PRODUCING OR PLAYING? INVESTIGATING INTERNET INFLUENCE ON ECONOMIC GROWTH

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Abstract: This paper is focused on determining the effects of increase in the Internet usage on economic development of two groups of countries: OECD and NON-OECD countries. Two separate Vector Autoregression models were used. The hypotheses were inspired by claims that GDP per capita and trade, including trade in services, have a positive correlation with Internet usage growth. The hypotheses were tested on a set of 26 OECD and 21 NON-OECD countries for a period of 20 years, from 1995 to 2015. Results of the paper do not confirm the existence of a direct positive correlation between GDP per capita and Internet users. For all countries, a direct comparison of the chosen variables show a negative correlation. For OECD countries, trade in services has a positive correlation with Internet usage growth, while for NON-OECD countries both trade and trade in services showed a positive correlation with Internet usage growth.

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Introduction

The introduction and expansion of the Internet became one of the last major league game shifters. Every world economy is influenced by the Internet and its positive interaction with financial development (Sassi and Goaied, 2013). This paper's main purpose is to find out and compare the correlation of the Internet users with economic growth in Organisation for Economic Co-operation and Development (OECD) and NON-OECD countries. The estimated variable for economic growth representation is GDP per capita (growth). However, this paper will also investigate the influence of users on trade and trade on services. This will be accomplished because the majority of previous findings were able to determine correlations with international trade (Meijers, 2013; Lin, 2015) and did not consider disaggregated trade components.

Literature review

The Internet landscape in its current form has numerous daily interactions with trade in service procedures. Many services were developed, and many completely new service approaches were created and are continued to be created from the beginning of the exploration of the Internet. Research conducted in 13 countries shows that the Internet activity was on average responsible for 3.4 percent of GDP, which hence contributs more than the agricultural or energy industries (McKinsey & Company, 2011). Similar conclusions on the correlation between economic growth and Internet penetration were determined by Salahuddin and Gow (2015) by applying empirical models, Clarke and Wallsten (2006) by implementing an Ordinary Least Squares (OLS) model, and MacDougald (2011) by using a financial macroeconomic model and OLS model. A strong positive correlation was found: every increase in the amount of Internet users leads to GDP per capita growth. MacDougald (2011) noted that the strength of such influence has a straight correlation with the income level of the country. The greatest positive influence of the Internet usage was in low income countries. However, Meijers (2013) showed a negative correlation between determined variables. By applying a Generalized Method of Moments (GMM) and a Vector Auto-regression Model (VAR) model, he came to the conclusion that GDP per capita and Internet users are negatively correlated. The author gave no clear explanation on the discovery of such an outcome. However, after discovering the positive correlation of international trade with GDP per capita and Internet users with international trade, the author claimed that there is an indirect positive influence of the increase in the Internet users on economic growth of a country. Lin (2015) and Meijers (2013) worked with variables such as trade and international trade. They studied the correlation between these two variables and Internet users. In both cases, there was a strictly positive influence of Internet users' growth on trade or trade export. In his research, Lin (2015) additionally determined that Internet accessibility positively and strongly correlated with the increase in trade performance between the countries. Another research field which interprets Internet users' influence on trade in services was widely explored by Freund and Weinhold (2002). A positive correlation and the influence of Internet users on a countries' trade in services was found by applying an OLS model to two sets of variables.

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The first set contains Internet accessibility, population, and GDP; and the second set consists of trade in services, services import, services export, population, GDP, and Internet accessibility. Choi (2010) achieved outcomes which suggest that Internet accessibility can directly influence not only a country's trade in service development, but also its general macroeconomic performance, which means that such indicators as Foreign Direct Investment, Human Development Index, and GDP growth are also boosted by Internet usage growth. Another interesting attempt was made by Bojnec and Ferto (2010) who investigated the impact of the number of Internet users on food industry trade. The authors applied the adapted gravity model to investigate the matter. It was implied by the results that an increase in the number of users reduced the specific entry cost for a food export market. In countries with a major focus on food import, a significant positive impact created by the Internet adaptation was observed as well. This positive effect on food export was determined by the economic development level of a country. Implementation of Internet technology increased the regular distance between trading countries by providing simpler means of communications and financial activities.

Methodology and data

In order to test a correlation between the Internet and key growth indicators, the VAR model was implemented, in line with Meijers (2013). The model allows a clear investigation of linear interdependence between the variable reflecting Internet usage and the chosen indicators of economic growth. Applied to the group of OECD countries, the overall regression consists of observations from 26 countries for a time frame from 1995 to 2015. The dataset is created on a yearly basis. The following equations describe the econometric representation of the model, where Internet users and GDP per capita are stationary variables; however, trade and trade in services are represented by the first difference of their values:

$$GDP\_PC = \alpha + C(1,1)*GDP\_PC(-1) + C(1,2)*D(TR(-1)) + C(1,3)*D(TR\_IN\_S(-1)) + C(1,4)*INT\_U(-1) + C(1,5) + \mu \quad (1)$$

$$D(TR) = \delta + C(2,1)*GDP\_PC(-1) + C(2,2)*D(TR(-1)) + C(2,3)*D(TR\_IN\_S(-1)) + C(2,4)*INT\_U(-1) + C(2,5) + \omega \quad (2)$$

$$D(TR\_IN\_S) = \beta + C(3,1)*GDP\_PC(-1) + C(3,2)*D(TR(-1)) + C(3,3)*D(TR\_IN\_S(-1)) + C(3,4)*INT\_U(-1) + C(3,5) + \lambda \quad (3)$$

$$INT\_U = \eth + C(4,1)*GDP\_PC(-1) + C(4,2)*D(TR(-1)) + C(4,3)*D(TR\_IN\_S(-1)) + C(4,4)*INT\_U(-1) + C(4,5)+ \theta \quad (4)$$

Where:
α, δ, β, and $\eth$ – estimated intercepts
C – coefficient
μ, ω, λ, and θ - error terms
GDP_PC – GDP per Capita
INT_U – the amount of the Internet users per 100 people
TR – trade
TR_IN_S – trade in services
D() – means that the first difference is taken in order to adopt the variable

The equations differ for the datasets of OECD and NON-OECD countries. The difference lies in the stationary issue. In the model for OECD countries, two out of four variables were stationary and the values of the other two variables experienced first differentiation. While constructing the VAR model for NON-OECD countries, only the GDP per capita appeared to be stationary and the first difference was applied to the other variables. The OECD countries were chosen to be the first group for the estimation because members of this organization are technologically developed countries with the biggest economies in the world. The total GDP of OECD members accounted for around 62% of the entire world's in 2014 (OECD, 2014) as mentioned above, and it is appropriate to evaluate how Internet growth influences these indicators of leading economies. However, due to the lack of observations,

several OECD members were excluded from the dataset due to the lack of available statistics. After conducting the necessary procedures of sample selection, the number of countries included has the following structure: 26 countries which are OECD members and 21 NON-OECD countries. The period for which, observations were collected initially covered 24 years from 1992 to 2016. For both OECD and NON-OECD countries' datasets, the substantial amount of observations for the years from 1991 to 1995 and for 2016 was not available in any investigated databases. In order to avoid data corruption and keep high reliability of the sources, the following years were excluded from the estimation: 1991, 1992, 1993, 1994, and 2016.

The initially collected dataset for both OECD and NON-OECD countries consisted of 9 variables. After all of the necessary reductions, four variables were recognized as the most suitable for the research: GDP per capita (growth), trade, trade in services, and Internet users (per 100 people). Data values were collected from the World Bank and the International Telecommunication Union databases.

Two major hypotheses of the paper deal with the growth rate of GDP per capita, which is chosen as the main economic indicator for the research. In order to examine its interaction with Internet usage growth, the following hypotheses were produced:

H0: "For OECD and NON-OECD countries, an increase in the Internet usage positively affects economic growth (GDP per Capita)."

H1: "In NON-OECD countries, the amount of Internet users has a stronger positive influence on the economic growth of countries than in OECD countries."

Other hypotheses analyzed in the paper would not concern the GDP per capita variable. A different approach of economic growth influence determination would be evaluated. Indicators such as trade and trade in services are going to represent evaluation measures. They are worth exploiting due to the significant increase in trade in services over the last 20 years. A substantial amount of new tools and services were developed and could only be provided on the on-line basis, thus the trade in services index is presumably interconnected with the Internet in a strong way. Such dependency is the basis for the hypothesis that trade in services has a stronger correlation with Internet usage than trade in general. However, as far as services supported by the Internet are technology advanced their presence and influence in NON-OECD countries may be substantially lower than in OECD member states. Therefore, the variables of trade and trade in services would be tested for the strength of their correlation with Internet usage growth. The following hypotheses represent estimated assumptions:

H2: "In OECD countries, an increase in the number of Internet users has a stronger positive correlation with trade in services than with general trade."

H3: "In NON-OECD countries, an increase in the number of Internet users has a stronger positive correlation with trade in services than with general trade."

For the OECD countries, the implication of four tests in the Unit Root Panel (ADF, IPS, LLC, and PP) revealed that only two variables are stationary without taking the first difference, which are GDP per capita and the amount of Internet users per 100 people. After running the tests with the first difference application, the remaining two variables gained stationarity e.g. trade in services and trade. The application of the same test for NON-OECD revealed that only GDP per capita has acceptable results in terms of stationarity without implementation of the first difference to the dataset, while others have to be expressed by first differences.

For the proper evaluation and application of the VAR model, it is crucial to determine the number of lags required to eliminate autocorrelation. Schwarz information criteria (SC) test statistics were applied to indicate a proper number of lags in this research. Schwarz information criteria results suggest that one lag of the variables is a proper amount to eliminate autocorrelation during the VAR model estimation. The majority of the selected variables were not stationary. Such variables as the amount of Internet users per 100 people, trade, and trade in services contained outliers, resulting in the unequally of the distributed mean and variance of the obtained observations. The application of first differences resolved this issue. Following and applying the results of the tests and the estimation of the lags order, the proper VAR model was constructed. This model is based on 1st lag order as suggested by Schwarz information criterion results. Outputs of this VAR estimation are revealed in Tables 1 and 2.

Table 1: Vector Autoregression Estimates for OECD countries.

	GDP_PC	D(TR)	D(TR_IN_S)	INT_U
GDP_PC(-1)	0.335745***	-0.063664	0.016021	-0.109260
D(TR(-1))	-0.030364	0.016272	0.014510	-0.050964
D(TR_IN_S(-1))	-0.093781*	-0.254078**	-0.058075	0.189845
INT_U(-1)	-0.013466***	-0.017086*	0.006410*	0.896107***
C	1.883311***	2.697621***	0.119247	10.47524***
R-sqr.	*0.167736*	*0.020156*	*0.009108*	*0.938368*

Source: Authors. *** - significance at 1% level; ** - significance at 5% level; * - significance at 10% level

Table 2: Vector Autoregression Estimates for non-OECD countries.

	GDP_PC	D(TR)	D(TR_IN_S)	INT_U
GDP_PC(-1)	0.544048***	-0.127869	-0.051458	-0.008598
D(TR(-1))	-0.048134**	-0.096103*	0.014737	-0.029171*
D(TR_IN_S(-1))	0.029307	0.216817**	0.271218***	0.084415**
INT_U(-1)	-0.115233**	0.227791*	0.163324**	0.350113***
C	1.828268**	-0.077945*	0.208824**	1.758730***
R-sqr.	0.304598	0.028947	0.096702	0.146625

Source: Authors. *** - significance at 1% level; ** - significance at 5% level; * - significance at 10% level

Causality Tests and results decomposition

Another matter to be assessed in this paper is whether Internet growth influences GDP per capita or vice versa. To answer this question, a new VAR model was constructed by including only the abovementioned observations. These variables have no need to be expressed as the first difference to become stationary and suitable for evaluation. A straight influence of the GDP per capita on the growth of Internet users cannot be observed since its p-value is above 0.1 level. Second, a VAR model estimation is made for trade and trade in services. In this case it is possible to conclude that trade in service influence on trade is much stronger that the other way around. A similar procedure as for the OECD countries was conducted for the NON-OECD dataset. Results of the Granger causality between NON-OECD countries' economic growth and Internet users shows that the amount of Internet users has much stronger influence on the GDP per capita, than GDP per capita's influence in the opposite direction. Again, it may also be considered that trade in services influences trade. Additionally, to figure out responses and correlations between GDP per capita, trade, trade in services, and the amount of Internet users per 100 people, a Cholesky method of decomposition was applied. This technique conducts an evaluation of the historical data for each variable to provide accumulated responses regarding their correlation. Accumulated responses of GDP per capita to Internet users for both OECD and NON-OECD countries shows that an increase in the number of users lead to a reverse effect for GDP per capita growth. The negative correlation between those variables has a straight vector with a strong impact during the first 8 years. In the long run, the tendency is stabilized on the -1.2 point level.

Discussion of the results

The results show that in the case of both groups of countries, a negative correlation of internet users and GDP growth exists. There could be some explanations of this phenomenon from a social point of view. With the substantial increase in users' possibilities, consumers started to spend more time surfing the Internet, using social networks, and communicating with each other. Users might be adversely affected by these time-consuming activities in the way that they are less eager to work and produce some output accounted for the GDP, or actually some of these activities, usually undertaken in the home environment may count rather to the shadow economy sector, as suggested by Mare, Motroni, Porcelli (2016). However, the economic growth of NON-OECD countries receives no direct positive influence from the increase in Internet users. Results are completely contradictory to H1 expectations. There is no linear positive influence of the variable on NON-OECD countries' economic development indicator; moreover, there exists a negative correlation between the two of them. These results are in conflict with

Salahuddin and Gow (2015), Clarke and Wallsten (2006), and MacDougald (2011) research results which claimed the existence of a positive influence of Internet users' growth on GDP per capita. H0 which presumed that an increase in Internet users positively affects economic growth in OECD countries is also rejected however, as Groshen at al. (2017) suggested, one of the reasons could be inadequate adjustment of statistic techniques to digital era challenges. The background of the H0 rejection lies in the fact that the VAR model outputs in short and long runs are not in line with the initial predictions. There are no direct positive correlations between the estimated variables. Outcomes imply a straight negative trend without volatility. Consequently, H0 is rejected for both OECD and NON-OECD countries.

Following the comparison of trade and trade in services of OECD countries may not seem obvious from the results already discussed. The first notion concerns the OECD sample which is relevant for H2 evaluation. This hypothesis expects that OECD trade in services has a stronger positive correlation with the amount of the Internet users than general trade. By comparing responses of GDP, it is possible to conclude that trade showed no positive correlation. On the other hand, results concerning trade in services were in line with general positive correlation expectations. As far as the hypothesis 2 assumed that trade in services has a stronger positive correlation with Internet usage, even though trade outputs showed the completely negative correlation, H2 should be considered partially confirmed. The conducted estimation is in line with McKinsey's (2011) claim on a strong influence of the Internet accessibility on trade in services.

A similar conclusion on trade and trade in services correlation should be expected for NON-OECD countries. According to the H3 statement, trade in services positively correlates with the amount of Internet users; this correlation is stronger than trade's positive correlation with the variable. For NON-OECD countries' the long-run positive correlation of trade with Internet users has a 1.3 points level, while trade in services prediction reached only 1.1 points. That outcome showed trade superiority by 0.2 points. Such results are considered to be the background for H3 rejection. Table 3 summarizes the results.

Table 3: Hypotheses and their results.

Hypothesis	Results
H0: "For OECD and NON-OECD countries, increase in the amount of the Internet usage positively affects economic growth (GDP per Capita)."	Rejected
H1: "In NON-OECD countries, the amount of the Internet users has stronger positive influence on countries' economic growth than in OECD countries."	Rejected
H2: "In OECD countries, increase in the Internet users has a stronger positive correlation with trade in service than with trade."	Accepted
H3: "In NON-OECD countries, increase in Internet users has a stronger positive correlation with trade in service than with trade."	Rejected

Source: Authors.

Conclusions

The results did not show a direct positive influence of the growth of Internet users on a countries' economic development. However, it has to be noted that trade is a part of every country's GDP estimation. That implies, Internet accessibility growth positively affected trade in service and it is a part of trade, and that there may be an indirect positive influence of Internet users on economic development. Thus, the influence is indirect and is not substantially proven in this research. This conclusion indicates that a positive correlation of Internet usage with trade in services should be considered the main outcome of this research. It proves that many services which were created and developed during the Internet's existence generated trade in service growth.

Further exploration of this topic can be accomplished by employing a sample which includes a full set of OECD countries and a larger set of NON-OECD countries. The application of different econometric models can also produce more diversified outcomes. For greater understanding of the Internet's possible influence on the GDP of countries and other variables, indexes such as government spending, FDI (foreign direct investments), and trade in goods may be included in the VAR model estimation.

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