THE RELATIONSHIP BETWEEN INTERNET USAGE AND GDP PER CAPITA

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Abstract

This paper examines the relationship between internet penetration and GDP per capita across 30 countries, focusing on the exponential nature of this association. Using data from the World Bank, the study applies graphical analysis and a log-linear regression model to assess how expanding digital connectivity relates to national income levels. Prior research has shown that the economic impact of internet penetration tends to be stronger in both highly developed and rapidly developing countries. In contrast, the effect observed in this study is more modest, suggesting that the income gains associated with increased internet usage are not uniform across contexts. Moreover, high levels of digital connectivity do not necessarily indicate strong or comprehensive digital infrastructure, which may help explain variations in economic outcomes across countries. Overall, the findings highlight the potential contribution of digital connectivity to economic development while underscoring the importance of broader infrastructure quality and country-specific conditions.

Keywords: *digital connectivity, economic growth, GDP per capita, exponential functional relationship*

MARRËDHËNIA MIDIS PËRDORIMIT TË INTERNETIT DHE PPB PËR FRYMË

Abstrakt

Ky punim shqyrton marrëdhënien midis penetrimit të internetit dhe PBB-së për frymë në 30 vende, duke u fokusuar në natyrën eksponenciale të kësaj lidhjeje. Duke përdorur të dhëna nga Banka Botërore studimi aplikon analizë grafike dhe një model regresioni log-linear për të vlerësuar se si zgjerimi i lidhshmërisë digjitale lidhet me nivelet e të ardhurave kombëtare. Kërkimet e mëparshme kanë treguar se ndikimi ekonomik i penetrimit të internetit priret të jetë më i fortë si në vendet shumë të zhvilluara, ashtu edhe në ato me zhvillim të shpejtë. Në kontrast, efekti i vëzhguar në këtë studim është më i moderuar, duke sugjeruar se përfitimet në të ardhura që lidhen me rritjen e përdorimit të internetit nuk janë uniforme në të gjitha kontekstet. Për më tepër, nivelet e larta të lidhshmërisë digjitale nuk nënkuptojnë domosdoshmërisht një infrastrukturë digjitale të fortë apo gjithëpërfshirëse, gjë që mund të shpjegojë ndryshimet në rezultatet ekonomike midis vendeve. Në tërësi, gjetjet theksojnë kontributin potencial të lidhjes digjitale në zhvillimin ekonomik, ndërkohë që nënvizojnë rëndësinë e cilësisë së infrastrukturës më të gjerë dhe kushteve specifike të secilit vend.

Fjalë kyçe: *analizë statistikore, impakt, lidhje dixhitale, PBB për frymë, rritje ekonomike*

Introduction

As internet access becomes an essential component on our lives, its potential economic impacts have come under growing attention. By extending access to information, boosting business operations, promoting innovation, and generating new job possibilities, internet use can stimulate economic growth. This paper analyses the statistical relationship between increased internet penetration and GDP, a common indicator of national economic performance. While many people claim that income levels and digital access have a direct connection, it is important to examine this relationship through statistical methods. Some studies argue that the internet boosts economic opportunity and productivity, and others point out that other

elements like infrastructure, policy quality or education, could serve as a mediating component in this relationship. In order to figure out if there is a meaningful correlation between internet usage and GDP per capita, this study will examine data from 30 different nations. By applying simple regression analysis, this research aims to measure the strength and direction of this relationship, offering insights into the role of digital connectivity into shaping economic outcomes.

Literature Review

The connection between digital connectivity and economic performance has been the subject of a considerable academic interest, in the recent decades. Numerous academics have examined how internet availability affects productivity, innovation, and national income levels as it grows throughout the world. Overall, most studies suggest that higher levels of internet usage are positively correlated with economic growth, still the strength and nature of this relationship may vary by region, income level, advancement on infrastructure etc. According to a Word Bank report by Qiang et al. (2009), developing nations GDP may rise by 1.21% for every 10% increase in broadband adaption. Their results demonstrate how internet may be a game changing instrument for inclusive development and productivity. In the same manner, Czernich et al. (2011) discovered that broadband infrastructure significantly increased GDP in OECD countries, indicating that internet growth promotes long-term economic output, especially when combined with sensible regulatory frameworks.

Choi and Yi (2009) conducted a cross-country panel analysis and found that, even after controlling for other important variables like trade openness and education, internet usage ad a statistically significant positive effect on GDP per capita. This is consistent with Katz and Koutroumpis (2013) research, which showed that investing in digital infrastructure is essential for increasing national productivity, particularly in low and middle income nations. Nevertheless, the linearity of this relationship remains contested. Goldfarb and Tucker (2012) caution that the economic benefits of internet adoption often accrue first, and more intensely, to individuals with higher educational attainment, stronger digital competencies, and better access to financial resources.

According to this perspective, balanced development cannot be ensured by internet access alone unless it is supported by

complementary social and economic policies. The World Bank (2016) also points out that although digital technologies have a lot of potential, their real influence is mostly dependent on the existence of "analog complements" such as regulation, educational systems and institutions. Without these, digital divide may persist or even widen. Muto and Yamano (2009) discovered in a regional of Sub-Saharan Africa that the implementation of internet and mobile connectivity increased household income and agricultural market participation, emphasizing the transformative potential of digital tools in rural, underdeveloped areas. Their results, reinforce the argument that internet access can lead to new business opportunities, particularly in areas where physical infrastructure remains limited. On the other hand, Hilbert (2010) highlighted that the economic advantages of internet use are not always present in the meta analysis of digital development in Latin America. He noted that countries with week institutions or poor educational systems often experience limited returns on digital investment. This supports the idea that, even if internet access has the potential to be a significant economic driver, its effects must be sustained by more extensive structural changes and inclusive policies. When combined, these studies provide a strong theoretical framework for examining how internet access affects GDP per capita. Despite the majority favour a positive association, they also imply that more general structural and environmental factors may have an impact on the relationship. Building on previous research, this study examines data from 30 nations to discover if and to what degree there is a statistically significant correlation between increased internet usage and GDP per capita.

Methodology

Procedure and data analysis

This study adopts a quantitative research methodology to examine the relationship between GDP per capita and internet usage across a sample of 30 countries. The primary objective is to determine whether a statistically significant correlation exists between the share of the population with access to the internet and GDP per capita measured in U.S. dollars, which serves as a key indicator of a country's economic performance and standard of living.

The analysis relies on secondary data obtained from reputable international sources, specifically the World Bank Open Data and Our

World in Data (2023), ensuring reliability and comparability across countries (Table 1). By utilizing cross-country data, this study aims to capture broad patterns in the association between digital connectivity and economic output, providing empirical evidence on the potential role of internet access in supporting economic development. All statistical computations and estimations were carried out using Microsoft Excel for data processing and Eviews for econometric analysis. Excel was additionally employed to produce graphical visualizations supporting the identification of the functional relationship between the variables. The assessment of the fundamental assumptions of the simple regression model, specifically the normality of residuals, autocorrelation, and heteroskedasticity, was carried out in EViews.

Table 1: Internet users (%) and GDP per capita ($) in 30 countries

Countries	Internet users (%)	GDP per capita ($)
Norway	98	87.93k
Germany	92	54.34k
United States	93	82.77k
Canada	94	53.43k
France	87	44.69k
China	77	12.61k
India	55	2.48k
Brazil	84	10.29k
Nigeria	39	1.60k
Australia	97	64.82k
Japan	87	33.77k
South Africa	75	6.02k
Mexico	81	13.79k
Russia	92	13.82k
Sweden	95	55.52k
Switzerland	97	99.56k
Spain	95	33.51k
Italy	87	39k
Turkey	86	13.11k
Indonesia	69	4.88k
South Korea	97	33.12k
The Netherlands	97	64.57k
Pakistan	27	1.37k
Argentina	89	14.92k
Egypt	72	3.46k
Thailand	89	7.18k

Vietnam	78	4.28k
Kenya	35	1.95k
Saudi Arabia	100	33.09k
Albania	83	8.58k

Source: World Bank (2023)

Research Question

To what extent does Internet use (% of the population) influence GDP per capita across countries?

Based on this question, the statistical analysis focuses on two key variables:

- Independent Variable (X): Internet use (% of population)
- Dependent Variable (Y): GDP per capita (current US dollars)

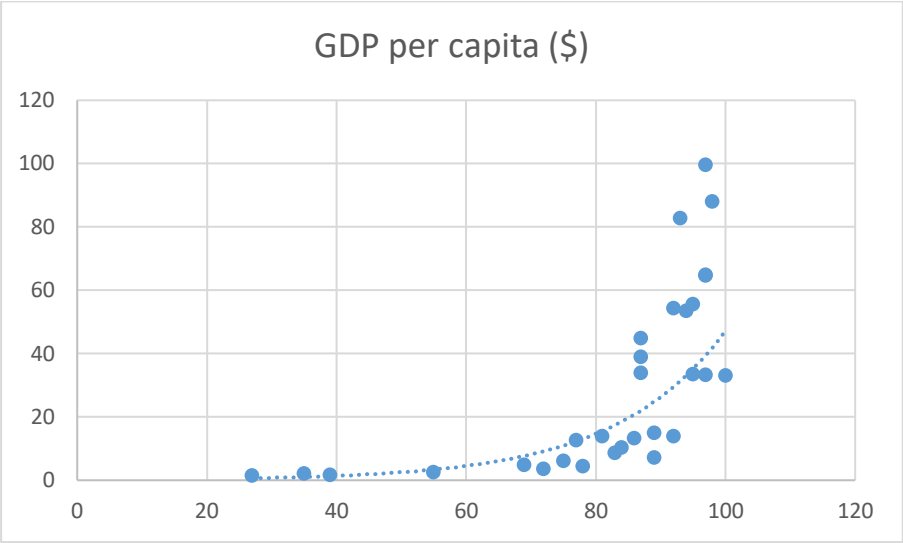
To empirically test the relationship, the following hypotheses were specified:

- Null Hypothesis (H_0): There is no significant relationship between Internet use and GDP per capita.
- Alternative Hypothesis (H_1): There is a significant relationship between Internet use and GDP per capita.

Results

Initially, the data presented in Excel were examined graphically to obtain a visual understanding of the functional form of the relationship between the two variables. By comparing several candidate functional forms, including linear, exponential, logarithmic, quadratic, power, and reciprocal specifications, the exponential model emerged as the most appropriate representation of the relationship between the variables, as also visually suggested by the scatter plot (Figure 1).

Figure 1. Internet use (%) vs GDP per capita



The functional relationship between the two variables is expressed as: $Y = \alpha e^{\beta X}$, which, in order to be linearized, can be transformed into a log-linear equation of the form:

$$\text{Ln(GDP per Capita)}=\beta_0+\beta_1\times\text{Internet Usage (\%)}$$

Results and Discussion

The results of the log-linear econometric model are presented in Table 2.

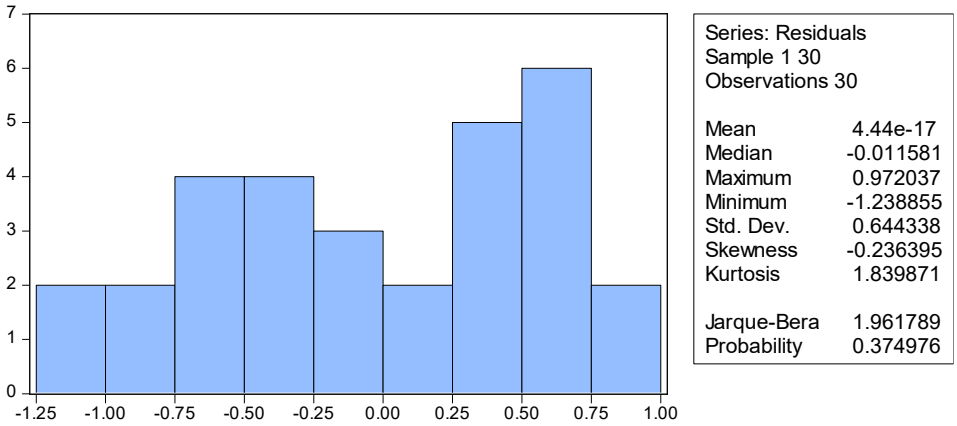
Table 2. Simple regression output

Dependent Variable: LOG(GDP_PER_CAPITA__$_)				
Method: Least Squares				
Sample: 1 30				
Included observations: 30				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTERNET_USERS___	0.058469	0.006356	9.198765	0.0000
C	-1.993561	0.532093	-3.746637	0.0008

R-squared	0.751370	Mean dependent var	2.775536
Adjusted R-squared	0.742491	S.D. dependent var	1.292222
S.E. of regression	0.655743	Akaike info criterion	2.058244
Sum squared resid	12.03996	Schwarz criterion	2.151657
Log likelihood	-28.87366	Hannan-Quinn criter.	2.088128
F-statistic	84.61728	Durbin-Watson stat	1.165686
Prob (F-statistic)	0.000000		

Before interpreting the model parameters, the normality of the residual distribution was formally verified, as evidenced by a non-significant Jarque–Bera test ($p > .05$) (Figure 2).

Figure 2. Histogram and distribution statistics of the model residuals



No residual autocorrelation was detected, given that the Lagrange Multiplier–based statistic produced a non-significant p-value ($p > .05$) (Table 3).

Table 3. Results from Breusch-Godfrey Serial Correlation LM Test

F-statistic	2.706510	Prob. F(2,26)	0.0856
Obs*R-squared	5.169531	Prob. Chi-Square(2)	0.0754

In addition, homoskedasticity of the residuals was supported by the Breusch–Pagan–Godfrey test, given that the p-values of the relevant test statistics were greater than .05 (Table 4).

Table 4. Results from Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.076622	Prob. F(1,28)	0.7840
Obs*R-squared	0.081871	Prob. Chi-Square(1)	0.7748
Scaled explained SS	0.029949	Prob. Chi-Square(1)	0.8626

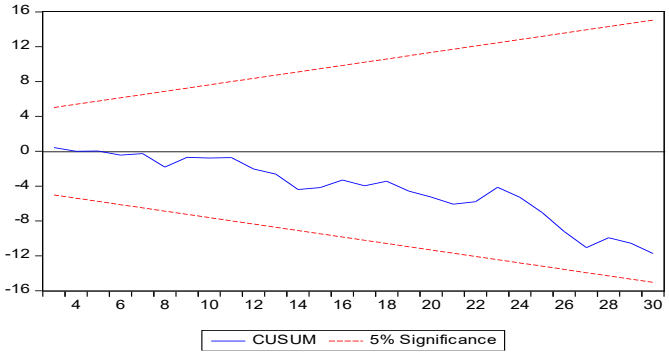
After confirming that none of the model assumptions related to the residuals were violated, we proceeded to the interpretation of the estimated model parameters.

As shown in Table 2, the model demonstrated good overall fit. The p-value associated with the F-statistic was less than .0001, indicating that the model was statistically significant. The coefficient for Internet use exerted a statistically significant effect on GDP per capita, as evidenced by the corresponding t-statistic, whose p-value was also below .0001. Furthermore, Internet use accounted for 74.25% of the total variance in GDP per capita, as reflected by the adjusted coefficient of determination ($R^2 = 0.7425$).

The estimated regression coefficient $b_1=0.058$ indicates that a 10% increase in Internet use is expected to result in a 0.58% increase in GDP per capita.

As shown in Figure 3, the model demonstrated predictive stability, with the recursive estimation line lying entirely within the 95% confidence limits, consistent with the results of the CUSUM test.

Figure 3. Recursive estimation line of the model



The results of the statistical analysis conducted on data from 30 countries regarding the relationship between the percentage of broadband Internet use and GDP per capita indicated that the estimated model was adequate, stable, and compliant with its core assumptions. The independent variable explained a substantial proportion of the total variance in the outcome variable (approximately 75%). The exponential functional form emerged as the most appropriate specification, as it better accommodates the heterogeneity present in the sample, which includes both developed and developing countries. In contrast to earlier findings (Qiang et al., 2009), which were based on statistical analyses of more homogeneous samples, where developed and developing countries were examined separately, our sample exhibits greater heterogeneity. The regression coefficient estimated in our model is smaller than the values of 1.21 and 1.38 found in previous research for high-income countries and for low- and middle-income countries, respectively.

This discrepancy can be explained primarily by the greater heterogeneity of our sample, which includes both developed and developing economies analyzed jointly. Such heterogeneity tends to average out country-specific effects, thereby reducing the magnitude of the estimated elasticity. Additionally, the exponential functional form selected for our model captures non-linearities associated with diminishing marginal returns to Internet use, particularly in countries where broadband adoption is already high. In contrast, Qiang et al. employed separate models for more homogeneous country groups, a strategy that typically produces larger coefficients due to more uniform structural conditions and growth dynamics. Taken together, these factors provide a coherent explanation for why the elasticity estimated in our study is comparatively lower.

Conclusion

This research identifies a strong and statistically significant positive association between internet usage and GDP per capita. Countries with higher levels of internet access generally exhibit stronger economic performance, suggesting that digital connectivity is an important driver of economic growth. The findings indicate that expanding internet access, particularly in developing economies, may serve as an effective policy tool for fostering economic development.

Nevertheless, internet usage is not the sole determinant of economic output, even though it contributes meaningfully to variations in GDP per capita. National economic performance is also shaped by factors such as physical infrastructure, governance quality, and educational attainment. Future research could incorporate these additional variables to develop a more comprehensive understanding of economic growth in an increasingly digitalized global economy.

References

Choi, C., & Yi, M. H. (2009). The effect of the Internet on economic growth: Evidence from cross-country panel data. *Economics Letters, 105*(1), 39–41.

Czernich, N., Falck, O., Kretschmer, T., & Woessmann, L. (2011). Broadband infrastructure and economic growth. *The Economic Journal, 121*(552), 505–532.

Goldfarb, A., & Tucker, C. (2012). Internet advertising and the new media ecosystem. *Industrial and Corporate Change, 21*(1), 1–27.

Hilbert, M. (2010). *When is cheap, cheap enough to bridge the digital divide? Modeling income-related structural challenges of technology diffusion in Latin America*. World Development, 38(5), 756–770. https://doi.org/10.1016/j.worlddev.2009.11.019

Katz, R., & Koutroumpis, P. (2013). Measuring digitization: A growth and welfare multiplier. *Technovation, 33*(10–11), 314–319.

Muto, M., & Yamano, T. (2009). *The impact of mobile phone coverage expansion on market participation: Panel data evidence from Uganda*. World Development, 37(12), 1887–1896.

Qiang, C. Z., Rossotto, C. M., & Kimura, K. (2009). *Economic impacts of broadband*. (World Bank Report).

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https://doi.org/10.1016/j.econlet.2009.06.003
https://doi.org/10.1111/j.1468-0297.2011.02420.x
https://doi.org/10.1016/j.ijindorg.2012.01.006
https://doi.org/10.1016/j.technovation.2013.06.004
https://doi.org/10.1596/978-0-8213-7605-8
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD
https://data.worldbank.org/indicator/IT.NET.USER.ZS