Area: Public Administration, Government, State and Society and Third Sector (Administração Pública, Governo, Estado e Sociedade e Terceiro Setor)

A STUDY ON THE EVOLUTION OF THE DETERMINANTS OF THE DIGITAL DIVIDE IN BRAZIL

ABSTRACT

The search for the understanding of the digital divide, its definition, its causes, and effects and, finally, the actions that can be taken from a public policies standpoint in favor of inclusive access to the internet is an effort that has already lasted longer of two decades. In Brazil, although the number of users grows every year, according to the Regional Center for Studies for the Development of the Information Society (Cetic.br), approximately one in four Brazilians, aged 10 or over, did not have access to the network in the year 2019. In order to better understand the factors that influence the establishment of the digital divide in the country and contribute with updated information to the discussion of actions to tackle it, this research sought, through the analysis of microdata from the TIC Domicílio survey, conducted annually by Cetic.br, and use of logistic regression, to identify and measure the relevance of the effects of social, economic, demographic and cultural indicators that determined digital inequality in the period 2015-2019. The research findings suggest that, in the period analyzed, the variables age, level of education, economic income level, economically active population, religion and area of residence presented, with statistical significance, characteristics of determinants of the digital divide in Brazil.

Keywords: Digital divide. Digital literacy. Digital inclusion. Digital transformation. Brazil. Public Policies.

RESUMO

A busca pela compreensão acerca do abismo digital, da sua definição, das suas causas e dos seus efeitos e, finalmente, das ações que podem ser tomadas sob a ótica de políticas públicas em prol do acesso inclusivo à Internet é um esforço que já dura mais de duas décadas. No Brasil, ainda que o número de usuários cresça a cada ano, segundo o Centro Regional de Estudos para o Desenvolvimento da Sociedade da Informação (Cetic.br), aproximadamente, um em cada quatro brasileiros, com 10 anos ou mais de idade, não se conectou à rede no ano de 2019. No intuito de compreender melhor os fatores que influenciam no estabelecimento do abismo digital no país e contribuir com informações atualizadas para a discussão de ações que o combatam, esta pesquisa buscou, por meio da análise dos microdados da pesquisa TIC Domicílio, conduzida anualmente pelo Cetic.br, e uso de regressão logística, identificar e mensurar a relevância dos efeitos dos indicadores sociais, econômicos, demográficos e culturais que determinaram a desigualdade digital no período de 2015-2019. Os achados desse estudo indicam que, no período analisado, as variáveis idade, grau de instrução, classe econômica, população economicamente ativa, religião e área de residência apresentaram, com relevância estatística, características de determinantes do abismo digital no Brasil.

Palavras-chaves: Abismo digital. Alfabetização digital. Inclusão digital. Transformação digital. Brasil. Políticas publicas.

1. Introduction: Internet access in Brazilian society

Year after year, the number of internet users grows in Brazil. According to the 2020 report by the Regional Center for Studies on the Development of the Information Society (Cetic.br), an entity linked to the Brazilian Internet Steering Committee (CGI.Br), in 2019, there were approximately 133.8 million users in the country. This number represented, at the time, a coverage of 74% of the Brazilian population aged 10+ years (CETIC.BR, 2020).

However, approximately 1 out of 4 Brazilians did not have access to the internet in the same period. This represented approximately 20 million digitally marginalized households, and 47 million Brazilians aged 10+ years, who did not have the opportunity to enjoy the expected benefits of using this technology (CETIC.BR, 2020).

This is a critical situation, from a Public Administration standpoint, since governments, public policies, and public services, are heading more to digital services provided over internet.

Over time, new legal, regulatory, and public policy milestones have paved the way for a citizen-centric digital era in Brazil. Internet access has become essential to the exercise of citizenship and citizens have been legally entitled (Law 12.965/14) to a series of users' rights and guarantees (e.g., privacy, accessibility, quality, non-suspension of the service, etc.) (BRAZIL, 2014). Strategic actions within the national digitization agenda have been established – for example, the Digital Governance Strategy (BRAZIL, 2018a), Digital Government Strategy (BRAZIL, 2020c), National Plan for the Internet of Things (Brazil, 2019b), National Cyber Security Strategy (BRAZIL, 2020d), Adaptation of Telecommunications Services Regime – from concession to authorization – established by Law nº 13.879/19 (BRAZIL, 2019a), and 5G auction. Public policies such as country-wide internet access (BRAZIL, 2010, 2021a; GSP, 2021), digital public services (BRAZIL, 2017a; BRAZIL, 2017b), personal data protection and privacy (Law 13.709/18) (BRAZIL, 2018b), and law enforcement against cybercrimes will soon show its impact in everyday life.

Additionally, public services digitization has been boosted by the necessity to cut costs and promote efficiency. Out of the 3,600 services available on the Gov.br website, 58% of them are already considered digital. According to the Digital Government Strategy, the goal is for the country to reach 100% in 2022, providing a reduction of R$ 38 billion in government expenditures between 2020 and 2025 (BRAZIL, 2020e).

The adoption of digital public services is a reality. ICT Households survey in 2019 informs that 68% of internet users aged 16 and over performed some e-government activity in the 12 months prior to the survey (CETIC.BR, 2020).

And that was before the COVID-19 pandemic, which has contributed with the adoption of technology in Brazil (e.g., increase in the number of internet users), but has made "the digital exclusion of a significant portion of the population more evident" (CETIC.BR, 2020, p. 59). In fact, some of the technological responses to the global health crisis are not compatible with the reality and conditions of vulnerable segments of Brazilian society (BRAZIL, 2020a; BRAZIL, 2020g; BRAZIL, 2020h). For instance, the use of teleworking, for example, is not applicable to all professional activities and usually benefits, particularly, workers with higher levels of education and higher wages (CEPAL, 2020). While remote education was adopted by many schools (mainly, private schools), public basic education was fully paralyzed, resulting in an educational gap. And even with online public services being available, a citizen would still be required – in addition to having internet access – to either know how to use the application or count on someone's help

to do it for them. And under a situation of global pandemic and social distancing and isolation, it could be very challenging (NGUYEN et al., 2021).

2. Literature Review

The expression “digital divide” is widely used in the scientific literature to refer to the disparities in access to ICT resources, such as computers (WILSON et al., 2003), communications infrastructure (LOO; NGAN, 2012), mobile phones (NISHIJIMA; IVANAUSKAS; SARTI, 2017), and the internet (DIMAGGIO et al., 2001). It is part of the digital inequalities semantic field, together with “digital literacy” and “digital inequality” (SCHEERDER; VAN DEURSEN; VAN DIJK, 2017).

One important aspect of the research on the digital divide has been the study of the knowledge gaps (TICHENOR; DONOHUE; OLIEN, 1970; BONFADELLI, 2002), which prevent people from benefiting or maximizing their gains in relation to the promises of using the internet. And based on these gaps, a three-level digital divide classification system has emerged.

The Level-I digital divide is characterized by a focus on internet access and the ownership or availability of the tools or resources that provide it. In this approach, researchers demonstrate the differences between populations of internet users and non-users (dichotomous approach) (RICE; KATZ, 2003). These studies try to understand the causes of the lack of access (“gap in access”) and identify its determinants through the analysis of sociodemographic and economic information.

Gil-Garcia, Helbig and Ferro (2006) recall that ICT resources encompass a series of different technologies, such as computers, radios, satellites, cell phones and so on. Additionally, the resources available on the internet are accessible through a variety of platforms – from computers to digital television to WAP mobile phones (SELWYN, 2002).

However, numerous studies tend to treat ICT resources in a homogeneous and indiscriminate way, without considering their particularities and possible impacts on service adherence. They do not usually consider the distinctions between these resources, their technological evolutions, and their respective impacts in relation to the digital divide. Moreover, the use of the internet over non-traditional endpoints (e.g., Smart TVs, video game consoles, and virtual assistants) is still getting momentum and brings new perspectives to this facet of digital divide. If computer peripherals (for instance, printers, webcams, etc.) are also considered as part of the Level-I digital divide equation, the access gap is still an issue even in developed countries (VAN DEURSEN; VAN DIJK, 2019).

Level-II digital divide starts from the proposition that there is no single digital divide (HARGITTAI; HINNANT, 2008) and access, or connectivity, even if it is a basic requirement, does not translate, by itself, into value or benefit to the user. “Instead, usage generally determines how much value individuals derive from the internet.” (GOLDFARB; PRINCE, 2008, p. 2).

The research on the Level-II digital divide addresses the use of internet and issues such as the real motivation, the goal and the difficulties faced by users. The relevance of aspects such as digital illiteracy, behavioral and cultural issues and types of content accessed are topics that can also be found in literature (FERRO; HELBIG; GIL-GARCIA, 2011).

From the point of view of knowledge gaps, research tries to understand the multidimensional issues related to the use and skills ("gap in use" and "gap in skills") of users. Researchers seek to understand them through elaborated attempts to measure digital literacy and digital fluency (HARGITTAI; HINNANT, 2008). Methods used usually involve the creation of user typologies (e.g., basic or advanced, novice or veteran and connected or partially connected) (BONFADELLI, 2002; FERRO; HELBIG; GIL-GARCIA, 2011; RICE; KATZ, 2003), the categorization of skills (e.g., related to content) (SCHEERDER; VAN DEURSEN; VAN DIJK, 2017) and frequency metrics (BRANDTZAEG; HEIM; KARAHASANOVIC, 2011).

According to Wei et al. (2011, p.170), "the digital divide of results (the third level digital divide) is the inequality of results (e.g., learning and productivity) of the exploitation of ICT resulting from the second-level digital divide and other factors". It relates to gaps in individual users' abilities to translate internet access and use into favorable off-network outcomes (VAN DEURSEN; HELSPER, 2015).

In other words, the Level-III digital divide deals with inequalities in ICT use and its effects on the possibility of obtaining economic capital (e.g., network of professional contacts and access to goods and services), cultural capital (e.g., knowledge), and social capital (e.g., relationships) (GÓMEZ, 2020). From the point of view of knowledge gaps, Gómez (2020) refers to the one associated with the Level-III digital gap as the utility gap.

2.1. The determinants of the digital divide

The term determinant is used in the scientific literature to refer to the social, economic, demographic, cultural, personal, material, and motivational aspects that affect the existence of the digital divide. Gil-Garcia, Helbig and Ferro argue that digital inequality is related to "other characteristics that define the social opportunities of an individual such as gender, education, employment status, IT skills, and an ability to speak foreign languages, among others" (GIL-GARCIA et al., 2006, p. 2). Among these, some are particular to studies related to a certain level or approach to the topic addressed (e.g., motivation, skills). Others, such as income and education, are widely present in the scientific production on this research field.

Studies show a greater concentration rate of users among individuals with a higher level of education (HAIGHT; QUAN-HAASE; CORBETT, 2014; VAN DEURSEN; VAN DIJK, 2011). Additionally, education is related to the issues of skills, uses, and outcomes studied in Level II and III digital divide research. According to Cullen (2001), the Internet is not, in itself, education, it is not literate, and it requires highly developed skills to access and interpret the information found.

Economic situation or condition (e.g., family income, and economic class) is a very important determinant of Internet adoption. Numerous articles corroborate its positive impact on the probability of an individual be an Internet user (CHAUDHURI; FLAMM; HORRIGAN, 2005; FERRO; HELBIG; GIL-GARCIA, 2011; NISHIJIMA; IVANAUSKAS; SARTI, 2017). According to Bonfadelli (2002), this finding could be explained by the economic barriers associated with the costs of equipment and network access services.

Research indicates age as a determinant of the digital divide and identifies its relationship inversely with the probability of Internet use (CHAUDHURI; FLAMM; HORRIGAN, 2005; GOLDFARB; PRINCE, 2008; RICE; KATZ, 2003).

Gilleard and Higgs (2008) suggest that attempts to explain this finding are generally associated with the context of social inequality related to the elderly population (e.g., low

income, low education, poor health, labor exclusion), learning difficulties, aversion to natural to new technologies and clash of generations (mechanical world versus electronic world).

Regarding locality as a determinant of the digital divide, residents of urban centers are more likely to be Internet users (GOLDFARB; PRINCE, 2008; HAIGHT; QUAN-HAASE; CORBETT, 2014). According to Loo and Ngan (2012), taking the necessary infrastructure to support the installation of the service to remote locations can be laborious and costly.

Research also points out religion (LISSITSA; CHACHASHVILI-BOLOTIN, 2015; D'HAENENS et al., 2007) and sex (GOLDFARB; PRINCE, 2008) as a factor that influences the use of technology.

The unification of concepts and the creation of a universal terminology that deals with these indicators is something difficult to do, however, it would make the literature clearer and easier to manage. In order to advance in this direction, the systematic literature review that deals with levels II and III of the digital divide establishes 7 categories for the determinants - Sociodemographic, Economic, Social, Cultural, Personal, Material, and Motivational (SCHEERDER; VAN DEURSEN; VAN DIJK, 2017).

3. Methodology

This article aims to answer the question that deals with the evolution of the digital determinants in Brazil in recent years and their respective effects on the establishment of the digital divide – represented, in this study, by the inequalities in internet access.

The terms “access” and “use” are used, in this academic work, in the context of the Level-I digital divide and in a sense of being “online”, that is, being able to connect to the internet and consume its services – regardless of how and where it occurs.

The survey is carried out using structured questionnaires, with closed questions and predefined answers (single or multiple) and follows the references of the Partnership on Measuring ICT for Development initiative, led by the International Telecommunication Union (ITU) (CETIC.BR, 2020).

3.1. Theoretical model

The theoretical model used in this empirical study is composed of the demographics, socioeconomic and cultural characteristics of the participants of the ICT Households 2015-2019[1] survey.

As the dependent variable has a dichotomous nature, logistic regression is the most recommended process of analysis (RICE; KATZ, 2003) and widely used in several articles on the researched topic (GIL-GARCIA et al., 2006; HAIGHT; QUAN-HAASE; CORBETT, 2014; NISHIJIMA; IVANAUSKAS; SARTI, 2017).

The mathematical foundation associated with logistic regression is the natural logarithm of the odds ratios (“logito”), which is used to address the challenges of describing, through a linear expression, the characteristics of the sigmoid curve (PENG; LEE; INGERSOLL, 2002, p. 4) and the non-linearity between the independent and dependent variables.

[1] ICT Households 2020 results, even though available, have been produced by an adapted methodology, due to the constraints and challenges provoked by the COVID-19 pandemic, resulting in a larger margin of error – and, hence, hasn’t been considered for this study (Cetic.br, 2021).

The dependent variable, transformed into a dichotomous one, suggests that a certain person, who has used the internet 03 months prior to the survey, is considered a user[2].

The independent variables have been selected from the information on socio demographics, economic and culture found in the ICT Households survey that could be classified in any of the categories of determinants of the digital divide in the systematic literature review article (SCHEERDER; VAN DEURSEN; VAN DIJK, 2017).

3.2. Data treatment

The variables referring to the level of education and family income were transformed from categorical variables to discrete variables. The level of schooling was transformed into years of education. The family income variable was transformed into monetary values using the averages between the floors and ceilings of their categories, converted into thousands of reais and corrected by the Broad National Consumer Price Index (IPCA).

Subsequently, “dummies” were created, respectively, for the dependent variable and for the other independent variables with categorical characteristics, and their references were established for carrying out the logistic regression (ONO; ZAVODNY, 2007). For religion, the “dummy” variable used represents the characteristic of an individual not being Catholic (reference: Catholic).

A five-year logistic regression has been adopted for this study with the addition of:

(a) an auxiliary variable 'YEAR’ that identifies the record year.

(b) interaction variables for each digital determinant and the auxiliary variable.

Among the independent variables, age and education have presented characteristics of polynomial predictors, transforming the statistical model into a polynomial logistic regression model. Hence, Age[2] and Education[2] and their respective interaction variables have been inserted in the model.

The calculation of the Adjusted Effect (AE) for a specific independent variable in terms of internet usage is expressed by the general formula (1), where 'YEAR' refers to a particular year between 2015-2019, 'VAR' to an independent variable, and 'i' to a value relative to the independent variable (e.g., 10 years for age and 1 for dichotomous variables).

$$\mathrm{AE}_{Var\mathrm{Year}} = \beta_{\mathrm{Year}}(\mathrm{YEAR}-2014) + \beta_{Var2}VAR_i^{\,2} + \beta_{Var}VAR_i + \beta_{AnoVar2}(\mathrm{YEAR}-2014)VAR_i^{\,2} + \beta_{\mathrm{Year}Var}(\mathrm{YEAR}-2014)VAR_i + \mathrm{Intercept} \quad (1)$$

4. Results presentation and analysis

The final logistic regression for this study on the determinants of the digital divide in Brazil[3] for the years 2015-2019 is presented in Table 1. The table shows that the independent variables related to Age, Education, Income level, Economically Active Population, Religion and Residential Area (Urban / Rural) have remained in the final model.

[2] This period is stipulated by the ITU itself, which recommends a reference period of 3 months (ITU, 2014, p. 37).

[3] Regarding the logistic regression, the Logit Function, the Complementary Log-Log and the Probit function have been tested. The Logit Function has proven to be the best option and, therefore, has been selected.

The independent variable related to Sex, Ethnicity, and Region haven't presented statistical significance and, consequently, have been disregarded from the proposed model. Family income hasn't been considered because of the correlation with economic income level.

4.1. Age

The age result, presented in Table 1, confirms, with statistical significance (e.g., β = -0.0587, SE = 0.005, p value < 0.001), its impact, inversely proportional, in the adoption of the internet in the country. In other words, the older a Brazilian citizen is, the less likely they are to use the network.

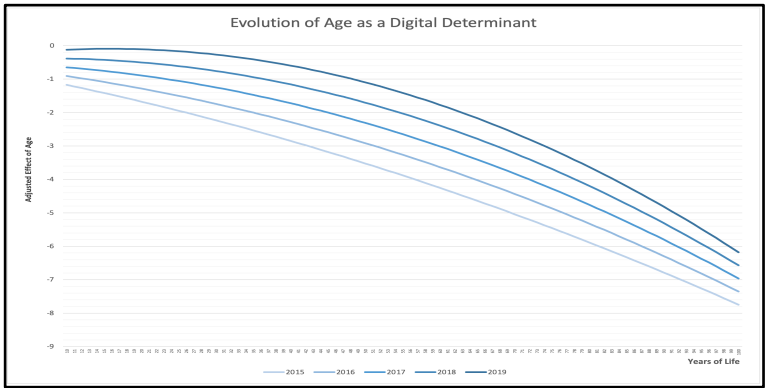

Figure 1 – Evolution of Age as a Digital Determinant

Figure 1 shows the evolution of the age AE throughout the years 2015-2019. In it, it is possible to see that age, as a digital determinant, has lost strength in the period (a fact indicated by the approximation of the annual curves of the coordinate axis). Additionally, the curves of the annual parables have got more prominent, which indicates that the probability of internet adoption decreases, with increasing age, for young people, but decreases in an intensified rate in case of adults and seniors.

Over time, there has been an improvement in the inequalities between youngsters and elders. In 2015, the chance of a 60-year-old person using the internet, compared to a 10-year-old person, was 0.0460:1 (Odds Ratio), which corresponds to a probability of 4.40%, calculated according to (PAMPEL, 2000, p. 25). In 2019, the number jumped to 0.1925:1, which corresponds to a probability of 16.14%.

This finding is supported by other findings in scientific articles about the digital divide in Brazil and in the world (HAIGHT; QUAN-HAASE; CORBETT, 2014). According to Van Deursen and Van Dijk (2014, p. 511), in a study on Dutch society, "age appears to be one of the most significant variables that affect internet use".

Regarding, specifically, the Brazilian reality, Nishijima, Ivanauskas and Sarti (2017, p. 19) claim that "elderly individuals also have lower access to the internet;". Although, they see a reduction in the impact of the age-related determinant in the years surveyed (2003, 2005, 2011 and 2013) and argue, as an explanation for this, the stronger relationship between digital illiteracy in Brazil and the lack of access to formal education than with the difficulties of using the network (NISHIJIMA; IVANAUSKAS; SARTI, 2017, p. 19).

However, articles identified about the reality of other countries point to other explanations regarding the improvement of this situation, such as, for example, the natural aging of young people (VAN DEURSEN; VAN DIJK, 2014) and the adoption of services focused on the context of the elderly (for instance, monitoring of patients with chronic diseases (CHOI; DINITTO, 2013).

4.2. Education

The results presented in Table 1 confirm, with statistical significance (e.g., β = 0.1539, SE = 0.008, p-value < 0.001), the positive impact that the level of education has on the adoption of the internet in Brazil. In other words, the greater the number of years of study that a Brazilian citizen has, the greater the probability that they will use the network.

The variation on the impact of education, however, hasn't occurred uniformly within every year of schooling according to Figure 2. The point of the annual graphs located between 11-12 years of schooling practically hasn't changed. The graphical analysis suggests a leveling trend over the years 2015-2019, with an improvement in the chance of using the network among those who haven't studied or have been in the first years of studies and its reduction for those who have been completing or had already completed the superior education. Additionally, the marginal reduction relative to higher years of education has been quicker, indicating that the relevance of higher education has decreased in relation to other educational levels and, hence, has contributed to minimize the effects of age in the digital gap.

In 2015, for example, a person who could read and write, but who hadn't attended school, and another person with 18 years of education (higher education) had a probability respectively of 36.12% and 95.44% of using the internet. In 2019, the updated probabilities were, respectively, 46.20% and 91.81%. The Odds Ratio of uneducated people using the network, in relation to others, in 2015 was 0.0270:1 (2.63%) and, in 2019, 0.0766:1 (7.12%).

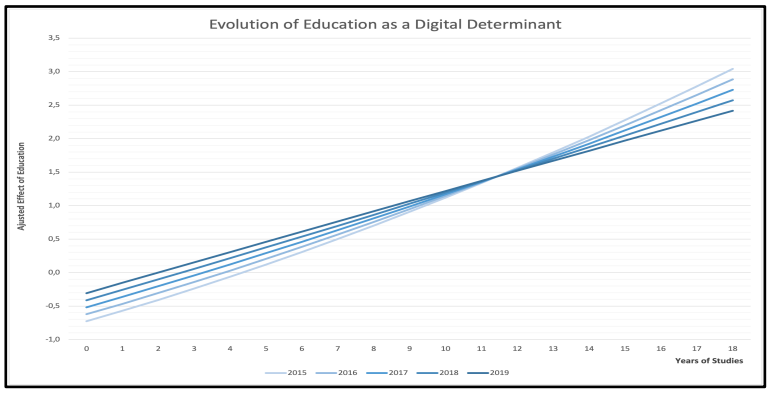

Figure 2 – Evolution of Education as a Digital Determinant

In other words, the probability of using the network by the population with less education has increased and the probability of those with more education has dropped, thus characterizing the drop in the effects of age in the country's digital inequality scenario.

According to Van Deursen and Van Dijk (2011, p. 897), “education is the most consistent global predictor of the use of ICTs”. And according to Nishijima, Ivanauskas

and Sarti (2017, p. 22), “improvements in educational policy represent an effective strategy to reduce the digital divide among individuals of the Brazilian population in the long run by reducing barriers related to digital illiteracy.”

However, Bonfadelli (2002, p. 69) highlights that, “empirical research has proved that knowledge inequalities based on educational deficits can be altered or reversed - at least partly - by factors like personal relevance or interest". This perspective opens possibilities for more immediate gains in combating the digital divide, without students having to wait for long years within the educational system to reverse such a situation.

4.3. Income level

The methodology used in the ICT Household survey to identify the income level uses the Critério Brasil 2015, which is an indicator of the purchasing power of the population, consisting of meters related to the possession of consumer goods (e.g., refrigerators and cars), including products of ICT (e.g., computers and notebooks), access to public services (e.g., piped water and paved street) and the level of education of the head of the household.

Regarding this economic indicator as a determinant of the digital divide, the results presented in Table 1 confirm, with statistical significance, the positive impact of a person being part of income level A (e.g., β = 2.7706, SE = 0.150 , p value < 0.001), income level B (e.g., β = 2.2719, SE = 0.064, p value < 0.001) and income level C (e.g., β = 1.1662, SE = 0.038, p-value < 0.001), in relation to income levels D and E - established as the referential level.

The findings indicate a high chance, in the beginning of the period, of an individual with income level A use the internet, compared to income levels D and E (Figure 3). However, over the period studied, it has remained stagnant. In the years 2015 to 2019, the chance of an individual from income level A making use of the network, in relation to another individual from income levels D or E, has been 15.9682:1 (94.11%).

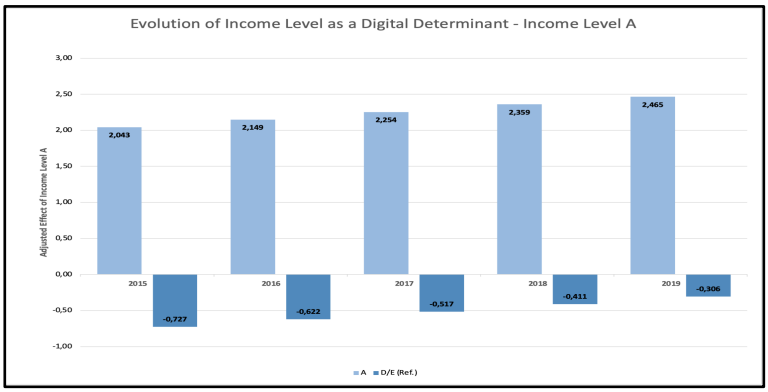

Figure 3 – Evolution of Income Level (Income Level A) as a Digital Determinant

The findings indicate a higher chance, at the beginning of the period, of an individual from income level B, compared to those from income levels D and E, using the internet and its reduction until the end of the period (Figure 4). In 2015, the chance of an individual from income level B using the network, in relation to another from income level D or E, was 8.7426:1 (89.74%). In 2019, the chance was 5.7753 (85.24%).

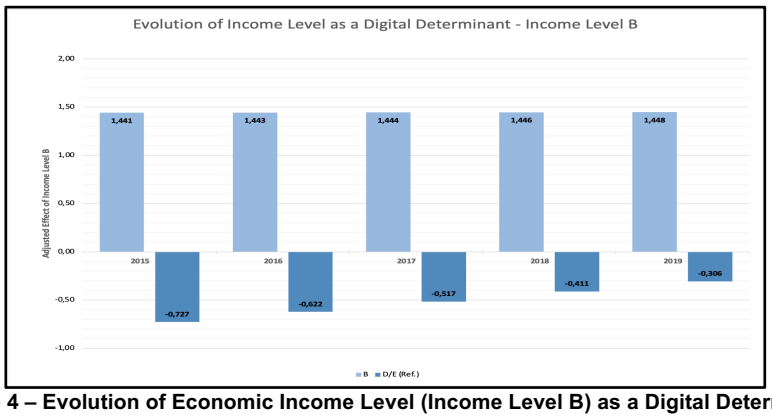

Figure 4 – Evolution of Economic Income Level (Income Level B) as a Digital Determinant

With regards to income level C, Figure 5 indicates the constant fall in the influence of this level, in relation to levels D and E, and presents a perspective of improvement in relation to digital inequality for this determinant between these income levels.

In 2015 and 2019, the chances of a member of income level C, in relation to members of income levels D and E, using the internet were, respectively, 3.0420:1 (75.26%) and 2.4548:1 (71.06%).

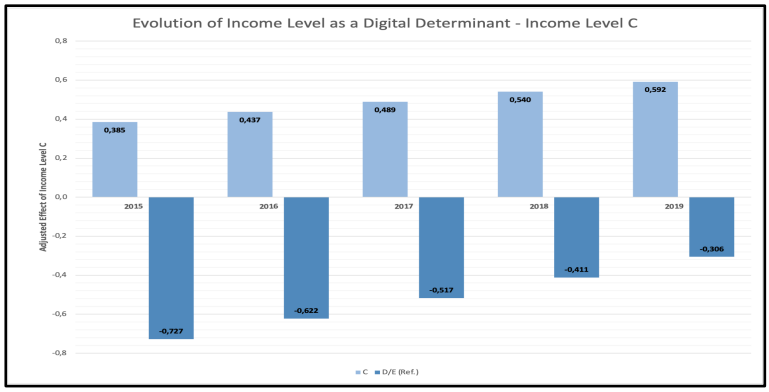

Figure 5 – Evolution of Economic Income Level (Income Level C) as a Digital Determinant

4.4. Economically Active Population (EAP)

Several articles that address the issue of employment as a determinant of the digital divide point out its positive impact on the use of the internet (FERRO; HELBIG; GIL-GARCIA, 2011; VAN DEURSEN; VAN DIJK, 2011).

In Brazil, being part of the economically active affects, with statistical significance (e.g., β = 0.2183, SE = 0.041, p value < 0.001), the chance of a person being an internet user (Table 1).

Nishijima, Ivanauskas and Sarti (2017, p. 22) conclude, for the years studied, that, in Brazil, low income, not having a job and high number of people in a household are barriers significant for access to ICT goods and demonstrate a decline in their respective impacts with regards to digital inequality.

According to Figure 6, the effect of being part of EAP has lost relevance over time, in relation to its reference, reaching the end of the period, with a similar effect to the one

associated with not being part of EAP. In 2015, people with a job or looking for a job in the last 30 days had a chance of 1.1924:1 (54.39%), compared to those not considered economically active, to use the internet. In 2019, the number dropped to 1.0067:1 (50.17%).

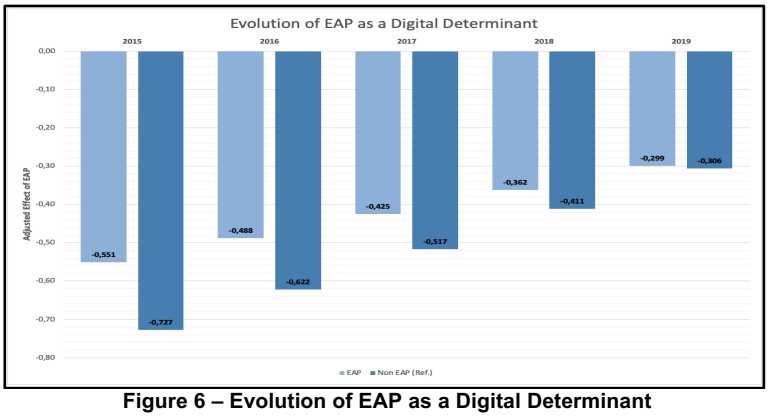

Figure 6 – Evolution of EAP as a Digital Determinant

4.5. Religion

The results presented in Table 1 confirm, with statistical significance (e.g., β = 0.2469, SE = 0.035, p value < 0.001), the positive impact of religion (characterized by the Catholic and non-Catholic binomial in this study) on the adoption of the internet in Brazil during the analyzed period.

According to Figure 7, the graphical analysis of the evolution of the adjusted effect of this determinant informs that it has increased during the period. Not being Catholic has played an increasing role in the country's internet adoption between 2015-2019. In 2015, the chance of a non-Catholic individual using the network, compared to an adherent of this religion, was 1.3330:1 (57.14%). In 2019, the figure rose to 1.5675:1 (61.05%).

From a literature perspective, the variable religion is income levelified as a cultural determinant in the systematic literature review article, according to which, research on "social (e.g., digital support and formal volunteering) and cultural (e.g., cultural capital and religion) determinants need more attention and might provide better explanations of how internet users obtain (or do not) beneficial outcomes" (SCHEERDER; VAN DEURSEN; VAN DIJK, 2017, p. 1614).

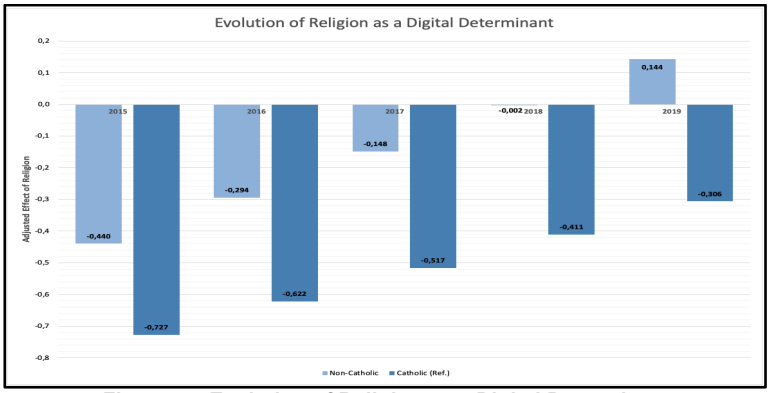

Figure 7 – Evolution of Religion as a Digital Determinant

In one of the articles identified in the literature review, Dilmaghani (2018, p.1) suggests, for the Canadian reality, that “religiosity is found to negatively associate with internet access and activity”. And Lissitsa and Chachashvili-Bolotin (2015, p.47-48) recall that, regarding the digital divide in Israel, “studies indicate a rising rate of internet access and range of digital uses as level of religiosity declines”. The findings of this study, however, do not support this perspective. negative of religion for the Brazilian reality.

Finally, other analyzes regarding religion were verified (e.g., Christian/non-Christian), but only the Catholic/non-Catholic binomial showed statistical relevance in adoption of the internet in Brazil during the years 2015-2019.

4.6. Residential Area

The results presented in Table 1 confirm, with statistical significance (e.g., β = 0.5549, SE = 0.05, p value < 0.001), the positive impact of living in an urban area on internet adoption in Brazil.

Nishijima, Ivanauskas and Sarti (2017, p. 21) argue, in relation to the Brazilian reality, that “individuals living in rural areas have reduced probability of internet access, possibly due to lack of infrastructure” and project that “geographic location (including state and urban/rural areas) shows an increasing trend as determinant of inequalities on internet access and mobile property”.

Figure 8 shows the evolution of the adjusted effect of this determinant between the years 2015-2019, whose data demonstrate the increased relevance of this determinant. However, it is possible to see that the differences between countryside and city, for the purpose of adopting the internet, decrease, characterizing an improvement, in the period studied, of the digital abyss.

In the first year studied, the probabilities of a resident of urban centers and a resident of rural areas using the internet were, respectively, 44.37% and 32.58%. In 2019, these values were, respectively, 49.49% and 42.41%. Between 2015 and 2019, the chance of a rural user using the internet, in relation to an urban user, jumped from 0.6059:1 (37.73%) to 0.7517:1 (42.91%). At the end of the period, 68.77% of urban residents in Brazil were using the internet and, for the first time, rural areas contained more people connected (50.75%) than unconnected.

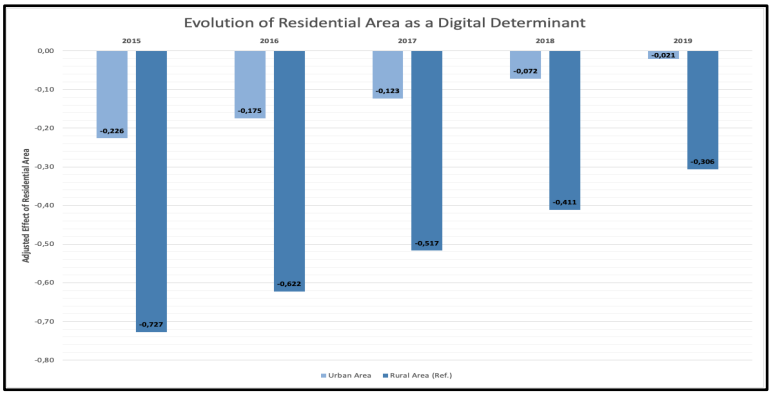

Figure 8 – Evolution of Residential Area as a Digital Determinant

The challenges of bringing connectivity to communities in rural or remote areas are complex and, inevitably, costly. According to Haight, Quan-Haase and Corbett (2014, p.

505) suggest, when dealing with the issue in the Canadian context, the limited number of economic incentives and the low demographic density in view of the enormous geographic area of a country may not be attractive for telecom operators to take bandwidth services wide to remote locations - although there may be people in them with conditions to pay for this service (ZHANG, 2013).

Zhang (2013, p. 526) argues that governments should establish public policies to encourage or subsidize investments in infrastructure where high costs discourage telecommunications companies. Willies and Tranter (2006, p. 46) ratify the understanding of the focus on access and quality of telecommunications services - including the privatization of telecommunications companies, as in the case of Australia.

Conclusion

Although internet access has been established as a necessary means for the exercise of one's citizenship in Brazil and, in recent years, public and private initiatives have sought to contribute to the access universalization in the country, the truth is that the digital divide persists within Brazilian population - especially among those coming from low-income households, uneducated individuals, elderlies, and members of rural communities.

The findings of this study indicate that, among the socioeconomic, demographic, and cultural indicators present in the ICT Households survey, age, education level, economic class, economically active population, residential area, and religion impacted, with statistical relevance, the use of the internet in Brazil over the analyzed period and, therefore, present characteristics of digital determinants. The indicators of sex, ethnicity and regionality did not present a statistically relevant relationship with the use of the network in the country in the years analyzed. And family income was disregarded by the correlation with economic class.

Among the determinants of the proposed model, the level of education, economic class, being economically active, not being Catholic and living in urban centers have a positive influence on Internet adoption, while age had a negative influence.

Regarding the evolution of the determinants in the years 2015-2019, age lost relevance in the establishment of digital inequalities. The level of education, in turn, showed a drop in the influence of secondary and higher education (12 years of study or more) and an increase in case of illiteracy and early school life, thus minimizing the undesired consequences of this determinant for the establishment. of the digital abyss and benefiting the less educated public.

Considering the economic indicators, the importance of being economically active lost relevance over the period, being equaled, in 2019, by the effects of not being a member of this population. From an economic class point of view, the negative impact associated with the social strata with lower purchasing power has decreased, contributing to an increase in the probability of members of classes C, D and E to make use of internet and reducing the digital divide associated with this determinant.

From a cultural standpoint, in the analyzed period, not being Catholic showed a growing influence to determine whether an individual will be a user of the network. Further research is suggested to understand this finding, since the reason that explain it hasn’t been fully understood. And, finally, the increase in the number of people connected in rural areas, presented in the years 2015-2019, caused the positive effect of living in urban

centers to lose strength, contributing to the reduction of digital inequalities between countryside and city.

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Appendix

Table 1 – Logistic Regression for the Determinants of the Digital Divide in Brazil (2015-2019)

Independent Variables	Dependent Variable: Internet Users			
	β Coeficient	Standard Error	z	P > | z |
Intercept	-0,8324	0,107	-7,760	0,000
YEAR	0,1053	0,042	2,506	0,012
Age^2	-0,0001	0,000	-2,358	0,018
Age	-0,0587	0,005	-11,488	0,000
Education^2	0,0039	0,000	8,025	0,000
Education	0,1539	0,008	19,372	0,000
Income level A (ref. Income levels D and E)	2,7706	0,150	18,445	0,000
Income level B (ref. Income levels D and E)	2,2719	0,064	35,494	0,000
Income level C (ref. Income levels D and E)	1,1662	0,038	30,567	0,000
EAP (ref. Non EAP)	0,2183	0,041	5,291	0,000
Non-Catholic (ref. Catholic)	0,2469	0,035	7,112	0,000
Urban Area (ref. Rural Area)	0,5549	0,058	9,596	0,000
YEAR:Age^2	-0,0001	0,000	-6,141	0,000
YEAR:Age	0,0172	0,002	8,549	0,000
YEAR:Education^2	-0,0008	0,000	-7,760	0,000
YEAR:Income level B (ref. Income levels D and E)	-0,1037	0,029	-3,620	0,000
YEAR:Income level C (ref. Income levels D and E)	-0,0536	0,015	-3,495	0,000
YEAR:EAP (ref. Non EAP)	-0,0423	0,016	-2,591	0,010
YEAR: Non-Catholic (ref. Catholic)	0,0405	0,014	2,852	0,004
YEAR: Urban Area (ref. Rural Area)	-0,0539	0,023	-2,384	0,017
McFadden Pseudo-R^2	0,4370			
LLR p-value	0,000			

Source: ICT Households 2015-2019 (CETIC.BR, 2016, 2017, 2018, 2019, 2020) microdata