trend of the two productivities, we could observe that the average national productivity trend is relatively stable with slight oscillations and synchronizes from evolution point of view with the trend of the sector Activities of services in information technology expecting 2012 and 2013 when the national average increased and the sector average decreased.

Table 2. Average yearly productivity of the sector compared to the national average

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<tbody>
<tr>
<td>2004</td>
<td>1.2436</td>
<td>14.76</td>
<td>11.87</td>
<td>4.40</td>
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<tr>
<td>2005</td>
<td>1.2452</td>
<td>15.14</td>
<td>12.16</td>
<td>4.60</td>
<td></td>
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<tr>
<td>2006</td>
<td>1.256</td>
<td>21.16</td>
<td>16.85</td>
<td>4.90</td>
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<tr>
<td>2007</td>
<td>1.3705</td>
<td>24.49</td>
<td>17.87</td>
<td>5.20</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>1.3944</td>
<td>25.80</td>
<td>17.54</td>
<td>5.60</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1.3926</td>
<td>24.24</td>
<td>17.38</td>
<td>5.40</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>1.3276</td>
<td>21.97</td>
<td>16.55</td>
<td>5.30</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>1.2858</td>
<td>22.85</td>
<td>16.41</td>
<td>5.40</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>1.3281</td>
<td>23.40</td>
<td>18.20</td>
<td>5.60</td>
<td></td>
</tr>
<tr>
<td>2013</td>
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<td></td>
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Also, the productivity of the sector is of 3.1 - 3.2 or higher than the national average so that in 2013 an employee from the sector, code NACE 620, produces 21.35 dollars per hour while an employee from Romania produces on average 7.44 dollars per hour. According to studies conducted by Blinder & Baumol (1993) productivity growth is the most important factor that can increase a country’s standard of living, reduce poverty rates, increase funding for education and health system and protecting the environment. Over time researchers as Krugman (1992), Gomez, Musso, Stocker & Turunen (2006), Bagley (2010), Frankel & Kendrick (2008) argue that the ability of a country to raise their standards of living depends on its ability to increase labor productivity. Taking into account that this sector is the basis of future economy development according to digital era and of its potential for the creation of the added value, it is important for Romanian authorities to create the premises of a strong increase. As can be seen from the statistics of foreign direct investments, this sector does not have a large share in the total exports of multinational companies; the first place being held by the products with low added value and increased natural capital. This has a negative impact on sustainable development and the sustainable economic growth. The intelligent use of information is a source of increased productivity, just as the natural resources were in the 20th century. The difference is that the natural resources are connected to a specific place while information has no such restrictions. This could be produced as well in India, China, Russia or Estonia as in Romania. Geography is no longer the most important factor because everyone has equal access to information worldwide. The new restructuring of the economy can be as large as the one that took place in more than 100 years ago, when electricity and phone were invented.

Figure 1. Comparison between the productivity in NACE 620 sector and national average (USD/Hour)

Own processing. Source: Eurostat database
In order to determine the market concentration, it has been used (HHI) Herfindahl Hirschman Index, being determined as:

$$\text{HHI} = \sum_{i=1}^{n} \alpha_i^2$$

where $n$ is the number of companies from the market and $\alpha_i$ is the individual market share. The values obtained for every year, as we could observe from the table below, show that HHI value is under 1000 meaning that the market concentration degree is very low and the type of concurrence is of monopolistic type. Therefore, there are no dominant companies on this market which could influence the price formation, this being freely created.

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</tr>
</thead>
<tbody>
<tr>
<td>HHI</td>
<td>143.60</td>
<td>166.56</td>
<td>114.01</td>
<td>108.05</td>
<td>144.56</td>
<td>105.35</td>
<td>76.91</td>
<td>82.83</td>
<td>66.68</td>
<td>62.41</td>
</tr>
</tbody>
</table>

Own processing. Source: ORBIS database

From the chart below you can see the oscillating evolution of this index. The maximum value of market concentration was registered in 2008, after that it started to decrease considerably reaching in 2013 the level of 62.41 with 56.81% less than 2008. This thing could be possible due to turnover decrease of the companies presented in this sector during crisis period. As we have just observed this thing could be due to the correlation between productivity – net income demonstrated above because the level of the productivity in this sector decreased in 2008 when reached the maximum value for this period. Another cause of the decrease of net incomes resulted from operation could be given by the rethinking of costs structures of client companies due to crisis. A part of them renounced to the externalization of services connected with information technology, creating their own department and taking advantage of tax deduction specific to IT domain given by the Romania’s Government, decreasing in the same time the level of consumption. However, this was reflected in this sector to an activity decrease. Networked Readiness Index (NRI) is an index created by the World Economic Forum and measures the ability of countries to exploit the opportunities offered by information and communications technology.

According to the Report of 2014, Romania occupied the 75th place of 149 countries, maintaining the same place as in 2013, while in 2014, registered a score increase from 3.86 to 3.95, the maximum value being 7 (the best performance). For Romania, this score shows that there is a low tendency over the average concerning the absorption of the opportunities offered by this sector, the difficulties coming from the inefficiency of the legal system, from the low impact of IT products to economic level and from the absorption degree of technology within the company which is not above average.

4. Conclusions

Due to the nature and high efficiency of this sector, over the national average, it is hopeful for the future to become a priority for the National Sector Development Strategy to be a source for economic growth and for rising the contribution of added value.

Therefore, a more strategically approach is necessary concerning the penetration degree of this sector from economic point of view, but a strategy is necessary both at the infrastructure development and costs consumption level; there is also necessary a more strategically approach concerning the penetration degree increase, the innovation and information change promotion, the reformation of educational system for a better knowledge of the future labour work. The information era, e-government and e-commerce has to become a priority of this strategy.
Acknowledgements
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References