Semestre Económico (2022), 11(1), 38–48
doi:10.26867/se.2023.v12i1.143
http://semestreeconomico.unap.edu.pe/index.php/revista/index
ISSN: 2072-0572 (Versión impresa) **ISSN: 2523-0840 (Versión digital)**

ARTÍCULO ORIGINAL

Internet access and socioeconomic determinants in Peru, period Altiplano 2016-2019.

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(Received January 05, 2023; accepted April 15, 2023)

Abstract

In Peru, internet access is scarce, due to its high payment in acquisition and low coverage or broadband. Considering that currently it has become an extremely necessary service for daily life, having an impact on inequality in various aspects such as the acquisition of better information, communication and streamlines processes. The main objective of this research is to analyze internet access and identify the main socio-economic factors that influence internet access in Peru during the 2016-2019 period. For this, the National Household Survey (ENAHO) was taken a sample of 142,396 households for the analysis of internet access and to identify the main socioeconomic factors that influence internet access 9,612 households, using the panel data methodology. Among the main results prevails, the Coast as a region with a greater number of households in internet access compared to the Sierra and Selva regions, likewise the urban area is the one with more households in internet use unlike the rural one, but in general, there are mostly more households without internet access compared to households with internet. In addition, it was obtained that the main socioeconomic determinants that influence internet access are; household income, age of the head of household, years of education of the head of household (positively and with a significance level of 1%) and poverty (negatively with a significance level of 1%).

Keywords: internet access, panel data, gap, socioeconomic factors.

1. Introduction

In the last decade, Internet access has caused changes in many dimensions of society. It is now possible to perform various activities from the comfort of the home, such as shopping, studying, paying bills and working. Several of these activities are now possible thanks to the Internet, thus generating positive externalities that increase productivity and innovation in a country and its economy (Autor et al., 2003).

Thanks to technological innovation, as well as the display of network infrastructure, which has been developing in the telecommunications market over the last decades, people are integrated or connected to a greater extent through Information and Communication Technology (ICT), this is carried out both regionally and worldwide, thus facilitating greater globalization internationally, economically, culturally and socially (Ponce & Rojas, 2010).

According to the Supervisory Body for Private Investment in Telecommunications (OSIPTEL, 2011) ICTs are considered the electronic media that streamlines the management, storage, creation and dissemination of information, as well as communication between people in an economy. Among the information and other communication media are television, fax, radio, telephony, computers and,

of course, the Internet. Echeverría (2001) considers that at a social level, the efficient use of ICTs helps people to have better and more information, in a timely and rapid manner, making possible an improvement in different aspects such as social development, health and education; it allows for greater integration, providing greater opportunities and good conditions that enable human capabilities, promoting a democratic and equal society.

The Internet, as has been emphasized since the work of Becker (1993), makes possible the access to knowledge, being a primordial factor for development, becoming a priority where the population has the information available, since we must take into account that information needs to be transmitted economically and quickly for the realization of human activities.

The Internet is represented as a pillar of sustainable development, and improves the quality of education in a potential way, as indicated by the Internet Society (2017), where legislators establish five priorities, which are: inclusion, infrastructure and access, capacity, content and devices, vision and policies. If the internet community and legislators work together, if policies would be developed with a comprehensive approach, having the necessary infrastructure and resources, access to devices and content, creating capacities, so ensuring inclusion by adapting to the circumstances. The aforementioned contributes to the implementation of the Sustainable Development Agenda, to a better education and an information society that satisfies the needs of the entire world.

In developed countries, the presence of the Internet is dependent on interests, individual preference and certain restrictions, as well as on the expansion of infrastructure, although to a lesser extent. In Latin America and the Caribbean, the situation is similar; there are factors that limit the capacity to use and consume technology. The gap in Internet demand becomes more important over time, even with a large number of restrictions in different countries, the factors that generate the gap are the structure linked to socioeconomic variables in the field of income, geographic location and education; it also considers the accessibility of broadband, taking into account the level of service fees and income (Economic Commission for Latin America and the Caribbean [ECLAC], 2013). In South America and Latin America, Peru has the highest number of Internet users, but if we compare it with those members that make up the Organization for Economic Cooperation and Development (OECD) and the Asian Tigers, we represent a low level and lag behind this group of countries, in the collection of such technology, the difference is notorious since a gap is generated which continues to grow with the passage of time (Huaroto, 2012). The National Institute of Statistics and Informatics (INEI), for the year 2018 its statistical data show that 56.2% of the population has internet service. In contrast, in 2017 in one quarter there is an increase from 50.7% to 56.2% having a difference of 5.5 percentage points. For Metropolitan Lima, internet use in the population was 77.0%, in total, of which the rural sector represents 17.9% and the urban sector 59.1%. The above detailed, it can be inferred that only in certain places and for a short time, it is possible to reach an optimal consumption of the service, in addition to the fact that this good is considered of utmost importance for decision making; the concern arises to know what aspects or factors would influence when making the decision to consume or not the internet. In this aspect, Peru still needs to improve internet access, so that the population has greater opportunities.

Likewise, before making the decision of whether or not to obtain a good, the consumer's behavior should be analyzed and in this way it will be observed how a person achieves the desired welfare (Coronado, 2019).

Marshall (1963) mentions that both demand and supply are the source of microeconomics, implying that if a product has a lower price, the greater the possibility of selling it, or conversely, if the price is higher, sales will be lower. In this way, consumer behavior is oriented to the satisfaction of their utility and the decisions they make when buying are conscious, rational and according to their availability. To satisfy the needs of the individual or group, it is done through the procurement or use of goods or services (Fernandez, 2014). In addition, nowadays, a consumer is exposed to the change or evolution of technology and society.

On the other hand, taking into account the work done by Ortiz and Ruiz (2014), this examines

the impact of use and access to internet service in Peruvian households. To do so, they consider panel data from the National Household Survey (ENAHO) from 2007 to 2009, applying the Differences in Differences (DID) method, they obtain the following. Total household expenditure, income level, number hold members with adequate employment and higher education are positively affected by Internet access. In 2011, at least one member of the household can access the Internet, representing 59%, of which the urban area has the highest concentration with 71.3% as opposed to the rural area with only 22%. This shows that there is a gap in infrastructure which must be filled, and the State has been applying certain initiatives in the "National Plan for the Development of Broadband", aiming that the different regions of the country can have access to the Internet by making a fiber optic network. This work, among others, will serve as a reference for the discussion of the present work.

2. Materials and methods

The population under study is referred to as the set or sum of all private dwellings and their occupants residing in the urban and rural areas of the country (Instituto Nacional de Estadística e Informática [INEI], 2019).

2.1 Type and sample size

The sample is of the probabilistic type, with stratified areas, multistage and independent by department or region under investigation. The sample results have a confidence level of 95% (INEI, 2019). In objective 1, as a sample, households in urban and rural areas were considered, whether coast, highlands and jungle of Peru, with a total of 142396 households, in the period 2016 - 2019, this in Table 1 is detailed.

Table 1. Distribution of the sample by geographic domain 2016 - 2019.

Year	Geographic Domain			Total
	Costa	Sierra	Selva	
2016	17313	11506	6966	35785
2017	16934	10631	7019	34584
2018	18983	10928	7551	37462
2019	17581	9994	6990	34565
Total				142396

Source: INEI-ENAHO

Thanks to the annual ENAHO surveys, a panel sub-sample was made for objective 2, which consists of interviewing a population or households year by year, thus obtaining a sample of four panel-type periods. Table 2 shows the distribution by geographic area after balancing T=4 years, thus identifying n=2,403 households per year, with a total sample of 9,612 observations (Nt=2,403*4=9,612).

2.2 Information Sources

The information was obtained from ENAHO which is generated by INEI, these are secondary source data corresponding to the period 2016 - 2019. Four modules were used to obtain the necessary information: (1) Housing and Household Characteristics, (2) Characteristics of Household Members, (3) Education and (34) Summaries (Calculated Variables).

2.3 Description of methods

An econometric model using panel data was used to estimate the socioeconomic factors that influence Internet access in Peruvian households for the period 2016-2019.

2.4 Panel Data Model

According to Gujarati and Porter (2009) panel data attach the dimension of space and time. Panel data are called by different names, such as pooled data (grouping of time series and cross-sectional observations); mixture between time series and cross-sectional data; longitudinal data (a study over time of a variable or group of subjects); micro-panel data.

But taking into account that the dependent variable is dichotomous, a Logit model is considered, where the continuous dependent variable is transformed to binomial when it takes values of 1 if the event occurs and 0 if it does not occur. This econometric model is called binomial or discrete.

2.5 General model

Considering the above, the econometric model to be estimated is as follows:

$$INTER_{it} = \beta_0 + \beta_1 ING_{it} + \beta_2 EDAD_{it} + \beta_3 NPEE_{it} + \beta_4 ELEC_{it} + \beta_5 POB_{it} + \beta_6 AE_{it} + \varepsilon_{it}$$
$$i = 1, 2, ..., 2403 \quad (1)$$
$$t = 2016, 2019$$

Where: Households with internet connection (INTER), household income (ING), age of household head (EDAD), number of household members of school age (NPEE), household has electricity (ELEC), poverty (POB), years of education of household head (AE), and error term (ε *or* μ).

Table 2. Identification of variables

Variable	Measurement unit	Quantification	Definition
Endogenous variable			
Households with internet connection	Dummy variable, where 1 refers to the household having an Internet connection and 0 indicates that the household does not have an Internet connection.	[1 - 0 yes or no]	It is know if the household or any member of the household has an Internet connection or not.
Exogenous variables			
Household income	Soles (S/.)	[400 - 4200 soles]	Refers to the total sum of income, both from the main and secondary activity and is received by the household.
Number of school-age members of household	Number of school-age household members	[3 - 17 years]	It is the total number of people are studying, taking into account the minimum years of education required and are living at home.
Age of head of household	Years completed	[18 - 90 years old]	Age in completed years of the person who is recognized as such by the rest of the household members.
Household has the electricity service	It is a dummy variable, where 1 refers to the fact that a household has the electricity service and 0 indicates that a household does not have electricity service.	[1 - 0 yes or no]	It is consist in the fact of whether the home has electricity service or simply does not have it.
Poverty	It is a dummy variable, where 1 refers to a household being poor and 0 refers to a household being non-poor.	[1 - 0 yes or no]	It is when a household has at least one social deprivation or insufficient income.
Years of education of the head household	Years completed	[0 - 18 years old]	Years of total education reported by the head of the family or household.

Source: INEI-ENAHO

3. Results and discussion

3.1 Household Internet access at the national level in Peru

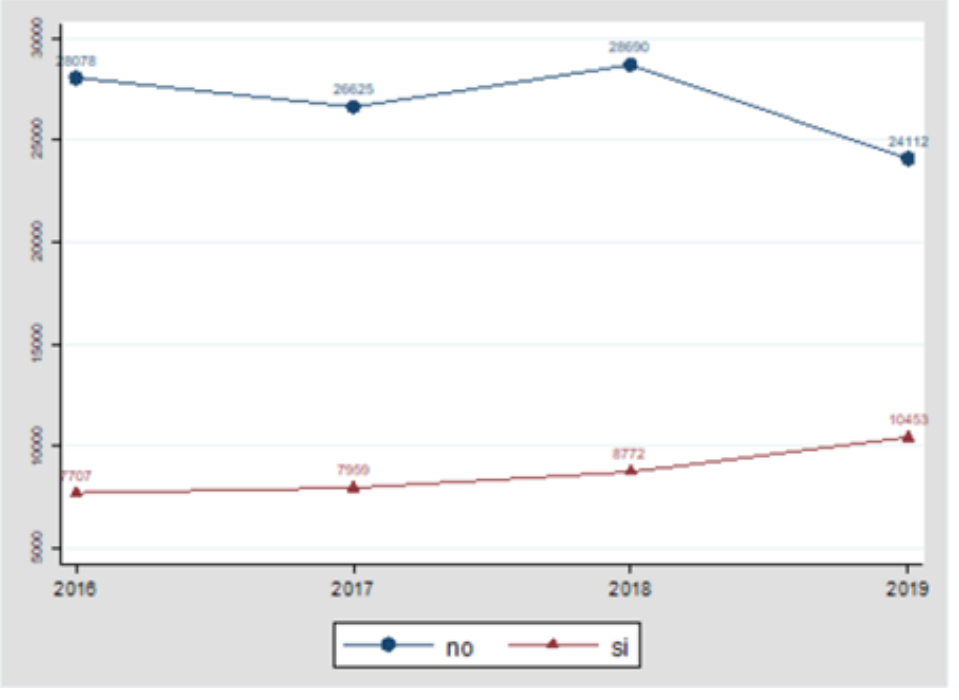
Internet access is measured by the number of households, which can access or not access the internet service at the national level, this is represented in Figure 1, for the period 2016 - 2019 analyzed year by year.

Starting with the year 2016, households nation wide accessing the internet are 7707, this is a much lower amount as opposed to the overall population of Peru at that time being 30,422,831. There is an increase of 252 households in the year after the initial one, it means in 2017, and 813 more households in 2018. Already in the year 2019 the number of households amount to 10453, having an increase of 2746 households, which choose for the use of the internet, the trend of access to internet service is upward or positive.

On the other hand, households that do not have internet access in 2016 are 28078, decreasing to 26625 in 2017, but in 2018 it reaches the amount of 28690 having a growth of 2065 compared to the previous year, this is carried out due to several factors. Finally in 2019, the number of households that do not have internet are 24112 decreasing again.

In view of this, a large technological gap can be seen, with reference to households that have or do not have Internet, which is of great significance since at the level of amount, households with Internet are denoted only of 7707 and those who do not have it with 28078 in 2017, representing approximately three times more, it would reflect an inadequate intercommunication or relationship, which if it were less would improve the quality of life of the person or household, such gap has been lessening over time, but still continues to show a considerable sum, shown in Figure 1. For this, the government promotes preventive actions and standards which would help to improve such situation.

Figure 1. Households with and without access to Internet in Peru



Source: INEI - ENAHO

3.2 Household Internet access in the Coast, Highlands and Jungle of Peru

Internet access is analyzed by natural regions, considering the coast, highlands and jungle of Peru.

- COSTA: With respect to households accessing internet in the four years of analysis, this is the most significant region, with an amount of 5371 for the year 2016, a year later only 9 households were added to the fact of having internet, but 2018 grew by 321 more users, later it reaches up to 6638 households in 2019, the growth in percentage is 23% corresponding to the initial year with increasing trend; but what happens with households that do not have internet access, this region would be as second with high amounts starting from 9970 up to 7628, it has decreasing trend. While it is true that there is not much difference between households that have internet with respect to those that do not, but it is expected to improve over time.
- SIERRA: This is the second region with the most households with internet access reaching 1536 in the base year of analysis, then increasing to 1641 and in 2018 already with 1959, but in greater amount in 2019 with 2366, growing in percentage 51%, unlike the coast, this area has a greater growth. In the case of households that do not have internet holds the first place with very considerable amounts of 11942 for 2016 decreasing to 11554, but in 2018 grows the amount to 13282 with respect to the previous year, decreasing again in the following year to 10943. The difference in amounts is clear, due to several aspects such as infrastructure, poor access and lack of knowledge about the service, there is already a lot to work on in this sector to reduce the gap.
- JUNGLE: Finally, there is the jungle, which in both cases, households with and without internet access, represent a small percentage, starting with a total of 800 households with internet access, rising by 138 in 2017, then adding 174 households and reaching 1449 from the base year to 2019, there was an 81% increase in access in this region. In the same way as the highlands, this region starts with high amount of households without internet being 6166 in 2016, rising in 2018 to 6439 and decreasing again in the following year, it was to be expected such trend if we remember the previous figure. Making the simple comparison from 800 to 6166 there would be an abysmal difference.

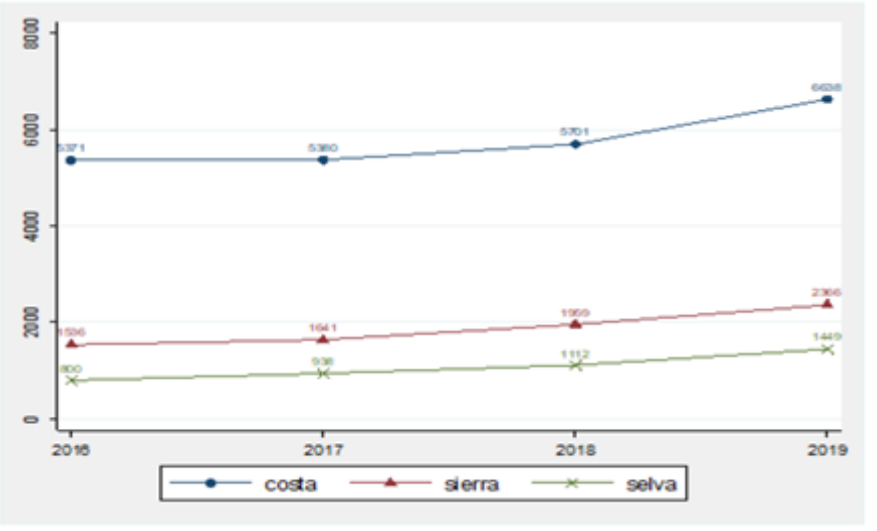
If we consider the year 2016, and compare the number of households with internet or those without access to it, there is a difference of 5366 households in the jungle, that is, if we take into account the amounts of households with internet access (N=800) and compare it with those without internet (N=6166), we find that there are much more households without internet and this would be the amount in difference generating gap between the two, of which this amount decreases to 4092 already in 2019. Figure 2 indicates that in the case of the Sierra the amount is higher being 10406 in 2016 and year after year it decreases to 8577; finally, there is the Coast but it has a lower proportion in difference starting with 4599 and reaching 990 for 2019. It can be seen that the gap tends to be greater in the Jungle and Highlands regions, but less in the Coast, while it is expected to continue decreasing over the years.

Table 3. Average number of households with Internet access in Peru

REGION	YEARS OF STUDY				AVERAGE
	2016	2017	2018	2019	
Coast	5371	5380	5701	6638	5773
Highlands	1536	1641	1959	2366	1876
Jungle	800	938	1112	1449	1075

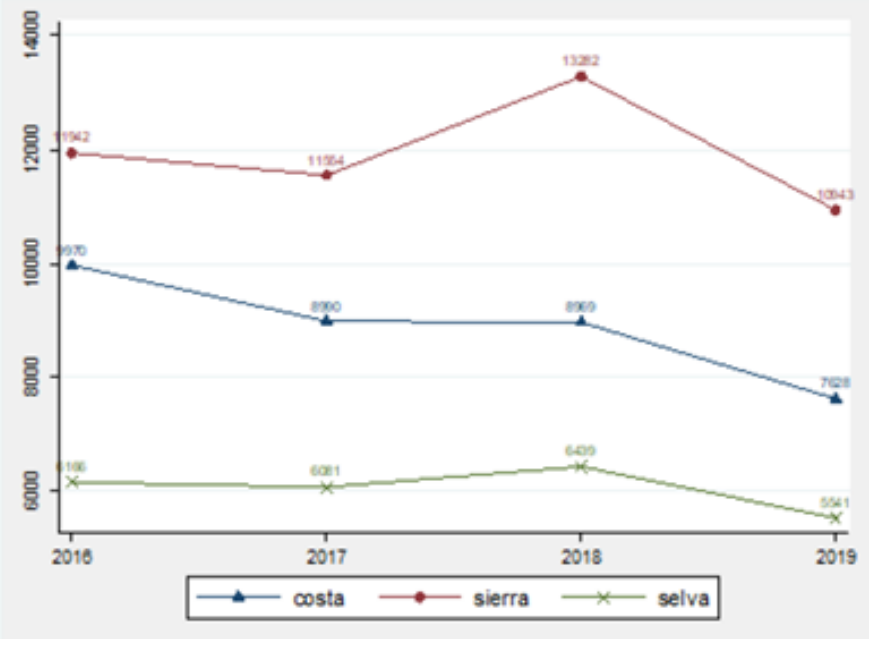
Source: INEI-ENAHO

Figure 2. Households with and without Internet access in the Coast, Highlands and Jungle of Peru (Households with Internet)



Source: INEI - ENAHO

Figure 3. Households with and without Internet access in the Coast, Highlands and Jungle of Peru (Households without Internet)



Source: INEI - ENAHO

3.3 Model estimation

In order to recognize which socioeconomic factors affect or influence in great proportion in the fact of accessing the internet service in households throughout Peru. An estimate is developed using the

data panel sample for the period from 2016 to 2019.

The model considered for the estimation is a logarithmic or Logit model rather than a probabilistic or Probit model because the last one can only be estimated by random effects. Once the above is defined, the fixed and random effects models are estimated, as shown in Table 4. In order to identify whether the fixed or random effects model is used, the Hausman contrast is applied, with a significance level of 1%, taking into account the following data of chi2(5)=66.80 and Prob>chi2=0.0000, being this better than 0.05, the results indicate that the fixed effects model should be used.

According to Table 4, the results show that the variables household income, age of the head of household, poverty and years of education of the head of household are significant at the 1% significance level. As for the variables of number of household members of school age and the household has electricity, although not significant, they influence to some extent the access or obtaining of Internet in the households.

In the household income variable, the coefficient of this variable turns out to be positive and significant, in other words, those households with higher incomes are more likely to access the Internet (if household income is increased by one sol, access to the Internet in the household would increase by 0.00044). As for the coefficient of the variable, age of the head of household, it is positive and significant, thus confirming that if the age of the head of household is older, access to the Internet becomes more possible, since the sample is larger in the range of 30 to 75 years of age of the head of household (when the age of the head of household increases by one year, access to the Internet increases by 0.04175). Likewise, variables such as the number of school-age household members and whether the household has electricity, increase the probability of accessing the Internet by 0.07274 and 0.22798 respectively; however, they are not statistically significant. The poverty variable has a negative but significant coefficient, indicating that if a household is increasingly poorer, it is unlikely to have access to the Internet. The opposite happens with the variable years of education of the head of household, which has a positive and significant coefficient, indicating that if the head of household has an additional year of education, the probability of accessing the Internet increases by 0.10701.

Table 4. Socioeconomic determinants of internet access for all households in Peru with panel data 2016 – 2019.

Variables	Fixed effects	Random effects
Household income	0.00044***	0.00092***
	(0.00007)	(0.00006)
Age of head of household	0.04175***	0.01603***
	(0.01247)	(0.00498)
Number of school-age household members	0.07274	-0.14761**
	(0.11254)	(0.06786)
Household has electricity	0.22798	1.61987***
	(0.93616)	(0.42714)
Poverty	-0.74068***	-1.24464***
	(0.24279)	(0.20908)
Years of education of head of household	0.10701***	0.22179
	(0.03349)	(0.01720)
Constant		-9.12155***
		(0.58399)
Lnsig2u		
Constant		1.37442
Number of observations	2016	9612
Chi2	70.84	541.99
Log likelihood	-718.01	-2462.86

Standard errors are in parentheses.
*,**,*** denote significance at the 10%, 5% and 1% level, respectively.

Source: INEI-ENAHO, Prepared by: INEI-ENAHO.

4. Discussion

The results obtained are consistent with the work of Ortiz and Ruiz (2014), who estimated the Differences in Differences method, which shows that the variables of total household expenditure, income, the number of household members with adequate employment and higher education are positively impacted. He also mentioned that internet access is mostly concentrated in urban areas compared to rural areas, evidencing that there is a gap in infrastructure which must be filled; he also announced that the State has been implementing initiatives, as set forth in the "National Plan for the Development of Broadband", aimed at building a fiber optic network.

Likewise, Becerra (2019) in his work, examines ICTs, including the Internet, estimated a logit-probit model, and finds statistically significant and positive impact of the independent variables, which are: the existence of electricity, income and the educational level of the head of household.

Household income is the main variable in statistical significance, which is supported by several authors, starting with Botello (2014), who contrasts the above at the departmental level and precisely in urban areas. Similarly, OSIPTEL (2011), although it focuses on the fact of acquiring a PC to acquire internet, indicates that low-income households face difficulties in acquiring goods, in this case computers, since they undergo changes or evolution year after year in design and model. On the other hand, Botello (2015) conducted a study for Ecuador on internet access and observed that the most relevant independent variable is income, in which households with higher incomes are the best favored, thanks to their geographic location; another equally important variable is educational level.

It is worth noting that, in the Peruvian case in general, there are currently no studies that analyze internet access as such, linking it to the independent variables mentioned in this study, and even more scarce is the consideration of panel methodology or other types of data, there are only alternative or linked studies, without an economic point of view, and only in a statistical way, providing data at a numerical level. Apart from the aforementioned, the present study considers several variables those are related to it, such as income, in addition to considering other variables such as the age of the head of household, poverty and years of education of the head of household.

5. Conclusions

Thanks to the results obtained in this research, the following conclusions are drawn:

1. Internet is currently considered a very important service, perhaps even a basic necessity, so Internet access in Peruvian households for the period 2016 - 2019, was increasing year after year, being only 7707 households in 2016 and reaching 10453 households with internet by 2019, where of the three regions in analysis of Coast, Highlands and Jungle. We conclude that, the Coast region prevails reaching an average of 5773 households with internet in the period of time in question, followed by the Highlands but with only 1876 households on average and finally the Jungle with 1075, but still these amounts are tiny with respect to households without internet access, where within it the urban area concentrates the largest number of households with internet access compared to the rural area, in this way the access or acquisition of internet in Peruvian households within the period 2016 - 2019, presents a growing trend compared to those households that do not have access to internet service. Taking into account the aforementioned, the hypothesis stated above is accepted.
2. When estimating the logit model with panel data, in the first instance the fixed effects model is considered as the most appropriate for the period 2016 - 2019. With this, we confirm that the most fundamental for accessing the internet is the household income, as well as the variables; age of the head of household and years of education of the head of household, these will be positive and significant at a significance level of 1%. As for the poverty variable, it also turns out to be significant but negative, indicating that if the household is in a situation of poverty, the possibility of accessing the internet will be lower. The variables referring to the number of household members of school age and household has electricity do influence to internet access, but they are not significant. ,

Therefore, we conclude that access to internet service in Peruvian households is influenced by the aforementioned variables, as a result we accept the hypothesis stated above.

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