THE EFFECT OF COMPETITION ON THE PRICE AND QUALITY OF TRIPLE-PLAY BUNDLES: EVIDENCE ON THE BRAZILIAN TELECOMMUNICATIONS MARKET

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RESUMO: A análise empírica busca estimar, pelo modelo diferenças em diferenças, o efeito da presença de rivais no preço e na qualidade dos combos *triple play* ofertados pelos três principais grupos de telecomunicações no Brasil: Oi, Telecom Américas (NET) e Telefônica (GVT). Os resultados indicam que a presença de rivais tem um impacto negativo nos preços dos serviços comercializados pelos grupos, a exceção da NET, que responde à presença da Oi aumentando os valores cobrados, o que indicaria competição assimétrica entre as empresas. No entanto, observou-se que a Oi tem um efeito positivo na qualidade dos serviços de TV por assinatura ofertados localmente pela NET, o que indica que a empresa responde à concorrência da Oi aumentando concomitantemente os preços e a qualidade de seus pacotes *triple play*.

Palavras-chave: defesa da concorrência, telecomunicações, banda larga, telefonia fixa, TV por assinatura, *triple play*, competição assimétrica

ABSTRACT: This empirical study seeks to estimate the effect of competition on the price and quality of triple-play bundles by applying the differences-in-differences empirical model to data on three major telecommunications groups in Brazil: Oi, Telecom Américas (NET), and Telefônica (GVT). Results show competition has a negative impact on prices, except for NET, which reacts to the presence of Oi in the market by increasing the price of its services. This indicates asymmetric competition between these companies. However, Oi has a positive effect on the quality of pay TV services offered locally by NET, suggesting that it competes with Oi by increasing the prices and improving the quality of its triple-play bundles.

Keywords: Competition, antitrust, telecommunications, broadband, telephony, pay TV, triple play, asymmetric competition

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1. Introduction

This study seeks to estimate the effect of competition on the prices of triple-play bundles and on the quality of broadband, pay TV, and landline call plans included in the bundles. Cross-sectional data on the services, sorted by municipality, provided by the three major telecommunications groups in the Brazilian market (Oi, Telecom Américas (NET), and Telefônica (GVT), are used.

Bundle[3] offers have taken on an important role in the dynamics of telecommunications markets, prompting players not only to compete for services, but also for platforms (OCDE, 2015). In Brazil, these bundles offer substantial discounts (around 23%) for consumers and enjoy a large market presence across the Brazilian territory (63% of municipalities)(Leandro and Gomes, 2017). In addition, at least 24.6% of broadband access and 15.9% of pay TV services are offered to subscribers as bundles.[4]

The higher supply of bundled services has ambiguous effects on the market, as such services may provide consumers with benefits or eventually lead to less competition in wholesale and retail markets (Burnett, 2014; BEREC, 2010). Therefore, it is usual to come across quantitative studies in the international literature that estimate the impact of bundles on the market, including those developed or financially supported by regulatory agencies. However, the literature on telecommunications bundles in the Brazilian market is still very much in its infancy, in part due to the lack of data on the supply of and demand for this type of service.

The present empirical study created a unique cross-sectional database with information on offers, per municipality, made by telecommunications companies that sell triple-play.[5]-[6] Besides prices and average discounts for this sort of service, we also collected information about product characteristics, such as broadband speed, number of channels included in pay TV packages, and amount of minutes for local and national long-distance calls. Hence, it was possible to assess some aspects related to the quality of services that, alongside prices, are a key element of competition among economic groups (OCDE, 2013). In differentiated products markets, companies usually react to competitors not only through price, but also by changing the quality of their products (Crawford and Shum, 2007).

Accordingly, the present study investigates how competition affects the prices and quality of triple-play. Following the empirical analyses performed by U.S.[7] and Brazilian[8] antitrust authorities, we adopted a differences-in-differences model, controlling for demographic and economic characteristics of local markets that could explain fluctuations in prices and in the quality of services.

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[3] Bundles and telecommunications service packages are synonymous in the present study.

[4] Source: Limited database with information on bundles, services, and sales promotions offered by Anatel, per economic group. Reference period: Fourth quarter of 2016. Since data from all companies that offer triple-play bundles are not available, the rate described above refers to the minimum broadband accesses that are interconnected or integrated with other telecommunications services such landline and cell phone plans.

[5] No offers specifically targeted at firms were included.

[6] The variables that indicate the technology through which the service is delivered to consumers were obtained from Anatel's database.

[7] Concentration Act between Staples and Office Depot, *1997*.

[8] Statement from the Department of Economic Studies in Concentration Act no. 08700.009732/2014-93, whose claimants are: Telefônica Brasil S.A. and GVT Participações S.A. Statement from the Department of Economic Studies in Concentration Act no. 08700.009426/2015-38, whose claimants are Claro S.A and Brasil Telecomunicações S.A.

Two models were estimated. The first one assumes that companies react to competition by only changing their prices. We used dummies for the number of rivals in each municipality as proxies for the level of competition. The impact of competition on price was estimated by ordinary least squares (OLS) with robust errors, controlling for the characteristics of triple-play bundles.

Results suggest both Oi and Telefônica react to the presence of competitors by reducing the prices of their triple-play bundles. However, this effect is more remarkable for Telefônica: the presence of two competitors causes prices to decrease by up to 8%. Interestingly enough, the offer of pure triple-play bundles by Oi, which solely gives consumers the option to purchase pay TV in bundles, accounts for a price hike of around 6%, indicating this strategy has negative consequences for the final consumer.

For NET, the government policy for the incentive of broadband services known as Popular Internet[9] has a remarkable impact on the prices of triple-play, reducing price by approximately 15%, a rate that is significantly higher than the impact associated with the presence of competitors (lower than 1%). Note also that local prices are lowered in those municipalities where Telefônica and Algar compete. Nevertheless, the presence of Oi has a positive impact (lower than 1%) on the price of services provided by this company, revealing asymmetric competition between the groups: Oi reduces the price of its services to compete with NET, not the other way around.

In this context, the second model assumes that companies react to competition by changing their prices and the quality of their services. As the quality of triple-play packages is multidimensional, being related to broadband, landline calls and pay TV, we estimate a system of simultaneous equations using linear regression with instrumental variables and robust errors. The model was applied only to NET, since this company was the one with the largest variation in the level of quality of services in local markets.

Regarding broadband services, Oi has a positive effect on speed, whereas GVT has a negative effect. This suggests that NET seeks to differentiate their bundled services by offering different speeds from those provided by its competitors. As for pay TV, NET does not change the characteristics of this service to compete with GVT or Algar, but it competes with Oi by expanding the number and image quality of television broadcast channels included in their pay TV packages.

Aside from this introduction and the conclusion, the present paper includes five sections. Section 1 reviews the previous literature on the impact of competition on the prices and quality of telecommunications services. Section 2 describes the database used for the empirical analysis. Section 3 describes the empirical method utilized in the analysis. Section 4 shows the identification strategy and the results for the first model, which estimates the impact of competition on price, considering the product characteristics to be exogenous. Finally, Section 5 discusses the results obtained for the second model, which estimates the impact of competition not only on prices, but also on the quality of the bundled services.

2. Previous literature

The impact of competition on price and quality in differentiated products markets is difficult to predict. Depending on the consumer's preferences, a boost in competition may result in a new equilibrium with lower prices and better quality, lower prices but worse quality, or even higher prices with better quality (OECD, 2013; Ezrachi and Stucke, 2014).

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[9] This program, among other strategies for moving broadband services into the mainstream, grants tax exemptions in exchange for services with better prices in the municipalities.

In the telecommunications market, this type of analysis is commonplace for the pay TV sector. Goolsbee and Petrin (2004) analyzed competition between local cable TV and national satellite TV companies. They used the probit multinomial method to estimate the price elasticity of demand for two technologies with microdata on more than 317 municipalities. The empirical analysis regards the product characteristics as exogenous and controls for fixed effects in each market. Results show that cable TV companies react to satellite TV rivals by reducing price and improving quality, making consumers better off.

Chu (2010) uses a discrete choice model for vertically differentiated markets, in which pay TV providers react to competition by choosing the optimal combination of price and quality. Panel data are used at the local level for prices, product characteristics, and market share. Results indicate that the market entry of providers that offer satellite TV typically reduces prices and increases quality. However, 14% of providers react to a boost in competition by increasing their prices and product quality, mainly in markets whose consumers' preferences are more homogeneous and demand is more sensitive to product characteristics. Access to content with a lower cost makes providers more prone to compete by improving quality.

Crawford and Shum (2007) use the Mussa-Rosen's monopoly model to calculate the optimal choice of cable TV providers concerning the prices and quality of their products and the impact of regulation on such choices. In a monopolistic scenario, the quality of the most basic service plans decreases when compared with optimal social level. Moreover, results demonstrate that cable TV providers in those markets with local regulatory supervision offer significantly higher quality, but prices are higher as well.

Later on, Crawford, Shcherbakov and Shum (2015) extended this model to quantify the effects of the choice of better quality pay TV products on overall welfare, comparing it with the results of a welfare maximization conducted by a central planner. They employed the random coefficient logit method for prices and quality in order to estimate, by GMM, data on approximately 12,000 cable TV companies between 1997 and 2006. Results point out that the optimal choice of TV companies consists in offering products with higher quality and price than would be socially optimal, thereby leading to a "quality inflation."

Similarly to the aforementioned studies, the present analysis seeks to exploit the effect of competition on quality and price of telecommunications services in the Brazilian market. Nevertheless, given the lack of data on the number of subscribers per municipality and on the type of packages, a different method was chosen. We adopted the differences-in-differences method, which is usually employed by antitrust authorities to assess the impact of concentration acts on the market. This method became popular in competition analysis after being used by the U.S. antitrust authority, Federal Trade Commission, for the assessment of the merger between two major office material suppliers – *Staples* and *Office Depot*. In Brazil, the method was adopted by CADE to evaluate competition between the claimants in two recent concentration acts in the telecommunications market. Using cross-sectional database on municipalities where there might be overlapping, CADE estimated the impact of competition on the number of pay TV, broadband, landline calls and triple-play service subscriptions. In both cases, the results suggest that the mergers would not affect competition on the market (DEE/CADE, 2015a, DEE/CADE, 2015b).

3. Database

We used cross-sectional data containing information about the first quarter of 2016,[10] including information on the prices and characteristics of triple-play offered on the websites of the three major telecommunications providers in Brazil: Oi, Telecom Américas (services delivered by NET), and Telefônica (services delivered by *Global Village Telecom*).

The data on the characteristics and prices of service plans and packages reflect the local scenario, providing a set of accurate information about service options for a given customer in a given location. This is especially relevant in competition analyses, since the antitrust literature defines the municipality as the dimension where competition between telecommunications companies takes place. In addition, a company may use different types of technology and commercial strategies for delivering the services to the final consumer. Because of that, it is quite common for bundled services to vary across locations.

In what follows, we analyzed the geographic distribution of each group, in addition to the prices and characteristics associated with the quality of services.

3.1. Economic groups

Oi is a concessionaire created after the privatization of Sistema Telebrás in 1998, having inherited most of the fixed telephony system available in Brazil, especially after the acquisition of Brasil Telecom. This economic group has an extensive xDSL network, being able to explore the efficiencies from the use of a single infrastructure network only for landline and broadband services. As it delivers pay TV services through the use of DTH technology, it has become the main group in charge of the capillarity of triple play in Brazil, offering it in 3,358 municipalities.

Telecom Américas has played a pioneering role in the delivery of triple-play, offering this sort of bundle since 2006. However, it is present in a considerably smaller number of municipalities: 175. That is so because the group operates in local markets with higher potential for consumption (higher GDP per capita, number of inhabitants, local human development index (LHDI) – income, and LHDI – education), when compared with Oi. Triple-play packages are offered by NET, which uses cable technology, delivering the three services through the same infrastructure network.[11]

Finally, Telefônica, whose services are delivered by GVT, offers triple-play bundles in 146 municipalities, using mainly DTH technology for pay TV services and xDSL networks for broadband and landline calls.[12]

Figure 1 displays the map with the distribution of municipalities to which each of the assessed groups delivers triple-play services and the number of competitors in each

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[10] Conducted between February 20 and March 10, 2016.

[11] Claro offers bundles, however, with different services: fixed telephone, cell phone, and pay TV, not including broadband services. Embratel offers only pay TV services that use DTH technology. Thus, the services offered Claro and Embratel will not be assessed in the present study.

[12] The merger between Global Village Telecom and Telefônica, despite the fact that it was approved by CADE in late 2015, had not occurred yet at the time of collection of the data, and GVT and Telefônica (with services provided by Vivo) were selling their services separately. Only GVT was offering triple-play at the time of data collection and, therefore, only this company was included in the analysis. The companies were merged into Vivo in May 2016, and the sales were then performed on a single website. Thus, with the merger, the group probably began to offer bundled services in a larger number of municipalities in the state of São Paulo, further increasing the market presence of this type of service.

municipality. It shows that Telefônica and Telecom Américas are closer in terms of regional market presence, operating mainly in the south and southeastern regions and in metropolitan areas in the northeast of Brazil. Oi, on the other hand, has a large market presence throughout Brazil, except for the states of São Paulo and Pernambuco.

Figure 1 – Municipalities where the assessed groups offer triple-play bundles, by number of competitors

Oi

Telecom Américas | *Telefônica*
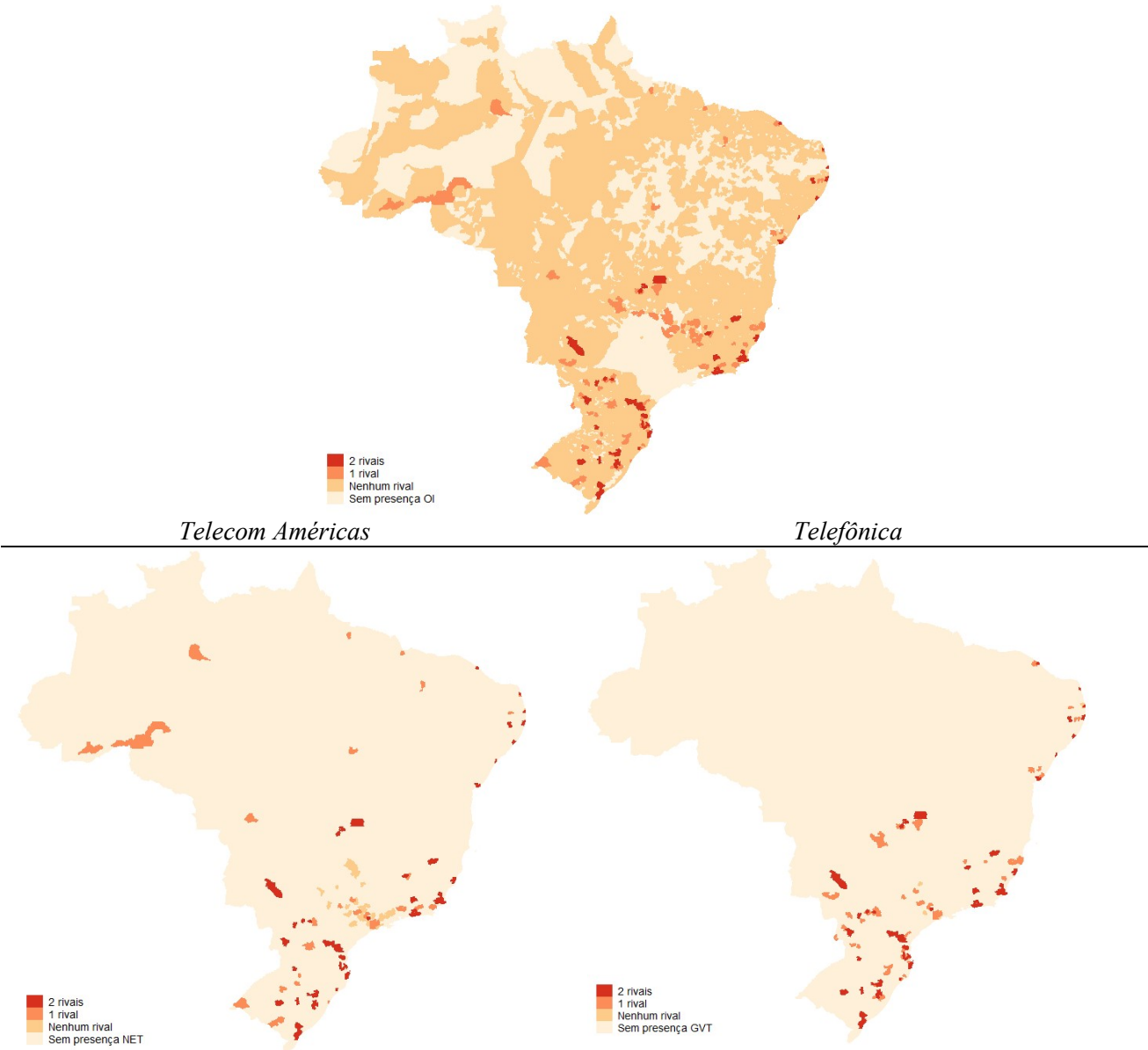
Source: Data compiled by the authors using information obtained specifically for the analysis.

3.2. Dependent variables*: price and quality*

The prices of triple-play bundles, collected from the websites of the three companies, are based on monthly data. When there were discounts in the first months in which the services were being offered, the average price charged during the first 12 months was used to avoid any bias. This initial 12-month period corresponded to the

customer loyalty period required by companies so that consumers could be eligible for the discount.

By combining three services, the analysis of quality of triple-play bundles has a multidimensional approach. Hence, the following factors were accounted for in the case of **broadband bundles**: i) broadband speed in megabits per second (Mbps); ii) a dummy variable that indicates whether the packages include WiFi connection.

Table 1 shows the broadband bundles offered by each company and the frequency at which they were observed in the database. The large number of broadband speed options indicates heterogeneous preferences among subscribers. Therefore, service packages were grouped into four speed ranges: i) 0 to 5 Mbps; ii) 6 to 20 Mbps; iii) 21 to 49 Mbps; and iv) > 50 Mbps.

Note that Oi has a limited portfolio compared with that of NET and GVT, as it does not offer speeds greater than 35 Mbps. NET, on the other hand, has a larger vertical differentiation for its products and makes all speeds commercialized individually available in its triple-play bundles. Oi and GVT do not include all the speeds offered in their triple-play packages, in which intermediate speeds (10 to 35 Mbps) take priority. In Table 1, it should be noted that both Oi and GVT usually offer similar packages in the different municipalities where they operate, as the frequency of speeds in triple-play are akin to each other. NET exhibits the largest variation in the frequency of services, which indicates that this company varies the level of quality of its broadband plans depending on the municipality where it operates.

Table 1 – Characteristics and frequency of broadband plans offered by Oi, NET, and GVT in their triple-play bundles

Range	OI		NET		GVT	
	Speed in Mpbs	# of services with this speed	Speed in Mpbs	# of services with this speed	Speed in Mpbs	# of services with this speed
0 to 5 Mbps	**.3**	**3,386**				
	.5	**3,386**	.5	228		
	1	**3,386**	1	204	**1**	**5**
	2	15,942	2	1,959	**3**	**5**
	5	21			**5**	**15**
6 to 20 Mbps	10	15,921	10	21	**10**	**15**
	15	15,921	15	1,953	15	286
21 to 49 Mbps	**20**	**3,379**	20	12	**20**	**15**
	25	15,921			25	389
	35	15,921	30	1,947	35	150
> 50 Mbps			60	1,947	50	47
			100	24	100	4
			120	1,875	**150**	**140**
					200	**17**
					300	**17**

Source: Data compiled by the authors. The plans offered by the companies but not sold in triple-play bundles are in boldface.

Regarding **fixed telephony** plans, the following variables were used in order to identify the quality of each plan offered: i) amount of minutes for local calls to landline numbers; ii) amount of minutes for local calls to cell phone numbers; iii) amount of minutes for long-distance calls.

Table 2 shows the fixed telephony plans offered by each company and their frequency in the database. The groups offer three options, but GVT does not include the lower-quality plan in triple-play bundles. Interestingly, the three companies offer unlimited calls to local and long-distance numbers; in addition, Oi and NET include unlimited calls to cell phone numbers that belong to the same provider. Note also that frequency varies considerably for the plans offered by Oi, and the higher-quality plans are offered as bundles to a smaller number of municipalities. NET and GVT have a smaller variation in their services across municipalities.

Table 2 – Characteristics and frequency of telephone services offered by Oi, NET, and GVT in their triple-play bundles

Group	Plan	Local Landline	Local Cell Phone	LDC Landline	# of services in the plan
Oi	Lower quality	Unlimited	0	0	50,727
	Médium quality	Unlimited	0	Unlimited	14.46
	Higher quality	Unlimited	Unlimited to Oi	Unlimited	14.46
NET	Lower quality	Unlimited to NET	0	0	3,350
	Médium quality	Unlimited	Unlimited to Claro	0	3,350
	Higher quality	Unlimited	Unlimited to Claro	Unlimited	3,350
GVT	Lower quality	**100**	**0**	**0**	**22**
	Médium quality	Unlimited	0	0	396
	Higher quality	Unlimited	0	Unlimited	480

Source: Data compiled by the authors. The plans offered by the companies but not sold in triple-play bundles are in boldface.

Among the three markets analyzed, **pay TV** is the one with the largest product differentiation. In general, companies offer three types of channel packages: i) first tier, with a lower price and smaller number of channels; ii) basic and expanded basic packages, which provide consumers with a broader variety of options, recalling that the expanded basic plan is superior to the basic one; iii) premium, which offers channels with unique TV contents and/or that broadcast sports events live, and often on an exclusive basis, which are appealing to a wider audience (HBO/MAX, TELECINE, and PREMIÈRE). Premium channels are not usually available in triple-play bundles and, therefore, they were not included in the present analysis.

Accordingly, as a way to control for the quality of these services, we used variables associated with the number of TV channels offered in each package. These channels were grouped into two categories:[13] i) pay TV[14]; ii) broadcast networks and other types of channels.[15]-[16] Given that channels may vary in terms of image quality, between

[13] Audio and radio channels were not accounted for.

[14] Only those channels included in the classification of broadcasters affiliated with the Brazilian National Film Agency (ANCINE), in February 2016, were considered to be pay TV channels, except for non-adapted channels and channels whose contents are broadcast over the internet. Available at: http://ancine.gov.br/sites/default/files/classificacao-canais-programacao/lista-classificacao-canais-04022016.pdf.

[15] The category known as "other types of channels" was defined in a negative way: all channels included in the package that are not pay TV channels. Those include channels classified as mandatory channels, as established by Law no. 12.485, enacted in 2011, including open TV channels and government-controlled institutional channels; and the channels referred to by some companies as complimentary channels, which include education channels (Futura), religious channels (Rede Vida), and shopping channels (Polishop).

[16] The packages offered by *lifeline* companies, which do not include any pay TV channel, were not included in the analysis.

standard definition (SD) and high definition (HD), we also controlled for the number of HD channels offered in the package. The following information was then included: i) total number of pay TV channels; ii) number of pay TV HD channels; iii) total number of broadcast networks and of complimentary channels; iv) number of open TV HD channels.

Table 3 shows the pay TV plans offered by each company and their frequency in the database. Note that all types of services are offered by the companies as triple-play bundles. NET has a larger number of plans and greater variation in the frequency of services. In addition, Oi offers packages with a smaller number of channels: when compared with the packages available from GVT, Oi's first tier has only 17 pay TV channels and the extended basic plan is comparable to GVT's basic plan. NET offers packages that are similar to those of Oi and GVT, with 8 to 126 pay TV channels. Finally, as occurs with broadband services, while Oi and GVT practically do not have any variation in pay TV channels per municipality (all plans have a similar frequency), NET usually shows some variations in the packages offered in each municipality where it operates.

Table 3 – Characteristics and frequency of pay TV plans offered by Oi, NET, and GVT in triple-play bundles

Group	Plan	Name	Open channels Total	HD	Pay channels Total	HD	# of services in the plan
	First Tier	Start HD	36	5	14	14	54,567
Oi	Basic	Mix HD	36	5	71	37	54,567
	Expanded Basic	Total HD	36	5	85	47	54,567
	First Tier	Easy HD	35	6	8	0	2,275
	First Tier	Easy TV	32	0	10	0	296
	Basic	Additional TV	30	0	49	0	48
NET	Basic	Essential	30	1	49	0	248
	Basic	Essential HD	35	6	49	0	2,290
	Expanded Basic	Additional HD	36	6	87	29	2,538
	Expanded Basic	Top HD	36	6	126	47	2,538
	First Tier	Super HD	24	0	56	21	288
GVT	Basic	Ultimate HD	24	0	83	28	294
	Expanded Basic	Ultra HD	24	0	114	36	294

Source: Data compiled by the authors.

Note that NET has more pay TV and broadband options, offering similar services to those of Oi and GVT. Moreover, NET offers more variation in the characteristics of both services, per municipality, which could indicate competition for quality. Oi has larger variation in landline services, suggesting that it chooses this strategy to compete for quality with the other two companies.

3.3. *Variables of interest: proxy for local market competition*

To construct the variables of interest, used as proxy for competition in each local market, it is necessary to identify which companies are considered by consumers to be near substitutes.

In a differentiated products market with a high switching cost for consumers, as is the case of telecommunications services, it is assumed that big companies will be closer rivals to each other, since they carry strong brand name or good reputation for service delivery and benefits from gains of scale and network. Therefore, the following leading groups in the triple-play market were considered to be competitors: Oi, Telecom Américas, Telefônica, and Algar.[17]

For the analysis of price competition, a dummy variable was included to indicate whether there is a relevant national rival in the local market. Another dummy was included to indicate whether there are two rivals. Finally, a dummy for small providers was included in order to control for possible effects of these players on price and quality.

Tables 4, 5 and 6 show the number of rivals that compete with each of the assessed groups in the municipalities where triple-play bundles are offered.

Table 4 – Number of municipalities where triple-play bundles are offered by Oi, by number of rivals and by company

	Companies			
	Oi	NET	Algar	GVT
# municipalities where Oi is the only player	3,183	-	-	-
# municipalities with 1 rival	103	30	23	50
# municipalities with 2 rivals	72	72	-	72
Total number of municipalities where triple-play bundles are offered by Oi	3,358	102	23	122

Source: Data compiled by the authors.

Table 5 – Number of municipalities where triple-play bundles are offered by NET, by number of rivals and by company

	Companies			
	NET	Algar	GVT	Oi
# municipalities where NET is the only player	53	-	-	-
# municipalities with 1 rival	49	3	16	30
# municipalities with 2 rivals	73	1	73	72
Total number of municipalities where triple-play bundles are offered by NET	175	4	89	102

Source: Data compiled by the authors.

Table 6 – Number of municipalities where triple-play bundles are offered by Telefônica, by number of rivals

	Companies			
	GVT	Algar	Oi	NET
# municipalities where GVT is the only player	7	-	-	-
# municipalities with 1 rival	66	0	50	16

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[17] Algar has a strong presence in the state of Minas Gerais, and for being a landline concessionaire, its brand name is widely known in that region

# municipalities with 2 rivals	73	1	72	73
Total number of municipalities where triple-play bundles are offered by GVT	146	1	122	89

Source: Data compiled by the authors.

3.4. *Descriptive statistics*

Table 7 shows the descriptive statistics for the variables used in the econometric models.

Table 7 – Descriptive statistics for the variables used in the econometric models

	Telefônica		Telecom Américas		Oi	
Variable	Mean	SD	Mean	SD	Mean	SD
Price	233.692	40.967	280.698	102.089	215.672	26.168
Local Landline	1.000	0.000	0.655	0.475	1.000	0.000
LDC Landline	0.548	0.498	0.327	0.469	0.363	0.481
Speed	25.131	10.445	42.682	41.737	17.393	11.536
Wi-Fi dummy	1.000	0.000	0.760	0.427	0.800	0.400
# Open TV	24.000	0.000	35.264	1.187	36.000	0.000
# Open TV – HD	0.000	0.000	5.677	1.309	5.000	0.000
# Pay TV	84.527	23.675	67.262	43.726	56.667	30.707
# Pay TV – HD	28.384	6.122	18.841	20.027	32.667	13.816
LHDI-income	0.752	0.054	0.760	0.045	0.675	0.074
LHDI-education	0.680	0.057	0.696	0.048	0.583	0.084
Log GDP *per capita*	10.224	0.508	10.301	0.508	9.713	0.666
ICMS (State VAT)	0.279	0.021	0.274	0.025	0.283	0.020
Log Pop.	12.446	1.054	12.482	1.061	9.583	1.192
% Urban Pop.	95.758	4.706	96.598	4.278	65.972	21.396
% Young Pop.	43.215	2.072	42.929	2.266	39.785	3.231
Observations	876		10,230		79,644	

Source: Data compiled by the authors based on information from Anatel and IBGE and on information specifically collected for the analysis.

Now that the database has been presented, we discuss the empirical model.

4. Methodology

The present empirical analysis exploits how competition affects the prices and quality of triple-play. To do that, two models are estimated. The first one seeks to assess how competition affects the prices of triple-play, assuming product characteristics are exogenous. The second one assumes that competition affects both the prices and level of quality of the delivered services.

Following the empirical analyses conducted by U.S.[18] and Brazilian[19] antitrust authorities, we adopt the differences-in-differences model to verify the effect of

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[18] Concentration Act between *Staples* and *Office Depot, 1997*.

[19] Statement from the Department of Economic Studies in Concentration Act no. 08700.009732/2014-93, whose claimants are: Telefônica Brasil S.A. and GVT Participações S.A. Statement from the Department

competition, exploring the fluctuations in prices and in the quality of triple-play bundles offered in the municipalities where the company operates under monopolistic competition, compared with those where the company competes with one or more telecommunications groups.

To find appropriate parameter estimates, mainly in the case of cross-sectional data, it is important to have a considerable number of observations in local markets with substantial variation in the competition framework (Ashenfelter *et al.*, 2004). In this context, it is an advantage for the implementation of this method the fact that the database includes detailed information on all municipalities where each of the three groups of companies sells triple-play bundles. To assess Oi's reaction to competition, we use data on 3,358 municipalities. In the case of Telecom Américas, the data included 175 towns, compared with 146 local markets in the case of GVT.

It is also important to use controls that eliminate other factors that could explain the differences in prices and quality unrelated to competition (Ashenfelter *et al.*, 2004), so that estimations provide factual evidence of rivalry between companies. Note that prices could be higher in regions where there are no competitors, not because of possible market power, but because they are regions with relatively higher costs. Likewise, fluctuations associated with the level of quality may be related to local preferences, to population characteristics, and to income level, rather than to the difference in competition across local markets.

Accordingly, demographic and economic characteristics of local markets were used to control for structural changes in local demand and supply that could affect the price of services. As proxy for the potential demand of each municipality, we use some variables such as LHDI-income, LHDI-education, log of the GDP *per capita*, log of the population, and percentage of young population. Regarding factors that affect the supply side, we used variables associated with companies' costs, such as area in the municipality and percentage of urban population, a dummy that indicates the presence of fiber-optic networks and the ICMS (state VAT) charged. In addition, as a way to verify the existence of lower costs as a result of economies of scale, the log of the number of pay TV subscribers was included, added to the number of broadband and fixed telephony subscribers in nearby municipalities (in this case, we used the definition of mesoregion given by IBGE).

The next sections discuss the identification strategies that are specific to each estimated model.

5. Effect of competition on price

5.1. Identification strategies

As discussed previously, the first estimated model assumes that companies react to competition by only changing the prices of their services. In such case, product characteristics are exogenous, and only the effect of the presence of competition on the prices of bundles is assessed.

As the variable of interest, proxy for the level of competition, we followed Gomes and Ribeiro (2016) and included dummies that indicate the number of competitors in each municipality.

Moreover, in order to check the effect of competition on the market, in addition to demographic and economic variables of the municipalities, we included the

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characteristics associated with quality of triple-play bundles, which affect the price of the delivered services. The variables associated with quality include the number of pay TV channels and broadcast networks offered in the package, broadband speed, and the number of minutes for local and long-distance calls, as well as dummies for identical packages offered in more than one municipality. We included a dummy variable associated with government-subsidized broadband (applicable to NET data) and another dummy when it was not possible to purchase a pay TV package separately (applicable to Oi data).

After organizing the data by economic group, the differences-in-differences method was estimated by OLS, with robust errors, following the functional formula below:

$$\ln(p_{sm}) = \sigma + \boldsymbol{\theta Z_m} + \boldsymbol{\beta G_{sm}} + \delta_1 dummy\_rival_{1m} + \cdots + \delta_n dummy_{rival_{nm}} + dummy_{local} + \mu_s + \xi_m$$

Where:
- $dummy\_rival_m$ is a set of dummies used as proxies for the level of competition in the municipality. $dummy\_rival_{1m}$ is equal to 1 if there is one rival in the municipality, 0 otherwise; $dummy\_rival_{2m}$ is equal to 1 if there are two rivals in the municipality, 0 otherwise.
- $dummy_{local}$ is the variable that indicates the presence or not of a local company.
- Z_m are the characteristics of municipalities that control for structural changes in local demand and supply that could affect the prices of services: LHDI-income, LHDI-education, log of GDP *per capita*, area of the municipality, ICMS (state VAT), log of the population, percentage of young population, and percentage of urban population, and dummy that indicates the existence of fiber-optic networks.
- G_{sm} includes variables to control for the differences in quality that affect the price of the product, associated with triple-play bundles. The estimates included: amount of minutes for landline numbers in long-distance calls (LDC), amount of minutes for landline numbers for local calls, broadband speed, dummy for the presence of Wi-Fi, total number of broadcast networks, number of broadcast networks in HD, number of pay TV channels, and number of pay TV HD channels. In the case of Oi, an additional variable was used to indicate the presence of pure bundles, and in the case of NET, another variable was used to indicate whether the broadband service is included in the popular broadband program.
- μ_s are dummies for identical packages offered in more than one municipality.
- ξ_m are unobservable characteristics that are specific to a given municipality.

5.2. Results

Table 8 shows the results for the regressions concerning the three assessed groups: Telecom Américas (NET), Telefônica (GVT), and Oi. The coefficients estimated for the characteristics of municipalities are displayed in the Appendix.

Table 8 – Effects of competition on the prices of triple-play bundles by economic group

	Oi	GVT	NET
1 Rival	-0.0075	-0.0240	0.0051
	(0.0000)	(0.0327)	(0.0000)
2 Rivals	-0.0073	-0.0779	0.0023
	(0.0000)	(0.0000)	(0.0006)
Local company	0.0093	-0.0074	-0.0006
	(0.0000)	(0.3622)	(0.5330)
LDC Landline	0.0000	0.0209	-0.0180
	(0.0000)	(0.1315)	(0.1299)
Local Landline	(omitted)	(omitted)	0.2233
			(0.0000)
Speed	0.0048	0.0029	0.0097
	(0.0000)	(0.0000)	(0.0000)
Wi-Fi dummy	-0.0140	(omitted)	-0.2544
	(0.0000)		(0.0000)
# Broadcast	(omitted)	(omitted)	0.0828
			(0.0000)
# Broadcast – HD	(omitted)	(omitted)	0.0224
			(0.0000)
# Pay TV	-0.0057	0.0054	0.0040
	(0.0000)	(0.0000)	(0.0000)
# Pay TV - HD	0.0185	(omitted)	-0.0040
	(0.0000)		(0.0000)
Popular internet	-	-	-0.1503
			(0.0000)
Pure Bundle	0.0631	-	-
	(0.0000)		
Constant	5.2233	5.0820	2.2412
	(0.0000)	(0.0000)	(0.0000)
Product dummies	48	16	198
Obs	79,527	876	10,230
R²	0.895	0.883	0.996

Source: Data compiled by the authors. P-value in brackets.

For all estimates, package characteristics are significant, except for the amount of minutes for LDC offered by GVT and NET. In the case of NET, the number of broadcast networks had an 8% increase in the price of the package, and this is the characteristic that affects prices most positively.

Oi's pure triple-play, which oblige consumers to purchase pay TV services as bundles, show a price hike around 6%, which indicates that this strategy has negative consequences for final consumers. Note that pure bundles were offered by Oi only in those municipalities where there are no competitors for triple-play, which could indicate

an attempt to reduce competition with companies that sell only pay TV services, such as Sky and Embratel.[20]

As for the variable of interest, which identified the number of rivals per municipality, there were different results for each group. For Oi, the presence of one or two rivals has a negative impact on prices (around 1%). The existence of a single rival reduces the prices charged by GVT by approximately 2%, whereas two rivals correspond to an 8% reduction in prices. NET demonstrates a counterintuitive result: the number of rivals has a positive impact on its prices.

A preliminary explanation for this result would be the existence of asymmetric competition, something that is quite common in differentiated products markets. In this case, NET would cause a decrease in GVT and Oi prices, but the opposite would not hold. Another explanation would be that NET competes with these two companies by improving the quality of its products and, consequently, its prices, adjusting their triple-play bundles to possible cater to the higher income population.

The section below discusses the preliminary explanation, whereas model 2 discusses the second hypothesis.

5.3. Asymmetric competition

To assess the existence of asymmetric competition, the same variables from the previous section were used for the estimation. In addition to the dummies for the number of rivals in each municipality, dummies for the presence of each group were also included. Results reveal that the market presence of Oi has a positive and significant effect on the prices charged by NET, but a negative effect on the Algar group (the presence of GVT was omitted from the analysis due to multicollinearity).

In this context, the same regression used in the previous section was estimated, with new dummies for the presence of rivals, excluding Oi from the analysis. The results are shown in the following table.

Table 9 – Effects of the presence of rivals on triple-play bundles, excluding Oi from the analysis

log Price	Coeff.	SE	T	P>t	[95%CI]	
1 Rival	-0.0066	0.0005	-13.68	0.0000	-0.0076	-0.0057
2 Rivals	-0.0030	0.0014	-2.14	0.0320	-0.0057	-0.0003
Local company	-0.0015	0.0010	-1.49	0.1360	-0.0034	0.0005
Oi dummy	0.0131	0.0008	16.43	0.0000	0.0115	0.0146
LDC Landline	-0.0827	0.0021	-40.01	0.0000	-0.0867	-0.0786
Local Landline	0.1457	0.0112	13.05	0.0000	0.1238	0.1676
Speed	0.0093	0.0002	45.18	0.0000	0.0089	0.0097
Wi-Fi dummy	-0.1437	0.0129	-11.14	0.0000	-0.1690	-0.1184
# Broadcast	0.0536	0.0009	62.60	0.0000	0.0519	0.0552
# Broadcast – HD	0.0314	0.0017	18.54	0.0000	0.0281	0.0347
# Pay TV	0.0049	0.0003	15.40	0.0000	0.0042	0.0055
# Pay TV – HD	-0.0054	0.0005	-10.44	0.0000	-0.0064	-0.0043
Popular internet	-0.1482	0.0012	-123.90	0.0000	-0.1505	-0.1458
Constant	3.1363	0.0286	109.53	0.0000	3.0802	3.1925
Product dummies	198					
R²	0.9964					
Obs	10,230					

[20] "Embratel" has been recently replaced with "Claro TV."

When Oi is not considered to be a rival, the estimates associated with the number of competitors in the municipality are negative and positively significant, indicating that NET competes with GVT and with Algar by reducing its prices. However, the impact on price is negligible (less than 1%). Nevertheless, the company could engage in a more aggressive price competition than what is suggested by the current analysis. This occurs because the database is based on the offers available from the company's webpage. However, NET may give additional discounts when the customer contacts the company by phone.

The presence of Oi in a municipality (Oi dummy) has a positive and significant effect (around 1.3%). This strengthens the hypothesis that, even though Oi decreases its prices due to the presence of NET, NET does not compete for prices with Oi, thus indicating asymmetric competition between these companies.

Interestingly enough, for NET, triple-play offers that include broadband services, which make up the Brazilian government's plan to promote broadband services (Popular Internet),[21]-[22] have a remarkable impact on prices, with a reduction of approximately 15%. Thus, taking part in programs that allow for tax cuts has a considerably better effect than the presence of price competition. This finding is in line with that of Baigorri (2014), who underscores the importance of cost reduction policies.

6. Effect of competition on quality and price

6.1. Identification strategy

Unlike the previous model, which assumes the characteristics of triple-play bundles to be exogenous, the second model uses differences-in-differences estimates, assuming that competition influences the company's decision, not only in terms of price, but also in terms of quality of its services. Therefore, the telecommunications company chooses these two components simultaneously.

In this context, as triple-play services have multidimensional features associated with broadband, landline numbers, and pay TV, the analysis of the effect of competition on quality may be represented by a system of simultaneous equations. Hence, each equation was estimated separately using linear regression with instrumental variables and GMM with robust errors.[23]

The dependent variables are the deviation observed in the quality of bundles offered in a given municipality when compared with the national average. To build this variable, the vertical differentiation seen in each type of service was taken into account. Pay TV plans were categorized into first tier, basic, and expanded basic. Broadband services were classified by speed as follows: 0 to 5 Mbps, 6 to 20 Mbps, 21 to 49 Mbps, and > 50 Mbps.

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[21] The "Popular Broadband Program" is an integral part of the National Broadband Plan (PNBL), whose aim is to foster internet access through a group of measures that include negotiation with telecommunications concessionaires under Anatel's General Plan for Universalization Goals (PGMU) and changes in the sector's legal framework. One of the main initiatives of the "Popular Broadband Program" is the tax cut, i.e., lower ICMS levied on some broadband speeds and on internet access devices (Henriksen, 2012).

[22] http://www.brasil.gov.br/governo/2014/03/banda-larga-popular-ja-esta-em-mais-de-4-500-municipios

[23] The model was also estimated using the three-stage estimation method for systems of simultaneous equations, which proved inappropriate due to the presence of heteroskedasticity in the errors.

Unlike the previous model, the variables of interest, proxy for the level of competition, are dummies that indicate whether a given rival is operating in a given municipality, in line with the analyses conducted by DEE/CADE (2015a, 2015b). So, one investigates whether Oi competes with the quality of services offered by NET.

In addition, we used economic and demographic variables of the municipalities as a way to control for structural changes in local demand and supply, which could affect the price and quality of the services. Besides the variables described in the methodology section, we included characteristics that could affect consumers' preferences such as ratio of the male population, of people aged 6 to 14 years and 14 to 24 years. The deviation from the national average price of services in the municipality is considered to be the endogenous variable, since it is affected by the presence of 1 or 2 rivals and by the presence of a local company.

The econometric model can be represented by a system of equations, with the following functional form:

$$
\begin{bmatrix} \Delta Price_{sm} \\ \Delta Quality1_{sm} \\ (\dots) \\ \Delta QualityN_{sm} \end{bmatrix} = \begin{bmatrix} \sigma_1 + \boldsymbol{\theta Z_m} + \beta_1 \Delta Quality1_{sm} + \cdots + \beta_1 \Delta\, QualityN_{sm} + \delta_1 rival_{1m} + \cdots + \delta_n rival_{nm} + \xi_m \\ \sigma_2 + \boldsymbol{\theta Z_{m_i}} + \delta_0 \ln(p_{sm}) + \delta_1 dummy\_Oi_m + \delta_2\, dummy\_GVT_m + \delta_3 dummy\_Algar_m + \xi_m \\ (\dots) \\ \sigma_n + \boldsymbol{\theta Z_m} + \delta_0 \ln(p_{sm}) + \delta_1 dummy\_Oi_m + \delta_2\, dummy\_GVT_m + \delta_3 dummy\_Algar_m + \xi_m \end{bmatrix}
$$

Where:

- The common variables in all equations were:
  - Z_m are the characteristics of municipalities, which control for structural changes in local demand and supply that could affect the price of services. The following variables were included in the estimates: LHDI-income, LHDI-education, log of GDP *per capita*, ICMS, log of the number of subscribers in the mesoregion, log of population, young population rate, and urban population rate.
  - ξ_m are the unobservable characteristics that are specific to each municipality.
- Specific variables with $\Delta Price$ as dependent variable:
  - $dummy\_rival_m$ is the variable that indicates the number of rivals in municipality *m;*
  - $dummy_{local}$ is the variable that indicates the presence or not of a local company.
- Specific variables with the characteristics of the services included in the triple-play bundles as dependent variable:
  - $\Delta Quality1_{sm}$ is the dependent variable associated with the deviation observed in the quality of services offered in a given municipality when compared with the national average. If it is associated with the number of pay TV channels, it will be equal to: $(C.payTV_{sm} - \overline{C.payTV_s})/C.payTV_{sm})$, where *s* is the type of pay TV bundle (subscription, basic, and expanded basic) and *m* is the municipality.
  - $dummy\_GVT_m$, $dummy\_Oi_m$ and $dummy\_Algar_m$ are the variables of interest, which indicate whether each of the economic groups are present in the municipality.

The model was applied exclusively to the data obtained from NET because, as observed in Section 3.2, it is the company with the largest variation in types of plans in local markets. Therefore, it was noted that NET changes some aspects of its plans at the local level, which could be an indicator of competition for quality. The company is likely

to have a national policy in which it defines the average features of the main triple-play bundles, and such policy may be influenced by the competition faced by the company in the major markets or by the companies that offer pay TV services with DTH technology. However, this is not within the scope of the present study, as the database does not have enough information to identify this phenomenon.

NET offers the same types of landline services in all municipalities. Regarding the number of channels included in the bundles, there is no variation across local markets concerning the number of pay TV HD channels. Thus, these features should not be used as a pretext for companies to react to the competition observed in local markets.

Accordingly, the system of equations for NET data used the deviation from the national average as dependent variable, associated with the following characteristics: i) broadband speed, according to speed range; ii) total number of broadcast networks, iii) number of broadcast networks in HD, iv) total number of pay TV channels, according to the type of bundle.

6.2. Results

Table 10 shows the results for NET regressions.

Table 10 – Effects of the presence of rivals on price and quality of triple-play bundles offered by NET, by competitor

	Speed	# Open TV	# Open TV - HD	# Pay TV
Var. in price	-6.971	-0.231	-5.499	0.205
	(0.000)	(0.002)	(0.008)	(0.000)
Algar dummy	-0.101	-0.003	-0.070	0.002
	(0.010)	(0.270)	(0.288)	(0.090)
Oi dummy	0.123	0.008	0.187	-0.006
	(0.002)	(0.002)	(0.008)	(0.000)
GVT dummy	-0.106	0.001	0.016	0.000
	(0.000)	(0.501)	(0.596)	(0.753)

Source: Data compiled by the authors. P-value in brackets.

With respect to broadband plans included in NET's triple-play bundles, the presence of GVT has a negative effect on the average broadband speed, whereas the presence of Oi has a positive effect. As discussed in Section 3.2, when compared with NET's portfolio, Oi offers lower speeds whereas GVT offers higher speeds. Thus, this could indicate that NET seeks to differentiate its portfolio by offering broadband services with different speeds from those available from its competitors.

Regarding pay TV bundles, the coefficients associated with the presence of GVT and Algar are nonsignificant at 5% for the total number of pay TV channels, total broadcast networks and broadcast networks in HD. This demonstrates that NET does not change the characteristics of its pay TV bundles to compete with these two economic groups.

Oi has a negative and significant effect on the total number of pay TV channels. Interestingly, Table 3 shows that the basic and expanded basic bundles contain the same number of pay TV channels in all available bundles. There is some variation only in

subscription bundles which, in most cases, include 8 channels and, in some municipalities, 10. This reveals that in those municipalities where it faces fiercer competition from Oi, NET offers a smaller number of pay TV channels in the first tier package. The opposite is observed for the total number of broadcast networks and HD broadcast networks. The coefficients associated with the presence of Oi has a positive and significant effect for these two variables. So, NET seems to make up for the reduction in the number of pay TV channels by increasing the number of broadcast networks, in those municipalities where it competes with Oi.

In Brazil, broadcast networks are quite appealing to subscribers, who spend a longer average time watching programs on these channels when compared with the time spent watching pay TV, according to viewing surveys.[24] Moreover, nearly 27% of consumers seek better image quality when they subscribe to pay TV.[25] This way, it may be assumed that HD broadcast networks play a crucial role in competition. So, when NET increases the number of these channels in its plans, it competes for quality with Oi in the pay TV sector.

7. Conclusion

The present empirical study aimed to estimate the effect of competition on triple-play bundles using an approach often adopted by CADE to assess competitive pressure between players. By employing cross-sectional data, we sought to identify changes in the strategies used to react to the presence of rivals, comparing local markets under monopolistic competition with local markets with one or more competitors.

Unlike the analysis performed by the Department of Economic Studies (DEE/CADE, 2015a, DEE/CADE, 2015b), which evaluated the effect of competitive pressure on the number of subscribers in some local markets, the present study intended to estimate the impact on both price and quality of services included in triple-play bundles. To do that, two models were estimated, controlling for demographic and economic characteristics of local markets that could explain the fluctuations in price and in quality of the services. Large companies engage in fiercer competition between themselves, as their brand names enjoy reputation, have possible scale and network effects, and are widely known for their services. Accordingly, the following groups were considered to be competitors in the triple-play services market: Oi, Telecom Américas, Telefônica, and Algar.

The first model assessed the effect of competition on prices, defining the level of quality of its triple-play bundles as exogenous. Results show that the competitive pressure from national companies has a negative effect on the prices of Oi and GVT services, demonstrating competition between these companies. This effect is more pronounced for GVT: there is a reduction of around 8% when there are two competitors in the local market. On the other hand, the impact for Oi is less than 1%. For NET, the presence of Algar and GVT has a negative effect on prices, but that is smaller than 1%. Note that the Popular Internet Program has a significant effect on prices: a decrease of nearly 15%, indicating that the participation in government-subsidized cost minimization programs is more important than competition itself for NET, at least for lower speeds (0.5 to 2 Mbps). The presence of Oi has a positive impact on prices – a poorly intuitive result, which could indicate asymmetric competition.

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[24]Source: https://tvefamosos.uol.com.br/noticias/ooops/2016/09/15/assinantes-de-tv-paga-ficaram-56-do-tempo-em-canais-abertos-em-agosto.htm
[25] Source: Ancine's internal survey with data on approximately 2,000 households.

The second model aimed to estimate the effect of competition in local markets on prices and on the quality of services offered in the bundles. Only data on NET, company with the largest variation in the types of plans, were used. Results show that NET tries to differentiate its broadband services, offering different speeds from those available from Oi and GVT. In addition, NET competes with Oi by changing the characteristics of pay TV bundles, reducing the number of pay TV channels in the subscription bundle and increasing the total number of broadcast networks included in its pay TV bundles.

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