# Performance and Vertical Integration of Firms in the Fixed Internet Service.

***ALEJANDRA MOLINA OSORIO***

Tesis Maestría en Economía

Asesor, docente

*John Jairo García Rendón*

UNIVERSIDAD EAFIT

ESCUELA DE ECONOMÍA Y FINANZAS

MAESTRÍA EN ECONOMÍA

MEDELLÍN

2021

**CONTENT**

**Performance and Vertical Integration of Firms in the Fixed Internet Service.**

*Alejandra Molina Osorio*[*]*, John Jairo García Rendón*[†]

---

## HIGHLIGHTS

- For vertical integration, a static and dynamic panel model are proposed that combines the variables of the wholesaler and retailer market.
- The concentration is due to the fact firms have high market shares at retailer levels.
- Although there is no complete information, a database was built to analyze a backward vertical integration.

## ABSTRACT

The main objective is to examine business performance and possible vertical integration in the fixed Internet service. The hypothesis of the research is that vertical integration in the fixed Internet market is a practice that generates an increase in market power. This generate concentration in a few firms, hence the importance of having competition policies that are not only focused on the final consumer-seller relationship, but must also have competition policies in the wholesaler-retailer relationship. A model based in vertical integration backward with panel data per firm was estimated that relate the quantities of megabytes and price in the wholesaler market with some variables that show vertical integration as quantities of final subscribers. The main result is that in the vertically integrated firms, the price that comes from the wholesaler is fundamental and significant for the retailer because it represents the cost of the input and the number of subscribers have an impact in the quantities of megabytes.

**Keywords:** Vertical integration; internet; telecommunications; industrial organization; retailer; wholesaler.

**J.E.L:** L81, L96, L22

---

[*] Authors´ affiliations: Professor of Business and Economics department of Universidad Autónoma de Manizales – Colombia. PhD(c) in economics from Universidad EAFIT Medellin-Colombia. Member of the research group on entrepreneurship. Telephone: (57)3105103449. Orcid 0000-0001-9609-9698 e-mail: alejamoli@autonoma.edu.co, amolinao1@eafit.edu.co

[†] Professor and Researcher in the Economic department, Universidad EAFIT Medellin-Colombia. PhD in Economics, Director of the Economics and Business Studies Group at EAFIT University. Telephone: (574)2619149, Colombia. Orcid 0000-0002-1269-2548 e-mail: jgarcia@eafit.edu.co.

## I. INTRODUCTION

Internet is one of the most important services worldwide, its use and increase in coverage is one of the main concerns of the development agendas. The market has high investment and have constant advances in it, the market tends to be highly concentrated and competition policies have few tools to differentiate between Firms with market power or possible abuse of it.

The advance of the internet has transcended to mobile internet and wireless networks. The internet is transforming not only the telecommunications sector, such as radio, telephony and television; but also, business, education and interaction with people and things, where internet is a service that is used by all areas of the firm for management, planning, communication and diffusion of many activities. It has also transformed the engineering and technology sector with the internet of things to remotely control the things that are used daily.

A definition for internet was given in a resolution of the Federal Networking Council in October 24 of 1995.

> "Internet refers to the global information system that: i) is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/follow-ons. ii) is able to support communications using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite or its subsequent extensions/follow-ons, and/or other IP-compatible protocols. iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein".

One of the most used practices in different markets to increase profits and market power is vertical integration, although in the internet market these practices added to the horizontal and conglomerate integration are equally used. Cabral (2017) defines the relations between firms are called vertical relations, in addition the

relation between producer and retailer is different from the relation between the firm and the final consumer.

The vertical integration has been extensively discussed in literature of theory of industrial organization. On the contrary, the empirical literature on the reasons for vertical integration and the impact of vertical integration on performance is scarce. Some authors empirically analyze the mergers of a specific firm such as Howell and Potgieter (2017) and Okoeguale and Loveland (2017). Others such as Glock and Kim (2015) analyze the entire industry because the attainment of data at the firm level is difficult.

Some important author that refers to vertical integration are Motta (2004), Cabral (2017), Belleflamme and Peitz (2015) and Avenali (2014). For the telecommunication market, specifically the internet market Molnar and savage (2017), Garcia and Posada (2017) and Lee, Katayama and Oh (1997). Incentives and innovation are important topics with some author like: Karaboga (2001), Laffont and Martimort (2018) and Armstrong, Laffont and Tirole (1995).

This research contributes to the current state of knowledge since it analyzes the performance of the fixed internet service and the possible vertical integration. The question to answer is: how is the performance of internet firms and how vertical integration affects in Colombia? A theoretical review and an empirical analysis were made to find the implications of vertical integration in the Colombian market and made a contribution to competition policies. The empirical evidence for the Internet market in Colombia is analyzed with an unbalanced panel, 154 firms with monthly data between 2008 and 2015.

The objective is to examine the performance of firms and vertical integration in the fixed Internet service and it analyze what is the impact of vertical integration on firms and competition policies. An empirical approach to the Colombian case is interesting and has not been studied. Different estimates of data panel models are made. It is

clear that the acquisition of data is the biggest limitation that the reason database was built using different sources.

The main results can be divided from the analysis of the literature review and from the empirical evidence. i) from the literature review the current competition policy has a clear focus on the end-user firm relationship, but does not take the backward chain of firms, that's why regulation should have a broader focus, although the difficulty of making measurements is recognized. The internet market needs to be more competitive. The vertical integration strategy is a mechanism to seek permanence in the market and to increase its market power since a decrease in costs is generated. ii) from the empirical evidence the estimation of models takes into account the backward vertical integration model, the main result is that in the vertically integrated firms, the price that comes from the wholesaler is fundamental and significant for the retailer who have vertical integration, because it represents the cost of the input. The firms who are present in the wholesaler and retailer market are 21 firms who have vertical integration. The main incentive to have this relation is gain power in the input service.

The document has this structure: in the second part, is the theoretical framework and literature review, in the third part the analysis of the fixed internet service. The fourth part is the empirical evidence with the methodology, data, and variables used, estimated models and results; the fifth part is the recommendations of competition policy and finally, the conclusions.

## II. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

On a **theoretical level,** Vertical relationships or vertical integrations are an important part to the competition policy of countries. Motta (2004) defines competition policy as "The set of policies and laws that guarantee that competition in the market is not restricted in a way that is detrimental to society" and "The set of policies and laws that guarantee that competition in the market is not restricted in a way that reduces economic well-being". Competition policies should help control the abuse of market power, but a distinction should be made between market power and abuse of market power.

Horizontal agreements are agreements between competitors that generally restrict competition and reduce welfare and should therefore be prohibited apart from very specific cases (e.g. R+D+i cooperation agreements). Vertical agreements are agreements between firms at different stages of the production process (e.g. between a manufacturer and a retailer) which often try to gain efficiency in competition but generate concerns if they are a firm with substantial market power. The vertical, horizontal or conglomerate integration could provide tools to implement price discrimination policy, which may be ineffective or declared illegal by competition authorities.

Cabral (2017) defines that the relations between firms are called vertical integration, the relation between producer and retailer is different from the relation between the firm and the final consumer: The firm that sells directly has control over the variables of the demand, such as price, quality and advertising. The retailers compete among themselves; the price of the firm is the marginal cost so it is interesting not only analyze the price of the firms but also other retailers. The firm that sells to the final consumer has the greater market power, for example, a large supermarket chain has power over suppliers.

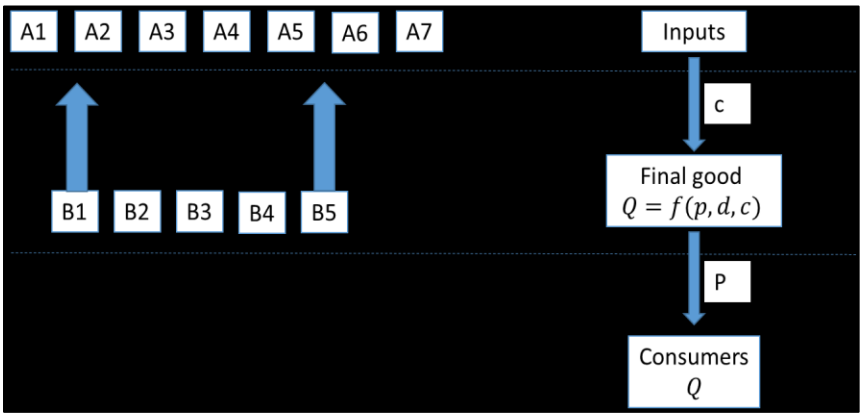
Before vertical integration, the problem of double marginalization happens because both, the wholesaler and the retailer are monopolies with two prices, which will result

in a higher price for final consumer than the joint monopoly price. As a result, the combined profits of wholesaler and retailer are lower than if they were integrated. In fact, consumer welfare is also lower in vertical separation, because the price is higher than the monopoly price.

The vertical integration can be "forward" or "backward". If the seller is a monopoly, it wishes to integrate backward with the producer firm, this must be an uncompetitive industry to achieve cost savings, this argument is known as the Adelman-Spengler hypothesis (Adelman, 1949, Spengler, 1950) with fixed factors. Upstream (or backward) vertical integration refers to a situation where a firm gains control over the production of inputs necessary for its own operation. The incentives are gain market power, reduce cost of transactions and do price discrimination. Now, if the supplier market is competitive, the firm would have an incentive to integrate forward with the seller. Downstream (or forward) vertical integration refers to a situation where a firm gains control over an activity that utilizes its outputs (Scherer and Ross, 1990; Vernon and Graham, 1971).

Figure 1 shows the backward vertical integration or upstream vertical integration where the firms located in the downstream level want to gain control over the inputs located in the upstream level.

**Figure 1:** Backward vertical integration




Source: own elaboration based on Carlton & Perloff (2015) and Lipczynski, Wilson & Goddard (2017)

Williamson (1971, 1975, 1989, and 2002) argues that vertical integration can generate reduction of transaction costs. Specific sources of cost savings include the following:

- Technological conditions: Vertical integration can reduce production costs. This happen when complementary processes are best completed together.
- Uncertainty: The relationship between firms in different stages of production is subject to uncertainty arising from incomplete information. Vertical integration help reduce such incompleteness.
- Assured supply: Firms may be concerned about the risks of supplier failure. Backward vertical integration help to ensure a constant supply of inputs.
- Externalities arise when a firm incurs in additional costs caused by the actions of its suppliers or distributors. Vertical integration helps eliminate these costs.
- Complexity: Vertical integration can be characterized by complex technical and legal relationships. The resulting difficulties can be reduced by vertical integration.
- Moral hazard: Moral hazard issues can affect contracts between firms at different stages of a production process these disincentives can be eliminated.
- Avoiding tax or price controls may also be possible through a vertical integration strategy.

Economists have also advanced rationales for vertical integration such as economies of scope between successive stages of production (chandler 1990) uncertainty in the supply of the upstream product (Arrow 1975), risk shifting in the presence of stochastic availability of the input (Carlton 1979), tax evasion and price controls (Stigler 1951), as well as anticompetitive rationales. Most of the reasons that firms choose to vertically integrate have to do with reducing costs or eliminating a market externality.

As stated by Lipczynski, Wilson, and Goddard (2017), the issue of vertical integration has been extensively dealt in the literature of industrial organization theory. In contrast, there is little empirical literature on the motives for vertical integration and the impact of vertical integration on performance. Carlton and Perloff (2015) also argue the need of more empirical studies to identify desirable and undesirable vertical arrangement.

Some **empiric literature** about vertical integration focus on the transaction cost and market power theories as Williamson (1975), Eccles and Williamson (1987) the market power theory holds that firms vertically integrate to increase profits or eliminate market power. Monteverde and Teece (1982) examine the quasi-integration by automobile manufactures. Masten (1984) studies vertical integration in the aerospace industry. As in the previous study, integration is more likely when specialized assets are used. Other studies showing the importance of asset specificity include Spiller (1985), Weiss (1992), Crocker and Reynolds (1993), Minkler and Park (1994), Whyte (1994), and Wimmer and Garen (1997). Lieberman (1991) examines the importance of asset specificity, market power, and assurance of supply as explanations for vertical integration in the chemical industry. Resale price maintenance is other used variable in research Ornstein and Hanssens (1987), Ippolito (1991) and Overstreet (1984).

Spiller (1985) evaluates two competing hypotheses on the motives for vertical integration. The study is based on 29 vertical mergers that took place in the US during the 1970s and early 1980s. The findings generally appear to favor the asset-specificity hypothesis. John and Weitz (1988) develop a transaction cost analysis of forward vertical integration. The study identifies the direct and indirect distribution channels used by producers. Much of the information for the empirical analysis is obtained from interviews with managers. The estimated model explains 28 percent of the variation in sales through direct channels. In general, the results tend to support the transaction cost hypothesis.

D'Aveni and Ravenscraft (1994) examine the effects of vertical integration on costs. The results suggest that vertical integration produces some cost savings, through lower overheads, marketing costs and innovation. However, these cost savings are often offset by technical inefficiencies resulting from reduced competitive pressure. Using a historical rather than an empirical approach, Krickx (1995) applies the transaction cost methodology to the computer frame industry by observing changes in vertical governance patterns over a 20-year period. The institutional analysis focuses on 10 firms, and three separate governance patterns are identified: vertically integrated, intermediate exchange and market exchange.

Gertner and Stillman (2001) examined vertical relationships and the ability of firms to respond to sudden changes in their competitive environment. Kwoka (2002) examines vertically integrated economies in the power generation industry in the United States; Nemoto and Goto (2002) explore similar issues in Japan.

Mergers in the telecommunications sector are important for analyzing changes in the sector, Goldman, Gotts and Piaskoski (2003) analyses efficiency when reviewing mergers in telecommunications in Canada. Warf (2003) analyses the wave of mergers in the 1990s that reshaped the telecommunications market; in Europe and the USA; telecommunications firms have steadily consolidated into a shrinking group of suppliers, which has rapidly become an oligopoly, the results focus on the impacts of the oligopoly on consumer prices, labor, equity of access to telecommunications services, and the political and cultural impacts of increasingly concentrated ownership.

Shin, Ahn, and Lee (2015) conducted a study of telecommunications firms in Korea analyzing diversification strategies by comparing diversification results with and without a clustering strategy - The results show that related diversification has a positive impact on corporate performance and that the impact of diversification related to commodity clustering is greater than that of related diversification without commodity clustering. Howell and Potgieter (2017) analyze mergers in New Zealand

and packaging in the telecommunications sector. The more variety there is in the available content packages, and the more heterogeneous consumer preferences in different content types, the greater the number of possible markets in which interaction is likely to occur and the more problematic it is to identify the relevant market elements for merger and antitrust analysis.

Okoeguale and Loveland (2017) study mergers in the regulated telecommunications industry to test theories of merger profits. The results indicate that deregulation did not encourage merger collusion in the telecommunications industry, but that merger profits are due to merger-induced efficiencies.

Although competition policies and the theory of incentives have a broad development, here it focuses on what is important for vertical integration in the internet market. For Competition policy and incentives, According to Karaboga (2001), the theory of incentives refers to the problem that a planner (alternatively called a designer, director or government, depending on the context) faces when their own objectives do not coincide with those of the members of society (agents).

In the Internet market Molnar and Savage (2017) focus on investigating the effects of the number of firms and their type of product on the quality of broadband Internet, they estimate a model that relates real speeds delivered, in groups of census blocks, with the number of wireline and wireless Internet service providers. Kraemer and Schnurr (2014) offer a definition and a conceptual framework through which Open Access efforts can be uniquely identified and classified. Avenali, Matteucci, and Reverberi (2014) analyzed how the vertical structure of the industry affects investment in network quality and social well-being, this is done with a model that considers three alternatives of vertical integration structure the first where they are fully integrated, the second where they are functionally separated and third structure is with separate owners.

In the internet market, vertical integration has been studied, Guo, Bandyopadhyay, Cheng, and Yang (2010) focus on whether vertical integrations should be allowed

as it can generate problems of net neutrality since the integrated firm can prioritize the delivery of content at the expense of competitors. Another case very similar to the Colombian one is that of Glock and Kim (2015) who study a supply chain from a single supplier and many retailers and considers the case in which the supplier merges with one of its retailers. Mergers are important and are a form of vertical integration. Howell and Potgieter (2017) analyze mergers in New Zealand and packaging in the telecommunications sector. Okoeguale and Loveland (2017) study mergers in the regulated telecommunication industry to test theories of merger gains.

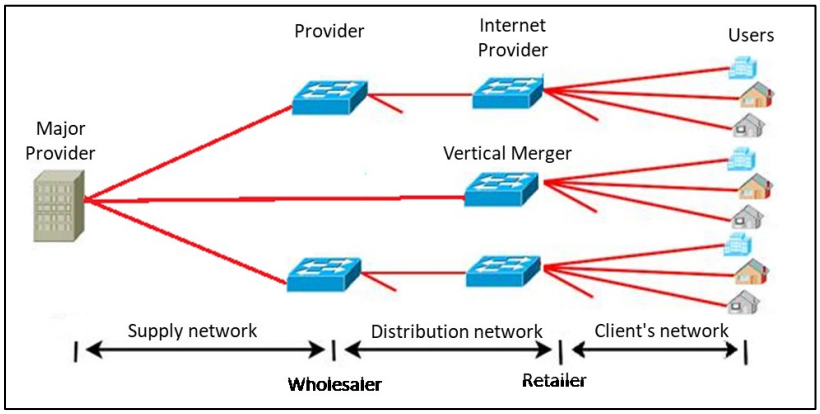
The variables for market analysis are fundamental, usually the variable quantity of product and the price are used, but those variables are not always available. Therefore, it is possible to make use of variables of financial economic performance as Maury (2006); Einav and Levin (2010), Villalonga and Amit (2006); Cashman, Gillan, and Jun (2012); Fich and Shivdasani (2012), Field, Lowry, and Mkrtchyan (2013). Other authors who have studied vertical integration are: Fiocco (2016), Biancini and Ettinger (2017), Choi and Lee (2017), Zanchettin and Mukherjee (2017), Lee, Katayama and Oh (1997) and Maruyama and Minamikawa (2009).

## III. PERFORMANCE OF FIXED INTERNET SERVICE

Although the fixed Internet was born in the 1960s, it was only in the 1990s that its use became popular. The best-known internet service is the world wide web but there are many other protocols such as e-mail (SMTP), file transmission (FTP and P2P), online conversations (IRC), instant messaging and presence, content transmission and multimedia communication telephony (VoIP), television (IPTV), electronic bulletins (NNTP), remote access to other devices (SSH and Telnet) among others.

The internet is transforming not only the telecommunications sector, such as radio, telephony and television; but it is also transcending to business spheres where the internet is a service that is used by all areas of the firm from management, planning, communication to diffusion of many activities. It has also transformed the engineering and technology sector with the internet of things that remotely control many of the utensils that are used daily from air conditioning, refrigerators to machines that interact and feed pets. Some authors like Miorandi, Sicari, De Pellegrini and Chlamtac (2012) and Zanella, Castellani, Vangelista and Zorzi (2014) analyses the challenges of the application of the internet of things in research and innovation and also the importance of the internet of things for the challenge for smart cities.

**Figure 2**: Fixed internet




Source: own elaboration

In figure 2 it can be seen how is the process of the Internet from major provider until it reaches the final user. In the fixed internet market, there is a major provider which is a monopoly and is in charge of providing and maintaining the main network. This firm sells Internet to a group of firms that are wholesalers it is the upstream level, here is also included the public and educational institutions; the wholesalers sell to retailers, which are the firms that interact directly with the final customer, i.e. the users or downstream level. The vertical integration occurs between the supplier firm and the retailer; the firm integrated buys directly from the wholesaler and sells directly to the users, so the cost of the internet is the tariff charged by the major supplier avoiding the double marginalization.

As in international markets, such England, the Colombian government had a monopoly in the telecommunications market until the 1990s. Television began in 1954 during the government of General Gustavo Rojas Pinilla; in 1979, color television arrived and in the 80s, the regional channels began, like Teleantioquia, Telepacífico, and Telecaribe; it is in 1998 when the first private channels begin operations. Telephony was controlled by the government, with different local firms and one nationally, the national telecommunications firm TELECOM (*Empresa Nacional de Telecomunicaciones*).

The liberalization of fixed telephony began in 1993 and followed the opening of competition in long-distance services in 1998. Mobile telephony began in 1994 with a duopoly that experienced rapid growth with the entry of a third operator in 2003. In Colombia, the OECD (2014) generated recommendations for the telecommunications market, including the Internet, to improve not only indicators but also policies. The recommendations given by the OECD (2014) focus on the competition policies of the telecommunications sector, where the regulation and possible sanctions should fall on firms that have direct contact with end users but also wholesalers' firms.

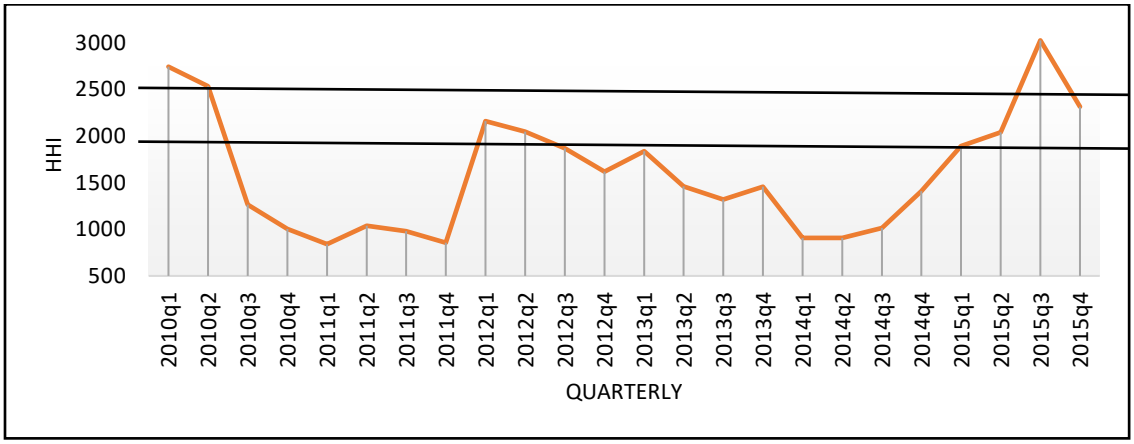
Colombia has an area of just over 1.2 million square kilometers, 47 million habitants, the low density of population per kilometer, is due to the large size (26th place in the world) and 75% of the population lives in the urban area. According to data from the OECD (2014), the gap in the use of ICTs in large and small firms is high, only 20% of SMEs (Small and medium-sized enterprises) are connected to the internet; this is low given that 96.4% of firms in Colombia are micro businesses. The penetration of fixed broadband in the market was 8% in 2012; in the third quarter of 2013, it reached 9.2% well below the OECD average of 26.3%, even lower than the lowest penetration rate, which was Turkey with 10.4%. At the end of 2011, about 48% of broadband connections have speeds of 2Mbps and only 0.68% higher than 10Mbps. The broadband market is an oligopoly with a few firms, Claro, 30.55%; UNE-EPM, 26.62%; Movistar, 18.53% and ETB, 12.94%. The lack of competition in fixed and mobile broadband translates into higher prices. The price of mobile telephony is one of the highest compared to other members of the OECD. Law 1341 of 2009 or the ICT Law, give advanced instruments to fight against the situation of the dominance of fixed, mobile, broadband and television markets, and also reduced barriers to entry with the adoption of a "single license" controlled by the ministry of information technology and telecommunications (Mintic).

In Colombia in 2018 with data of Ministry of Information and Communication Technologies (2019) the fixed Internet access technologies by cable, had 3.9 million accesses; xDSL, 1.7 million accesses; Optical fiber, 900,000 accesses and other technologies, 300,000 fixed Internet accesses. The behavior and decisions that firms make today are important in competitive and imperfect markets. The firms have strategic behaviors that follow their market characteristics, competition policies, regulation, asymmetric information, and costs.

The competition policy in the Colombian case is focused on regulate and sanction the firms that are directly related to the end user or client, but the regulatory framework for the wholesale market is not clear or well defined. The subject of vertical integration has been extensively discussed in the theory of industrial

organization literature. On the contrary, the empirical literature on the reasons for vertical integration and the impact of vertical integration on performance is scarce.

**Figure 3**: Concentration of wholesaler market HHI




Source: own elaboration

The wholesale internet market in Colombia is concentrated, the HHI index (Herfindahl-Hirschman index) measures the concentration, according to the literature, markets are concentrated when the HHI is higher than 2000 and highly concentrated when it is greater than 2500. Figure 3 show this market is concentrated, and highly concentrated in 2015, but between 2010 and 2014 had a normal concentration, in that period many firms entered to demand Mbps. The high concentration of market shares is range from 16% (Media Commerce Partners SA) to 53% (Tv Azteca branch Colombia). The concentration of the market has an impact on market power; Sung (2014) analyzes the concentration in the mobile telecommunications markets of the OECD member. The empirical results indicate that the more concentrated the mobile markets are, the higher the prices and the gains, which supports the hypothesis of market power.

The retailer internet market is considered an oligopolistic market, there are few firms that offer fixed and mobile internet and some firms have market power, this is one of the main incentives to establish a vertical integration. An approximation of a study of the internet demand in Colombia was made by Garcia-Rendon and Posada-Aparicio

(2017), they estimate an internet demand model, as well as a price formation model for the internet wholesaler market. Chong y Micco (2003) provides an overview of the situation of the Internet in Latin America. Although the rate and quantity are determining variables, what is introduced by Lipczynski, Wilson, and Goddard (2017), which is an important debate in the industrial organization which refers to the implications of vertical integration for market power.

**Table I**: Average internet prices in Colombia USD

AVERAGE INTERNET PRICES IN COLOMBIA USD

| | Internet (60 Mbps or more, Data unlimited, Cable/ADSL) | | | |
|---|---|---|---|---|
| | Bogotá | **Medellin** | **Cali** | **Barranquilla** |
| 2018 | 31.33 | 36.42 | 27.45 | 31.47 |
| 2017 | 33.86 | 29.88 | 25.42 | 33.56 |
| 2016 | 26.44 | 25.17 | 21.46 | |
| 2015 | 31.09 | 29.24 | 33.92 | |

Source: own elaboration with data of numbeo (2018)

The retailer market in Colombia that provide internet services is composed with national and local firms, usually the telecommunications firm of each region, which have a government percentage. Table I shows the average internet price in Colombia measured in United States dollars for the four main cities: Bogotá, Medellin, Cali, and Barranquilla. According to data from numbeo (2018), Colombia ranks 47th in countries where the internet is more expensive, with an average price of 30.45USD, while Ukraine ranks 90th with an average price of 4.25USD and the United Arab Emirates the first with an average price of 96.86USD.

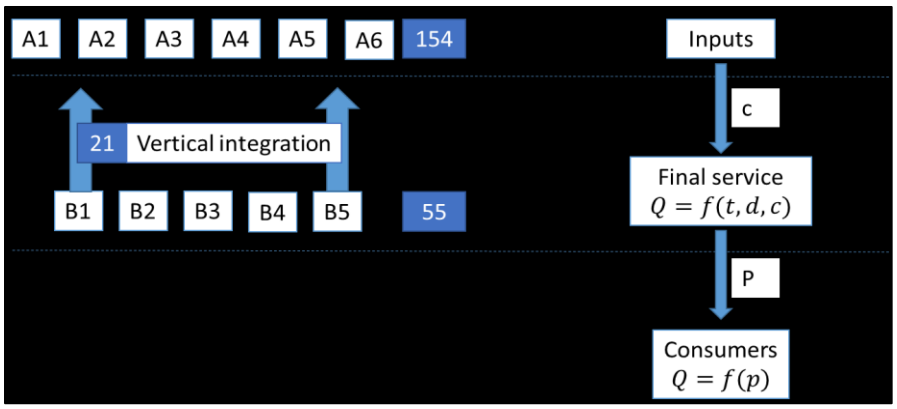
## IV. EMPIRICAL EVIDENCE

For the empirical analysis, we have data from the Ministry of Information Technology and Communications of Colombia (*Ministerio de Tecnologías de la Información y las Comunicaciones de Colombia, MinTic*); the National Administrative Department of Statistics (*Departamento Administrativo Nacional de Estadística DANE*)

The data is in the form of an unbalanced panel with 154 firms with monthly data since January of 2008 to December of 2015. Figure 4, show how is the internet market in Colombia, in the upstream level or wholesaler have 154 firm. The downstream level has 55 firms who sell internet directly to the final user in Colombia or the retailers. 21 firms have presence in both levels so this firms have vertical integration. The main variables in the upstream level is the price to the retailers or cost of the input in this case the internet, in the retailer the variables are cost, differentiation like service, quality, coverage and others, and the price.

The model proposes to understand how vertical integration affects the performance of mobile internet firms is based in a supply model where the dependent variable is the quantities in this case the Megabytes per second (Mbpst) the independent variables are the price of the internet; this is the price that paid the retailer or the cost of the service. This is not the price the end consumer pays. The market exchange rate MER, the Gross domestic product of the telecommunications and mail sector GDPtelcos and Unemployment rate. For analyzes the vertical integration there is a dummy that show which of the firms are in both markets (wholesaler and retailer), and the last variable is the number of subscribers, this is just for the 21 firm who have vertical integration. There is not available information of the final price, specialized assets and cost of transaction that is why estimation like Williamson (1975) Masten (1984), Ippolito (1991) and Overstreet (1984); were not possible to do.

**Figure 4**: Internet market in Colombia




Source: own elaboration

Table II shows the definitions and sources of these variables as well as their descriptive statistics.

**Table II**: Data

| Variable | Name | Definition | Source | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|---|---|
| Average Price | *LnPrice* | Average at what price the internet has been sold to the firm | Isa Internexa | 4947 | 7.712 | 3.818 | 2.929 | 18.867 |
| Megabytes per second | *lnMbpst* | Total number of megabytes sold to the firm | Isa Internexa | 4947 | 3.203 | 2.051 | 0.000 | 10.463 |
| Subscribers | *lnSub* | ln of the number of people with internet subscription | Mintic** | 483 | 7.031 | 3.008 | 0.693 | 13.824 |
| Market Exchange Rate | *MER* | It is the number of Colombian pesos for a United States dollar, it is calculated based on the operations of buying and selling currencies between financial intermediaries | DANE* | 4946 | 2066.844 | 339.558 | 1732.286 | 3149.470 |
| GDP telecommunication and mail | *GDPtelcos* | Gross domestic product of the telecommunications and mail sector. % growth | DANE* | 4947 | 1.112 | 2.910 | -7.243 | 7.701 |
| Unemployment rate | *Unemployed* | It is the proportion of people who, having the intention to work, can be employed. | DANE* | 4947 | 10.110 | 1.500 | 7.271 | 14.623 |
| Dummy for retailer firms | *Retail* | 1 if the firms are presence in the retailer and wholesaler market | Mintic** | 4947 | 0.170 | 0.376 | 0 | 1 |

* National Administrative Department of Statistics (Departamento Administrativo Nacional de Estadística DANE)

** Ministry of Information Technology and Communications of Colombia (Ministerio de Tecnologías de la Información y las Comunicaciones de Colombia MinTic)

Source: own elaboration with data (2008-2015)

With this information, endogeneity is common that is why the use of instrumental variables is proposed. Equation 1 is a dynamic panel data, this panel data has some

problems: a) autocorrelation, b) individual effects due to the heterogeneity of the individuals, c) there is a correlation between $Y_{i,t-p}$ and the disturbance component $v_{i,t}$. This makes the OLS (ordinary least squares) estimator inconsistent.

(1) $Y_{i,t} = \eta_i + \alpha Y_{i,t-1} + \beta_2 X_{2i,t} + \cdots + \beta_k X_{ki,t} + v_{i,t};\ i = \{1,2,\dots,N\}$, t $= \{1,2,\dots,T_i\}$; $\eta_i$ individual effects.

The instrumental variables method leads to consistent but not necessarily efficient estimates because it does not use all existing moment conditions, which is why dynamic models Arellano-Bond and Arellano–Bover/Blundell–Bond are estimated. Arellano and Bover (1995), Blundell and Bond (1998) developed a systemic GMM estimator that uses additional moment conditions. This estimate uses as instrumental variables the lags in differences and levels. This allowed to work with panel data composed by a small period of time, and therefore with a small number of instruments. Labra Lillo, and Torrecillas (2018) explain the difference between panel data estimations.

As Monteverde and Teece (1982), Masten (1984) and Eccles and Williamson (1987) the used of the variable price is important, because is the main cost for the retailers, the variable assets were not possible to get, but this model try to combine variable from de wholesaler market and the retailer market to analyzed the performance and the vertical integration. A static model and a dynamic model are estimated which is represented by equations (2) and (3):

The static model:

(2) $lnMbpst_{it} = \beta_0 + \eta_i + \alpha_1 lnMbpst_{i,t-1} + \beta_1 lnPrice_{it} + \beta_2 MER_t + \beta_3 Retail + \beta_4 GDPtelcos_t + \beta_5\ Unemployed_t + \varepsilon_{it}$

i $= \{1,2,\dots,121\}$, t $= \{2008Q1,\dots,2015Q4\}$; $\eta_i$ Individual effects

The dynamic model:

(3) $lnMbpst_{it} = \alpha_1 lnMbpst_{i,t-1} + \beta_1 lnPrice_{it} + \beta_2 MER_t + \beta_3 Retail + \beta_4 GDP_t + \beta_5 Unemployed_t + \varepsilon_{it}$

$i = \{1,2,\dots,121\}$, $t = \{2008Q1,\dots,2015Q4\}$ Where $\varepsilon_{it} = \lambda_t + \eta_i + u_{it}$

Where

$lnMbpst_{it} =$ Megabytes per second for firm $i$ in $t$

$lnMbpst_{it-1} =$ Megabytes per second for firm $i$ in $t-1$

$lnPrice_{it}$= Average Price for firm $i$ in $t$

$MER_t =$ Market Exchange Rate

$Retail =$ Categorical 1 if firm have vertical integration $i$ in $t$

$GDPtelcos_t$= Gross domestic product of the telecommunications and mail sector.

$Unemployed_t$= Unemployment rate

Find an instrumental variable is hard but with the Arellano–Bover/Blundell–Bond estimation, the difference variable and the lag variable are used as instrument.

**Results of empirical evidence**

The models estimated, static and dynamic fulfill specific assumptions and have signs according to economic theory. The estimates were obtained considering the possible problems of heteroscedasticity, autocorrelation, and contemporary autocorrelation using the test of Sargan for overidentification, the Wald test for linear hypotheses after estimation and the test of Arellano and Bond for autocorrelation.

The variable subscriber was not considered at the same time, because it generates problems with the categorical variable retail, to validated the result and made it robust others estimations are available in the annex with the variable subscribers. Some of the variables are significant at 95% the estimation are elasticities, in the panels an increase of 1% in the price generate an increase in Mbpst, this relation price and quantities are positive so we are modeling a supply. We incorporated a dummy for the 21 firms with presence in the wholesaler and retailer market the

results show significance of the vertical integration in the quantities these 21 firms have an impact in the wholesaler market. This is one of the main wishes of the firms who have vertical integration, have some power in the primary input. In the other estimation when we have the subscriber as independent variable is also significant the effect in the quantities of the wholesaler market.

**Table III:** Results

| | **Static Panel** | **Dynamic Panel** | **Dynamic Panel** |
|---|---|---|---|
| | **Random Effects** | **Arellano-Bover/Blundell-Bond** | **Arellano-Bond** |
| ***Variable*** | **RE** | **One step** | **Two steps** |
| ***lnPrice*** | 0.00070747 | 0.01569355 | 0.01003144 |
| | (0.00128) | (0.00274)*** | (0.00051)*** |
| ***MER*** | -0.00004277 | 0.00007785 | 6.289E-06 |
| | (0.00001)** | (0.00001)*** | (9.206E-07)*** |
| ***GDPtelcos*** | -0.00019446 | 0.00283136 | 0.00122753 |
| | (0.00168) | (0.00175) | (0.00008)*** |
| ***Unemployed*** | -0.00928036 | -0.00200887 | -0.03124383 |
| | (0.00344)** | (0.00298) | (0.00011)*** |
| ***lnMbpst*** | | | |
| ***L1.*** | 0.98707675 | 0.88697705 | 0.84206528 |
| | (0.00257)*** | (0.00722)*** | (0.00198)*** |
| ***i.Retailes*** | 0.03995781 | 0.69267047 | omitted |
| | (0.01388)** | (0.09263)*** | |
| ***_cons*** | 0.23661869 | | |
| | (0.05481)*** | | |
| ***N*** | 4805 | 4805 | 4664 |
| Wooldridge | 189.9(1,119) | | |
| Wald | 177459.6(6) | 44963.8(6) | 699298.3(5) |
| Sargan | | 4147.8(3506) | 117.75(3413) |

* p<0.05; ** p<0.01; *** p<0.001
Source: own elaboration

Static panels can have some problems and dynamic Panel data methodology offers some advantages in comparison to the static version. The possibility to address the heterogeneity of the individuals, and the use of several instrumental variables in order to deal with the endogeneity of the variables of the model.

The dynamic panel was estimated with the one-step model Arellano-Bover / Blundell-Bond and two-step Arrellano-Bond model. For the one-step model an increase of one percent in the Price, increase the quantities in 0.015%. The lag number 1 of the Mbpst has a direct impact with 0.88%. The MER has a positive effect on Mbpst of 7.8E-05%, such as in the random effects the categorical variable of retail has an impact in the quantities.

The two-step model Arellano–Bond is a parsimonious model with five, 95% significant parameters, an increase of 1% in the price, increase the Mbpst in 0.010%, the lag Mbpst have an impact of 0.84% the MER and GDP of telecommunication have direct effects and increase of 1 %, increase the Mbpst in 6.28E-06% and 0.0012%. The unemployment variable has indirect effect and increase of 1% decrease the Mbpst in 0.03%.

This model is an estimation with the available information, to analyze the complete impact of the vertical integration it is need more information at firm level like financial information as assets and cost, final price and final quantities.

**Implications in competition policy from literature review**

The competition policy for the internet sector in Colombia is mainly focused on regulate the retailer market, which has direct contact with the end users of the service. It is common to hear that the superintendence of commerce, industry, and tourism of Colombia has sanctioned an operator, but they're still a lot to do with the regulation of the wholesale market in aspects such as quality of service, speed, innovation and infrastructure development, regulations that can compare with international standards and sanctions.

The internet market needs to be more competitive, worldwide innovation in the same markets show firms selling speeds up to 300 megabytes, but in the plans sold in Colombia it usually includes 5 megabytes and business 20 mega. It is necessary to give tools for an efficient market; this is achieved through clear regulation of the fixed and mobile markets. In addition, packaged service should be reviewed, while it helps to sale undesirable services such as fixed telephony, generate asymmetries towards the consumer, who is unaware of the real value of each of the services received. This must be complemented with strategies to reduce the asymmetry of information for the end user, which can be done through public databases online.

The regulation of the telecommunications markets is carried out by the National State, as stated by the OECD (2014). The Ministry of ICT (Mintic) is a member in all decision-making bodies related to telecommunications, it chairs the Telecommunications Regulatory Commission (Comisión de Regulación de Telecomunicaciones CRC), the National Agency of the Spectrum (Agencia Nacional del Espectro ANE) and the National Television Authority (Autoridad Nacional de Televisión ANTV). It also directs a department in which the telecommunication policy is made, have many regulatory functions such as conducting the spectrum auction and imposing sanctions. In addition to the significant participation that the government has in some telecommunications firms, the concerns of conflicts of interest are aggravated. In this sense, it cannot be forgotten that one of the good governance practices of a regulatory body refers to its independence in order to avoid these conflicts.

The regulator must be an independent entity that supervises the competition in the market, if it is efficient, analyzes the concentration and verify if there is abuse of market power to sanction it. This does not mean that the market power itself is bad. In addition, it must analyze the entry and exit of new firms because it may be generating skimming that makes the concentration falls on the same firms.

The Mintic additional to the descriptive statistics that it has in the quarterly reports must have variables of industrial organization that give signals of the market, the proposed variables are: market share (by quantities and by income), Herfindahl-Hirschman index HHI, markup of benefits and the Lerner index. These variables give concrete signals of the markets and help find where regulation and intervention should be focused. Other economic performance variables such as costs, revenues, net profits, assets, product differentiation variables such as know-how, patents, investments and licenses, are also important to consider, because they provide information on how the firm's market power is and generate incentive policies for research, innovation and development.

With the entry of Colombia to the OECD in 2018, many of the recommendations given by the entity must begin to be implemented so the sector becomes more competitive, improves its service and reaches international standards.

## V. CONCLUSIONS

The objective was to examine the performance of firms and vertical integration in the fixed Internet service and it analyze what is the impact of vertical integration on firms and competition policies. The date was an unbalanced panel with industrial organization variables supported by the behavior, structure and performance paradigm of Carlton & Perloff (2015), static and dynamic models are estimated.

Analyzing markets from an industrial organization point of view remains a challenge given the lack of available information. From the **empirical evidence,** in the internet market in Colombia there some backward vertical integration, this relationship is common when the firms in the downstream level want to gain control in the upstream level. One of the reasons is the increase of the market power.

Since there is not available information of the final price, specialized assets and cost of transaction that is why estimation like Williamson (1975) Masten (1984), Ippolito (1991) and Overstreet (1984); were not possible to do. The estimation of static and dynamic panel used performance variable as price, quantities, GDP and for the vertical integration was used the variables subscribers and a dummy for the firms that belong to the wholesaler and retailer market.

It can be concluded that have a vertical integration in the internet market in Colombia generate an effect in the quantities sold in the wholesaler market, the dummy and the subscriber variable were statistically significant. To made a complete analysis of the impact of the vertical integration more information is need but this research contributes to the analysis of the market with available data.

The empirical analysis of vertical integration has been little studied in the telecommunications market can be found analysis of mergers such as Howell and Potgieter (2017) who analyze mergers in New Zealand and packaging in the telecommunications sector. Okoeguale and Loveland (2017) study mergers in the regulated telecommunication industry to test theories of merger gains, and Crawford,

Lee, Whinston and Yurukoglu (2018) analyze the welfare effects of vertical integration in multichannel television markets.

As stated by Lipczynski, Wilson, and Goddard (2017), the issue of vertical integration has been extensively dealt in the literature of industrial organization theory. In contrast, there is little empirical literature on the motives for vertical integration and the impact of vertical integration on performance. Carlton and Perloff (2015) also argue the need of more empirical studies to identify desirable and undesirable vertical arrangement.

From the **literature review,** the current competition policy has a clear focus on the end-user firm relationship but does not take into account the backward chain of firms, which is why regulation should have a broader focus, although the difficulty of making measurements is recognized. The internet market needs to be more competitive.

The vertical integration strategy is a mechanism to seek permanence in the market and to increase its market power since a decrease in costs is generated. In markets where there is a high concentration, vertical integration is an option to avoid double marginalization that makes prices higher for the final consumer, but final prices have distortions, due to what is known as packaging where the end user rarely knows the price of each of the services.

It is important this kind of studies can be made in different sectors of the economy at the firm level, but this means that better indicators and variables must be created and generated to collect information from firms in Colombia. Although the problem of access to Microeconomic databases is worldwide, it is necessary to have more and better open access databases every day to generate useful information about the markets, since the asymmetry in information generates concentration and abuse of market power.

There are still questions to be resolved, one regarding the relevance of variables such as investment in innovation, service quality, entry barriers, product differentiation and advertising. Another regarding the impact of strategies such horizontal integration and the formation of conglomerates that have also occurred in this sector in recent years and how this has affected market power and competition policies.

## VI. REFERENCES


Adelman, M. A. (1949). Integration and antitrust policy. Harvard Law Review, 63(1), 27-77.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. Journal of Econometrics, 68(1), 29–51. https://doi.org/10.1016/0304-4076(94)01642-D

Armstrong, M., Laffont, J.-J., & Tirole, J. (1995). A theory of incentives in procurement and regulation. The Economic Journal. https://doi.org/10.2307/2235329

Arrow, K. J. (1975). Vertical integration and communication. The Bell Journal of Economics, 6(1), 173. https://doi.org/10.2307/3003220

Avenali, A., Matteucci, G., and Reverberi, P., (2014), Broadband investment and welfare under functional and ownership separation. *Information Economics And Policy*, 28, 70-82. https://doi.org/10.1016/j.infoecopol.2014.07.003

Belleflamme, P., and Peitz, M., (2015), Industrial organization: markets and strategies. Cambridge, United Kingdom: Cambridge University Press.

Biancini, S., and Ettinger, D., (2017), Vertical integration and downstream collusion. International Journal of Industrial Organization, 53, 99-113.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics, 87(1), 115–143. https://doi.org/10.1016/S0304-4076(98)00009-8

Cabral, L. M. (2017). Introduction to industrial organization. MIT press.

Carlton, D. W. (1979). Vertical Integration in Competitive Markets Under Uncertainty. The Journal of Industrial Economics, 27(3), 189. https://doi.org/10.2307/2098317

Carlton, D. W., and Perloff, J. M., (2015), Modern industrial organization. London, United Kingdom: Pearson Higher Ed.

Cashman, G. D., Gillan, S. L., and Jun, C., (2012), Going overboard? On busy directors and firm value. *Journal of Banking and Finance*. https://doi.org/10.1016/j.jbankfin.2012.07.003

Caves, R. E., and Bradburd, R. M. (1988), The empirical determinants of vertical integration. *Journal of Economic Behavior and Organization*, 9(3), 265-279. https://doi.org/10.1016/0167-2681(88)90037-6

Chandler, A. D. (1990). Strategy and structure: Chapters in the history of the industrial enterprise (Vol. 120). MIT press.

Choi, K., and Lee, D., (2017), Welfare-improving vertical separation with network externality. Economics Letters, 151, 115-118.

Chong, A., & Micco, A. (2003). The internet and the ability to innovate in Latin America. Emerging Markets Review. https://doi.org/10.1016/S1566-0141(02)00063-8

Crawford, G. S., Lee, R. S., Whinston, M. D., and Yurukoglu, A., (2018), The welfare effects of vertical integration in multichannel television markets. *Econometrica,* 86(3), 891-954. https://doi.org/10.3982/ECTA14031

Crocker, K. J., & Reynolds, K. J. (1993). The Efficiency of Incomplete Contracts: An Empirical Analysis of Air Force Engine Procurement. The RAND Journal of Economics, 24(1), 126. https://doi.org/10.2307/2555956

D'Aveni, R. and Ravenscraft, D. (1994) Economies of integration versus bureaucracy costs: does vertical integration improve performance? Academy of Management Journal, 37, 1167–206.

Departamento Administrativo Nacional de Estadística (DANE), Datos históricos del PIB, empleo, TRM entre otros del 2008 al 2015, http://www.dane.gov.co/

Eccles, R. G., & Williamson, O. E. (1987). The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting. Administrative Science Quarterly, 32(4), 602. https://doi.org/10.2307/2392889

Einav, L., & Levin, J. (2010). Empirical industrial organization: A progress report. Journal of Economic Perspectives, 24(2), 145-62.

Federal Networking Council, (1995), resolution October 24, 1995.

Fich, E. M., and Shivdasani, A., (2012), Are busy boards effective monitors? En *Corporate Governance: Recent Developments and New Trends*. https://doi.org/10.1007/978-3-642-31579-4_10

Field, L., Lowry, M., and Mkrtchyan, A., (2013), Are busy boards detrimental? *Journal of Financial Economics*. https://doi.org/10.1016/j.jfineco.2013.02.004

Fiocco, R., (2016), The strategic value of partial vertical integration. European Economic Review, 89, 284-302.

Garcia Rendon, J. J., and Posada Aparicio, J. P., (2017), Demanda de internet: el sector mayorista de telecomunicaciones colombiano. *Revista de Economía del*

*Rosario*, 19(2), 175. https://doi.org/10.12804/revistas.urosario.edu.co/economia/a.5624

Gertner, R. and Stillman, R. (2001) Vertical integration and internet strategies in the apparel industry, Journal of Industrial Economics, 49, 415–40.

Glock, C. H., and Kim, T., (2015), The effect of forward integration on a single-vendor-multi-retailer supply chain under retailer competition. *International Journal of Production* Economics, 164, 179-192. https://doi.org/10.1016/j.ijpe.2015.03.009

Goldman, C. S., Gotts, I. K., & Piaskoski, M. E. (2003). The role of efficiencies in telecommunications merger review. Fed. Comm. LJ, 56, 87.

Guo, H., Bandyopadhyay, S., Cheng, H. K., and Yang, Y.-C., (2010), Net neutrality and vertical integration of content and broadband services. *Journal of Management Information Systems*, 27(2), 243-275. https://doi.org/10.2753/MIS0742-1222270208

Howell, B. E., and Potgieter, P. H., (2017), Competition and vertical/agglomeration effects in media mergers: Bagging bundle benefits. SSRN. https://doi.org/10.2139/ssrn.2992394

Ippolito, P. M. (1991). Resale price maintenance: Empirical evidence from litigation. The Journal of Law and Economics, 34(2, Part 1), 263–294. https://doi.org/10.1086/467226

John, G. and Weitz, B.A. (1988) Forward integration into distribution: an empirical test of transaction cost analysis, journal of Law, Economics and Organisation, 4, 337–56.

Karaboga, H., (2001), The Theory of Incentives I : the Principal-Agent Model. *Journal of Economic Development*, 2(4), 123-222. https://doi.org/10.1111/1468-0297.01399

Kraemer, J., and Schnurr, D., (2014), A unified framework for open access regulation of telecommunications infrastructure: Review of the economic literature and policy guidelines. *Telecommunications Policy*, 38(11), 1160-1179. https://doi.org/10.1016/j.telpol.2014.06.006

Krickx, G.A. (1995) Vertical integration in the computer main-frame industry: a transaction cost interpretation, Journal of Economic Behaviour and Organisation, 26, 75–91.

Kwoka, J.E. (2002) Vertical economies in electric power: evidence on integration and its alternatives, International Journal of Industrial Organisation, 20, 653–71.

Labra Lillo, R., & Torrecillas, C. (2018). Estimating dynamic Panel data. A practical approach to perform long panels. Revista Colombiana de Estadística, 41(1), 31–52. https://doi.org/10.15446/rce.v41n1.61885

Laffont, J.-J., & Martimort, D., (2018), The theory of incentives: The principal-agent model. Princeton university press. https://doi.org/10.2307/j.ctv7h0rwr

Lee, D. J., Katayama, H., and Oh, H. S., (1997), Vertical integration in the telecommunication market. Computers and industrial engineering, 33(3-4), 841-844.

Lieberman, M. B. (1991). Determinants of vertical integration: An empirical test. Academy of Management Proceedings, 1991(1), 31–35. https://doi.org/10.5465/ambpp.1991.4976493

Lipczynski, J., Wilson, J. O. S., and Goddard, J. A., (2017), Industrial organization : competition, strategy, policy. London, United Kingdom: FT Prentice Hall.

Maruyama, M., and Minamikawa, K., (2009), Vertical integration, bundled discounts and welfare. Information Economics and Policy, 21(1), 62-71.

Masten, S. E. (1984). The organization of production: Evidence from the Aerospace Industry. The Journal of Law and Economics, 27(2), 403–417. https://doi.org/10.1086/467071

Maury, B., (2006), Family ownership and firm performance: Empirical evidence from Western European corporations. *Journal of Corporate Finance*. https://doi.org/10.1016/j.jcorpfin.2005.02.002

Ministerio de Tecnologías de la Información y las Comunicaciones (Mintic), Boletín trimestral del sector TIC, Datos históricos telecomunicaciones desde 2008 hasta 2015. download of: https://colombiatic.mintic.gov.co/679/w3-channel.html

Ministerio de Tecnologías de la Información y las Comunicaciones (2019) Boletín trimestral del sector TIC 2019 Q1, download of: https://colombiatic.mintic.gov.co/679/w3-article-103108.html

Minkler, A. P., & Park, T. A. (1994). Asset specificity and vertical integration in franchising. Review of Industrial Organization, 9(4), 409–423. https://doi.org/10.1007/BF01029514

Miorandi, D., Sicari, S., De Pellegrini, F., & Chlamtac, I. (2012). Internet of things: Vision, applications and research challenges. Ad hoc networks, 10(7), 1497-1516.

Molnar, G., and Savage, S. J., (2017), Market Structure and Broadband Internet Quality. *Journal of Industrial Economics*, 65(1), 73-104. https://doi.org/10.1111/joie.12106

Monteverde, K., & Teece, D. J. (1982). Appropriable rents and quasi-vertical integration. The Journal of Law and Economics, 25(2), 321–328. https://doi.org/10.1086/467018

Motta, M., (2004), Competition policy : theory and practice. Cambridge, United Kingdom: Cambridge University Press.

Nemoto, J. and Goto, M. (2002) Technological externalities and economics of vertical integration in the electric utility industry, International Journal of Industrial Organisation, 22, 67–81.

Numbeo, (2018). Download of: https://www.numbeo.com/cost-of-living/

Okoeguale, K. I., and Loveland, R., (2017), Telecommunications deregulation and the motives for mergers. *Journal of Economics and Business*, 94, 15-31. https://doi.org/10.1016/j.jeconbus.2017.08.002

Organisation for Economic Cooperation and Development (OECD), (2014), Review of Telecommunication Policy and Regulation in Colombia. OECD Publishing. https://doi.org/10.1787/9789264208131-en

Ornstein, S. I., & Hanssens, D. M. (1987). Resale Price Maintenance: Output Increasing or Restricting? The Case of Distilled Spirits in the United States. The Journal of Industrial Economics, 36(1), 1. https://doi.org/10.2307/2098593

Overstreet, T. R. (1984). Resale price maintenance: Economic theories and empirical evidence. Federal Trade Commission, Bureau of Economics Staff Report (November).

Plan único de cuentas (PUC). download of https://puc.com.co/

Scherer, F. M., & Ross, D. (1990). Economic Performance. Boston: Houghton-Mifflin.

Shin, J., Ahn, J., & Lee, D. (2015). The impact of diversification with and without commodity bundling on corporate performance: An empirical analysis in Korea telecommunication markets. Technological Forecasting and Social Change, 101, 314-319.

Sistema de Información y Reporte Empresarial (Sirem) – Superintendencia de sociedades, Estados financieros de las empresas desde 2010 hasta 2015 Registro único empresarial y social cámaras de comercio RUES, confecamaras

red de cámaras de comercio. download of: https://www.supersociedades.gov.co/delegatura_aec/estudios_financieros/Paginas/sirem.aspx

Spengler, J. J. (1950). Vertical integration and antitrust policy. Journal of political economy, 58(4), 347-352.

Spiller, P.T. (1985) On vertical mergers, Journal of Law, Economics and Organisation, 1, 285–312. https://doi.org/10.1093/oxfordjournals.jleo.a036893

Stigler, G. J. (1951). The Division of Labor is Limited by the Extent of the Market. Journal of Political Economy, 59(3), 185–193. https://doi.org/10.1086/257075

Sung, N., (2014), Market concentration and competition in OECD mobile telecommunications markets. *Applied Economics*, 46(25), 3037-3048. https://doi.org/10.1080/00036846.2014.920480

Vernon, J. M., & Graham, D. A. (1971). Profitability of monopolization by vertical integration. Journal of Political Economy, 79(4), 924-925.

Villalonga, B., and Amit, R., (2006), How do family ownership, control and management affect firm value? *Journal of Financial Economics*. https://doi.org/10.1016/j.jfineco.2004.12.005

Warf, B. (2003). Mergers and acquisitions in the telecommunications industry. Growth and Change, 34(3), 321-344.

Weiss, A. (1992). The Role of Firm-Specific Capital in Vertical Mergers. The Journal of Law and Economics, 35(1), 71–88. https://doi.org/10.1086/467245

Whyte, G. (1994). The role of asset specificity in the vertical integration decision. Journal of Economic Behavior and Organization, 23(3), 287–302. https://doi.org/10.1016/0167-2681(94)90003-5

Williamson, O.E. (1971). The vertical integration of production; market failure considerations, American Economic Review, 61, 112–27.

Williamson, O.E. (1975). Markets and Hierarchies. New York: The Free Press

Williamson, O.E. (1989). Transaction cost economics, in Schmalensee, R. and Willig, R.D. (eds) Handbook of Industrial Organisation, vol. 1. Amsterdam: North-Holland, ch. 3.

Williamson, O.E. (2002). The theory of the firm as governance structure: from choice to contract, Journal of Economic Perspectives, 16, 171–95

Wimmer, B. S., & Garen, J. E. (1997). Moral hazard, asset specificity, implicit bonding, and compensation: The case of franchising. Economic Inquiry, 35(3), 544–554. https://doi.org/10.1111/j.1465-7295.1997.tb02031.x

Zanchettin, P., and Mukherjee, A., (2017), Vertical integration and product differentiation. International Journal of Industrial Organization, 55, 25-57

Zanella, A., Bui, N., Castellani, A., Vangelista, L., & Zorzi, M. (2014). Internet of things for smart cities. IEEE Internet of Things journal, 1(1), 22-32.

## ANNEX: OTHER ESTIMATIONS

| | Static Panel | Dynamic Panel | Dynamic Panel |
|---|---|---|---|
| | Random Effects | Arellano-Bover/Blundell-Bond | Arellano-Bond |
| ***Variable*** | **RE** | **One step** | **Two steps** |
| ***lnPrice*** | 0.00996181 | 0.08086161 | 0.07387791 |
| | (0.00793) | (0.01157)*** | (0.00396)*** |
| ***MER*** | -0.0001723 | 0.00018532 | 0.00013778 |
| | (0.00008)* | (0.00007)* | (0.00003)*** |
| ***GDPtelcos*** | -0.00017764 | -0.02727622 | -0.03053385 |
| | (0.01199) | (0.01073)* | (0.00358)*** |
| ***Unemployed*** | -0.0230387 | -0.01584436 | -0.03760729 |
| | (0.02297) | (0.01452) | (0.00756)*** |
| ***lnMbpst*** | | | |
| ***L1.*** | 0.9589535 | 0.73446703 | 0.75766 |
| | (0.01502)*** | (0.02799)*** | (0.08480)*** |
| ***lnSub*** | 0.02202137 | 0.16144958 | 0.0892856 |
| | (0.01299) | (0.02655)*** | (0.15245) |
| ***_cons*** | 0.61258694 | | |
| | (0.33689) | | |
| ***N*** | 473 | 473 | 452 |
| Wald | 8703,5(6) | 15319,9(6) | 5977,7(6) |
| Sargan | | 583,1(512) | 9,81(446) |