Anastasiia Filohina
First-year Master student,
Taras Shevchenko National University of Kyiv,
Kyiv, Ukraine
nastyafilogina@ukr.net

MODELING THE IMPACT OF E-COMMERCE ON LABOR PRODUCTIVITY

Abstract

Nowadays e-commerce market is rapidly growing, and it becomes increasingly important along with an ICT progress in general, which leads to constant changes and improvements in current business models, helping to provide more efficient solutions to business problems in all industries. Thus, these developments affect the working process as well. This study focuses on estimating the impact of e-commerce and ICT diffusion on labor productivity at the country level. Models have been created using growth-accounting and econometric approaches, and the resulting linear regressions showed the significance of these factors' impact on the labor productivity.

Key words: e-commerce, labor productivity, ICT, regression modeling, EU.

Introduction

Today e-commerce opens up new market opportunities for business both at the country level and at the international level, in terms of expanding foreign economic relations and export opportunities. According to the Statista [5], in 2019, retail e-commerce sales worldwide have been valued at 3.53 trillion US dollars and in 2022 this number will rise to approximately 6.54 trillion US dollars. Revenue in the European e-commerce market [3] is projected to reach 423 billion US dollars in 2020 and has 481 million users (Fig. 1).

Various newly developed business models have revolutionized the current market. The explosive development of the Internet and information and communication technologies (ICT) has accelerated the implantation of e-commerce, as well as changed the work process. Thus, the goal of this study is to estimate an impact of e-commerce and ICT diffusion in general on labor productivity. The hypothesis is that productivity depends on e-commerce usage and ICT diffusion.

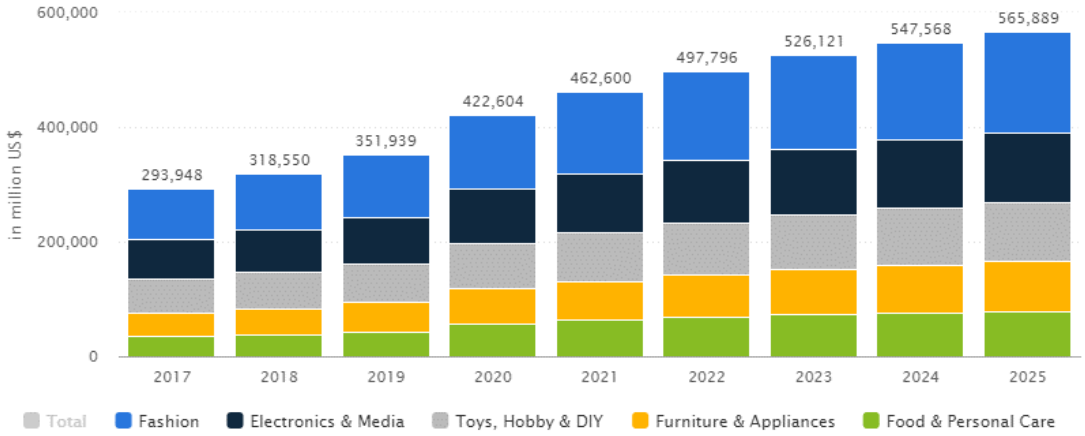

Figure 1. European e-commerce market value in 2017-2025 (in million US$)
Source: Statista [3]

Literature overview

Nicole Ballouz Baker, Mona Said Boustany, Maroun Khater and Christian Haddad (2020) [2] showed the impact of the Internet use on the labor productivity by sector. The research points out the problem of inequality of Internet outcomes or tangible benefits, because of the gap, caused by usage efficiency. Main goal of their study was to look closely at the third level digital divide by investigating the effect of Internet use on the relationship between labor productivity by sector in developing countries. Model consisted of 4 regression equations, which were 1) labor productivity depends on human capital; 2) on Internet use; 3) Internet use depends on human capital; 4) the impact of human capital on productivity depends on Internet use. Results showed a presence and significance of those effects.

Ronia Hawash and Guenter Lang (2019) [6] focused on the digital gap as well, examining the impact of ICT endowments on the productivity growth in developing countries. Data of 76 countries for the years 1991-2014 had been used, which helped to analyze it in the long-term perspective, including both periods before and after the ICT infrastructure and usage expansion. Three models had been created: 1) capacity-based; 2) ICT revenues-based; 3) ICT physical usage. Results of the research showed that IT diffusion has significant spillover effects on the world economy, however unevenly distributed among countries.

Nadezda Abramova and Natalia Grishchenko (2020) [1] studied the impact of ICTs in general on labor productivity, and the relationships between ICTs, employment in inter-

sector comparison and labor productivity in Russia. Methodology consisted of creating a pair regression model, concerning changes in particular types of information technologies. Results showed heterogeneous effects. Also, there were separate industries with the primary influence of one or several types of IC technologies.

Leonardo Ortega, Alison Cathles, and Matteo Grazzi (2017) [7] investigated the impact of e-commerce adoption on firm productivity in the context of a middle-income economy. Study was based on microdata from the Chilean firm survey, which helped to conduct an analysis of the relationship between e-commerce and productivity across different sectors and firms' sizes in Chile. The results were consistent with the evidence in the developed countries and showed that e-commerce engagement increases productivity for 17%. The difference between the manufacturing and service sectors was confirmed as well. It's vital to note that it is e-buying that explains this relationship.

Marcin Relich (2017) [8] examined relationships between labor productivity and particular ICT components, which are ERP, e-commerce and CRM usage, and the number of ICT specialists on the country level. First type of hypotheses consisted of those ones which were about a positive effect of those ICT components on labor productivity, and the second one had to verify that this effect is greater in transition economies of EU than in the developed ones. According to the results of the study, these components have a positive and a significant impact on labor productivity in EU countries, and it was higher in transition economies.

Methodology

Model is based on the following measurements of e-commerce usage and ICT diffusion: percentage of enterprises with e-commerce sales, employed ICT specialists and the percentage of enterprises with internet among all enterprises. Labor productivity was characterized by real labor productivity per person and nominal labor productivity per hour worked, using available data on Eurostat [4]. Data was collected for Poland, Latvia and Lithuania from 2010 to 2019.

Impact of ICT on labor productivity can be analyzed using econometric and growth-accounting approaches [7; 8]. Growth-accounting method is useful for determining key factors' contribution in dependent variable's growth:

$$Y = f(A, K, L),$$

where Y is the dependent variable or output, A is the level of technology or TFP (total factor productivity), K is capital stock and L is the labor quantity.

Model, presented in this study, expressed the Y output as follows:

$$Y_{it} = A_{it} EES_{it}^{\beta_1} EICT_{it}^{\beta_2} EI_{it}^{\beta_3},$$

where an output Y_{it} is taking two aforenamed forms, A_{it} is total labor productivity, EES_{it} is percentage of enterprises with e-commerce sales, $EICT_{it}$ is number of employed ICT specialists, EI_{it} is percentage of enterprises with internet among all enterprises, i and t express country and time period, respectively.

This formula is linearized using the following linear regression model:

$$\log(Y_{it}) = \log(A_{it}) + \beta_1 \log(EES_{it}) + \beta_2 \log(EICT_{it}) + \beta_3 \log(EI_{it}) + \varepsilon_{it},$$

where ε_{it} is residual error.

Results

Six different models have been created that had to determine the impact of e-commerce usage and ICT diffusion on labor productivity in three selected EU countries. The criteria for choosing one model over another was R-squared value, or, if they were relatively close (difference less than 0.05) the model was chosen that had more predictors in it, for reasons of more all-round investigating of all factors' impact on the dependent variable.

The following models have been considered as the best ones:

- For Latvia: $\log(Y_t) = 0.9126 \cdot \log(EI_t) + 2.4975 \cdot \log(EES_t) + \varepsilon_t$;
- For Lithuania: $\log(Y_t) = -128.7053 + 1.8392 \cdot \log(EI_t) + 0.4426 \cdot \log(EES_t) + \varepsilon_t$;
- For Poland: $\log(Y_t) = 0.5432 \cdot \log(EI_t) + 1.3087 \cdot \log(EES_t) - 0.0157 \cdot \log(EICT_t) + \varepsilon_t$.

The above-mentioned regression equations show that in two countries out of three there was no impact of number of ICT specialists, whereas another two factors were included in all three models chosen as the best ones. Their results including p-values and adjusted R-squared values are presented below in Table 1.

Table 1

Results of regression models

Country	Latvia		Lithuania			Poland		
Variable	EI	EES	Constant variable	EI	EES	EES	EICT	EI
Coefficients	0,9126	2,4975	-128,7053	1,8392	0,4426	1,3087	-0,0157	0,5432
Standard error	0,0359	0,3269	34,5635	0,3367	0,1624	0,1199	0,0054	0,0197
t-statistics	25,4463	7,6395	-3,7237	5,4618	2,7251	10,9128	-2,8859	27,5662
p-value	0,0000	0,0001	0,0074	0,0009	0,0295	0,0000	0,0235	0,0000
Adjusted R Squared	0,8748		0,7668			0,8571		
Significance F	0,0000		0,0025			0,0000		

Source: author's calculations based on data from [4]

All models are significant and have pretty high R-squared, all mentioned variables are also significant with a 0.05 level of significance. Diffusion of Internet usage among enterprises by 1% increases labor productivity by 0.5-2.0% in these countries, and an increase of e-commerce implantation by 1% leads to productivity growth, on average, by 1.0-2.5%.

Conclusions

E-commerce and ICT impact on today's economy is hard to overestimate, because it leads to various improvements, including growth of efficiency in business processes in enterprises. Nowadays it is crucial to understand what has an effect on labor productivity and to investigate the particular mechanisms of those relationships, as well as to evaluate that impact.

Study shows that ICT and e-commerce implementation helps to improve the working process, making it more efficient and increasing the labor productivity. Thus, it can be visible on the country level. The main contribution of this research is the estimation of impact of e-commerce and ICT-related improvements on labor productivity, which have been proved to be significant.

References

1. Abramova, N., & Grishchenko, N. (2020). ICTs, Labour Productivity and Employment: Sustainability in Industries in Russia. Procedia Manufacturing, 43, 299–305. https://doi.org/10.1016/j.promfg.2020.02.161
2. Baker, N. B., Said Boustany, M., Khater, M., & Haddad, C. (2020). Measuring the indirect effect of the Internet on the relationship between human capital and labor productivity. International Review of Applied Economics, 34(6), 821–838. https://doi.org/10.1080/02692171.2020.1792421
3. eCommerce - Europe | Statista Market Forecast. (2020). Retrieved 25 November 2020, from https://www.statista.com/outlook/243/102/ecommerce/europe
4. Eurostat. Ec.europa.eu. (2020). Retrieved 25 November 2020, from https://ec.europa.eu/eurostat
5. Global retail e-commerce market size 2014-2023 | Statista. (2020). Retrieved 25 November 2020, from https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales
6. Hawash, R., & Lang, G. (2019). Does the digital gap matter? Estimating the impact of ICT on productivity in developing countries. Eurasian Economic Review, 10(2), 189–209. https://doi.org/10.1007/s40822-019-00133-1
7. Ortega, L., Cathles, A., & Grazzi, M. (2017). E-Commerce and Productivity: Evidence from Chile. In Catalyzing Development through ICT Adoption (pp. 239–252). Springer International Publishing. https://doi.org/10.1007/978-3-319-56523-1_13
8. Relich, M. (2017). The impact of ICT on labor productivity in the EU. Information Technology for Development, 23(4), 706–722. https://doi.org/10.1080/02681102.2017.1336071