

The Econometric Assessment of Correlation between Internet Connectivity and Economic Growth: the Case of the RA

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Ինտերնետ կապի և տնտեսական աճի փոխառնչության էկոնոմետրիկ գնահատումը Հայաստանի օրինակով **Պոգոսյան Մարիամ Վ.**

Կրտսեր գիտաշխատող, ՀՀ ԳԱԱ Մ. Բոթանյանի անվան տնտեսագիտության ինստիտուտ (Երևան, ՀՀ)

Ամփոփագիր. Անհնար է պատկերացնել ժամանակակից աշխարհն առանց ինտերնետի: Ինտերնետը ծառայում է որպես կատալիզատոր հեռահաղորդակցության ընկերությունների կողմից առաջարկվող ծառայությունների ընդլայնման համար և հիմք է հանդիսանում այլ ոլորտների ամենօրյա գործունեության համար: Ինտերնետի աճող կարևորությամբ է պայմանավորված այդ ոլորտությամբ կատարվող հետազոտությունների քանակը, որոնք գնահատում են ինտերնետ կապի դերը ինչպես ընկերությունների, այնպես էլ երկրների մակարդակում: Այս թեմայի վերաբերյալ հետազոտություններն իրականացվել են տարբեր հետազոտողների կողմից տարբեր ժամանակահատվածներում:

Տվյալ հոդվածի նպատակն է պարզել ինտերնետ կապի և երկրի տնտեսական աճի միջև հնարավոր կապը՝ դիտարկելով Հայաստանի հեռահաղորդակցության կազմակերպությունների գործունեությունը: Ուսումնասիրության շրջանակում վերլուծել ենք ինովացիոն սարքավորումների ներմուծման, 1 օգտագործողի հաշվով ինտերնետ տրաֆիկի ազդեցությունը Տեղեկատվություն և կապ ճյուղի կողմից ստեղծվող ՀՆԱ վրա:

Հանգուցաբառեր և բառակապակցություններ՝ հեռահաղորդակցություն, ինովացիա, ինտերնետ, ՀՆԱ, տնտեսական աճ, ինովացիոն սարքավորումներ, Հայաստան, բաժանորդներ, ինտերնետի օգտագործում

Эконометрическая оценка взаимосвязи между интернет-подключением и экономическим ростом: пример Армении **Погосян Мариам В.**

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Аннотация. Невозможно представить современный мир без интернета. Интернет служит катализатором расширения услуг, предлагаемых телекоммуникационными компаниями, и основой для повседневной деятельности других секторов. Объем исследований, проводимых в этом направлении, обусловлен растущей важностью интернета, в которых оценивается роль интернет-соединения как на уровне компаний, так и на уровне стран. Исследования по этой теме проводились разными исследователями в разное время.

Цель данной статьи-выяснить возможную связь между подключением к интернету и экономическим ростом страны, наблюдая за деятельностью телекоммуникационных организаций Армении. В рамках исследования мы проанализировали влияние импорта инновационного оборудования, интернет-трафика на 1 пользователя на ВВП, создаваемый отраслью информации и связи.

Ключевые слова и словосочетания: телекоммуникации, инновации, интернет, ВВП, экономический рост, инновационное оборудование, Армения, абоненты, использование интернета

Introduction. It is impossible to envision modern life without the internet. The internet has become the primary game-changer in every aspect of life. Dating back to 1969 [10], the internet has been widely operational, particularly in the last 20 years. So, what is the internet? It is a global network of billions of computers and other electronic devices. With the internet, accessing almost any information, communicating with anyone world-

wide, and much more become possible [11]. Internet can enable various services, it is the main pillar of modern civilization, it helps to foster digital transformation in a country.

Primarily, internet providers are telecommunications companies. These entities invest in and enhance infrastructure to extend internet connectivity to more individuals, businesses, and nations. The internet serves as a catalyst for expanding the

range of services offered by these telecom companies, establishing itself as the foundational support for the day-to-day operations of other sectors.

With its increasing significance, studies assessing the role of internet connectivity at both the firm and country levels are being conducted.

But does internet connectivity foster country's economic growth? Studies on this topic were implemented by various researchers in different periods of time.

The aim of this article to find out possible potential relation between internet connectivity and country's economic growth.

Literature review. The Internet is believed to facilitate the spread of knowledge between countries, which is thought to positively influence economic growth. Changkyu Choi et al. found out positive relation between the impact of Internet and country's economic growth. According to study, utilizing panel data covering 207 countries from 1991 to 2000, indicates that increased Internet usage indeed correlates with economic growth, even after accounting for factors such as investment ratio, government consumption ratio, and inflation. Specifically, 1% increase in the Internet-user ratio corresponds to a 0.057% increase in the growth rate [2, pp. 39-41].

Another researcher Yidan Li conducted a research utilizing a dynamic panel data approach to assess the impact of the Internet on gross domestic product (GDP) across 65 countries within the Belt and Road Region spanning from 1996 to 2014. Findings indicate a positive and statistically significant relationship between Internet usage and economic growth, with this association strengthening as Internet infrastructure advances. Enhancing Internet development is beneficial for economic growth promotion in countries as it clearly fosters technological progress [6, pp. 254-259].

The study done by Hjort and Lin Tian indicates that internet connectivity has a positive impact on macroeconomic outcomes in the majority of developing countries [4].

Over the last two decades, the Internet has increasingly emerged as a key indicator of economic development. The growth of GDP in developing nations has coincided, among other factors, with the rapid expansion of Internet connectivity. Presently, approximately half of the global population utilizes the Internet, with access rates surging particularly in low-income countries. Theoretically, Internet access holds the potential to drive economic development through both supply-side and demand-side mechanisms. For instance, connectivity enables workers to perform tasks more efficiently and with

higher quality standards. It also facilitates broader access to markets and services via e-commerce, particularly benefiting rural or remote areas [3].

A research conducted in Asia in 2016 analyzed panel data spanning 191 countries globally from 1990 to 2015. The study's results reveal divergent outcomes between advanced and emerging economies. In highly developed nations, heightened Internet usage is associated with a more pronounced decline in the Gini Index, indicating diminished inequality. Conversely, the influence of Internet penetration on inequality within the Asia Pacific region seems to be minimal. Nevertheless, among Asia Pacific nations, those classified as developed encounter a lesser adverse impact on income equality from Internet usage compared to their developing counterparts [9, pp. 163-165].

In many large and advanced economies, the Internet has a notable influence on economic growth rates. Another research demonstrates that, on average, the Internet contributes 3.4 percent to GDP across major economies, which together represent 70 percent of global GDP. If Internet consumption and expenditures were classified as a sector, its economic importance in GDP would surpass that of the energy or agriculture industry. The Internet's overall contribution to global GDP exceeds the GDP of Spain or Canada and is expanding more rapidly than Brazil's GDP [7, pp. 1-9].

Initial setup costs for internet-based businesses or services can be significant, but once the online platform is established, the additional expenses per customer, user, or transaction are minimal. In many cases, the marginal cost per transaction approaches zero, as tasks that used to require manual labor are now automated. For purely digital products like e-books, production costs are also negligible. This cost structure leads to economies of scale, often strengthened by network effects, where the system's value grows with more users. Most "new economy" firms operate within this framework [5, pp.42-46].

Discussion. In the framework of current study we aimed to explore the role of various technological, qualitative and quantitative factors on the development of Armenia's economic development. For that purpose an econometric model representing the following function is being established:

$$Y_t = \alpha_0 + \alpha_1 * X_{1t} + \alpha_2 * X_{2t} + \alpha_3 * X_{4t} + \alpha_4 * X_{5t} + \dots + \nu_t \quad (1)$$

To build the model, we considered the quarterly volume of output of information and communication services in GDP, in current prices (in the model: Y), the volume of imports of innovative equipment in quarterly terms, in current prices (in the model: X1), the average monthly traffic per 1 subscriber, in megabytes (in the model: X2) and in minutes (in the

model: X3), the volume of loans attracted by the telecommunications sector (in the model: X4).

Our preliminary data set contains 36 observations covering the period from January 2013 to December 2021. In the case of imports of innovative equipment, their value, expressed in US dollars [8], was recalculated in Armenian drams using the corresponding monthly exchange rate data published by the Central Bank of Armenia (CB) [1]. The model was evaluated using the least squares (OLS) method using the Eviews 4 software package, a linear model was selected:

$$y = f(X_1, X_2 \dots X_n) \quad (2)$$

The main hypothesis put forward by us in this study is that the GDP generated by the sector is significantly influenced by the cost of importing equipment, the volume of loans attracted, and the average monthly Internet and telephone traffic per 1 subscriber.

To confirm or disprove the hypothesis, we first checked the time series, and then estimated the correlation that exists between the variables that we included (Table 1).

Table 1: Correlation matrix

	Y	X ₁	X ₂	X ₃	X ₄
Y	1				
X ₁	0.49	1			
X ₂	0.96	0.37	1		
X ₃	0.29	-0.03	0.3	1	
X ₄	-0.05	-0.25	-0.006	0.25	1

where:

Y – is the quarterly volume of output of information and communication services in GDP

X₁ – is the volume of imports of innovative equipment in quarterly terms

X₂ – is the average monthly Internet traffic per 1 subscriber, in megabytes

X₃ – is the average monthly call traffic per 1 subscriber, in minutes

X₄ – is the volume of loans attracted by the telecommunications sector

The correlation coefficient between the independent variables does not exceed 0.5, which indicates the absence of multicollinearity.

There is a positive correlation between the GDP (Y) generated by the sector and the cost of importing innovative equipment (X₁), there is a direct correlation between factors: the growth of one leads to the growth of the other. Similarly, there is a positive correlation between Y and X₂, X₃. The relationship between Y and X₄ is reversed.

According to Table 1, there is a high correlation coefficient only between the GDP generated by the sector and two factors: the volume of equipments' imports and the average monthly Internet traffic per 1 subscriber are 0.49 and 0.96, respectively. Additionally the corresponding determination coefficients are calculated and are equal to 0.24 and 0.92, respectively. That is, the formation of the quarterly volume "information and communication" is influenced by the import of equipment by 24%, and the average monthly Internet traffic used by 1 subscriber is 92%.

Based on the matrix of correlation coefficients, for the regression model we consider the volume of output by sector in GDP, the average monthly Internet traffic per subscriber in megabytes, and the volume of equipment imports. The correlation between the other variables is rather weak, so we will not consider them in the model.

Features of the econometric model

We performed the analysis using the EViews4 econometric package using the least squares method. Data overview for the first quarter of 2013- the fourth quarter of 2021 (Table 2).

Table 2: Results of Regression model

Dependent Variable: Y				
Method: Least Squares				
Date: 09/26/23 Time: 15:24				
Sample: 2013:1 2021:4				
Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X ₁	0.347084	0.100030	3.469790	0.0015
X ₂	32001.05	1574.298	20.32719	0.0000
C	3.50E+10	9.61E+08	36.37859	0.0000
R-squared	0.943772	Mean dependent var		4.87E+10
Adjusted R-squared	0.940364	S.D. dependent var		8.77E+09
S.E. of regression	2.14E+09	Akaike info criterion		45.88815
Sum squared resid	1.52E+20	Schwarz criterion		46.02011
Log likelihood	-822.9868	F-statistic		276.9465
Durbin-Watson stat	1.601438	Prob(F-statistic)		0.000000

As we can see from the table, the included independent variables are statistically significant- **Prob.<0.05**. Tests to verify the model's accuracy were conducted.

To analyze the quality and significance of the model we look into the set of indicators obtained in the resulting table. To evaluate the quality of the regression model, we first consider the multiple correlation coefficient R and the coefficient of determination R². According to the resulting table, the coefficient of determination is **R²=0.94**, and the multiple correlation coefficient is **R=0,97**. This indicates that the variables included in the model explain 94.38% of the changes in GDP generated by the sector.

F-statistic=276.95, high and significant (p-value = 0.0000), so the model is statistically significant.

Therefore, the results obtained using the factors we selected indicate the statistical significance of the model.

As a result, we get the impact of the volume of imports of innovative equipment in quarterly terms and the average monthly Internet traffic per 1 subscriber, in megabytes on the quarterly volume of output of information and communication services in GDP which is represented by the following regression equation:

$$Y = C_1 * X_1 + C_2 * X_2 + C_3 \quad (1)$$

According to the obtained coefficients, we have the following equation (2):

$$Y = 0.35 * X_1 + 32001 * X_2 + 3.5 \quad (2)$$

Economic interpretation of the model results.

- An increase of 1 million drams in the volume of equipment imported by communications organizations leads to a 350,000 dram increase in the GDP generated by the industry, assuming all other factors remain constant.

- A quarterly increase of 1 MB per user in average Internet usage contributes to a rise of AMD 32,001 in the GDP generated by the sector each quarter.

Thus, as a result of our calculations, we have identified the relationship between the outcome indicators and the factors.

Conclusion

The findings from the literature review and our econometric model highlight the significant positive impact of Internet usage and infrastructure development on economic growth. Increased Internet penetration consistently correlates with higher GDP across various regions.

Our study of the Armenian economy supports these global trends. We found that a 1 million dram increase in equipment imports by communications

organizations leads to a 350,000 dram rise in GDP. Additionally, a quarterly increase of 1 MB per user in average Internet usage results in a 32,001 dram increase in GDP each quarter. These results demonstrate the substantial economic benefits of improving Internet infrastructure and usage.

In summary, our analysis confirms the crucial role of Internet development in driving economic growth. Continued investment in Internet infrastructure is essential for sustaining and accelerating economic progress, especially in developing countries, where it can significantly enhance productivity, market access, and overall economic development.

Literature review

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