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Master Degree in International Economics and Commerce

Diffusione della banda larga e politiche: un confronto tra Brasile e l'UE

Broadband Diffusion and Policies: a comparison between Brazil and the EU

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RIASSUNTO

L 'accesso alla banda larga è essenziale per lo sviluppo della nostra società. È già noto che internet è utilizzato da oltre l'80% della popolazione mondiale, solo per inviare messaggi di testo o per cercare, fino a quando l'utilizzo di internet per il lavoro a distanza. Internet è una tecnologia che oggigiorno non possiamo vivere senza di essa.

Il governo di ogni paese deve fare alcune politiche per rendere disponibile l'accesso a Internet (fisso o wireless) alla quota di popolazione non fornita dal mercato, concentrandosi su rendere possibile l'accesso a Internet a tutti, finché questo può essere un parametro per la crescita economica. Possiamo confrontare, ad esempio, la diffusione della banda larga sui paesi sviluppati nei paesi in via di sviluppo (utilizzando alcuni parametri come il salario minimo, l'accesso alle aree rurali x urbane, il tipo di internet consegnato alla popolazione, il potere d'acquisto, il prezzo di Internet, tra altri).

Le politiche per assicurarlo sono difficili e non hanno soluzioni facili e veloci. Questa tesi utilizzerà dati empirici comparativi per mostrare come è la situazione del Brasile nella diffusione della banda larga, confrontarla con l'Unione europea e trarre una conclusione su come si può diffondere l'Internet a banda larga, con particolare attenzione alle aree rurali e alle persone escluse digitalmente quelli in Brasile.

Parole-chiave: Banda larga, Brasile, Unione Europea, Crescita economica, Area rurale

ABSTRACT

Access to broadband is essential for development of our society. It is already known that the internet is used by more than 80% of the world population, just to text or to search, until the usage of the internet to work or remote work. The internet is a technology that nowadays we cannot live without it.

The government of each country needs to make some policies to make available the access to internet (fixed or wireless) to the share of population not supplied by the market, focus on making the access to the internet possible to everyone, as long as this can be a parameter for economic growth. We can compare, for example, the broadband diffusion on developed countries the developing countries (using some parameters such as minimum wage, rural x urban areas access, type of internet that is delivered to the population, purchasing power, price of the internet, among others).

The policies to assure it are challenging and have no easy and fast solutions. This thesis will use comparative empirical data to show how is the situation of Brazil in broadband diffusion, compare it with the European Union, and gives a conclusion on how can the broadband internet be spread, with a particular focus on rural areas and the digitally excluded ones in Brazil.

Keywords: Broadband, Brazil, European Union, Economic Growth, Rural Area

1. INTRODUCTION

The usage of internet can be applicated for a long list of interactions and activities, since for lazy parts until meetings of important companies, political analysis and etc. The broadband Internet is quite important for new technologies as the 3D printer, i.e. Not just for goods, but also for services or knowledge with online courses, i.e. We can see that the broadband internet is present in almost 100% of our daily activities. In the same point, the broadband internet can be used for bad reasons as well, for example to thefts, kidnapping or drug dealers.

The smartphones – created on 1992 but began to be more popular on 2002 – modified our lifestyle. The internet is something that we cannot live without it anymore, so after this technology, we are always trying to make it better, faster and secure. In the broadband internet (present in almost 100% of our daily activities) some protocols need to be implemented for your safety use of it, in example, when you share something personal or when you pay using your credit card. For those reasons, you need to have a safe connection with an encrypting part that will take care of your data used.

As long as the broadband internet is something so present in our daily activities, this thesis will start with what is broadband and how can the broadband influence the economic growth of a country and describe how can we model the broadband

penetration into a country with some factors that will be describe as the most important ones.

It will follow with a focus on the broadband in Brazil: what are the policies that the government are doing to grew the broadband diffusion, how is the internet in Brazil compared to the world, how is the diffusion by social class and by region of Brazil. It will assume some predictions using the Kagan estimates for the type of connection that will be diffused in Brazil and talk about the annual growth for the top 4 markets in Latin America.

After this, the focus will be on the broadband of European Union, showing how the Digital Agenda improved the diffusion of broadband around the EU, what are the main focus of this Agenda and how is it going nowadays compared to what should have be done if the countries had follow the guidelines of the digital agenda.

After presenting both broadband diffusion, it will compare both ones, showing what are the problems that we can have in developing countries, how can the economic relationship between Brazil and the EU can affect the economic growth and therefore the broadband diffusion in both areas (rural and urban), stabilizing a comparison between the price of the broadband, the GDP and the areas. It will present how was the adoption of the IPv6 in Brazil and in others countries and what are the comparison between countries average connection speed.

New technologies that uses the broadband for any reason and nowadays are emerging will be described and it will follow with how the implementation of the broadband in some areas (most in the remote ones) can implies a better and efficient production function, using the equations from Zeira (1998) and Acemoglu & Autor (2011).

To finish all those points presented before, it will show how can the Brazilian government makes the broadband diffusion a useful and important investment for the next years to be able to achieve the economic growth and the penetration rate of broadband as the same level of European Union and to be able to receive the new emerging technologies, as the Industry 4.0 or the 5G technology.

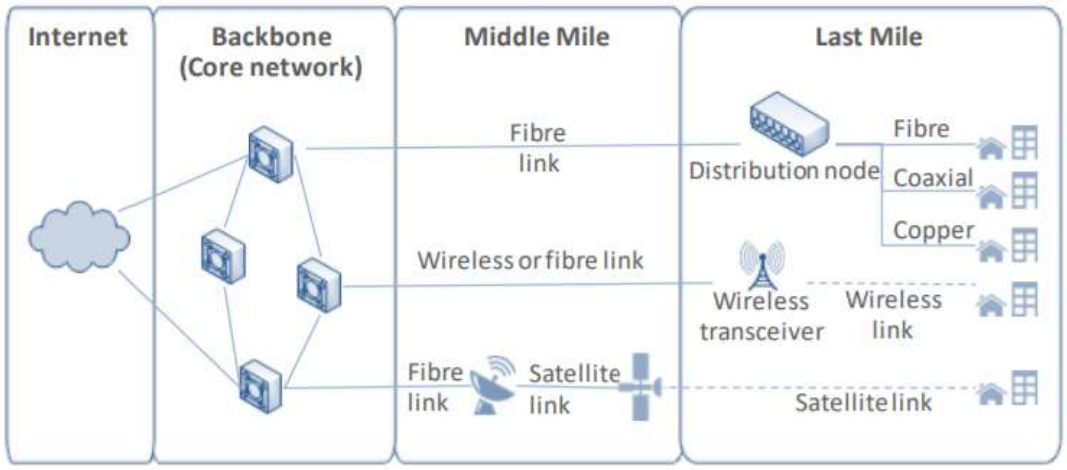
2. BROADBAND

2.1. INTRODUCTION

The definition of Broadband is: "*a high-capacity transmission technique using a wide range of frequencies, which enables a large number of messages to be communicated simultaneously"* (Figure 2.1.1.). In telecommunications, broadband is wide bandwidth data transmission which transports multiple signals and traffic types. The infrastructure can be, for example, coaxial cable, optical fiber, radio or twisted pair. (Table 2.1.1.) In the context of internet access, broadband is *"any high-speed Internet access that is always on and faster*

than dial-up access over traditional analog or ISDN PSTN services". (Jame, 2018)

Figure 2.1.1 - Segments of a broadband network



Source: ECA

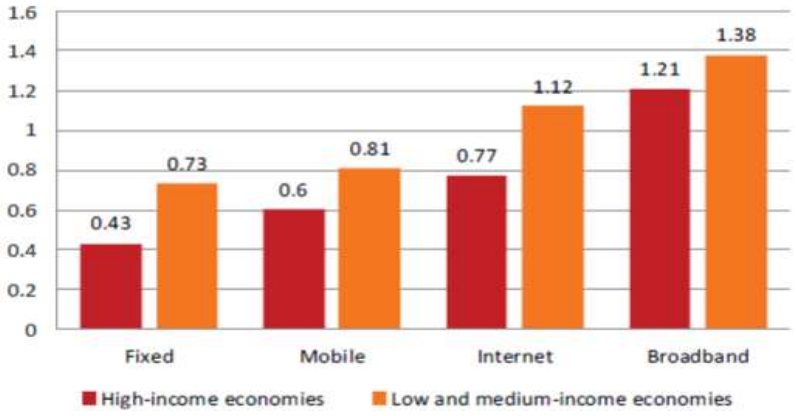
Table 2.1.1 - Broadband infrastructure types

WIRED OR WIRELESS	INFRASTRUCTURE	INDICATIVE DOWNLOAD SPEED	INDICATIVE UPLOAD SPEED
WIRED	Fibre	up to 2.5 Gbps	up to 1.2 Gbps
	Coaxial cable	300 Mbps up to 2 Gbps	up to 50 Mbps
	Copper phone	5 Mbps up to 100 Mbps	up to 10 Mbps
WIRELESS	Terrestrial wireless	60 Mbps	up to 10 Mbps
	Satellite	up to 20 Mbps	up to 8 Mbps

Source: Acreo Swedish ICT

"The Internet seems like magic to most of us, but it depends on infrastructures and institutional arrangements, public and private investment, policies, and regulation. Without this intricate ecosystem, the incredible innovations enabled by the broadband Internet would not be possible." (Knight, et al., 2016)

Figure 2.1.2. - How the investment in broadband and information technology can impact economic growth

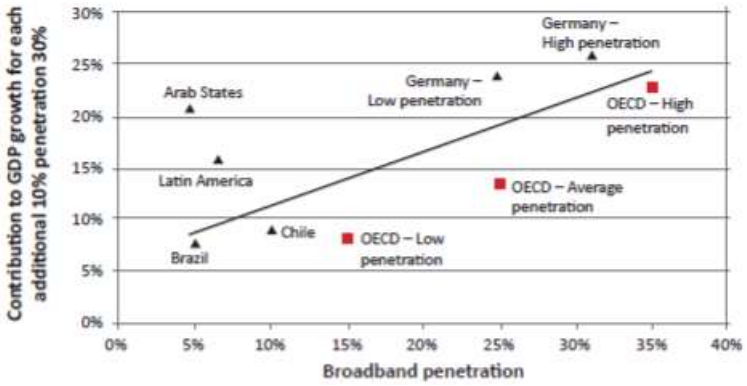


Source: Quiang and Rossoto (2009, p. 45)

A necessary condition to materialize the digital dividend is the existence of a broadband infrastructure, which requires massive investments. If we take a look into Figure 2.1.2. (QIANG; ROSSOTTO, 2009), where the vertical axis is the increase in the economic growth rate for each 10% increase in penetration, we can see a positive relationship between economic growth and the pervasiveness of telecommunications, in which broadband is the most impacting one.

Similar results were presented in a report published by the International Telecommunications Union (ITU) (Figure 2.1.3), which shows a direct relationship between broadband penetration and the magnitude of the impact on economic growth.

Figure 2.1.3 - The relationship between broadband penetration and the importance of its contribution to GDP growth



Source: Katz (2012, p. 93)

The Organisation for Economic Co-operation and Development (OECD) is an organization that have its roots in Europe after the World War II, and their mission is to promote policies that will improve the economic and social well-being of people around the world (OECD, 2019). We can see that into the figure above we have the parameters for the OECD Broadband penetration. Brazil is in the same line of the OECD-Low penetration talking about the contribution to GDP growth but with one third of the broadband penetration stabilized for the OECD. We can see that Germany, for example, has a better contribution with almost the same broadband penetration of the OECD-high penetration.

The OECD is a very good parameter to compare with other countries once it is an organization that is focus on helping governments around the world to:

- ✓ Restore confidence in markets and institutions that make them function;
- ✓ Re-establish healthy public finances as a basis for future sustainable economic growth;
- ✓ Foster and support new sources of growth through innovation, environmentally friendly 'green growth' strategies and the development of emerging economies;
- ✓ Ensure that people of all ages can develop the skills to work productively and satisfyingly in the jobs of tomorrow. (OECD, 2019)

2.2. BROADBAND IN THE WORLD

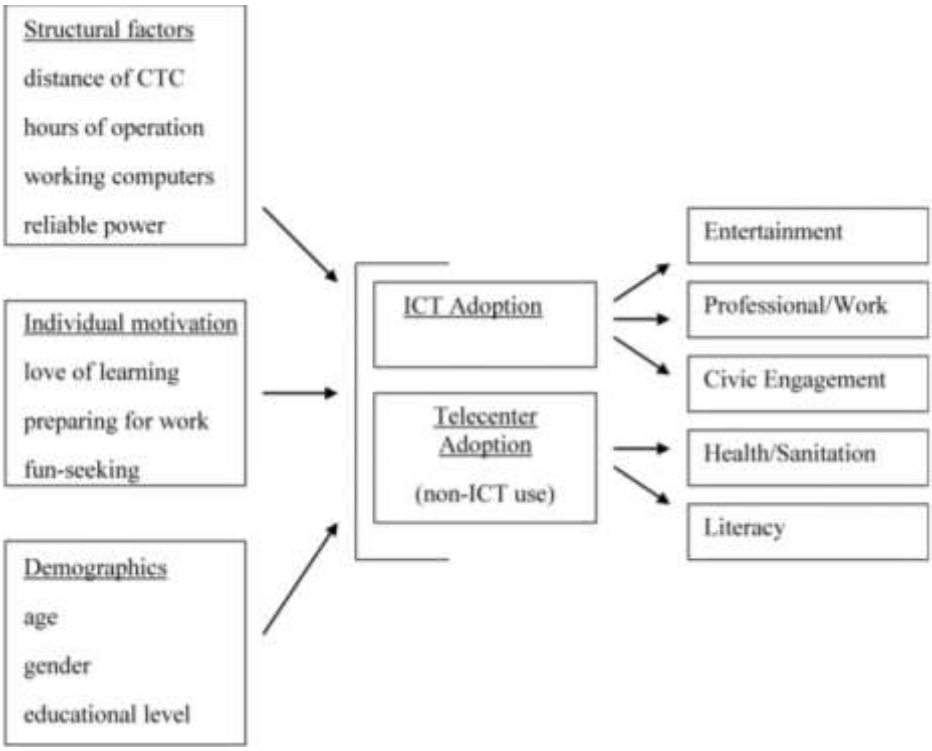
As written by (Galperin & Ruzzier, 2013), the determinants of broadband adoption over countries has two factors: the first one are the endowments facts (geography, demographics, wealth, etc.) where policymakers has small impact in short to medium term; the second is that the regulatory factors that shape the market competition, that is where national broadband policies usually focus on. That is why we have different adoptions of broadband around the world.

The country's competitiveness within a globalized economy increasingly depends mostly on knowledge and access to information. Broadband Internet is essential to the infrastructure of the 21st century. It leverages technological advances in several areas, reducing costs and increasing the quality of services such as

education, health and public security, among others. Broadband can also strengthen the research and education system, promote innovation and foster economic development, contributing to a fairer society and to a more dynamic and competitive economy (Figure 2.2.1).

It is important to consider the impact of some elements like demographic characteristics, education, individual attitude and behavior, etc. in order to examine the broadband diffusion from a holistic perspective.

Figure 2.2.1 - Conceptual Model Relating Structural Factors, Individual Motivation and Demographics to ICT use at ICT Telecenters



Source: Prado et al., 2011

Without a ubiquitous broadband infrastructure, social and economic inequality can only grow. The lower classes are known as digitally excluded – either because they are poor or by the lack digital literacy. Most of them live in remote areas where broadband infrastructure is not available, mostly known as rural areas.

The government needs to invest into broadband to make those people more integrated to the digital technology that is more and more present in our diary tasks. The digitally exclusion implies in some dimensions, each one with its impact into the social inequality: the existence of broadband connection infrastructure, the access to equipment and to the individual connection, the digital literacy, the intellectual empowerment and the development of specific content to the poorest sectors of the society, as the rural areas (Sorj, 2003). We know that with more digital inclusion, we have a better social and political development, more participation of citizens and so, more economic development for the country.

The model presented on Figure 2.2.1. consists to evaluate the impact of each of the factors that can impact on the likelihood of ICT adoption and how those ICT Telecenters can help in some cases, like in rural areas where the access is difficult, to not just for the digitally inclusion, but as well for some conditions that should be basics and sometimes those areas have precarious access to them. The role of

ICT has been very low, representing for example, less than one-sixth of the total capital contribution in Latin America. (Hofman, et al., 2016)

The interest about the characteristics and the implications of the phenomenal digital divide, as well as its actions to overcome such inequality, started in the second middle of the 90's. Since then, the understanding of this type of exclusion passed by a lot of transformations.

First of all, the studies about this digital inequality as well as the actions to promote the digital inclusion were restricted to the dimension of the access of the ICT (Information and Communications Technology). In another words, the focus on those works were limited into those that had access to the ICT. The analyze of the role of each one of the demography characteristics (geographic area, level of education, social class, sex, etc.) were determinates to the digital exclusion (Scheerder, et al., 2017).

With the expansion of the internet usage from the 2000s and on – mostly in the developed countries – it was verified that the simple overcoming to the access of ICT were not enough to cease this type of exclusion (Van Dijk & Hacker, 2003). Furthermore, due to the key role played by the Internet in modern society, the development of digital skills is a crucial part for digital inclusion Therefore, having knowledge about digital skills makes possible to understand issues related

to variety in ICT usage, and to characterize patterns of usage of internet among users (Litt, 2013).

The number of broadband subscriptions per 100 households in a country can be expressed by the Equation 2.2.1. This equation has as variables the average monthly subscriptions cost (in US$ Purchasing Power Parities, or PPP), GDP per household in a country (in US$ PPP), the percentage of population between 15-64 in a country, the average years of schooling for population above 25 years old and the error term. (Galperin & Ruzzier, 2013).

In the study case of Galperin & Ruzzier, 2013, it is possible to see the correlation between the penetration of broadband and its factors. The correlation between penetration and price (β_1) is negative, but for the other ($\beta_0, \beta_2, \beta_3, \beta_4$) is positive: so, if all the parameter stays the same and the price gets up, the penetration will be worse than before. If a country has more investments for the digitally excluded population, it will get a better penetration rate, once the education is direct proportional to the penetration rate.

Equation 2.2.1 - How to measure the penetration of broadband subscriptions per 100 households in a country i

$$\mathrm{PENET}_i = f(\mathrm{PRICE}_i, \mathrm{GDPCAP}_i, \mathrm{AGE}_i, \mathrm{EDUC}_i) + u_i$$

$$\mathrm{PENET}_i = \beta_0 + \beta_1 \mathrm{PRICE}_i + \beta_2 \mathrm{GDPCAP}_i + \beta_3 \mathrm{AGE}_i + \beta_4 \mathrm{EDUC}_i + u_i$$

3. BROADBAND IN BRAZIL

3.1. MAIN DEVELOPMENTS OF BROADBAND IN BRAZIL

Brazil is the fifth largest country in area (with 8.5 million square kilometers) and the fifth most populous one (with over 208 million people). The telecommunications sector legislation and regulation is widely regarded as pro-competitive and progressive and is considered to be among the most progressive due to the large-scale privatization, completed at the end of 1999, and the introduction of market competition (Pereira-Filho, 2003).

The General Guidelines for Opening Telecommunications in Brazil (GGTB-1997) was designed to achieve the main objectives that were the universal service and the introduction of competition. Before the General Guidelines, TELEBRAS had the monopoly control for 26 years over the telecommunication sector in Brazil. The reform of the telecommunication sector was one of the most well-structured reforms in the Latin America. The restructuring of TELEBRAS fixed broadband followed a mild horizontal segmentation strategy, divided by three new telecom companies: Brasil Telecom, Telemar and Telefônica. The mobile units were separated from their wire counterparts (Mattos & Coutinho, 2005).

In 2010 the National Broadband Program was initiated. This program is a Federal Government initiative, which was created with the goal of expanding the telecommunications infrastructure by the country and to reduce the price of those

services. This second goal might be one of the reasons regarding the growth of broadband users in IPEA research in 2017.

By that year, the government program launched high quality internet subscriptions with speeds of 2 Mbps (known as the first generation of broadband, henceforth FGB) at a monthly price of BRL 39.90, which contributed to the overall reduction in prices of broadband plans. It also introduced internet connections to many regions of the country that were previously devoid of reliable broadband services, including areas in the North and Northeast states of Brazil, which are known as areas with difficult access.

The telecommunications market is one of the most important sectors in the economy of Brazil, accounting 7% of the Brazil's GDP in 2008. The broadband internet has expanded significantly in Brazil in recent year, due to some factors as reduction in prices for broadband subscriptions and the expansion of telecommunications infrastructure. In November 2017, the IPEA (Instituto de Pesquisa Econômica Aplicada) indicated that there are over 39 million active internet subscriptions in Brazilian households with fixed broadband, while back in 2011 only 14 million broadband connections were found in the country. (IPEA, 2017)

In a world that nowadays is more and more technological, the broadband is extremely present in our lives but still has some problems that needs to be solved. If you use the data resulting of World Bank's World Development in 2019, you will see that Brazil occupies the fifth position in number of Internet users in the world; this number seems to be a significant accomplishment, but looking deeper, you will see a considerable portion of the population that still has a lack of broadband access or low quality connections. Widespread high-speed, high-quality and low-cost broadband are critical points to increase economic, social and political development.

The market of cellphones in the last years has shown high growth rates worldwide, especially in Brazil. Data from the Telecommunication National Agency (ANATEL) indicates that the number of customers of mobile services have risen at a Compound Annual Growth Rate of 35% in 2008. The data from the International Telecommunication Union indicates that the number of mobile service customers in the world has risen 19% between 2000 and 2008. (Baigorri & Maldonado, 2008)

The data from IBGE in 2018 shows that 70,5% of Brazilians households have internet access, against 63,6% in 2017 and 27% in 2010. We can see a quick development in broadband and a high adoption rate of broadband connection. Most of this connection is made by cellphones, where 69% of the interviewers

said that they use the internet by the cellphone, comparing to 60,3% in 2016. Writing about digital inclusion in Brazil, (Sorj, 2003) highlighted the importance of individual motivation and self-esteem as a driver for ICT use.

Nowadays, however, a significant number of households are still not connected with broadband services yet. Data from a study conducted by ANATEL between 2016 and 2017 shows that there is a demand in Brazil of 11.6 million households that are still with no connections. The main reasons underlined by the study were lack of service in many of the areas across the country and exorbitant prices charged to the users of those regions.

Looking into the rural areas, the data from 2018 of the Centro Regional de Estudos para o Desenvolvimento da Sociedade da Informação (CETIC) do Núcleo de Informação e Coordenação do Ponto BR (NIC), shows that just 34% of the households have internet access. The most important reason for this is that 27% of the interviewers says that the internet access is very expensive. We can see that even nowadays, after the Federal Government programs, we still have some problems with the poorest people to be connected, even if a part of them (almost 50%) owns a cellphone, as it can be seen in Table 3.1.1.

The population that lives in rural areas can have a lot of problems regards the broadband infrastructure: the most important of them is the physical access to a

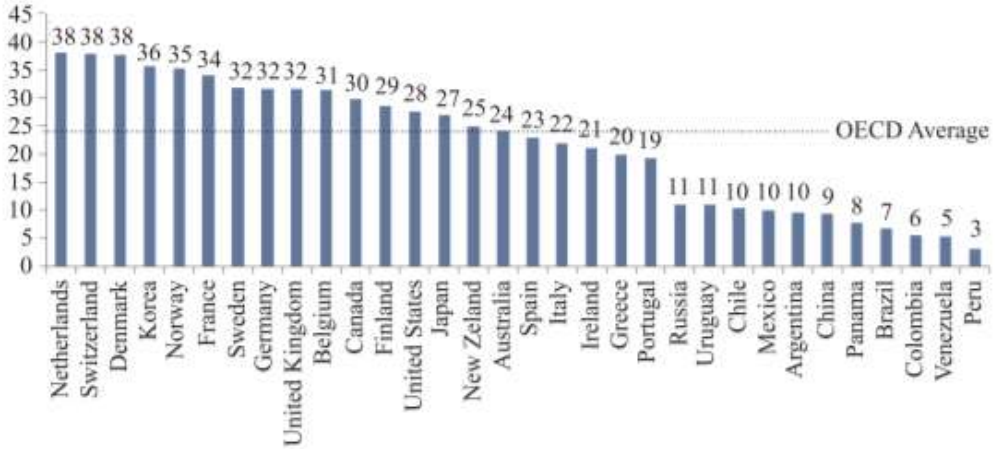
community access center or the broadband infrastructure, that can be far from home, or with precarious road conditions, unstable electrical power grids, thefts or limited financial resources, with results in the digitally excluded for the rural areas (Mori & Assumpção, 2007). The Federal Government started some strategies to take care of the digital divide in the rural areas, having three main strategies for the digital inclusion public policy: access to internet by home, by school and community access centers.

Table 3.1.1 - Percentage of population that used the internet, with more than 10 years old, by monthly house turnover per capita from 2013 to 2015

	2013	2014	2015
Without turnover or 1/4 minimum wage	23.9%	28.8%	32.7%
More than 1/4 to 1/2 minimum wage	33.8%	40.3%	45.0%
More than 1/2 to 1 minimum wage	43.0%	47.9%	54.7%
More than 1 to 2 minimum wage	55.6%	59.5%	57.9%
More than 2 to 3 minimum wage	68.4%	71.6%	70.9%
More than 3 to 5 minimum wage	78.4%	80.8%	81.9%
More than 5 to 10 minimum wage	84.5%	88.1%	88.6%
More than 10 minimum wage	89.9%	91.5%	92.1%

Source: IBGE (2013-2015)

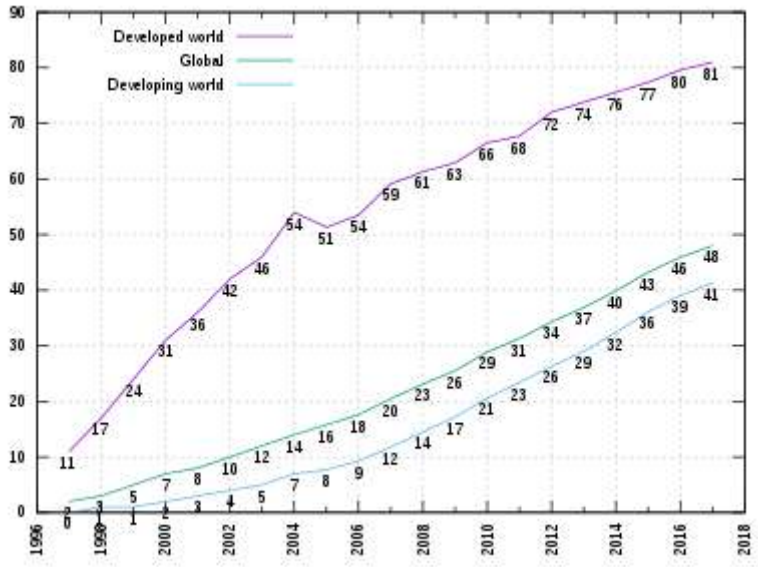
Figure 3.1.1 - Comparison of fixed Broadband in some countries in % at 2010



Source: International Telecommunication Union, 2010

If we compare the fixed broadband in some countries (see Figure 3.1.1.), it will be possible to see that Brazil is quite far away from what the others can offer for their people. Although the graphic shows just data of 2010 and into 2013 we had a better accuracy with more types of internet utilization (for example, smartphones, cellphones, tablets and others), we still have a lot to invest to get more people connected, as long as the last data (2017) showed that just 34% of rural areas had some internet access (CETIC/NIC).

Figure 3.1.2 - Internet users per 100 inhabitants by type of country

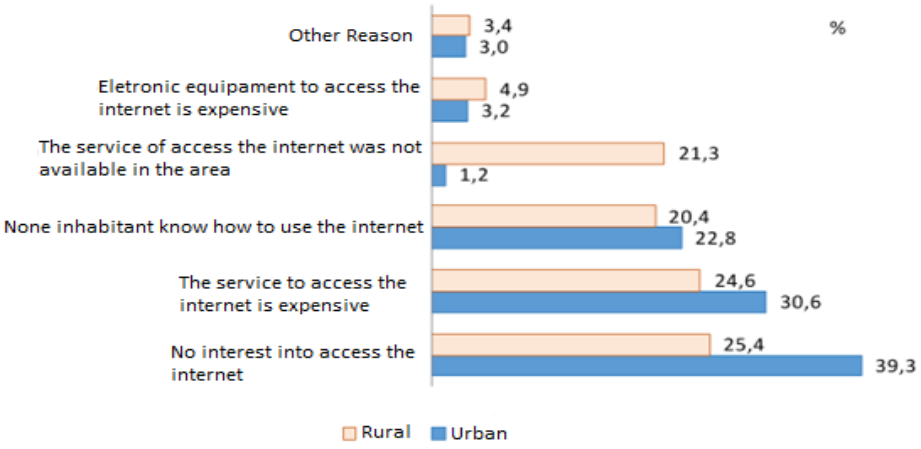


Source: International Telecommunication Union, 2017

In Figure 3.1.2., it is possible to see that Brazil should be in the line of the developing countries, where should have in 2018 around 41% of inhabitants with internet access. But with the last data from IBGE 2017 we see that 70,5% have internet access – which is almost the same percentage of the developed countries – concluding that Brazil has a better broadband access than the developing world. Comparing the data from Figure 3.1.1. with Figure 3.1.2., we can see that in 2010 Brazil had almost 7% of inhabitants with internet access, while the average of the developing country had around 26% of access, but since the National Broadband Program, that started in the same year, the percentage increased a lot, showing that if it was not a federal program, the data should be worse than it was.

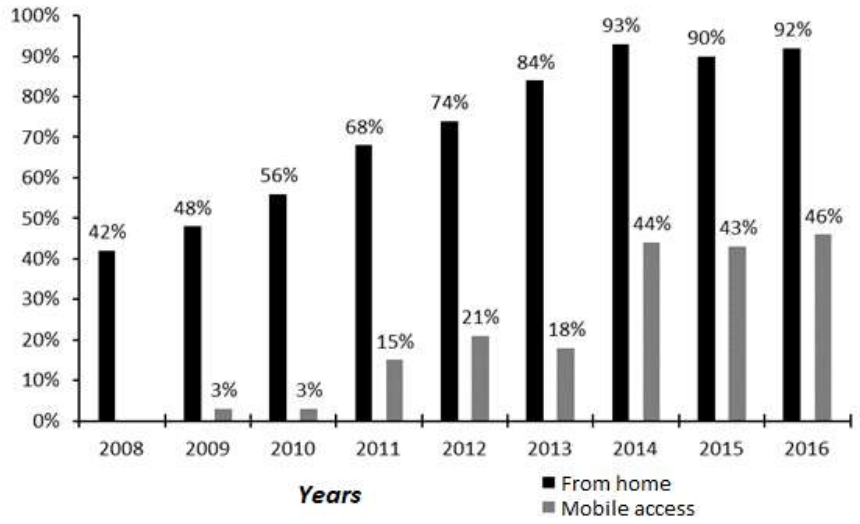
With those data, we can see that Brazil still has lot of problems with internet access, and in Figure 3.1.3. from the research of IBGE 2017, we can see the reasons why those percentage of population still does not have internet access. The first point is the not interest into access the internet (39,3% in urban area and 25,4% into rural area), following the service to access the internet is still quite expensive (for both rural (24,6%) and urban (30,6%) area), and from the not knowledge of usage of internet, that can be classified as the digitally excluded ones, explained before, but into the rural area we can see that the other point is that the service of internet is not available (21,3%).

Figure 3.1.3 - The reason for not have internet access by rural and urban area in 2017 from IBGE data



Source: IBGE (2017)

Figure 3.1.4 - Percentage of individuals that had access to internet in Brazil between 2008 and 2016 by type of local of access

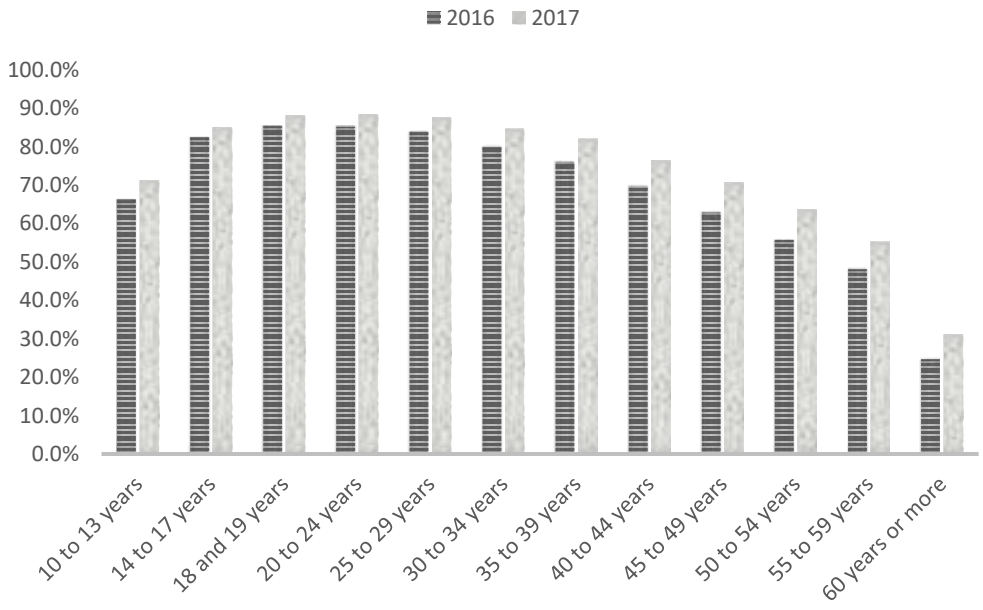


Source: IBGE (2015)

Figure 3.1.4. shows that the access by home and by mobile increased a lot in Brazil in the last few years. The fixed broadband internet got bigger and bigger, but with the popularization of the smartphone in 2007 (Chart 3.1.1.), most of the connection began to be made by mobile access. Another point that we need to get our attention is how people (divided by range of years) uses the internet to access something. Using the Figure 3.1.5. as a base, we can see that more and more the access to internet and the interest into using it is getting bigger for all the range of years. Most of this is due the technology that we have in the smartphone, like be in touch with someone that is far away, or to be able to receive some message of

the family or friends. The internet and the new technologies are something so important nowadays that should be delivered to all the inhabitants of the world.

Figure 3.1.5 - Percentual of people that utilize the Internet from 10 years or more, by range of years in Brazil in 2016 and 2017



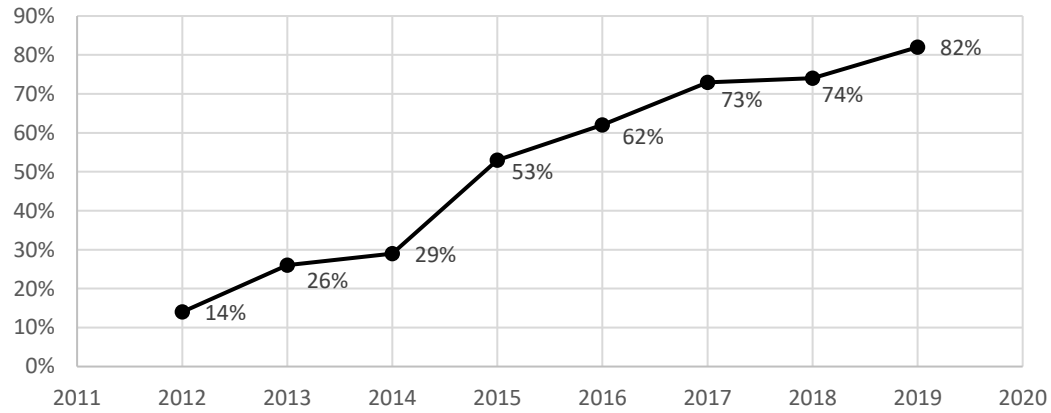
Source: IBGE (2016-2017)

From the year of 2013, we had a boom of utilization of the smartphones in Brazil, as it can be seen into Chart 3.1.1. With this, we can see how important is the smartphone nowadays. The cellphone is the most important good that we use and the Brazilians spend more than 20% of our time in the screen, searching for something, using WhatsApp, Facebook, Instagram or to just listen to some music, search for new places to visit, etc. The Brazilians uses the cellphone much more

than other countries like USA or Italy, for example (Figure 3.1.6.). Even if the cost of internet access in Brazil is quite expensive compared to other countries, people more and more wants to stay connected.

One of the main thrusts of a broader strategy for the use of the ICT to promote the economy must be divided into two main reasons: to extend fiber optic networks to almost all municipalities and build high-capacity networks in order to reach the most remote remaining municipalities, known as the rural areas. To accomplish these goals, a national debate was in discussion in Brazil with two elements: the first is the development of the Banda Larga para Todos (Broadband for All) program, proposed during the reelection campaign of President Dilma Rousseff, in 2014. Until 2016 the goals and the structure of the program were still unclear and under discussion; the second is about the so called “new telecommunications model”, subject of a public consultation by the Ministry of Communications (Ministério das Comunicações – MC).

Chart 3.1.1 - Percentage of penetration of the use of cellphones or smartphones in Brazil



Source: Panorama Mobile Time - Opinion Box, 2018

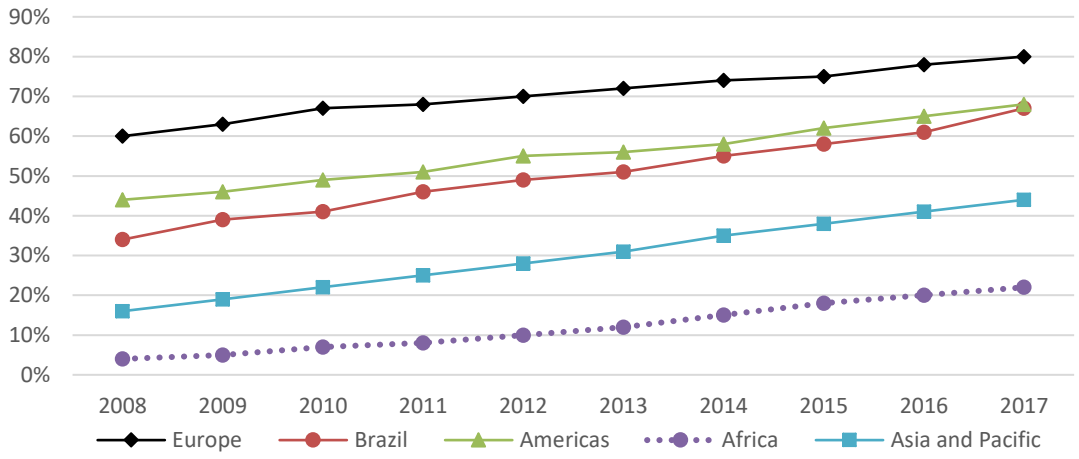
Figure 3.1.6 - Hours per day spent online via a mobile device, per user, per country

Source: Statista Digital Market Outlook, 2017

Those number take another vision if we take a look into the 2017's numbers (Chart 3.1.2. and Chart 3.1.3.). We can see that since the 2010 program in Brazil, the country increased quite huge compared to the other Under Development Countries, almost 22% more in 2017, but still 23% above the Developed Countries (Figure 3.1.2.). But if we take a look into Chart 3.1.2., we can see that Brazil is getting in the same ranking of the Americas and less than 20% than Europe.

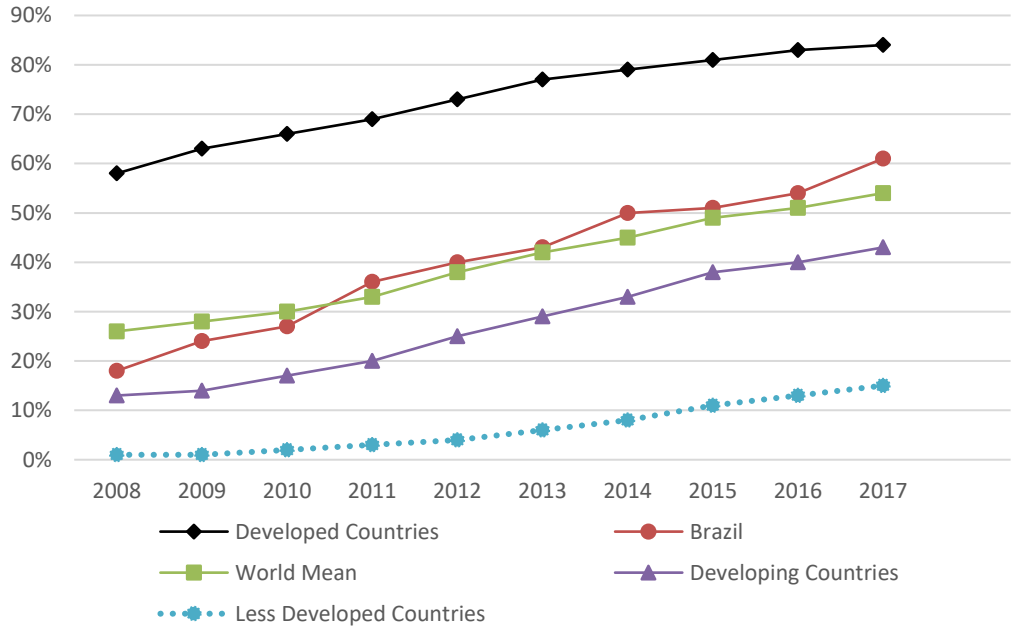
In Brazil we still have a problem with the internet in the rural areas that are very precarious, with low speed internet and a huge price compared to the urban areas. This is due to the fact that the telecommunications companies do not want to invest into those areas because is a low profit area and a high cost for infrastructure, and sometimes, for the rural population, having the low speed internet with a reasonable price is better than have a speed one with high prices.

Chart 3.1.2 - Internet users around the world (2008-2017) in percentage



Source: UIT and CETIC.br, 2018

Chart 3.1.3 - Households with internet access (2008-2017) in percentage

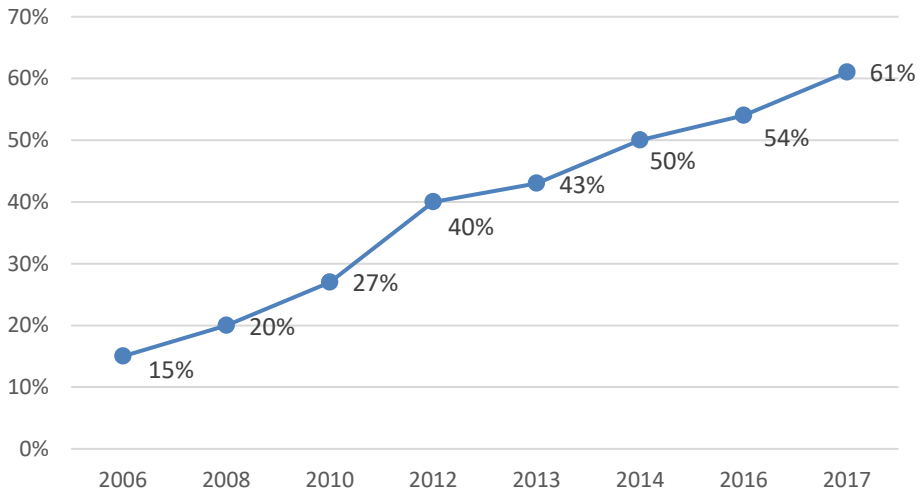


Source: UIT and CETIC.br, 2018

3.2. CURRENT STATUS OF BROADBAND IN BRAZIL

The Table 3.2.1. shows the Internet Penetration and the capacity of access connection over some years (2006/2017). We can see that the increasement of the percentage of private households with internet access nowadays is almost the triple from 2010, and since the government proposed the National Broadband Program, the increase got a boom in 2012, compare to what was being increased year by year without the government program (Chart 3.2.1.).

Chart 3.2.1 - Percentage of private households with Internet access over the years in Brazil



Source: CGI.br (2006/2017)

Table 3.2.1 - Internet Penetration and the capacity of access connection over 2006-2017

Statistics/Year	2006	2008	2010	2012	2013	2014	2016	2017
% private households with Internet access	15	20	27	40	43	50	54	61
% private households with Internet access with landline (fixed) broadband connection	6	10	18	27	28	34	37.2	42.4
% private households with Internet access with mobile broadband connection (3G modem)	n.a.	n.a.	3	8	9	13	14.7	16.6
% private households with Internet access with connection between 2 and 8 Mbps	n.a.	1	3	3	6	8	n.a.	33
% private households with Internet access over 8 Mbps	n.a.	n.a.	1	6	7	12	n.a.	15
% of individuals over 10 years old who accessed the Internet in the last 3 months before any local search (considered Internet users in the research)	28	38	41	49	51	55	61	67
% of individual Internet users over 10 years old who accessed the Internet every day from any location	13	21	25	34	36	44	69.3	74.9
% of individuals over 10 years old who accessed the Internet anywhere in the three months prior to the survey via computer, laptop or tablet	n.a.	n.a.	n.a.	n.a.	n.a.	80	63.7	56.6
% of individuals over 10 years old who accessed the Internet in the three months prior to the survey via cell phone, from any location	n.a.	n.a.	n.a.	n.a.	n.a.	76	94.6	97

Source: CGI.br (2006/2017)

From the last ICT Households survey in 2015, we have a demographic profile of the Brazilians internet users, using the main demographic factors considered in Scheerder, et al., 2017 to be digital divide determinants. In the ICT Households 2015 survey, 20,397 individuals from every region in Brazil, who were selected through a rigorous sampling process, were interviewed (Brazilian Internet Steering Committee (CGI.br), 2016). Only those classified as Internet users were selected for the analyses of the present study, i.e., those who used the Internet at least once in the three months prior to the survey. This resulted in a sample composed of 10,320 individuals.

As it can be seen into Table 3.2.2., the Brazilians uses mostly the desktop computer, the portable computer or a mobile phone as a mean of internet access, with 82,5%. The classes that have most internet access are the AB and C, with 81,2%; most of the people from the classes D and E lives in the rural area, so we can see that still need some infrastructure to increase the access into those classes and for the rural area.

Table 3.2.2 - Demographic Profile of Brazilian Internet Users (2015)

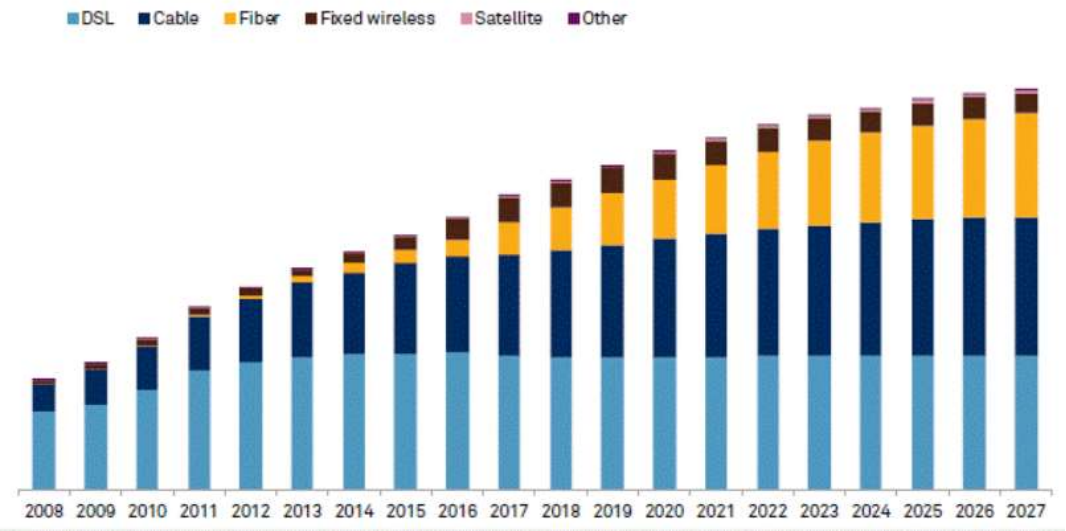
MAIN DEMOGRAPHIC FACTORS		NUMBER	%
GEOGRAPHIC AREA	Urban	9806	**95**
	Rural	514	**5**
AGE GROUP	10 to 15 years old	1067	**10.3**
	16 to 24 years old	2558	**24.8**
	25 to 34 years old	2929	**28.4**
	35 to 44 years old	1659	**16.1**
	45 to 59 years old	1565	**15.2**
	60 years old or older	542	**53**
SEX	Male	4872	**47.2**
	Female	5448	**52.8**
SOCIAL CLASS	AB	3228	**31.3**
	C	5145	**49.9**
	DE	1947	**21.6**
LEVEL OF EDUCATION	Illiterate/Pre-school	86	**0.8**
	Elementary Education	2940	**28.5**
	Secondary Education	5062	**49.1**
	Tertiary Education	2232	**21.6**
MEANS OF INTERNET ACCESS	Desktop computer	1905	**18.5**
	Portable computer	1965	**19**
	Tablet	864	**8.4**
	Mobile Phone	4643	**45**
	Game console	334	**3.2**
	TV	609	**5.9**

Source: ICT Households, 2015

In Figure 3.2.1. it is possible to see that nowadays is having a migration for the higher speeds technologies (fiber) but still with a growth in the average speeds using cable and DSL. Looking to Anatel data from 2016 and 2017, we can see that the connections above 12 Mpbs grown up from 35,2% to 42,0% in 2017. All the three major ISPs in Brazil (Vivo, Oi and Claro) got growing revenues despite

losses in DSL households, which can compromise the majority of their broadband subscribers. As it can be seen, the fiber should represent 25,8% of the market by 2027 (Jordan, 2018)

Figure 3.2.1 - Brazil fixed broadband subscribers by platform, 2008-2027

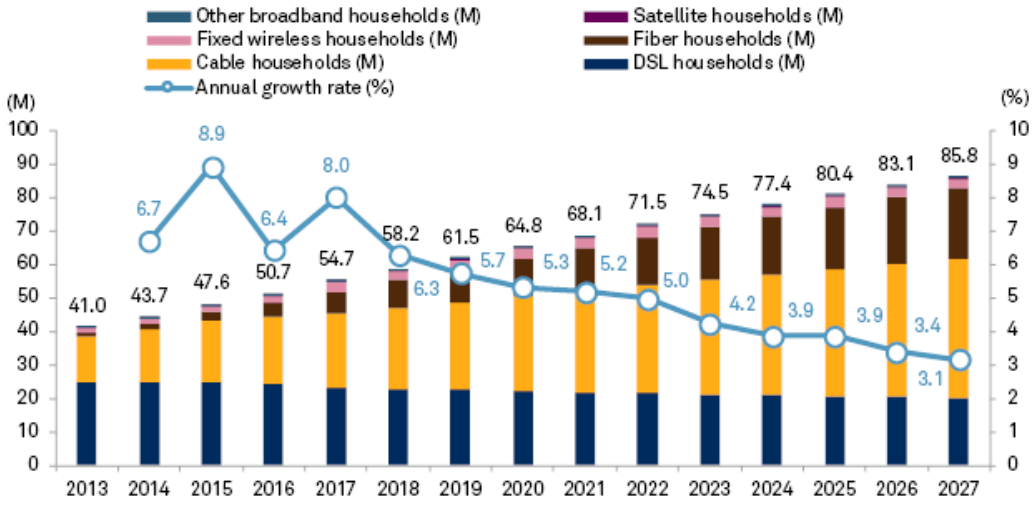


Source: Kagan, 2018

Nevertheless, the correlation between revenues earned from settlement payments and telecommunications development has been put into question by a number of studies. (Lie, 2007) We can see in Figure 3.2.2. that the top 4 markets of Latin America (Brazil, Mexico, Argentina and Colombia), represents 77,8% of the total broadband households in Latin America. While the growth of subscribes will be 41,9% more than now by the forecasting, the broadband annual growth rate will just drop off over the next years. (Campos & Jordan, 2019). This drop off can be

related to the fiber optic, that is a expensive infrastructure for the telecom companies and will be the platform that will most increase in the next years.

Figure 3.2.2 - Latin America top 4 markets' total fixes broadband households by platform, 2013-2027



Source: Industry data, Kagan estimates, 2019

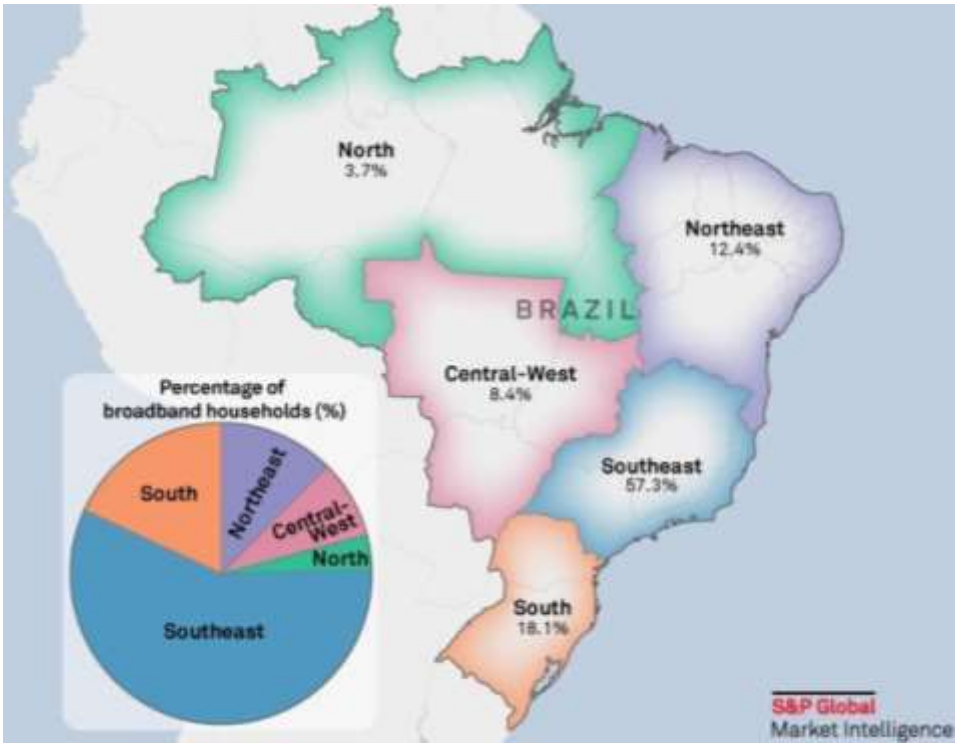
3.3. BRAZIL BROADBAND PER REGION

We can see in Figure 3.3.1. that almost 76% of the broadband distribution is related to the regions of Southeast and South of Brazil, that are commonly known regions as the most developed in Brazil. The more rural North and Central-West regions face significant barriers in broadband infrastructure deployment. However, the richer Central-West concentrates 8.4% of broadband subscriptions compared to its 7.7% total households, while the North, which includes the Amazon rainforest, totals a mere 3.7% of broadband connections with 7.3% of households. (Jordan, 2018)

If we take a look into the Chart 3.3.1. of 2016, we will see that in the rural areas (Northeast and North) just 54% and 45%, respectively, have broadband access, that is quite low compared to the urban areas, that holds 65% of broadband connection.

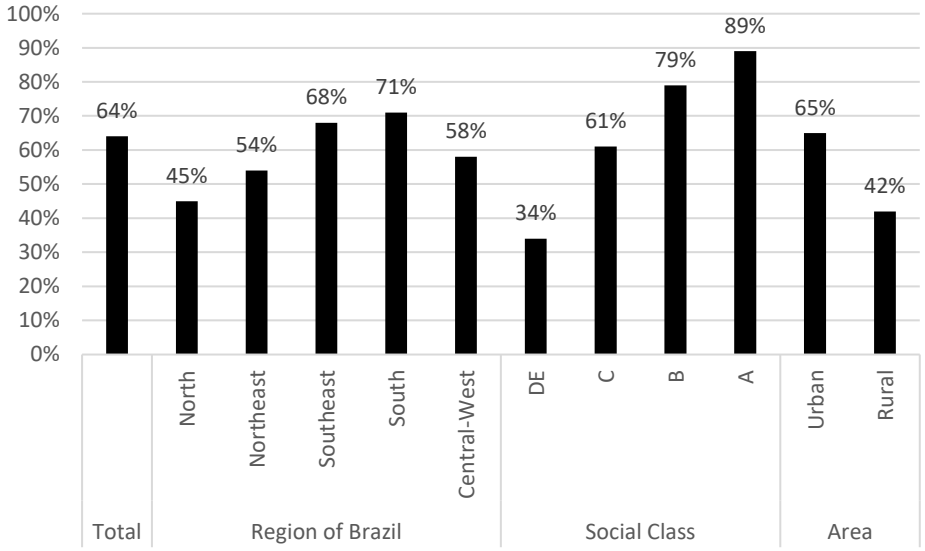
The D and E classes are the most known classes as digitally excluded. If we take a look into the social class in the Chart 3.3.1., we will see that those numbers just reinforce this, as long as just 34% of those population have broadband access to the internet.

Figure 3.3.1 - Brazil Broadband distribution per region in 2017



Source: S&P Global Market Intelligence, 2018

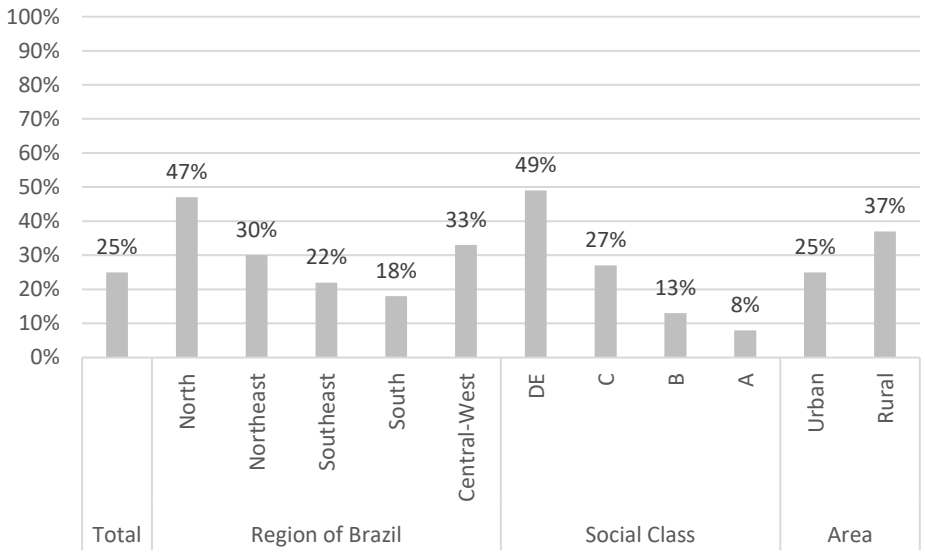
Chart 3.3.1 - Percentage of Households with fixed Broadband access per region, social class and area, in 201



Source: CGI.br/NIC.br, 2016

Those numbers take another point of view talking about mobile broadband access (Chart 3.3.2.), because as showed on Table 3.2.2., 90% of the households access the internet by a mobile phone. Those difference can be due the fact that in Brazil, when you do a broadband internet for your house, you have the internet for your cellphone together, and for those of the social classes D and E, it is better if you take a prepaid monthly subscription just for the mobile phone than a combo with broadband internet for the house (just to remember that most of those people into the social classes D and E does not have computers or laptops at home).

Chart 3.3.2 - Percentage of Households with mobile Broadband access per region, social class and area, in 2016



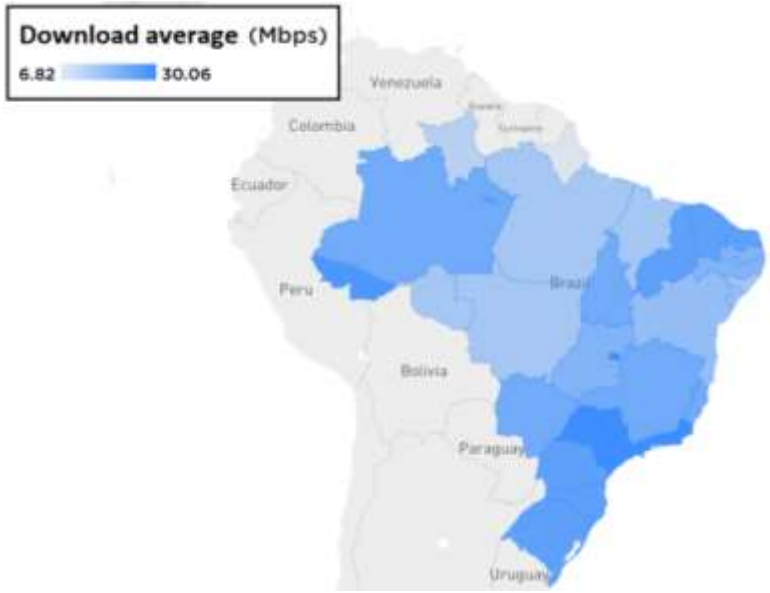
Source: CGI.br/NIC.br, 2016

That is why almost 49% of the households in social classes D and E have mobile access, and 37% of the rural areas have access against 25% in urban centers. Those differences, as mentioned before, can be due the fact that in urban centers as Southeast and South regions of Brazil, most of the people do a combo with fixed and mobile broadband access because it will be less costly than everything separated, and maybe those numbers can be together in the Chart 3.3.1., as long as the ISPs in Brazil uses the mobile access as inhabitants that just uses the mobile broadband, with a prepaid or postpaid services.

The average speed in each region is different, even for the fixed broadband (Figure 3.3.2.) and for the mobile broadband (Figure 3.3.3.). We can see that the regions of the North and Northeast in the mobile broadband is quite half of the average speed connection of the Southeast, for example. But into the fixed broadband, we can see that the average of download is not that different in the Northeast and in the Southeast. There are known that in the more industrialized areas we have more investments, as in the Southeast and South of Brazil.

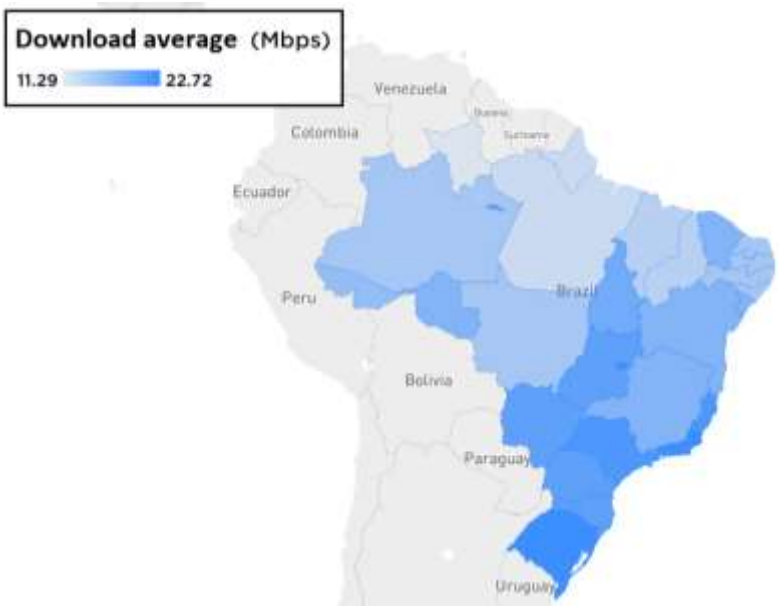
The Amazon part (Northeast and North of Brazil) is quite difficult region to access due the forest, but it has a good fixed broadband implementation, even if the investments for the mobile connection are quite exorbitant. Those price can be related to the fact that in the Amazon you have some remote areas (or rural areas) that you will arrive just by boat and some areas that are still with the primitive inhabitants, that does not allows the implementation of antennas into their share of land, which makes the price of the infrastructure quite expensive.

Figure 3.3.2 - Download average of fixed broadband per region in 2018



Source: OOKLA, Speedtest, 2018

Figure 3.3.3 - Download average of mobile broadband per region in 2018



Source: OOKLA, Speedtest, 2018

4. BROADBAND IN EU

4.1. HISTORY OF BROADBAND IN EUROPE

After the housing bubble in 2008/2009, the EU institutions began to change its orientation towards industrial policy and increased the public support to sectors such as broadband. This statement can be supported by the publication of two important policy documents in 2009 and 2010: the first edition of the EU Commission's Broadband Guidelines and the formal adoption of the Digital Agenda for Europe (Matteucci, forthcoming).

The European Union is formed by 28 countries (Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the UK) with an area of 4.3 million square kilometer. This is almost half of the Brazilian area.

The European Commission implemented in 2009 an instrument of soft law called "Broadband guidelines", for the EU countries, ad a guide for policy-making in the broadband sector. In March 2010, the European Commission started the Europe 2020, that propose a 10 years strategy for the advancement of the European Union economy. It is the EU's long-term strategy for smart, sustainable and inclusive growth. Into this project (known as Digital Agenda of Europe, DAE), we can find

proposes to a better exploit of the potentials of ICTs in order to foster innovation, economic growth and progress. The Digital Agenda's main objective is to develop a digital single market in order to generate smart, sustainable and inclusive growth in Europe (European Commission, 2019) and it is composed from seven pillars:

- Digital Single Market;
- Interoperability & Standards;
- Trust & Security;
- Fast and ultra-fast Internet access;
- Research and innovation;
- Enhancing digital literacy, skills and inclusion;
- ICT-enabled benefits for EU society.

One of the most important things into the DAE is the publicly-supported construction and the upgrade of the telecommunication network infrastructure to complete the coverage of the EU population. In order to complete this coverage, the project was divided into two part: the coverage of the first generation of broadband (FGB) networks by 2013 and the second generation of broadband (SGB) – or NGA networks – by 2020, including both fast broadband (equal or more than 30Mpbs) and ultra-fast (more than 100Mpbs).

4.2. EUROPEAN COURT OF AUDITORS AND ITS RESULTS

In 2016 the European Court of Auditors made an audit to know if the requirements in the Digital Agenda proposed in 2010 have been implemented among those years that had already passed. The audit covered the 2007-2013 and the 2014-2020 program periods and all the EU funding sources, including support provided by the European Investment Bank (EIB). The results show that broadband coverage generally has been improving across the EU, but the Europe 2020 targets will not all be achieved. Rural areas, where there is less incentive for the private sector to invest in broadband provision, remain less well connected than urban areas, and take-up of ultra-fast broadband is significantly behind the targets. (European Court of Auditors, 2018)

In Figure 4.2.1., it is possible to see that not all the member States had achieved the basic broadband coverage target by 2013 and talking about the 2020 target for the fast broadband, the member States will not be able to accomplish it. The rural areas remains problematic in most Member States: by mid-2017, just 14 of the 28 EU countries had coverage in rural areas of less than 50%; in the ultra-fast broadband, only 15 % of households had subscribed to internet connections at this speed by mid-2017, which is quite low compared to the target of the DAE. Despite these problems, if their plans are implemented as intended, three member States may be in good position to achieve the Commission's objectives for 2025

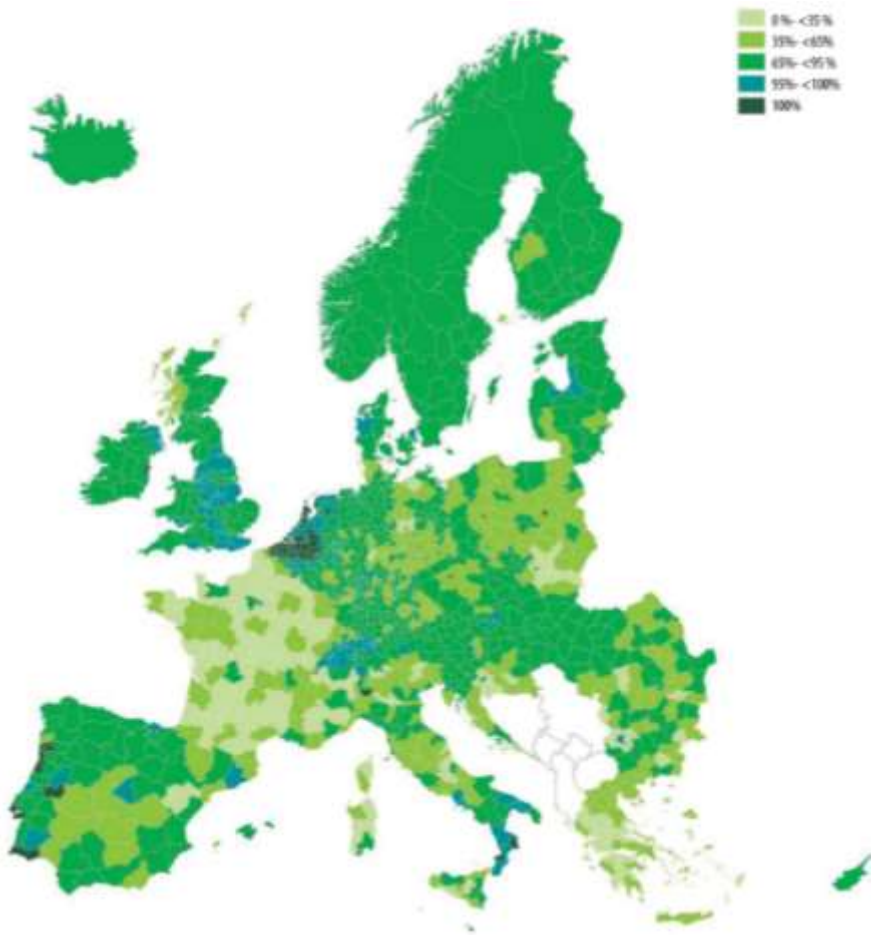
(all households should have access to ultra-fast broadband, upgradable to 1 Gbps, for example). (European Court of Auditors, 2018)

But if we take a look into Table 4.2.1., we can see that the coverage in the rural area is almost 100% but for the NGA, if took from 12,4% to 39,14% in 4 year, which is a very good percentage compared to what should be without the guidelines of the DAE. Some countries as Italy, Greece, Croatia and Ireland, got implementations in the NGA coverage 50% more in 4 years, getting together with the Europe average, that is 75,9% in 2016.

In figures 4.2.1. and 4.2.2. you can see that almost 70% of the territory of EU is coverage with NGA broadband, but if you take a look into the countries separated (Figure 4.2.3.), you will see that some countries still needs more infrastructure than others like, for example, France and Greece, that are the lowest ranking position with around 45% of households with NGA connection.

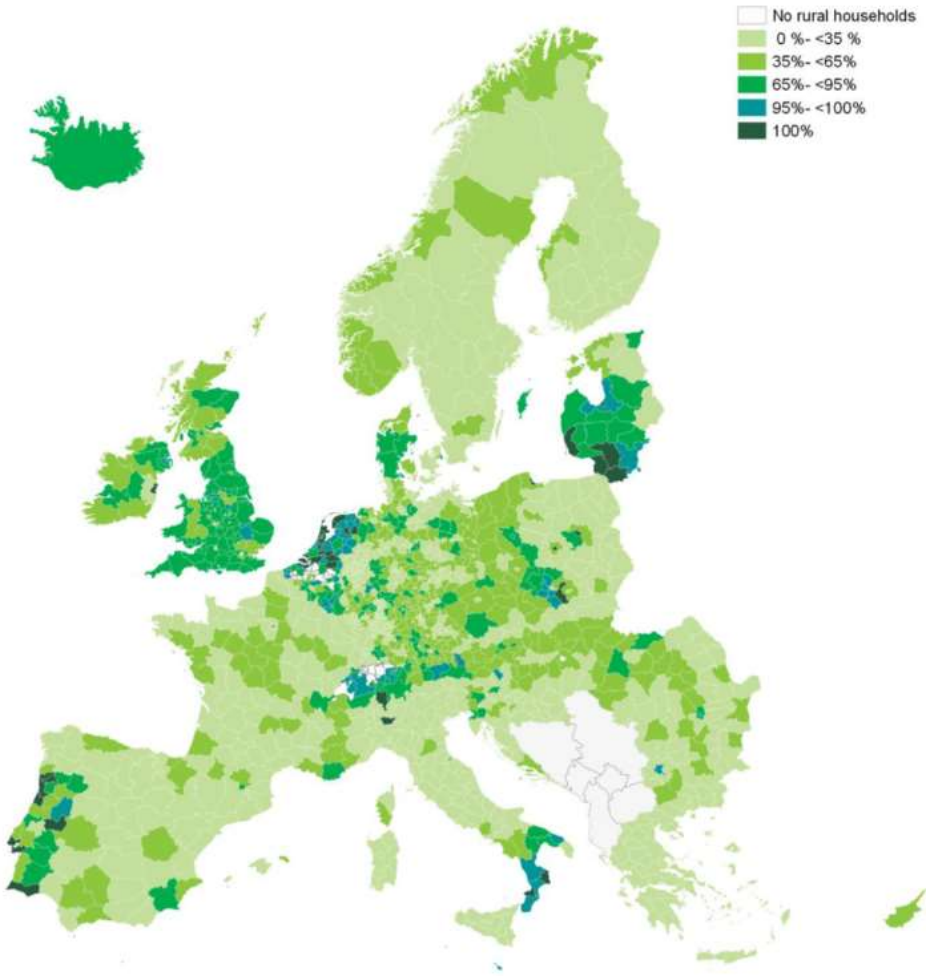
Talking about rural areas, the situation is totally different. The EU average, in this case, is 39,2%, compared to almost 80% that is the overall coverage (Figure 4.2.4.). Even if the implementation got really good in 4 years in some countries that had 0% of coverage, the average is still low compared to what should be the ideal one proposed by the Digital Agenda of Europe.

Figure 4.2.1 - Overall NGA Broadband coverage in Europe, 2016



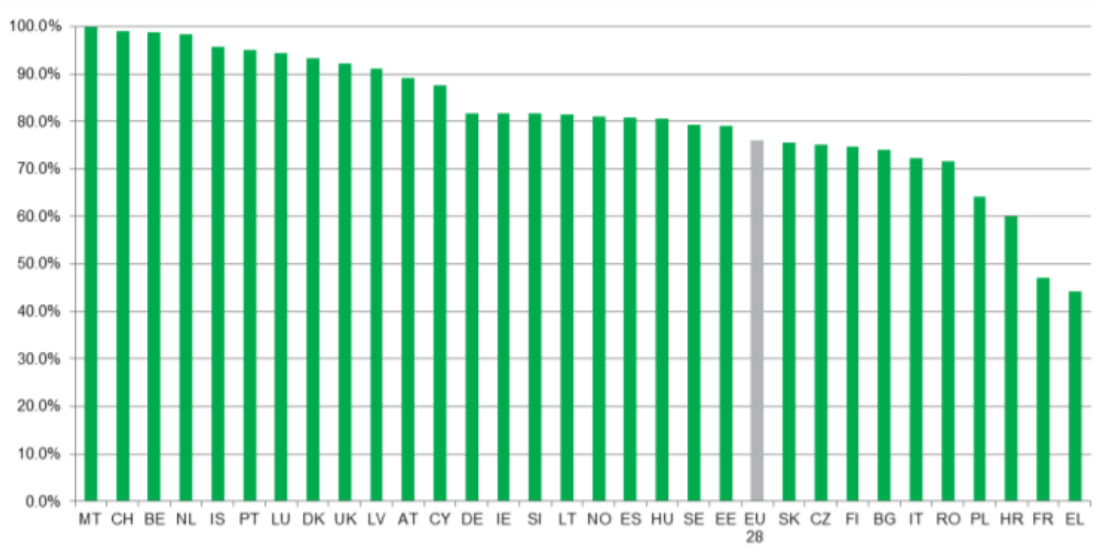
Source: IHS Markit, Point Topic, 2017

Figure 4.2.2 - Overall rural NGA Broadband coverage in Europe, 2016



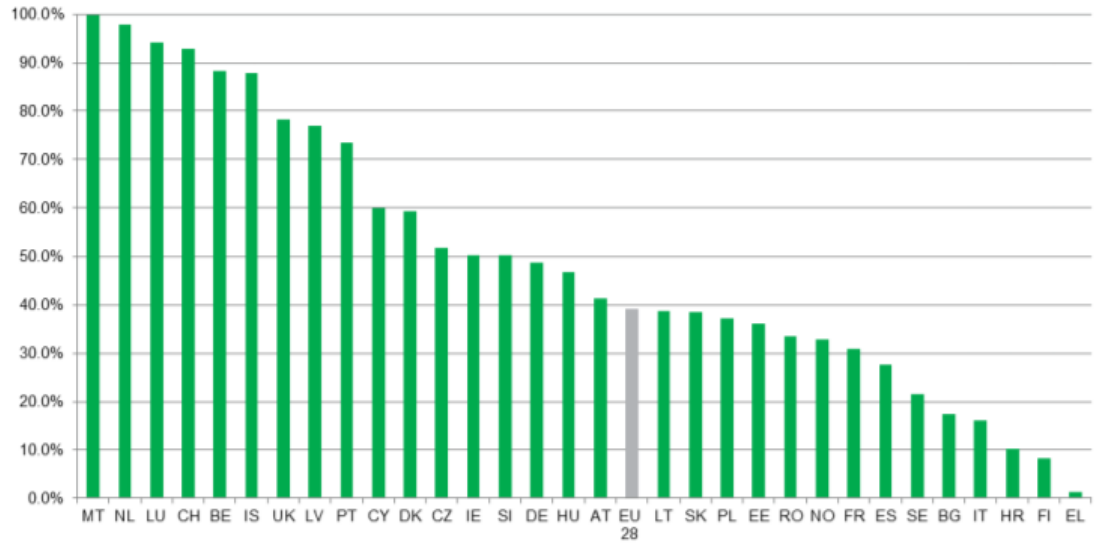
Source: IHS Markit, Point Topic, 2017

Figure 4.2.3 - Overall NGA coverage by country in 2016



Source: IHS Markit, 2017

Figure 4.2.4 - Overall NGA coverage by country in rural areas in 2016



Source: IHS Markit, 2017

Table 4.2.1 - Percentage of broadband coverage in Europe in 2012 and 2016

	2012			2016		
Country Code	Overall NGA coverage	Standard fixed - rural	NGA - rural	Overall NGA coverage	Standard fixed - rural	NGA - rural
AT	69.50%	93.80%	14.40%	89.20%	94.20%	41.50%
BE	97.10%	99.10%	65.40%	98.90%	98.50%	88.30%
BG	60.70%	59.20%	0.00%	74.10%	80.80%	17.30%
HR	19.10%	73.90%	0.00%	59.90%	89.20%	10.10%
CY	73.10%	100.00%	45.00%	87.50%	100.00%	60.00%
CZ	49.30%	86.80%	1.50%	75.10%	96.50%	51.90%
DK	73.20%	89.90%	3.00%	93.30%	96.80%	59.30%
EE	61.00%	52.20%	0.00%	79.10%	73.00%	36.00%
FI	65.50%	62.60%	6.60%	74.60%	84.00%	8.20%
FR	24.20%	96.10%	0.60%	47.00%	99.70%	30.90%
DE	66.20%	85.60%	26.40%	81.80%	93.80%	48.90%
EL	21.90%	95.30%	0.00%	44.20%	96.50%	1.30%
HU	59.70%	77.50%	10.10%	80.60%	85.90%	46.90%
IS	54.10%	84.60%	0.00%	95.70%	95.80%	87.70%
IE	42.10%	92.50%	1.40%	81.60%	93.30%	50.30%
IT	14.00%	87.50%	0.00%	72.30%	94.00%	16.00%
LT	80.00%	90.70%	42.20%	81.40%	86.50%	38.80%
LV	78.50%	39.80%	24.40%	91.10%	83.30%	77.00%
LU	93.80%	99.10%	91.30%	94.40%	99.90%	94.10%
MT	99.90%	100.00%	89.50%	100.00%	100.00%	99.90%
NL	98.40%	100.00%	84.50%	98.30%	100.00%	97.90%
NO	67.30%	83.70%	19.00%	81.00%	79.20%	32.90%
PL	44.50%	37.70%	0.70%	64.10%	82.50%	37.20%
PT	77.80%	97.50%	31.80%	95.00%	98.40%	73.50%
RO	63.70%	74.80%	25.00%	71.70%	82.30%	33.60%
SK	51.10%	50.00%	0.00%	75.50%	91.10%	38.40%
SI	65.10%	10.50%	0.00%	81.60%	92.20%	50.20%
ES	63.90%	90.30%	13.00%	80.80%	92.10%	27.70%
SE	56.60%	91.40%	6.30%	79.40%	91.10%	21.50%
CH	94.40%	98.80%	64.80%	99.00%	99.00%	92.90%
UK	70.30%	99.80%	18.20%	92.30%	99.80%	78.20%
EU 28	53.70%	83.20%	12.40%	75.90%	92.60%	39.14%

Source: EU Open Data Portal, 2012-2016

5. COMPARISON BETWEEN BRAZIL AND EU

The largest economic partner in Latin America for European Union is Brazil. There are four main reasons that makes signing of the free-trade agreement more important than ever:

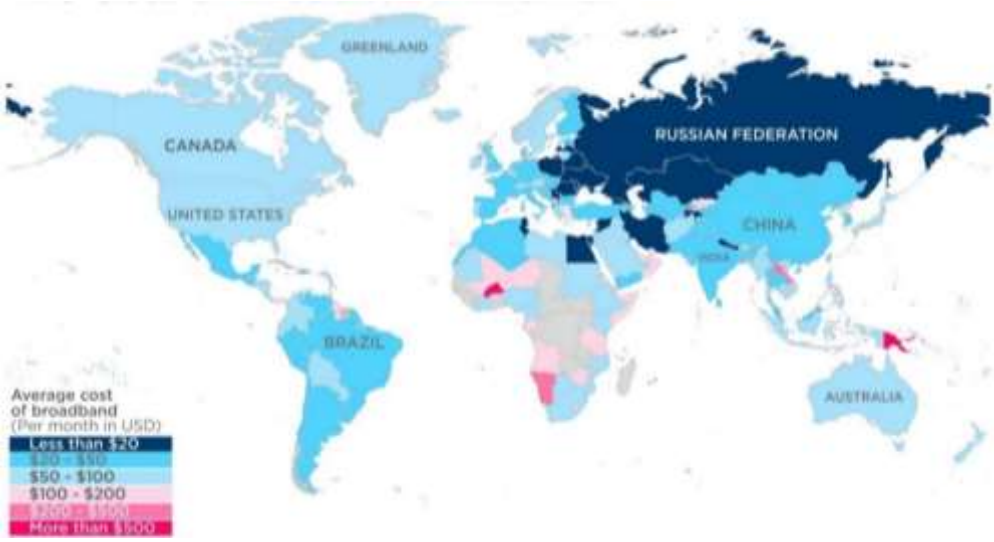
- Higher prospects for economic growth, with 2.3% for Brazil and 2.4% for Eurozone in 2018, according to the IMF;
- The freezing of the Transatlantic Trade and Investment Partnership (TTIP) negotiations between the EU and the US, which have dominated the EU trade agenda since 2013, and the decline in US–Latin American relations under President Donald Trump;
- Trump administration's decreasing commitment to the liberal world order, which still represents the main frame of reference for organizing international relations for both the EU and Brazil;
- China's increasing weight in Brazil's export markets, particularly of agricultural goods, reduces traditional EU – Brazilian tensions in this sensitive sector. (Gratius & Ayuso, 2018)

The EU – Brazil strategic partnership was established more than 10 years ago, but with the economics and political crises that both parties have recently undergone, nowadays we can have a better optimism look since both are experiencing economic growth again.

Brazil is known as a developing country and EU is composed mostly by developed countries. Those difference was shown in Figure 3.1.2., but as a statement into the third chapter, we concluded that the infrastructure and the broadband connection in Brazil was higher than the developing countries average but low than the developed countries average.

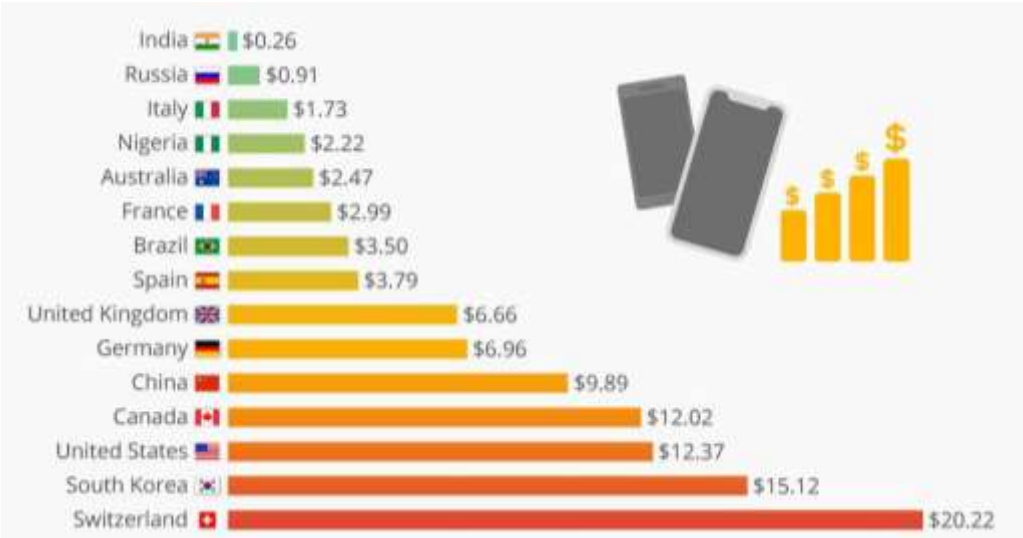
One of the most important things that we need to compare is that Brazil and most of EU countries are in the same range of average cost of broadband (Figure 5.1.), from $20 to $50 per month. But if we compare the price of each GB in each country (Figure 5.2.), we can see that the cost per GB in Brazil is bigger than in Italy and France, for example, and almost the same price in Spain. Taking into consideration the average of salary per each country (Figure 5.3.), we can see that in Brazil is almost 3,5 times smaller than in Spain, where the price per GB is almost the same (Figure 5.2.). So, for the Brazilians, we can conclude that the cost of each GB is quite expensive, using the statutory minimum wages and the purchasing power of statutory minimum wages as parameters for this comparison (Figure 5.3.)

Figure 5.1 – The average cost of broadband internet in $ in 2017



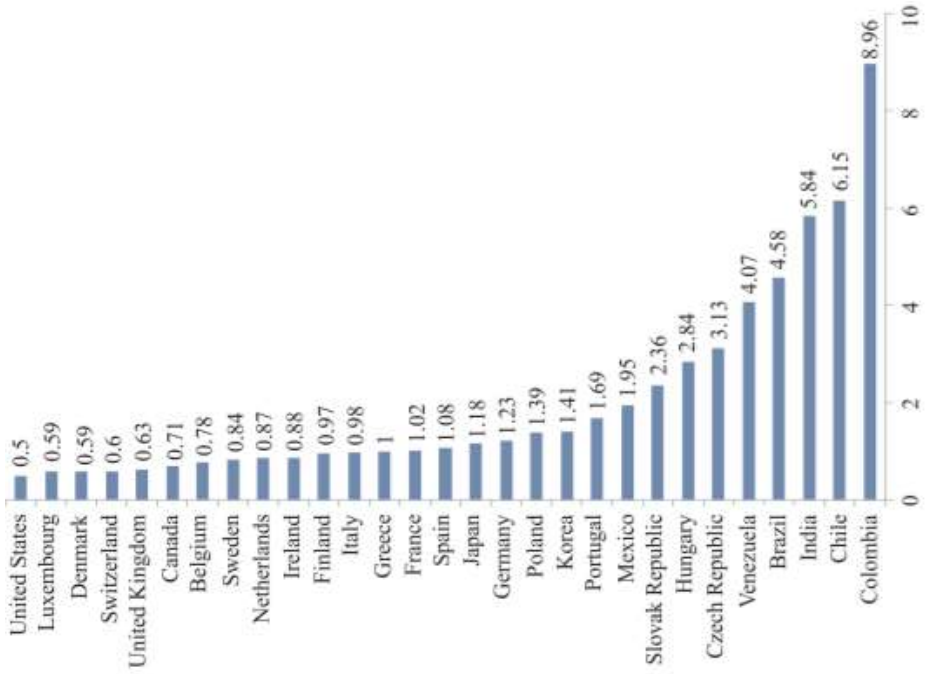
Source: BDRC Continental and Cable.co.uk, 2017

Figure 5.2 - Average cost of 1GB of mobile data in selected countries in 2019 (U.S. dollars)



Source: Cable.co.uk, 2019

Figure 5.3 - Relation between broadband monthly subscription cost and GDP per capita (2010)



Source: ITU, 2010

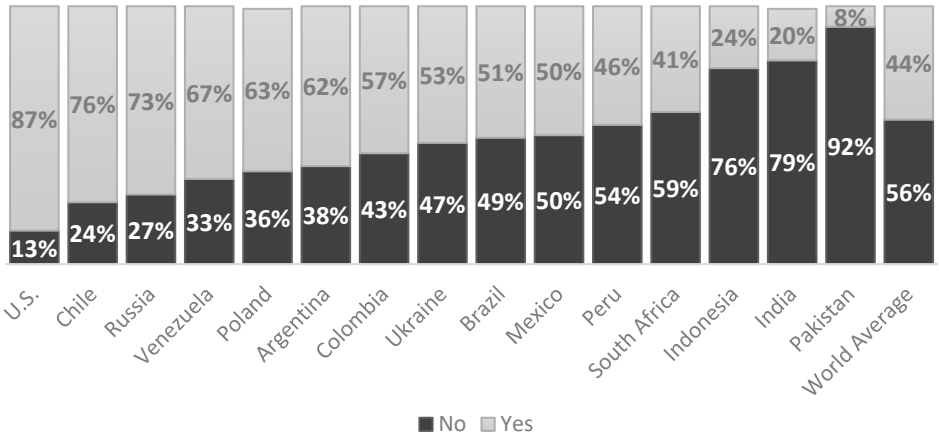
Using the statement from the abstract, "*The government of each country needs to make some policies to make available the access to internet (fixed or wireless) to the share of population not supplied by the market, focus on making the access to the internet possible to everyone, as long as this can be a parameter for economic growth.",* we need to understand that the economy of Brazil is being increasing among the years, as well as the infrastructure of the broadband.

We know that the access to the internet in Europe is almost the same of US, so if we take a look into Chart 5.1. we will see that in 2014 the access to smartphones and to internet were quite low in Brazil comparing to US or Europe.

The vast majority of people live along, or relatively near, the Atlantic coast of Brazil, in the east side; the population core is in the southeast, anchored by the cities of São Paulo, Brasilia, and Rio de Janeiro. We can see that the investments in those areas are quite good because the high velocity internet (that is around 2.4Mbps) in Brazil are into those areas (Figure 5.4.).

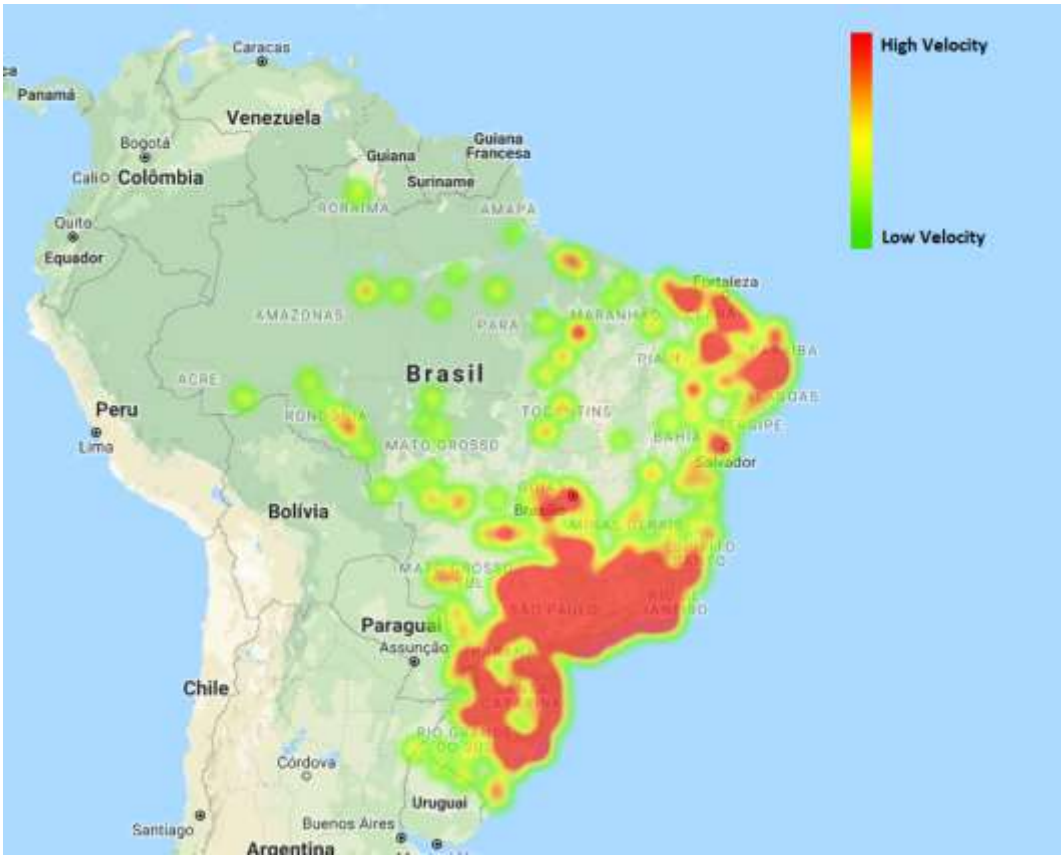
In European Union, the population distribution varies considerably from country to country, but tends to follow a pattern of coastal and river settlement, with urban agglomerations forming large hubs facilitating large scale housing, industry, and commerce; the area in and around the Netherlands, Belgium, and Luxembourg (known collectively as Benelux), is the most densely populated area in the EU.

Chart 5.1 - Percentage of people in each country that has access to internet or own a smartphone in 2014



Source: Spring 2014 Global Attitudes survey. Q67 & Q69

Figure 5.4 - Broadband Velocity in Brazil on May,2019



Source: SIMET.NIC.br, Map 6, 2019

In 2013, it was implemented the IPv6, and into that year, the growth and the transition of the IPv4 for IPv6 generated some problems in protocols on broadband, because in the first companies had to change some network infrastructure and then it was realized that the IPv6 is not safer than IPv4, but it was a solution as long as the IPv4 was running down *(Dawood, 2012)*. In Table 5.1. we can see that the percentage on Attack Traffic is the same in Brazil and in average in EU, which means that the protocols are implemented in the same way.

Brazil is still having some problems for the implementation of the IPv6 because is a technology that is expensive compared to the IPv4 and we can see in Figure 5.5. that just 17% of the traffic was with IPv6, while Belgium had 38% of adoption and Greece had 25%.

Table 5.1 - Percentage of Attack Traffic, Average and Peak Connection Speed (Mbps) per country in 2014

Country	% Attack Traffic	Avg. Connection Speed (Mbps)	Peak Connection Speed (Mbps)	% Above 10 Mbps	% Above 4 Mbps
Europe					
France	0.40%	5.7	24.2	6.8%	62%
Germany	0.60%	7.3	32.6	15%	75%
Greece	<0.1%	4.8	26.0	3.8%	47%
Italy	0.50%	4.9	23.3	37%	52%
Netherlands	0.20%	10.1	38.8	31%	83%
Portugal	<0.1%	5.4	35.1	6.9%	61%
Spain	0.20%	5.9	32.1	8.3%	64%
U.K.	0.50%	8.4	37.1	23%	75%
Latin & South America					
Argentina	0.40%	2.0	14,5	0.4%	8.3%
Brazil	1.40%	2.4	18.7	0.7%	15%
Chile	0.10%	2.9	19.3	0.6%	15%
Mexico	0.30%	3.6	18.9	1.0%	25%
Peru	0.10%	2.1	16.0	<0.1%	1.9%
North America					
Canada	0.30%	8.2	34,4	20%	80%
U.S.	6.90%	8.7	36.3	24%	72%

Source: Belson, 2014

Figure 5.5 - IPv6 adoption in Q1 of 2017, in percentage

Source: Akamai State of the Internet Report, 2017

Another point that we need to focus on is the average connection speed, that in Europe the average between the 28 countries is 7.2Mbps and Peak Connections in Europe (average) is 32.5 Mbps. Greece has the poorest broadband quality in Europe, as shown as in Figure 4.2.3., that gives 4.8Mbps as the average for the country, with 3.8% of the connections more than 10Mbps and 47% more than 4Mbps; if we compare to Brazil, those number are, respectively, 2.4 Mbps, 0.7% and 15%, which gives that the quality of the connection in Brazil is worse than in Greece, that is the poorest quality broadband connection in EU.

Figure 5.6 – Average of Download and Upload in Mbps in Brazil in 2017 by quarters in mobile internet

Source: OOKLA, SpeedTest, 2017

We can see in Figure 5.6. and Figure 5.7. that Brazil increased his rank from 84th global average to 71th global average in mobile and 79th global average in fixed broadband. Using the data from 2017, we can see that Brazil overtook the United Kingdom, for example, as the world's seventh-largest fixed broadband market with 8.4% annual growth, but with a small deceleration in subscriber growth during the country's economic downturn in 2015 and 2016.

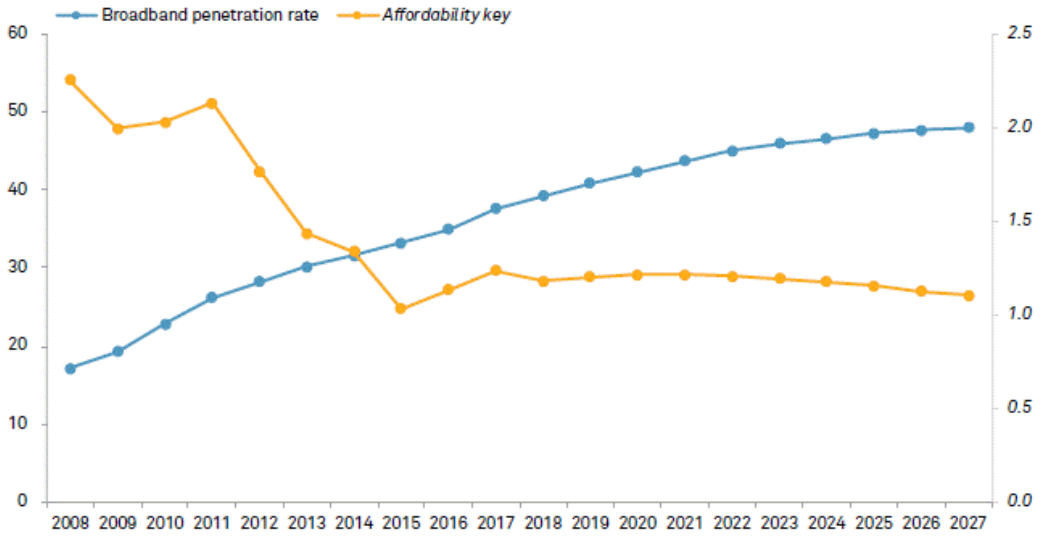
Figure 5.7 – Average of Download and Upload in Mbps in Brazil in 2017 by quarters in fixed broadband

Source: OOKLA, SpeedTest, 2017

Even if the quality of Brazilian's broadband is not that good compared to the European one (See Table 5.1 and 5.2) we can see that Brazil is growing its broadband range year by year, with a very good low percentage of Attack Traffic but still higher than the European average. In few years, as the prediction of the Figure 3.2.1, we will see that Brazil will have a very good internet compared to the European one due to the fact of implementation of high-speed technologies

and good broadband penetration rate but not more than 50.0% by 2027, as the prediction of the media research group Kagan in 2018. This is due to lower-income households that depends on cheaper mobile broadband services for connectivity. The equation 2.2.1. tells that if the price drops down, the penetration gets better, that is the same statement that we can see in Figure 5.8

Figure 5.8 - Brazil Broadband penetration and affordability, 2008-2027, in percentage



Source: Kagan, 2018

Broadband connectivity might constitute a factor favoring regional cohesion in an emerging economy such as Brazil (López-Bazo & Jung, 2019), which was quite the same for the regional convergence contributed by the ICT investments in Spain (Navajas , et al., 2008).

The adoption of regional policies together with country-level initiatives is important because the nature of technological change and innovation have a strong region component that make that public policies must be designed taking the regional dimension into account, and this was adopted by Europe (Barrios & Navajas, 2008). But looking for Brazil, the federal configuration makes possible the adoption by some states to promote active policies for the development of broadband networks. Some states in Brazil have already launched state-based public broadband plans to complement the national plan. (López-Bazo & Jung, 2019)

Table 5.2 - Average and Peak speed in the Second Quarter of 2013 by country

Country	Q2'13 Average Mbps	Q2'13 Peak Mbps
Europe		
France	3.1	11.5
Germany	5.2	24
Greece	5.6	54.9
Italy	4.1	28.5
Netherlands	2.1	7.2
Spain	3.8	26.8
United Kingdom	2.8	23.6
Latin & South America		
Argentina	0.9	9.4
Brazil	1.6	11.7
Chile	1.6	15.4
Colombia	1.4	7.9
North America		
Canada	4.1	15.2
United States	3.8	17.7

Source: Belson, 2014

6. NEW TECHNOLOGIES USING BROADBAND

The inhabitants of the planet nowadays got more intense conscious about the grown up of the environmental crises that we got in the end of the XX century, and with this, a new world was generate to make people sensible: sustainability. People got more conscious and with this, new types of energy got into the market, for example, wind power, solar power, geothermal, hydroelectrical power, among others and the countries that got more involved with this theme since the beginning are experience nowadays a grown up into the GDP. The rapid rates of improvement in smartphones, telecommunication systems and other forms of IT enable solutions for sustainability. (Funk, 2015)

The energy is one of the fundamentals pillars for the humanity since the nineteen centuries, and is one of the primary needs since we are living in a modern world. With the constant study about the energy and how to obtain energy (since our natural resources will be limited because of the intense exploration of those materials that will just re-generate a million years from now), people got more intense about the "eco-friendly" programs, with a preoccupation about the CO^2 emission and the ozone layer. This intense program got into the hands of the major players, that needed to get more sustainable to get success in their business.

In order to get the basic needs of a person for everyone (such as water, food, electricity…), a lot of countries had new plans that consider to have a lower cost

but with a higher efficiency, and with the new economy and the technology (which is the best thing that we discover and got progress into), more and more of those ideas have a sustainable way of doing, such as the solar power program (Indian Solar Loan Program, for example) or to provide less tax if you are an emission free company. People got more conscious about the environment and it is because of them that is really important to consider being a sustainable country as long as it can affect into the economy of the country.

Companies such as Apple, Intel, Microsoft, Unilever, etc. can make an enormous change into the way as a company can help the environment, begging to be as a model into this sector. In the twenty-one century, you have the Industry 4.0 that is a new model that developed countries are getting more and more close to this theme because it can help them to reduce the waste of natural resources because it gets more technological resources, that can reduce the flaws of a supply chain, a reduce into the costs (liabilities) and an optimization of the process. Most advanced countries such as Germany, Sweden, Italy or Spain have launched specific Industry 4.0 programs in recent years. Countries that are considers as in development (Brazil, India… for example) does not know yet about this new industry that can make those recognized into the environmental point of view.

But before talking about the new technologies, it is needed to talk about the Zeira Model of Automation and Growth (1998) that uses the Equation 6.1. as the production function.

Equation 6.1 - Production function of Zeira (1998)

$$Y = AX_1^{\alpha 1} \times X_2^{\alpha 2} \times \dots X_n^{\alpha n} \; where \sum_{i=1}^{n} \alpha_i = 1$$

Nowadays, we can use the Acemoglu & Autor, 2011 equation, represented on Equation 6.2. for the production function once tasks that have not yet been automated can be produced one-for-one by labor. Once a task is automated, one unit of capital X_i can be used instead as L_i for not automated tasks and K_i for automated.

Equation 6.2 - Production function of Acemoglu & Autor, 2011

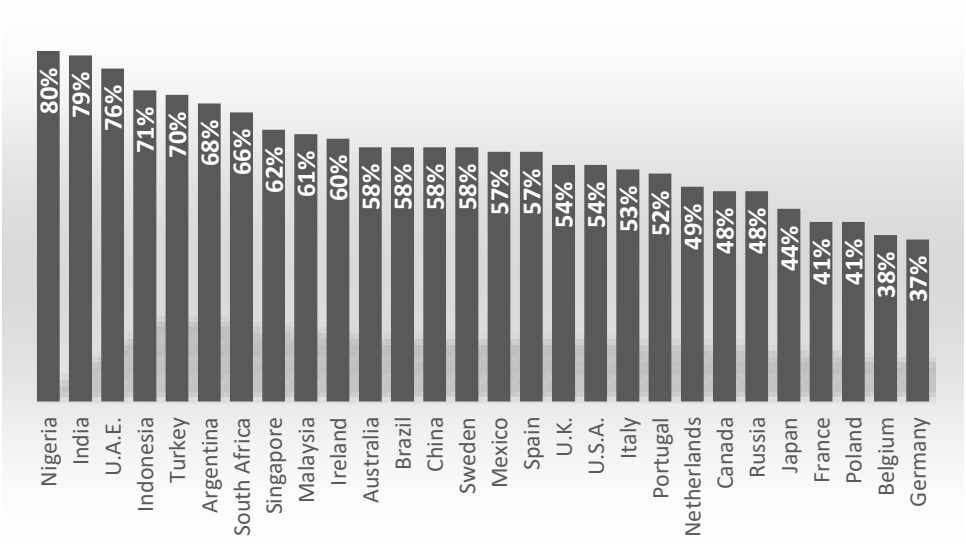
$$Y_t = A_t \, K_t^{\alpha} L_t^{\alpha - 1}$$

An increase in automation will therefore increase the capital share α and, because of the multiplier effect associated with capital accumulation, increase the long-run growth rate. (Aghion, et al., 2017)

Given the emerging nature and the extent of potential changes these technologies can bring about, normative prescriptions abound based on a relative consensus that innovations do not arise as "natural" process (Torracca, et al., 2019), but

looking into Figure 6.1., we can see that 58% of Brazil's population thinks that new technologies offers more opportunities than risks against just 37% of Germans' population, that is nowadays the most known country for the Industry 4.0.

Chart 6.1 - Percentage of population that believes new technologies offer more opportunities than risks



Source: Google Consumer Barometer, 2018

New technologies are more and more correlated with each other. Nowadays the use of broadband can be found in the smartphones, in smart TVs or even in the smart houses, that mixes the green evolution with the new technologies. We can see that in Brazil, the country's expenditure in 2016 in R&D as a share of GDP was 1,6%, while the OECD average was 2,15%. Brazil is relative specialized in

natural resource-based products, with an increase of 13% between 2000 and 2016. The foreign trade of Brazil is increasing where there is some cost (traditional sectors) or capability based (technology sectors) disadvantages and externally (increasing world demand). Brazil shows insignificant imports of natural based products, volatility in labor-intensive goods (due to exchange fluctuations) and persistent trade deficits in technology- intensive products (Torracca, et al., 2019).

The most recent advances related to Industry 4.0 (IoT, Big Data, Artificial Intelligence, etc.) surely will provide productivity gains in the future, and as a result, the public authorities will need to design specific programs to massify those deployments. Emerging economies, such as Brazil, should not miss the opportunity of being part of this so-called 4th industrial revolution; but, as a contradiction, there may be winner and loser territories into this process, as deployment of these sophisticated technologies and their impact on productivity may widely vary across regions within the same country (López-Bazo & Jung, 2019).

7. CONCLUSION

Each government has its own rules, and maybe when we take a look into Brazil, we can see that it still needs some years to get a better ranking position in internet access; but if some measures are used for the benefits of the population, everybody has something to gain with those policies.

While EU had created the Digital Agenda, Brazil still lacks an official strategy for digital transformation. Without this, Brazil cannot see their broadband as good as the EU ones because even if it covers more than 70% of the Brazil's territory, it still does not have the increase in the digitally included people, nor a better social and political development and neither a good participation of the citizens in the government programs.

It was said that the growth in the broadband access increases the economic development, but, even if Brazil is better than the developing countries and world average, it still behind the European countries. One of the reasons for this is the large extend of the Brazil's territory, that is two times more than the European Union territory, this dampens the access in remote areas (rural areas) and the increase in the infrastructure plan for those areas. Another reason could be the lack of incentives from the government to promote such an increase in the broadband access, with leads to the same point: if Brazil does not have an official

strategy for the digital transformation, it will not grow in the same ways that the Europeans countries are growing.

If Brazil has a better investment into those kinds of new businesses as the Industry 4.0 and the renewable energy with sustainability programs, this could attract more investment in the rural areas due to the fact that those companies mentioned can have their attention to Brazil (that has a labor cheaper than the European Union) and this investment of companies can influence directly the broadband access, with could improve significantly the rural areas situation, that still has slow, expensive and low quality internet.

Brazil should be aware that the data traffic through the networks will increase in the next years and will strain some current infrastructures, so it is urgently needed to make some investments in the increase of downloading speed, stimulating the next Generation Access (faster) networks, such as fiber optic and 5G, getting more focus on the less dynamic areas of the country.

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