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MODELING THE IMPACT OF E-COMMERCE ON R&D INVESTMENT IN THREE COUNTRIES (UKRAINE, POLAND, AUSTRIA)

Abstract

This paper investigated the impact of e-commerce and two other variables on R&D investment in three selected countries. Economic-mathematical models of the influence of e-commerce parameters on R&D investment in the Austria, Poland, and Ukraine are constructed on the basis of the production function. The production function of Koba-Douglas was used in the study of the relationship between the parameters characterizing e-commerce and R&D investment.

Key words: e-commerce, production function, R&D, math modelling.

Introduction

The rapid development of technology, the proliferation of the Internet and the emergence of the digital economy have all become characteristic of the twenty-first century. Under the influence of these technologies, changes have taken place in almost all spheres of human life and have markedly affected the development of the entire global economy. The emergence of an industry such as e-commerce has opened up completely new opportunities that have not been available so far. The e-commerce market is developing very fast. The average growth rate in the world is about 18-20% a year, which is about 10-12% of all retail sales. In turn, e-commerce is one of the most successful industries in Ukraine.

The subject of the research is e-commerce. The subject of this study is the study of the impact of e-commerce on investment in R&D in Ukraine, Poland and Austria.

The purpose of this paper is to build a mathematical model of the impact of e-commerce on investment in R&D in three countries.

The tasks of the work are as follows:

- Study of scientific literature and online resources for analysis;
- Modeling the impact of e-commerce on R&D investment;
- Analysis of the simulation.

Literature overview

During the study of Tetiana Zatonatska (2018) [1], the main world trends in e-commerce development were considered; it gave the possibility to prove the rapid growth of this sector of the economy and its impact on the indicators of the economic development of the countries in the world. Based on the comparison of key indicators of the e-commerce sector in Ukraine, Poland, and Austria, it has been determined that the Austrian e- commerce market is the leader at this stage. However, the pace of e-commerce development in Ukraine and Poland exceeds this indicator in Austria, as e-commerce markets in Ukraine and Poland are at the stage of formation and active growth.

In the study it was found that the simulation of the behavior of certain indicators shows the existing differences: for example, the growth of Internet sales per capita contributes to reducing of the unemployment rate in Ukraine and Poland, but in Austria, on the contrary, this phenomenon will cause an increase of this indicator. Perhaps this situation is due to the fact that Austria, in comparison with Ukraine and Poland, has a higher level of informatization in the branches of the economy. Therefore, the development of e-commerce in Ukraine and Poland will help to create new jobs and increase employment, while in Austria, the rapid growth of Internet transactions and automation of their processing will lead to a decreasing in it.

In the simulation of the dependence between e-commerce indicators such as the volume of the Internet-rade, Internet penetration, and the country's GDP growth rate we found that the degree of influence of e-commerce indicators on economic growth is the weakest in Austria. At the same time, the Ukrainian model shows the high sensitivity of the country's gross domestic product to the penetration rate of the Internet, while Poland's GDP is sensitive to the volume of trade through the Internet. The results of the simulation indicate that e-commerce has an impact on the country's development and contributes to an increase in the gross domestic product in all three countries.

The study of Anvari D. and Norouzi D. investigated the impact of the e-commerce and R&D, health expenditure and government size on the GDP per capita in twenty one selected countries, namely, Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, and United Kingdom. The panel model with GLS method was used to investigate the period of 2005-2013. The results showed that the explanatory variables in the selected countries played a significant role in the per capita income. In other words, it was revealed that e-commerce and R&D expenditure with GDP per capita had a long run impact based on the cointegration test results; also, both e-commerce and R&D expenditure were found to have a positive impact on GDP per capita, but e-commerce had a stronger development- enhancing effect. In addition, other variables such as government size and health expenditure also had a positive influence on GDP per capita. According to these findings, the level of government activity has led to a growing interest in the positive analysis of the size of government (Borcherding, 1977; Brunner, 1978; Frey, 1982; Meltzer & Richard, 1978, 1981; Peltzman, 1980; Fratianni & Spinelli, 1982), such that the present paper could be regarded as a contribution to that analysis.

Therefore, the policy this study recommends is that because of the importance of e-commerce in economic development and social welfare, governments should adopt appropriate policies and provide the necessary conditions for the development and promotion of ICT. For this purpose, according to the findings of empirical research, it is recommended that the government pay further attention to economic planning in order to improve e-commerce indicators, so that the total government measurements could eventually lead to economic development in the country. Our empirical results provided a good reference for other developing countries. In the future, we hope to further discuss the decomposition of e-commerce transactions into sales and procurement (e-sales or e-procurement), along with the relationship between knowledge variables, when more detailed data would become available. It would also be interesting to distinguish between different channels (reduction of the transaction cost between buyers and sellers or strong efficiency improvement in the production and supply of chain processes) through which e-commerce can raise GDP and employment.

Results

In this study, based on the production function of Cobb-Douglas, a model of the impact of e-commerce on R&D investment in three countries - Ukraine, Poland and Austria - was constructed. The period from 2008 to 2018 is analyzed. Based on the models built, it has been found that the most significant impact on R&D investment in all three countries is GDP per capita. While the volume of the e-commerce market has a positive impact on R&D only in Austria, in Ukraine and Poland it results in a slight decrease in R&D investment. These results are justified by the fact that over the past 10 years, e-commerce market volumes have been growing at a very high rate, and investment in R&D has been steady and in Ukraine tends to decline.

One of the results are shown in table 1.

Table 1

Results of construction of the first model (Ukraine)

Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)
Intercept	2.861e+08	1.340e+08	2.008	0.0879
GDPP	3.398e+05	2.518e+04	11.721	2.19e-05
IP	-2.404e+08	3.991e+08	-0.561	0.5330
EC	-3.187e-01	8.901e-02	-3.125	0.0212
R-squared	0.9201			

The general model can be interpreted as:

$$RD_t = 2.861 \cdot 10^8 + 3.398 \cdot 10^5 GDPP_t - 2.404 \cdot 10^8 IP_t - 0.319 EC_t$$

The R-squared rate is quite high, indicating a strong correlation between the variables. It can be concluded that the volume of e-commerce market has a negative impact on investment in R&D in Ukraine, while the overall welfare of the population, expressed as a GDP per capita, has a much larger impact and its growth by $ 1 US raises R&D costs by $ 33,980 USA.

References

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