Influence of ICT and Household Assets in the Penetration of Digital Economy in Mexico

An Empirical Analysis

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Abstract: The objective of this study is to validate the progress in the penetration of the digital economy in Mexico, between 2018 and 2022, from a composite index of household wealth based on microdata from a national telecommunications survey. An index of economic situation at the household level allowed us to measure that economic inequality persists between poor and rich households. Also, probabilistic regression models were used to validate the relationship between household wealth and digital economy participation. The models showed the gap remained practically at the same level between the two years; 26% in favour of the richest households. Educational level, age and experience in using the Internet were confirmed as the main differentiators in the condition of participation in the digital economy. The lack of progress observed in this research raises alarm bells about the lag of the poorest households in the productive use of the Internet and in the scope of its potential benefits. The digital issue should be included in the national political agenda, due to its scope in social, economic and social cohesion terms, along with other national problems, such as poverty, employment or well-being.

Keywords: digital economy, quantile regression, probit, household ICT wealth index, ENDUTIH.

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Introduction

At a global level, information and communications technologies (ICTs) are tools that enable rights to information, free expression, public participation, education, better health services and, ultimately, to be able to access a better quality of life. Furthermore, in different latitudes it has been found they can accelerate economic growth and positively impact productivity and employment (Ben Abdallah *et al.*, 2023; Katz, 2012; Pradhan, 2018). Therefore, at an aggregate level, interesting results are shown both in the aspect of telecommunications infrastructure and in their economic effect.

The pandemic accelerated the transition process towards the digital economy, since confinement forced people to use food delivery platforms, private transportation, and online buying and selling services, such as Amazon, AliExpress, eBay, Shopify, Uber and Rappi (CEPAL, 2023). It also encouraged the use of online financial services to carry out transactions, invest in financial or virtual assets, and so forth. According to official statistics from Mexico (ENDUTIH-INEGI, 2023) the percentage of people between 15 and 74 years old that used mobile banking services increased from 18.3% in 2018 to 23.3% in 2022, while people who carried out electronic commerce transactions increased from 18.2% to 43.9%. However, the literature that addresses the issue of the benefits of the digital economy from the demand side is scarce.

In such a context, the focus of this document is to fill a gap in the literature of the relationship between household assets and the digital economy. The validation of the relationship between these two variables is essayed to contribute a different scope. A strong assumption is that satisfaction with home, ICT and housing conditions positively influence the participation of people in the digital economy. The main background of this proposal is based on a study from India (Filmer & Pritchett, 2001) which accounted for the relevance of household asset variables. This research was done to describe the phenomenon of school access at a national or subnational governmental level, with the idea that complex phenomena in society can be explained with variables other than income or expenditure.

In microeconomic language, the principle of maximum utility (measured as satisfaction) is adopted, whereby more is better (Varian, 2010). In this research the reasoning is remarkably similar to that used in Varian's book, using 17 different variables to represent the welfare of the households (10 ICT assets and seven which represent household conditions habitability). Two editions of a national telecommunications survey, 2018 and 2022 (ENDUTIH-INEGI, 2023), are used to approximate progress in the use of the digital economy and account for inequalities in its use. A method is proposed to estimate digital gaps between households, based on socioeconomic variables. The sample is restricted to people between 15 and 74 years old.

Along with the implementation of a household wealth index to relate it to the digital economy, there is an absence of information on income or expenses. Consequently, the index is an input to measure the progress of the digital economy and inequalities in groups of households, according to their assets status. Therefore, said household wealth index is constructed and validated in two separate moments, 2018 and 2022, as an exercise that allows filling a gap on the issue of the digital economy in Mexico.

This article is structured as follows: the first section presents a review of the literature on the concept of digital economy and research for Mexico. Subsequently, the topic of advancement of digitalisation in Mexico is addressed, highlighting the main barriers to digital transformation. The fourth section presents the methodology, the work scheme and the variables used, both in the construction of the composite household index and in the probabilistic regression model by quantiles. Section five presents the results and their interpretation, as well as a sensitivity analysis. Subsequently, discussion sections, theoretical contributions, reflections on public policies and limitations are presented. Conclusions, references and an appendix are included in the final part of this literature review.

Varying definitions exist of what is meant by digital economy and its estimated size. The pioneering study of Tapscott in 1996 (in Bukht & Heeks, 2017, p. 4) defined digital economy as: "an economy based on digital technologies". However, Brynjolfsson & Kahin's (in Bukht & Heeks, 2017, p. 5) statement is more precise: "[it] refers specifically to the recent and still unrealised transformation of all sectors of the economy through the digitisation of information using computers." Nowadays, contemporary trends for the industry are reported (Groombridge, 2023). These represent new leading technologies in the industry such as digital immune system, applied observability, industrial cloud platforms, platform engineering, super applications, adaptive AI, metaverse and sustainable technology, among others.

According to the literature review, the relevance of the digital economy for a country seems clear, in terms of: i) new ways of production and distribution of goods and services (manufacturing, robotics, medicine, biochemistry, economics); ii) its impact on employment – valorisation and remuneration – of skills in more competitive markets; iii) its high added value, considering the amounts of capital and investment necessary for research and innovation; iv) institutional factors, such as the elements that allow for a smoother and more precise economic and social transition; and v) its contribution to aggregate income and general well-being.

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From an academic and scientific perspective, it has not been an easy task to reconcile the economic, technological and social impact aspects of the use of technology. For instance, there is a reduced amount of research accounting for the economic impact of the digital economy in Mexico. The aggregate data on electronic commerce in Mexico is encouraging: it increased from representing 3.3% of the national GDP in 2013 to 5% in 2021; more than USD66 billion (INEGI, 2023a). Digitalisation attracts positive expectations in the short and medium term; that is, the COVID-19 pandemic accelerated the use of the Internet and telecommunications networks for different academic, work and, in general, daily life activities globally.

The last perspective, the use of technology and its implications, is significantly more studied in Mexico; however, there have been few studies of the implications of COVID-19 in economic or social terms. The prevailing outcome is the digital transformation of the country with a rapid transition – although with obstacles – towards digital practice in education, health, interaction with the government, organisational aspects and, above all, in employment and the way of doing business. Thus, this study focuses a magnifying glass on inequalities in the specialised use of the Internet for online banking or electronic commerce activities.

The main antecedent of this proposal are studies that were carried out in India. Filmer & Pritchett (1999, 2001) constructed a household wealth index (at the level of countries and subnational governments) to validate its effect on school achievement. Their main findings were that a wealth index is a consistent and robust predictor as much or more than economic income or expenditure variables when studying social phenomena related to health or education. The proposal by Filmer & Pritchett (1999; 2001) of the composite index presented: i) internal consistency; ii) robustness; iii) comparison between territories; and iv) alternative interpretations .

In Mexico, a precedent for the use of household goods and services in studies on economic progress and economic inequality took place in the Espinosa Yglesias Studies Centre (Monroy & Vélez, 2023, p. 88). This group of researchers used a methodology to account for the disadvantaged conditions of the population to determine the social mobility of people through a household economic resources index (a list of 14 goods and services), with the purpose of overcoming inequalities and achieving a more equitable state in Nuevo Leon. In the same vein, the composed index proposed in this document combines methodologies implemented in other research (Ovando & Olivera, 2018; Rodríguez, 2019) in terms of measuring the variables that have an influence on the probabilities that households – or individuals – access, use and get the most out of the Internet tool. The assets – or satisfiers – are used from the perspective of minimum conditions to enable the individuals in the digital economy.

No less important is the Sixth Article of the *Political Constitution of the United Mexican States* (EPN, 2014) which in 2013 enacted the universal right to access broadband Internet, with the objective of guaranteeing the inclusion of the whole population as a knowledge society through a universal policy of digital inclusion. However, by 2022 there remains a persistent barrier to the advancement of digitalisation among Mexican households. The main reasons for the obstacle are economic 57.2%, followed by disinterest 25.2%, and lack of skills 9.6% (IFT, 2023).

Digitalisation efforts to reduce the digital divide in Mexico date back more than two decades (Ovando & Olivera, 2018): in 2002, first through the National e-Mexico System, later with the access to digital services in public libraries via Bill and Melinda Gates, after that within the framework of the Telecommunications Reform of 2013, the initial goal of Internet was connectivity of 65,000 public places (schools, health centres, parks and government buildings), rescheduled to 150,000 in 2016 and 120,000 in 2017 (SCT, 2017c). At the beginning of 2010, Casanueva-Reguart & Pita (2010) documented failures in the objectives of reducing the digital divide, concluding that poverty is one of the most important obstacles. Montiel (2016) attributed it to the lack of network coverage, fibre optic installation, lack of service providers and competition to inequalities in areas, cities and regions of Mexico. In the same order, the compilation of different studies for Mexico (Galperín & Mariscal, 2016) emphasised the relationship between the Internet and poverty for Mexico, in the context of the difficulties of moving towards a knowledge society.

In these terms, the national context frames a scenario of difficulties in the transition to a digital economy; that is, a transformation of such magnitude does not suggest an effortless path or straightforward policy measures. This context gives rise to the present empirical exercise, to validate the advance of the digital economy from the perspective of Mexican households.

Methodology

Variables that represent wealth in household ICT assets and living conditions are used to analyse their influence on household participation in the digital economy. The methodology is based mainly on three similar investigations: i) a pioneer study for India (Filmer & Pritchett, 2001) at the country level to analyse their relationship with educational attainment and educational enrolment; ii) a study for Mexico (Ovando & Olivera, 2018) focused on analysing the influence of household wealth on the adoption of the Internet, within the framework of the Telecommunications Reform of 2013; and iii) a study for Mexico (Rodríguez, 2019) where an ICT asset index was built to explain the determinants of adoption and use of the Internet in Mexico.

Based on the above, this paper fills a gap by doing an analysis by quantiles, comparing two different moments, pre- and post-COVID-19 pandemic (2018 and 2022). A household wealth index is constructed using the method of principal components (or PCA) and home conditions with two types of variables: ICT and home. A programming code STATA V17 was built in the statistical and econometric software.

The ENDUTIH survey (National Survey on Availability and Use of Information Technologies in Households) was used for both years. This survey has been carried out annually and systematically since 2015 in Mexico, with representation at the national, state, urban and rural levels and of cities. Previous instruments were MONACO (National Computing Module) 2002–2023, and MODUTIH (Module on Availability and Use of Information Technologies in Households) from 2004 to 2014. Information about income or expenses is not captured. So, variables of telecommunications assets and services were used, which allowed us to approximate the level of "wealth" of households in the long term.

Data

2018 (n = 76098)	**2022 (n = 38027)**

Dependent variable: digital economy participation
(e-commerce use | e-banking use)

Independent variables

Variables of household ICT services and assets: radio, analog TV, digital TV, videogames console, mobile cell phone, computer, tablet, Internet service, pay TV service, fixed telephony, monthly spending in ICT services[1]

Housing variables: no dirt floor, underground water, drainage, refrigerator, washing machine, motor vehicle

Analysis by quintiles

Construction of household wealth indices (ICT and non-ICT) PCA method

Probit model: quintile regression analysis

$$Digital\ economy_{t=2018,2022}(HQ, X)$$

$$Digital\ economy = \left\{\frac{1 = participation}{0 = no\ participation}\right\}$$

HQ = Household wealth by quintile: poorest, middle and, richest

X = Household and personal variables

Economic status index estimation

Probit model

Figure 1. Research framework

Notes: The amount was calculated based on the household's monthly spending on telecommunications services. The conversion from Mexican pesos to US dollars was carried out for both years based on the average value of the year: 19.24 Mexican pesos per USD in 2018 and 20.12 for the year 2022.

The indices for both years are used to validate their influence on the advancement of the digital economy in Mexico, through electronic commerce or online banking activities by a representative individual of households. Figure 1 presents the most important aspects of the scheme that this research followed.

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It should be clear that the household wealth indices constructed for the years 2018 and 2022 do not reflect levels of well-being but are used to relate them to participation in the digital economy. The idea behind domestically owned ICT assets is that they are held mainly for practical and useful reasons, not contemplative ones. The reason is that they are means that facilitate everyday activities such as obtaining valuable information, comparing prices and the quality of goods and services, saving time in transactions, reducing costs and definitely increasing consumer surplus, which is obtained when carrying out online banking or electronic commerce activities. Typically, consumer spending patterns have been used as an indicator to measure poverty in households. However, national surveys also provide a wealth of data that is very useful for econometric purposes (Deaton, 1997; Montgomery *et al.*, 2000).

In practical terms, using ICT assets carry conceptual and empirical limitations that cannot be attributed to the asset index. The major problem of grouping ICT household assets is: i) it is not done with any distinction between them (for example, allocating each different weights); ii) some of them do not embody the idea of being critical technology or even useful for all members of the household (for example, having a video game console); and iii) it is supposed that more ICT assets are better, in terms of their utility. This last assumption is overcome considering that the goods are consumed or possessed for non-contemplative purposes; for instance, for school or work purposes as a way to increase knowledge and skills, or simply for entertainment.

Regarding the use of the principal components method and microdata, a greater amount of information is used (Galperín & Mariscal, 2016; Martínez-Domínguez, 2020) by reducing external validity (due to the size of the sample). Allowing plausible assertions and methodologically sound assertions, there are lower levels of aggregation and they are usually representative, instead of using individual variables to explain economic performance, such as broadband (Castaldo *et al.*, 2018; Díaz *et al.*, 2016; Koutroumpis, 2009; Qiang *et al.*, 2009).

Also, at the end of this the document, a sensitivity analysis section is included to account for the consistency and robustness of the results: first, through a reduction of variables used to construct the household wealth index and second, through the use of parsimonious specification models, using only the variables of greater effect.

Variables and Data Used to Approximate Household Wealth

Given that digital economy insertion is examined, the sample was restricted to individuals who used the Internet in the last three months in two economic main digital activities: e-commerce and/or e-banking. Different from other studies and approaches, the household's information was captured because the goal of this study is to elucidate the economic and social pressure inside the family as a whole, not only from one specific person. Sample sizes were 76.098 and

38.027 for the 2018 and 2022 surveys, respectively (see Table 1 where the information is presented according to the condition of participation in the digital economy of households).

Table 1. Descriptive statistics by condition of participation in digital economy, 2018 and 2022

Year / Statistics / Household variables	2018						2022					
	observat-ions (in millions)		Mean		Standard deviation		Observat-ions (in millions)		Mean		Standard deviation	
	DE use	Non-DE use	DE use	Non-DE use	DE use	Non-DE use	DE use	Non-DE use	DE use	Non-DE use	DE use	Non-DE use
Radio	3.5	7.2	0.575	0.573	0.494	0.495	5.1	6.6	0.461	0.487	0.498	0.5
Analog TV	2	5.2	0.333	0.413	0.471	0.492	1.8	3.3	0.168	0.239	0.374	0.427
Digital TV	5.2	9.5	0.857	0.755	0.35	0.43	9.8	10.9	0.895	0.797	0.306	0.402
Video games console	1.7	1.6	0.278	0.125	0.448	0.331	2.9	1.4	0.263	0.105	0.44	0.306
Mobile cell	6.1	12.4	0.992	0.981	0.088	0.136	11	13.5	0.996	0.99	0.063	0.099
Computer	4.5	5.7	0.729	0.451	0.445	0.498	7.4	4.8	0.669	0.355	0.471	0.478
Tablet	2.5	2.9	0.413	0.228	0.492	0.42	3	1.7	0.275	0.121	0.446	0.327
Internet service	5.2	8.3	0.854	0.656	0.354	0.475	9.9	10	0.9	0.734	0.301	0.442
Pay TV service	3.7	6.5	0.61	0.512	0.488	0.5	5.4	5.7	0.491	0.415	0.5	0.493
Fixed telephony	3.4	5.2	0.562	0.412	0.496	0.492	5.8	5	0.525	0.369	0.499	0.482
No dirt floor	6.1	12.4	0.995	0.981	0.072	0.135	10.9	13.3	0.989	0.973	0.102	0.162
Underground water	5.7	10.1	0.927	0.796	0.259	0.403	10.1	10.5	0.915	0.772	0.279	0.419
Drainage	5.5	10.4	0.903	0.82	0.295	0.384	9.7	10.7	0.884	0.786	0.321	0.41
Refrigerator	5.9	11.6	0.97	0.915	0.171	0.279	10.6	12.4	0.964	0.906	0.185	0.291
Washing machine	5.3	9.9	0.871	0.783	0.335	0.412	9.6	10.5	0.875	0.768	0.33	0.422
Motor vehicle	4.2	6.1	0.683	0.485	0.465	0.5	7.1	6.1	0.642	0.448	0.479	0.497

Source: Prepared by the authors.
Notes: In 2018, there were 60,74 million people in 18,77 million homes. In 2022, there were 76,86 million people in 24,63 million homes. Information captured in the household questionnaire among informants between 15 and 74 years of age. DE use/ Non-DE use: participation and non-participation in digital economy. The average monthly spending amount for telecommunications services is presented in the Appendix (Figure A1).

Eleven out of 17 variables are related to the possession of telecommunications assets or services (radio, analog TV, digital TV, video games console, mobile cells, computers, tablets, Internet service, pay TV service and fixed telephony). They take values of 0 and 1 and represent one of the average monthly spending on ICT services. Whereas three of them account for the physical conditions of the house (no dirt floor, piped water and drainage), and three account for possession of durable household goods (refrigerator, washing machine and vehicle).

A first review allows us to observe some progress in the availability of ICT satisfaction between the two groups; between those who participated and those who did not participate in the digital economy. Likewise, that there is less disparity in home amenities, such as basic drainage services, refrigerator or washing machine, was considered.

The household was used as the unit of analysis and some information was recovered from another three questionnaires related to residents, users and housing conditions. In this survey, the information collected is from a key informant in the household, so the perspective is from the inhabitant's own experience and not from the perspective of all household members. The information was collected in the second quarter of the respective years.

In the next section, an economic index of households using principal components analysis is presented. The grouping of households into three quantiles (poorest 40%, middle 40% and, richest 20%) was defined, based on official data on the percentage of millions of people living in poverty in Mexico, which ranged from 41.9% to 36.3% between 2018 and 2022 (CONEVAL, 2023). The definition of poverty involves the percentage of the population whose income is less than the value of the well-being line and that suffer from at least one social deficiency in education, access to health services, access to social security, quality and spaces of housing, access to basic services in housing, and access to food.

Economic status index of households

In the Appendix (Table A1 and Table A2), the scoring factors of the first component of the PCA methodology of the selected variables are reported. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy takes values between 0 and 1, and values above 0.5 are considered satisfactory for a PCA. For 2018, KMO=0.8012, and for 2022 KMO=0.7658. The component loadings for PC1 and PC2 are presented in Figure A2 and Figure A3, where the first component contributed 22.23% and 22.05%, for each of the years 2018 and 2022. Households were ordered by their wealth index into three categories: poorest (40%), middle (40%) and richest (20%).

For 2018, the average value of the index is 0; the standard deviation is 1.94. Due to all of the set variables (except the availability of monthly payment in digital services) taking only the values 0 or 1, the weights are easily interpreted. A movement from 0 to 1 changes the index in terms of a derivative, which is the change in the variable when going from 0 to 1. Dividing the scoring factor by the standard deviation ($f1i/s^*i$) would mean an increase in the asset index; for example, a household that has Internet service has an asset index 0.77 higher than one that does not have it. Owning a computer increases a household's asset index by 0.66 units; the values make sense, since – in the opposite direction – having an analog TV (after the 2013 Telecommunications Reform, a public policy was implemented and digital televisions were granted to carry out the analog blackout and transition to digital television) reduces the asset index by 0.15.

The difference between a rich household and a middle one is 1.69 units and between a rich one and a poor one is 4.43 units. An example of a combination of assets that a household among the richest (top 20%) and not a household among the poorest (bottom 40%) would possess would be the condition of: owning a digital television (0.57), having a computer (0.66), a tablet (0.51), Internet service (0.77), home drainage system (0.51), washing machine (0.68) and a vehicle (0.58). The highest differences are present in ICT assets, like a tablet, Internet service or video games console, whereby in household goods, it is clearer through ownership of a vehicle.

The difference in points between the poorest group and the richest group is 4.40 units. One combination of assets that would make such a difference would be owning a cell phone, a computer, Internet service and a vehicle. As in the results of 2018, the difference between owning and not owning telecommunications assets and other goods used in the home would be maintained; that is, the value calculated in both years is remarkably similar and therefore the backlog of satisfaction would remain.

Taking into account the pressure for poorer households, the average household expenditure on fixed telecommunications from 2010 to 2014 (IFT, 2016) of the first decile with respect to their income, was reduced from 15.5% to 10%. However, a percentage still much higher than that allocated by households from the 10th decile in 2014 was 1.8%. Likewise, as a way of approximating such differences, the data of the year 2022 (ENDUTIH-INEGI, 2023) an average monthly expenditure of USD 17.5 was obtained, a reduction of 8.9% with respect to the year 2018 (ENDUTIH-INEGI, 2018). In Mexico the prices of the devices and of telecommunication services have been considerably reduced since the ends of previous presidential regimes since 2013 and it also helped the implementation of the public policy Mexico Connected (SCT, 2017a) through Internet access services in granted public sites and training and digital education. It sought to reduce the digital divide existing in the country, which prevents the free exercise of the constitutional right previously established in Article 6 of the Constitution.

For 2022, the quantitative variable of average monthly spending on digital services also sheds light on the differences between the groups; a rich household (decile 10) spends, in USD dollars, 22.5 times the amount of the poorest 10% of households, USD40.86 versus USD1.82 (Figure A1); a value that increased in respect of the 2018 data, to a value of 16.4 times, USD44.4 versus USD2.71.

Continuing with this scenario, the next section presents the results of the regression analysis by quantiles.

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The probit model

Due to the nature of the values of the dependent variable, a value of 1 is assigned if the household is integrated into the digital economy (use of electronic commerce or online banking) and 0 otherwise, and the effect of each explanatory variable on the dependent variable is approximated by a non-linear curve. Categorical variables are included in order to differentiate between groups of households.

In terms of the model, it adopts the following expression for each of the years 2018 and 2022, separately:

$$E(Y_i|X_i) = \beta_0 + \beta_i X_i$$

where $E(Yi|Xi)$ indicates the probability that the home has Internet, given certain characteristics or values that each independent variable takes, that is, Pi = Probability that Yi=1 y 1-Pi = Probability that the household does not participate in the digital economy. Xi = each of the independent variables that affects the probability that a home has Internet or not. That is, Yi follows the Bernoulli distribution (Gujarati & Porter, 2010). That is, the conditional expectation is interpreted as the conditional probability of Y_i

$$E(Y_i|X_i) = \beta_0 + \beta_i X_i = P_i$$

Or, in terms of probabilities, it would be equal to the probability of success divided by the total probability (success plus non-success). For the total model:

$$Prob(Dig\_Eco = 1) = \Phi(\beta_0 + \beta_1 * Sex_i + \beta_2 * Sq_{age_i} + \beta_3 * HQ_i + \beta_4 * Time_{Internet-user_i} + \beta_5 * Age_{group_i} + \beta_6 * School_{attainm_i} + \beta_7 * Locat\_size_i + \beta_8 * Hou\_size_i)$$

For the group models (separately), poorest (40%), middle (40%) and richest (20%):

$$Prob(Dig\_Eco = 1) = \Phi(\beta_0 + \beta_1 * Sex_i + \beta_2 * Sq_{age_i} + \beta_3 * Time_{Internet-user_i} + \beta_4 * Age_{group_i} + \beta_5 * School_{attainm_i} + \beta_6 * Locat\_size_i + \beta_7 * Hou\_size_i)$$

or seen in ratio terms:

$$Prob(Y|X) = \frac{\exp(\beta_0+\beta_i X_i)}{[1+\exp(\beta_0+\beta_i X_i)]}.$$

to validate the effect of the determining variables on the probability of household participation in the digital economy. Table A3 presents the results for 2018 and 2022, with the purpose of comparing their differences and magnitudes.

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Regression Model Results

As has been confirmed in other studies, the variables related to educational level, geographical location, average household members and age group do not present a divergent pattern (Martínez-Domínguez, 2020; Rodríguez, 2019). Furthermore, this result highlights the importance of the experience as an Internet user. The magnitudes of the effects by groups do stand out.

Interpretation of parameters

Regarding the **Sex** variable, the negative and statistically significant value indicates that women would have a probability of participating in the digital economy that is 5.9% lower than the probability that a man would have. This gap would have been reduced 50% in 2022 with respect to the level of 2018.

When comparing the **wealth of ICT assets** between households by quintile, two compelling facts are observed that shed light not only on the process of transition to the digital economy as a whole, but also on the widening of gaps between households; for example, quintiles 2, 3 and 4 consistently increased the use gap with respect to the poorest household group. In the case of the richest households, the gap was practically maintained for four years (a probability of 26% higher than that of the group of poorest households, *ceteris paribus*). This tells us that despite the global increase in the use of the digital economy, the issue of inclusion in the use of a fundamental purpose of the Internet is not being met.

The results on the variable of length of **time as an Internet user** and its influence on the probability of participating in the digital economy *ceteris paribus* would indicate progress in reducing the gaps between the different groups of households; in all cases, even if marginally, the differences compared to people who have used the Internet for less time were reduced. An important fact is that the availability of mobile phones allows free Internet connectivity at different points, whether in schools, recreation centres, government offices or workplaces, as long as there is network infrastructure.

In **age groups**, it is found that the most dynamic one in the digital economy is the one aged between 25 and 34 years old whereby the gap appears with greater intensity when considering wealth in ICT assets. It is interesting to note that there is little difference between the youngest age groups 15–24 years and people over 45 years of age (the coefficients are not statistically significant, with the exception of the group richest in ICT assets). This finding would initially raise concern in the economy since the income of mature people is consistently higher. The earnings of adults are not only higher, but will increase with age, especially among the most trained or educated people.

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Consistent with the above, the results of the models indicate that the variable with the greatest weight in the digital economy is **educational achievement**. First, the values of the coefficients for 2022 are greater than those for 2018, which means that the gaps in participation in the digital economy widened with respect to those who had schooling up to primary school. Second, in 2022 a person with a high school education from a poor, middle or rich household would have doubled their probability of participating in the digital economy *ceteris paribus*, compared to the difference that existed four years before (14.8% versus 6.9%, 20% versus 10% and 23% versus 11%, respectively).

Regarding the **size of the locality**, the effect of the most urbanised areas on the most dispersed territories or with lower population density is confirmed, with few differences in the coefficients for both years.

The last variable, the **number of members of a household**, accounts for the indirect effect of economic pressure in a family; for example, more household expenses have a negative impact on integration into the digital economy, in other cases it may mean whether or not to send one of the children to school. The effects of COVID-19 posed different challenges among students, at all educational levels in Mexico, from the impossibility of having a computer to browse the Internet, to not having spaces at home to study. In all cases and in all groups, there is an inverse relationship between household size and its insertion into the digital economy.

In all models the value of Chi2 is statistically significant (less than 0.05), so the independent variables integrated in the models are capable of predicting the dependent variable. The classification accuracy of the observations and the number of correct predictions of the models in all cases was greater than 70%. Therefore, the model is considered adequate to explain the phenomenon.

In the next section, a sensitivity analysis is detailed.

Sensitivity analysis

To validate the consistency and robustness of the results both to measure the Economic Situation Index and to run the quantile regression models, two additional analyses were carried out for 2018 and 2022: i) a reduction in the number of variables used to build the index of ICT assets and minimum home habitability conditions; and ii) use of the principle of parsimony in the approach of functional forms, in which a smaller number of variables is chosen (in this case, taking into account the literature). The essence of this final exercise is to corroborate that the group of the poorest, in its relationship with participation in the digital economy, did not advance in participation in the digital economy between the two years analysed, 2018 and 2022.

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One of the main initial advantages of quantile regression models – at least with respect to linear regression models, or those that use ordinary least squares, OLS – is that different results can be obtained for the dependent variable (not an average for the entire sample). This is due to the "piecewise" regression that is done according to the classification of individuals – in this case households – of the entire sample (Porter, 2015).

Scenario 1: Reduction of the variables used in the quantile regression models

We decided to reduce the number of variables used to construct the household ICT wealth index (from 17 to 11) following criteria of little variability between groups, assets with a tendency to disuse or to leave only fictitious variables, so the omitted variables were: radio, analog TV, mobile telephony, landline telephony, average monthly spending on ICT services and no dirt floor. The results indicate the pattern found in the previous models in respect of the use of digital economy (Table A4) that: i) the digital gap between the poorest and the richest households increased from 26.9% to 29.6% between 2018 and 2022; and ii) the educational level was confirmed as the differentiating variable by registering increases of between 60% and 80% between the two years, especially when considering higher education levels among the three quantiles.

Scenario 2: Results considering parsimonious models

Parsimonious models were run; that is, restricting the use of variables to those recurrent in the literature, such as education level, sex, urban–rural and age group, in addition to the household wealth index variable in quantiles, using the 11 aforementioned variables. The main results (see Table A5 and Table A6) indicate: The digital gap in the use of the digital economy increased between the two years analysed: i) the gap between quintile 5 and 1 increased from 29.9% to 31.9%; and ii) at the educational level the gap increased, although slightly, between 2 and 6 percentage points.

It is worth mentioning that the variations in the fit of these models (when observing the values of the pseudo R squared), with respect to the previous one, are marginal, so the results appear consistent, even when the number of predictors was reduced.

Discussion

The objective of this work allows us to affirm that, at the household level, digital gaps persist when specialised use of the Internet is analysed. Although progress has been made in the percentage increases in household asset ownership, gaps persist in asset wealth indices, which is presumed to hinder the advancement of the digital economy in general. The quantile regression analysis, in turn, allows us to identify that the variables with the greatest effect on the probability of using the Internet in the digital economy remain educational level, experience in using the Internet (which implies digital literacy), the place of residence and the age group. In this regard, at government level, efforts have been implemented for digital inclusion, such as the new National Digital Strategy (under the motto of "Leave no one behind") (EDN, 2021). Another implementation of that project was to supply the Internet at an affordable price and of quality, especially to locations with less coverage and use of the Internet network (CFE, 2023) and the Connected Mexico Points (SCT, 2017b).

Theoretical contributions

This paper provides several theoretical contributions: trying a different methodology from traditional ones; exploring what variables other than income or expenditure are capable of explaining a complex phenomenon such as participation in the digital economy; the use of microdata from a national survey to build an economic status index based on household assets, approximating their economic and social situation; to be interdisciplinary in academia and science, by addressing economic, social and demographic aspects of a cross-cutting issue, such as the use of technology and the possibility of influencing national digital policy; and the possibility of coinciding with other similar works, such as the Digital Economy and Society Index, DESI (EU-EC, 2023), which is prepared for European countries and attends social and economic aspects of the use of technology. With this work, an analysis of "digital" social mobility could also be prepared, recovering The Espinosa Yglesias Study Center (CEEY) approach.

The sensitivity analysis testing of two different scenarios made it possible to verify the persistence of the digital divide when comparing the poorest quintile with the richest. Also, the educational level remained the greatest differentiator between households. The results of the regressions by groups, in general, maintained the direction of the effects.

Reflections in terms of public policy

Households with less ICT wealth are less inserted in the digital economy; whether when considering the educational level, the distance from urban centres, the size of the home or the length of time in using the Internet tool. Thus, an opportunity exists to target subsidy programs for certain homes or populations far from urban centres, with active participation and coordination between the federation and local, state and municipal governments.

Educational policy, especially at basic levels, must be designed and implemented considering global trends in digitalisation. Mobile connectivity is also an area of opportunity for the use of the digital economy. The Connected Mexico Point Network was a worldwide award-winning project at WSIS 2017 (the World Summit on the Information Society Forum) (SCT, 2017b) as the best use case in the "Skills Development" category. It is an experience that must be resumed and renewed.

In the case of employment, around 55% of the population is found in the informal economy (INEGI, 2024). This fact inhibits potential advancements in digitalisation for a large part of the population from gaining access to the formal system (for instance, digital financial inclusion, appropriate use of credit, savings, and approach to investment instruments).

It is imperative to advance at an educational level as a determining variable in the take-off of the economy and, at the same time, to reduce the digital divide as a way to achieve greater digital inclusion of the Internet and associate it with digital literacy. This result addresses the risk predicted more than 20 years ago, in terms of the increasing gaps between those who do and do not have the Internet (Wresch, 1996) or when considering the specialised use of technology (Adeya, 2002).

Another approach is to set the issue of reducing inequalities in Mexico at the core. The Gini coefficient in Mexico is one of the highest not only in the Latin American & Caribbean countries , but in the world, for example, it is the second most unequal country among OECD countries, 45,4 (World Bank, 2022). These disparities are reflected and maintained when talking about the digital issue.

Limitations and futures perspectives

The main limitation to the study is that the instrument used did not collect information on household income or expenditure. The collected information was not from all members of the household but from a representative. The literature review was carried out mainly at the national level and, above all, on issues of digital divide and technological infrastructure (Escobar & Sámano, 2018). Another limitation is the analysis used: trying other models or with other aggregations should be tested to strengthen the arguments presented.

Another aspect that was not addressed in this work is how to exploit the issue of the contribution of the digital economy to the national economy, running an analysis at the level of the business ecosystem and its insertion into the digital economy, in a process of transition to digital transformation. An alternative would be the use of other official sources, such as the Economic Census (which is five-yearly) and the National Occupation and Employment Survey (ENOE-INEGI, 2023) which is quarterly, and which would allow the analysis of the Mexican business ecosystem, on the path of a digital transformation process.

These findings open the door to the possibility of measuring the concentration of human capital and skills, as attractive factors for companies, investments and technology. Or, on the

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other hand, of identifying vulnerabilities to overcome social lags and inequalities in different segments of the population.

Conclusions

The advancement of the digital economy is essential in Mexico. Its participation in GDP has increased in recent years. Mexico is a country of considerable heterogeneity in digital advancement but also in economic and social progress. The value of official statistics shows – both in percentage and in added value – the advancement of the digital economy. However, there are segments of the population on the margins of the information and knowledge society, in terms of using specialised Internet tools.

This work is focused on elucidating the advance of the digital economy in types of households, according to their wealth and based on two representative samples, pre- and post-COVID-19 pandemic, 2018 and 2022. The two main findings were: 1) the lack of progress in reducing household wealth gaps (a difference in favour of the richest households remained at 4.4 points, which translated into owning up to seven more assets or satisfiers in the rich household than in the poor one); and, 2) the persistence of inequality in participation in the digital economy between quintiles 1 and 5, a gap that remained 26% in favour of rich households over poor ones. The sensitivity analysis allowed us to corroborate the digital gap and the persistence of inequalities. Therefore, it is necessary to think about endowments when conducting an economic analysis (Milanovic, 2017).

Another outstanding fact is that the educational level was consolidated as the greatest differentiator in the probability of participating in the digital economy, which would indicate the need for policies and programs that result in digital literacy and the productive use of the Internet. The most recent results of the Programme for International Student Assessment (PISA) test are flags to the education sector at all levels that a national economic strategy needs implementation.

In Mexico, the transition towards an economy based on knowledge and technology is being perceived and worked upon. However, household conditions could be improved to accelerate the transition along this path. One of the dilemmas at the public policy level is to satisfy targeted policies to accelerate the digital economy.

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Appendix

Table A1. Comparison of scoring factors and summary statistics for selected variables entering in the computation of the principal component analysis, 2018

Variable/Stats	Mexico				Means		
	Scoring factors	Mean	Standard Deviation	Scoring factor/-Standard Deviation	Poorest 40%	Middle 40%	Richest 20%
Radio	0.094	0.554	0.497	0.189	0.477	0.544	0.726
Analog TV	-0.071	0.404	0.491	-0.145	0.477	0.387	0.294
Digital TV	0.233	0.786	0.41	0.568	0.593	0.876	0.99
Video games console	0.223	0.985	0.121	1.843	0.032	0.161	0.521
Mobile cell	0.083	0.985	0.121	0.686	0.97	0.993	0.998
Computer	0.33	0.556	0.497	0.664	0.2	0.704	0.968
Tablet	0.233	0.297	0.457	0.51	0.102	0.3	0.682
Internet service	0.34	0.737	0.44	0.772	0.396	0.947	0.999
Pay TV service	0.209	0.572	0.495	0.422	0.379	0.617	0.866
Fixed telephony	0.327	0.435	0.496	0.66	0.086	0.542	0.92
Average monthly spending in ICT services	0.368	19.15	16.75	0.022	7.18	21.86	37.69
No dirt floor	0.101	0.987	0.112	0.9	0.971	0.998	0.999
Underground water	0.257	0.875	0.331	0.777	0.717	0.972	0.997
Drainage	0.183	0.844	0.363	0.505	0.715	0.913	0.966
Refrigerator	0.226	0.943	0.232	0.975	0.862	0.996	1
Washing machine	0.263	0.814	0.389	0.675	0.618	0.921	0.991
Vehicle	0.285	0.575	0.494	0.577	0.296	0.672	0.941
Economic Status Index			**1.944**		**-1.979**	**0.756**	**2.447**

Source: prepared by the authors.
Note: Scoring factor is the "weight" assigned to each variable (normalised by its mean and standard deviation) in the linear combination of the variables that constitute the first principal component. The percentage of the covariance explained by the first principal component is 22.2%. The first eigenvalue is 3.78; the second eigenvalue is 1.38.

Table A2. Comparison of scoring factors and summary statistics for selected variables entering in the computation of the principal component analysis, 2022

Variable/Stats	Mexico				Means		
	Scoring factors	Mean	Standard Deviation	Scoring factor/-Standard Deviation	Poorest 40%	Middle 40%	Richest 20%
Radio	0.079	0.452	0.498	0.159	0.376	0.465	0.578
Analog TV	-0.078	0.223	0.416	-0.188	0.291	0.193	0.145
Digital TV	0.26	0.831	0.375	0.694	0.643	0.938	0.995
Video games console	0.215	0.164	0.37	0.581	0.026	0.138	0.492
Mobile cell	0.056	0.993	0.085	0.659	0.985	0.997	0.999
Computer	0.311	0.482	0.5	0.622	0.153	0.586	0.932
Tablet	0.206	0.187	0.39	0.528	0.049	0.167	0.505
Internet service	0.321	0.798	0.401	0.8	0.519	0.977	1.0
Pay TV service	0.217	0.463	0.499	0.435	0.252	0.506	0.799
Fixed telephony	0.328	0.393	0.488	0.672	0.058	0.483	0.884
Average monthly spending in ICT services	0.36	15.93	16.45	0.022	4.47	17.96	34.83
No dirt floor	0.108	0.982	0.133	0.809	0.961	0.995	0.998
Underground water	0.284	0.84	0.367	0.774	0.636	0.965	0.996
Drainage	0.209	0.785	0.411	0.509	0.613	0.872	0.955
Refrigerator	0.242	0.935	0.246	0.982	0.843	0.995	1

Variable/Stats	Mexico				Means		
	Scoring factors	Mean	Standard Deviation	Scoring factor/-Standard Deviation	Poorest 40%	Middle 40%	Richest 20%
Washing machine	0.275	0.811	0.392	0.702	0.604	0.927	0.991
Vehicle	0.273	0.552	0.497	0.549	0.29	0.632	0.918
Economic Status Index			**1.936**		**-1.951**	**0.725**	**2.453**

Source: prepared by the authors.
Note: Scoring factor is the "weight" assigned to each variable (normalised by its mean and standard deviation) in the linear combination of the variables that constitute the first principal component. The percentage of the covariance explained by the first principal component is 22.1%. The first eigenvalue is 3.75; the second eigenvalue is 1.40.

Table A3. Marginal effects of wealth groups in the probability of participate in digital economy: probit regression results, 2018 and 2022

Variables/Year	Total		Poorest (40%)		Middle (40%)		Richest (20%)	
	2018	2022	2018	2022	2018	2022	2018	2022
Dependent variable: Digital economy participation								
Independent variables								
Sex = man (reference)	-0.059***	-0.029***	-0.039***	-0.009	-0.064***	-0.035***	-0.088***	-0.054***
Squared age	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Households ICT asset wealth: quantile 1 (reference)								
Quantile 2	0.080***	0.101***						
Quantile 3	0.139***	0.154***						
Quantile 4	0.193***	0.201***						
Quantile 5	0.263***	0.260***						
Time as Internet user: less than one year/don't remember (reference)								
Between 1 and up to 2 years	0.012	0.006	0.011	0.025	0.027*	-0.026***	-0.065*	-0.039***
More than 2 and up to 5 years	0.067***	0.054	0.064***	0.064	0.078***	0.041	0.011	0.002**
More than 5 years	0.205***	0.171***	0.177***	0.176***	0.233***	0.166***	0.200***	0.146***
Age group: 15–24 years old (reference)								
25–34	0.044***	0.060***	0.011	0.007	0.062***	0.093***	0.095***	0.122***
35–44	-0.003	0.030***	-0.022	-0.024	-0.004	0.044**	0.047***	0.110***
45–54	-0.041***	0.001	-0.054**	-0.049	-0.039*	0.000	-0.005	0.096***
55–74	-0.080***	-0.025	-0.082***	-0.099**	-0.096***	-0.021	-0.023	0.094*
School level: some years of primary, 0–6 (reference)								
Secondary school level = 7–9	0.020***	0.053***	0.025***	0.040***	0.025**	0.080***	0.008	0.068**
High school level = 10-13	0.079***	0.171***	0.069***	0.148***	0.099***	0.199***	0.109***	0.233***
Professional level = 14–17	0.185***	0.316***	0.159***	0.300***	0.207***	0.355***	0.235***	0.346***
Postgraduate studies >16	0.308***	0.424***	0.253***	0.432***	0.334***	0.453***	0.348***	0.432***
Location size in population: less than 2,500 (reference)								
2,500–14,999	0.015**	0.052***	0.023***	0.060***	-0.012	0.037**	-0.020	0.023
15,000–99,999	0.067***	0.075***	0.082***	0.104***	0.044***	0.050***	0.015	0.038
100,000 +	0.087***	0.090***	0.106***	0.122***	0.061***	0.078***	0.045**	0.044
Average household members: 1–2 (reference)								
3–4	-0.045***	-0.036***	-0.022***	-0.026***	-0.056***	-0.033***	-0.052***	-0.039***
5–6	-0.065***	-0.061***	-0.032***	-0.037***	-0.080***	-0.056***	-0.075***	-0.085***
7+	-0.087***	-0.065***	-0.038***	-0.051***	-0.113***	-0.051***	-0.126***	-0.087***
Observations	76,098	38,027	30,440	15,211	30,448	15,214	15,210	7,602

Variables/Year	Total		Poorest (40%)		Middle (40%)		Richest (20%)	
	2018	2022	2018	2022	2018	2022	2018	2022
Correctly classified	73.08%	73.13%	79.50%	75.01%	69.01%	70.45%	68.29%	73.52%
LR Chi2(23)	17,947.82	11,658.78	3,833.73	2,894.66	5,722.34	3,800.42	2,846.86	1,462.78
Prob >Chi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudo R2	0.1816	0.2224	0.1216	0.1576	0.1396	0.1803	0.1357	0.1525

Source: prepared by the authors.
Notes: Statistical significance: * p <0.1. ** p <0.05 and *** p <0.01. Marginal effects are evaluated at the mean of each variable X. The sample was restricted to the population between 15 and 74 years of age. Household ICT assets variable estimated through Principal Component Analysis. No sample expansion factor was used.

Table A4. Scenario 1: comparison of scoring factors and summary statistics for 11 selected variables entering in the computation of the principal component analysis, 2018 and 2022

Variables/Year/ Group	Total		Poorest 40%		Middle 40%		Richest 20%	
	2018	2022	2018	2022	2018	2022	2018	2022
Sex: man (reference)	-0.057***	-0.028***	-0.038***	-0.006	-0.061***	-0.039***	-0.092***	-0.045***
Squared age	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Households ICT asset wealth: quantile 1 (reference)								
Quantile 2	0.069***	0.102***						
Quantile 3	0.125***	0.141***						
Quantile 4	0.193***	0.214***						
Quantile 5	0.269***	0.296***						
Time as Internet user: less than one year/don't remember (reference)								
Between 1 and up to 2 years	0.012	0.007	0.017	0.027	0.001	-0.033	-0.017	0.013
More than 2 and up to 5 years	0.066***	0.053	0.067***	0.063	0.060***	0.038	0.034	0.053
More than 5 years	0.202***	0.168***	0.178***	0.172***	0.219***	0.179***	0.221***	0.128***
Age group: 15–24 years old (reference)								
25–34	0.041***	0.059***	0.008	0.006	0.058***	0.085***	0.105***	0.132***
35–44	-0.008	0.025**	-0.031	-0.022	-0.008	0.036**	0.061***	0.120***
45–54	-0.046***	0	-0.058***	-0.048	-0.051*	0	0.019	0.109***
55–74	-0.083***	-0.034	-0.094***	-0.094**	-0.097***	-0.029	0.009	0.108*
School level: some years of primary = 0–6 (reference)								
Until some year of secondary school = 7–9	0.020***	0.053***	0.027***	0.040***	0.013(0	0.077***	0.04	0.075**
Until some year of high school = 10.13	0.080***	0.166***	0.070***	0.145***	0.094***	0.195***	0.127***	0.253***
Until some professional = 14–17	0.184***	0.303***	0.164***	0.288***	0.195***	0.336***	0.260***	0.371***
Postgraduate studies >17	0.304***	0.406***	0.244***	0.471***	0.329***	0.425***	0.365***	0.440***
Location size in population: less than 2,500 (reference)								
2,500–14,999	0.018**	0.054***	0.026***	0.064***	0.004	0.051**	-0.033	0
15,000–99,999	0.070***	0.076***	0.081***	0.106***	0.056***	0.068***	0.011(0.0	0.012
100,000 +	0.088***	0.091***	0.106***	0.129***	0.072***	0.100***	0.043**	0.004
Average household members: 1–2 (reference)								
3–4	-0.047***	-0.041***	-0.024***	-0.030***	-0.058***	-0.034***	-0.058***	-0,057***
5–6	-0,067***	-0,065***	-0,034***	-0,032***	-0,077***	-0,068***	-0,094***	-0,089***
7 +	-0,086***	-0,065***	-0,041***	-0,043***	-0,106***	-0,066***	-0,145***	-0,097***
Observations	76.098	38.027	31.876	15.211	30.318	15.214	13.904	7.602
LR Chi2(23)	18.102	11.659	4.047	2.895	5.391	3.800	2.432	1.463
Prob >Chi	0	0	0	0	0	0	0	0
Pseudo R2	0.1831	0.2224	0.1228	0.1576	0.132	0.1803	0.128	0.1525

Source: prepared by the authors.
Notes: statistical significance: * p<0.1. ** p<0.05 and *** p<0.01. Marginal effects are evaluated at the mean of each variable X. The sample was restricted to the population between 15 and 74 years of age. Household ICT assets variable estimated through Principal Component Analysis. A sample expansion factor was not used.

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Table A5. Scenario 2: probit regression using 11 variables for the household ICT wealth index in parsimonious models, 2018

Variables	Total	Poorest40%	Middle 40%	Richest 20%
Squared age	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Sex	-0.068*** (0.003)	-0.050*** (0.004)	-0.072*** (0.005)	-0.099*** (0.008)
Urban–rural	0.107*** (0.005)	0.122*** (0.006)	0.098*** (0.011)	0.055** (0.023)
Households ICT asset wealth: quantile 1 (reference)				
Quantile 2	0.077*** (0.005)			
Quantile 3	0.138*** (0.005)			
Quantile 4	0.215*** (0.005)			
Quantile 5	0.299*** (0.006)			
Age group (reference: 15–24 years old)				
25–34	0.047*** (0.005)	0.010(0.008)	0.066*** (0.009)	0.113*** (0.014)
35–44	-0.000128	-0.041*** (0.014)	-0.016(0.014)	0.053*** (0.020)
45–54	-0.059*** (0.013)	-0.073*** (0.021)	-0.063*** (0.021)	0.007(0.030)
55–74	-0.098*** (0.019)	-0.114*** (0.028)	-0.108*** (0.032)	-0.004(0.048)
School level (reference: until some year of primary. Maximum 6)				
Until some year of secondary school: 7–9)	0.041*** (0.006)	0.042*** (0.006)	0.037*** (0.011)	0.069*** (0.025)
Until some year of high school (10-13)	0.143*** (0.006)	0.122*** (0.006)	0.165*** (0.011)	0.204*** (0.024)
Until some high school (14–17)	0.290*** (0.006)	0.267*** (0.009)	0.313*** (0.011)	0.369*** (0.023)
Postgraduate studies (>17)	0.433*** (0.011)	0.382*** (0.033)	0.468*** (0.016)	0.489*** (0.025)
Observations	76.098	31.876	30.318	13.904
LR Chi2(23)	15.804	3.014	4.355	2.031
Prob > Chi	0	0	0	0
Pseudo R2	0.1599	0.0915	0.1066	0.1069

Source: prepared by the authors.
Notes: statistical significance: * p<0.1. ** p<0.05 and *** p<0.01. Marginal effects are evaluated at the mean of each variable X. The sample was restricted to the population between 15 and 74 years of age. Household ICT assets variable estimated through Principal Component Analysis. Standard error in parenthesis. A sample expansion factor was not used.

Table A6. Scenario 2: probit regression using 11 variables for the household ICT wealth index in parsimonious models, 2022

Variables	Total	Poorest 40%	Middle 40%	Richest 20%
Squared age	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Sex	-0.039*** (0.004)	-0.020*** (0.007)	-0.050*** (0.007)	-0.047*** (0.010)
Urban-rural	0.113*** (0.006)	0.140*** (0.007)	0.127*** (0.012)	0.026(0.023)
Households ICT asset wealth: quantile 1 (reference)				
Quantile 2	0.108*** (0.007)			
Quantile 3	0.154*** (0.007)			
Quantile 4	0.234*** (0.008)			
Quantile 5	0.319*** (0.008)			
Age group (Reference: 15–24 years old)				
25–34	0.076*** (0.007)	0.023** (0.011)	0.105*** (0.012)	0.142*** (0.019)
35–44	0.031*** (0.011)	-0.017(0.019)	0.044*** (0.017)	0.123*** (0.025)
45–54	-0.001(0.016)	-0.044(0.029)	0.001(0.025)	0.107*** (0.037)
55–74	-0.032(0.026)	-0.099** (0.043)	-0.020(0.039)	0.106* (0.057)
School level (reference: Until some year of primary. Maximum 6)				
Until some year of secondary school: 7–9)	0.070*** (0.008)	0.056*** (0.009)	0.095*** (0.014)	0.093** (0.038)
Until some year of high school (10–13)	0.216*** (0.008)	0.193*** (0.010)	0.253*** (0.014)	0.293*** (0.036)
Until some high school (14–17)	0.380*** (0.009)	0.377*** (0.014)	0.424*** (0.014)	0.425*** (0.035)
Postgraduate studies (>17)	0.490*** (0.015)	0.572*** (0.051)	0.523*** (0.021)	0.497*** (0.036)
Observations	**38.027**	**15.351**	**16.240**	**6.436**
LR Chi2(23)	**11.022**	**2.417**	**3.437**	**1.044**
Prob >Chi	**0**	**0**	**0**	**0**
Pseudo R2	**0.2102**	**0.1311**	**0.1527**	**0.1373**

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Source: prepared by the authors.
Notes: statistical significance: * p<0.1. ** p<0.05 and *** p<0.01. Marginal effects are evaluated at the mean of each variable X. The sample was restricted to the population between 15 and 74 years of age. Household ICT assets variable estimated through Principal Component Analysis. Standard error in parenthesis. A sample expansion factor was not used.

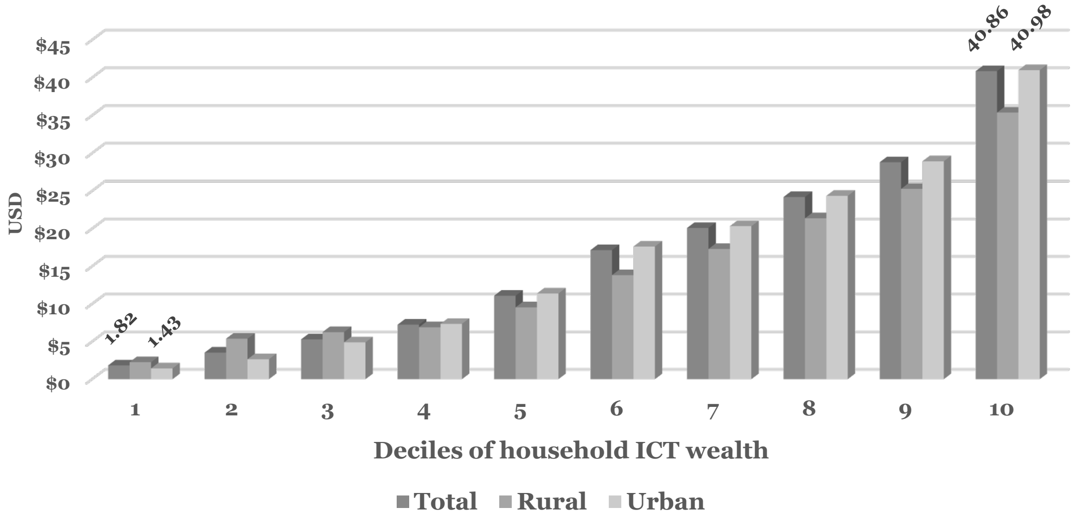

Figure A1: Average monthly spending on telecommunications services in households, grouped by ICT asset wealth, 2022 (Source: prepared by the authors)

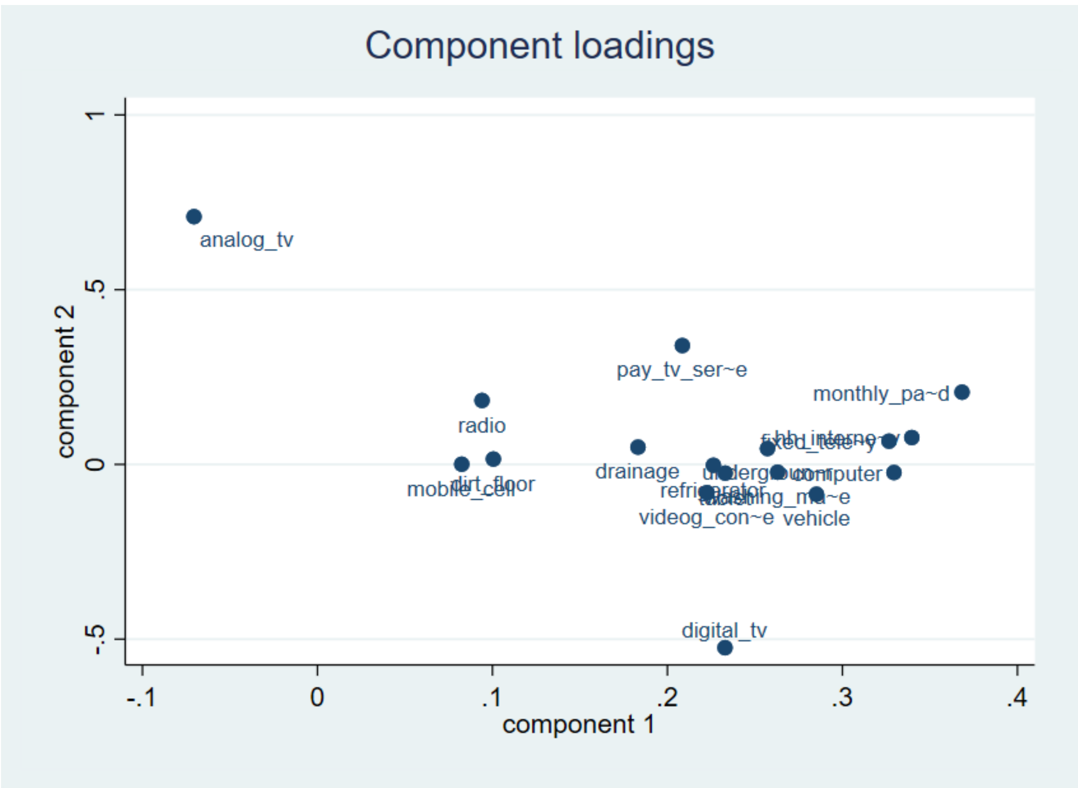

Figure A2. 2018: Loading of components 1 and 2 of the variables included in the probit models (Source: prepared by the authors)

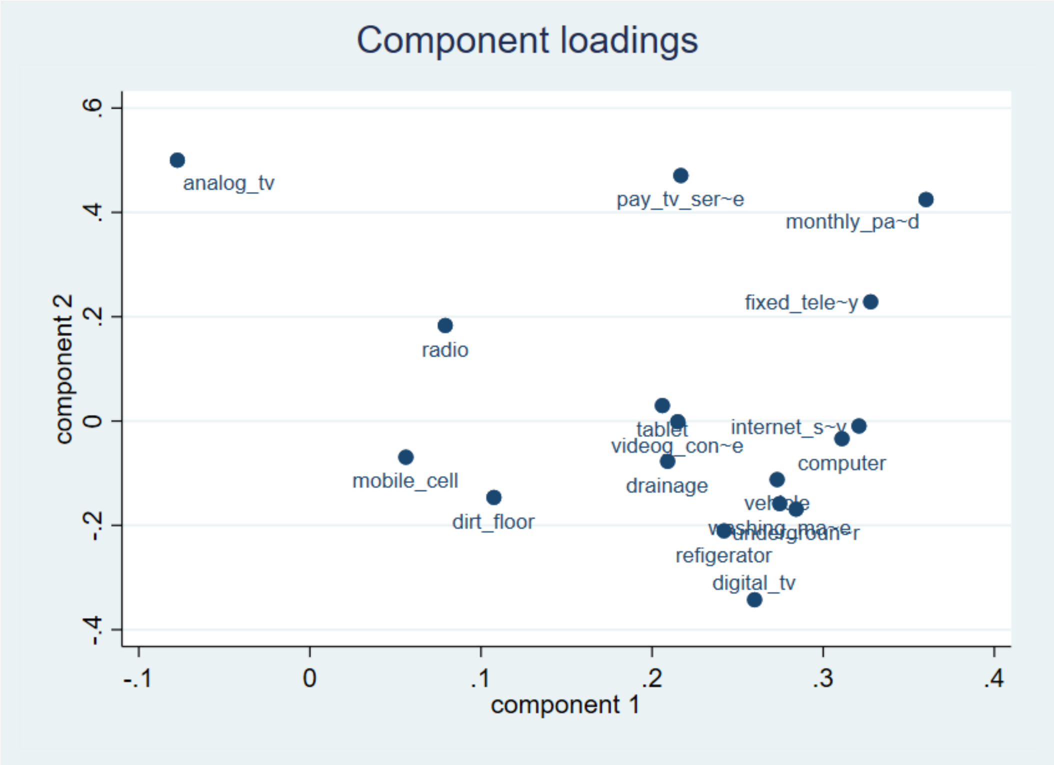

Figure A3. 2022: Loading of components 1 and 2 of the variables included in the probit models (Source: prepared by the authors)