



**UNIVERSIDAD DISTRITAL
FRANCISCO JOSÉ DE CALDAS**
Acreditación Institucional de Alta Calidad



Competition Analysis in Cellular Networks: A Colombian Case

**Ernesto Cadena Muñoz, PhD.
Cesar Augusto Hernandez , PhD
Luis Fernando Pedraza , PhD**

**Technological Faculty
Universidad Distrital Francisco José de Caldas
Bogotá, Colombia.**

Facultad Tecnológica - Ingeniería en Telecomunicaciones
ftecnologica.udistrital.edu.co

Acreditación Institucional de alta calidad. Resolución No. 23096 del 15 de diciembre de 2016



UNIVERSIDAD DISTRITAL
FRANCISCO JOSÉ DE CALDAS

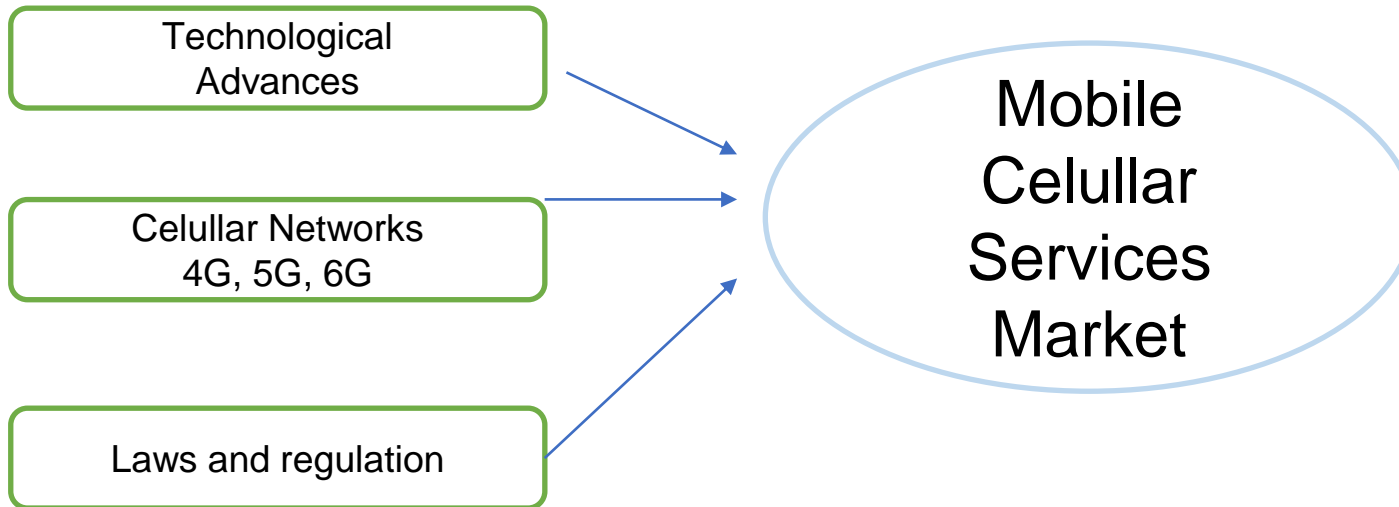


Content

- Introduction
- Data and Model
- Results
- Conclusions and Future Work

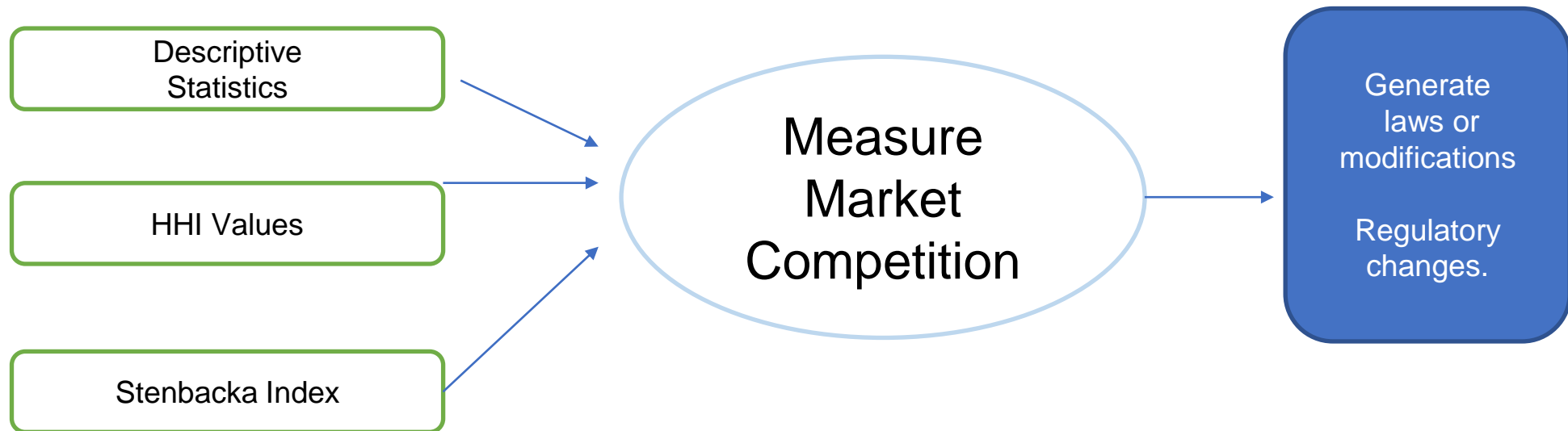


Introduction



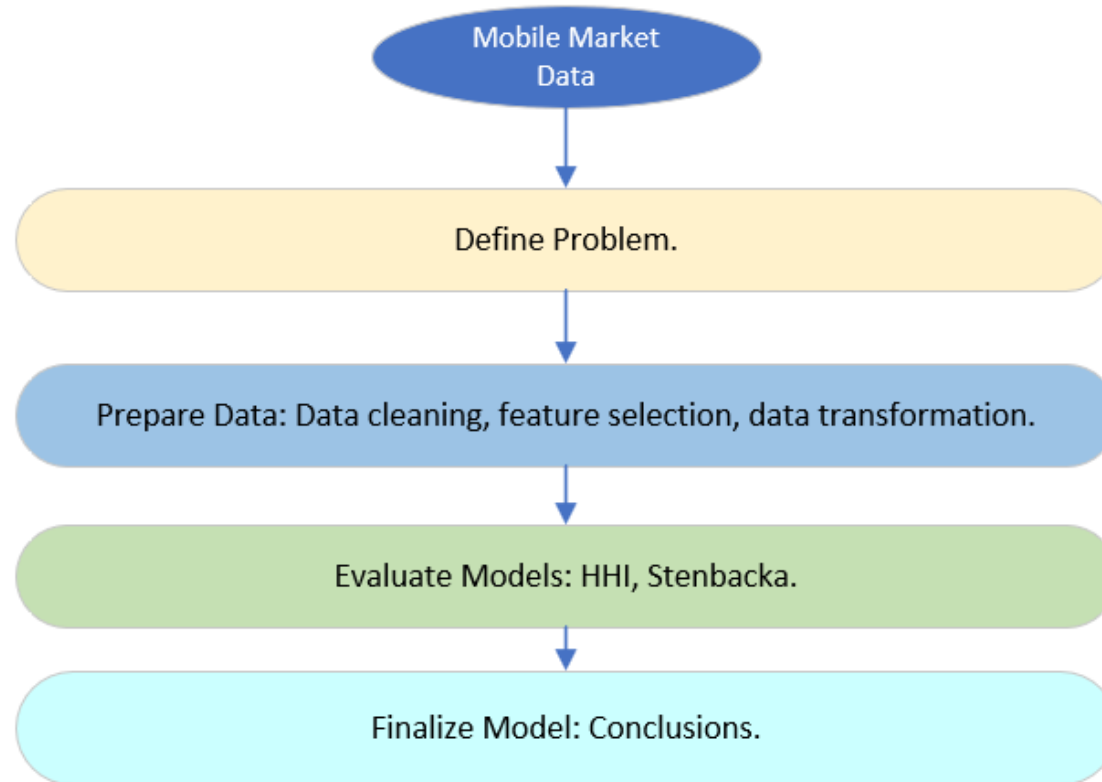


Data and Model





Data and Model





Data and Model

The HHI is a widely used coefficient for assessing business concentration, frequently applied to measure the level of concentration within a market. The HHI is calculated as in (1) by summing the squared revenue shares (s) of all service providers (i) in a given market (j) for a specific time (t). The HHI is the sum of the squares of the market percentage of each of the n companies that comprise it, expressed as follows [19]:

$$HHI_{jt} = \sum_{i \in j, t} s_{ijt}^2$$



Data and Model

The Melnik, Shy, and Stenbacka index [13] functions as a tool for identifying the values indicative of a company's market dominance through its share. This index is computed based on the variance in market share between the two main entities in the industry, which means the two service providers have more users in the mobile services case. The formula used to calculate it is shown in (2) [20]:

$$S^D = \frac{1}{2} [1 - \gamma(S_1^2 - S_2^2)]$$

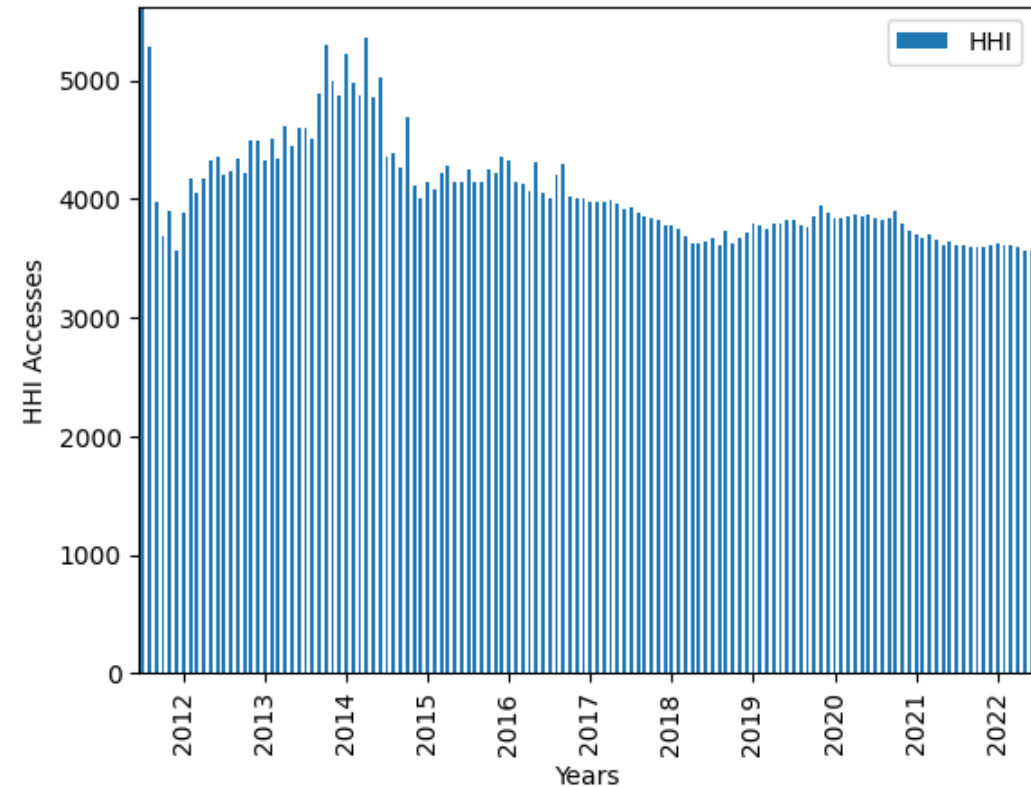


Results

The HHI is applied by calculating the participation of each mobile service provider in the country. Data from 2012 to 2022 available in postdata [22] is used.

After the feature selection process, the first variable to be used is the accesses (number of users). The HHI for accesses can be seen in Figure.

Results show that the index is above 3500, indicating a high concentration of the market and low competition in the accesses variable. The HHI has a decreasing trend.

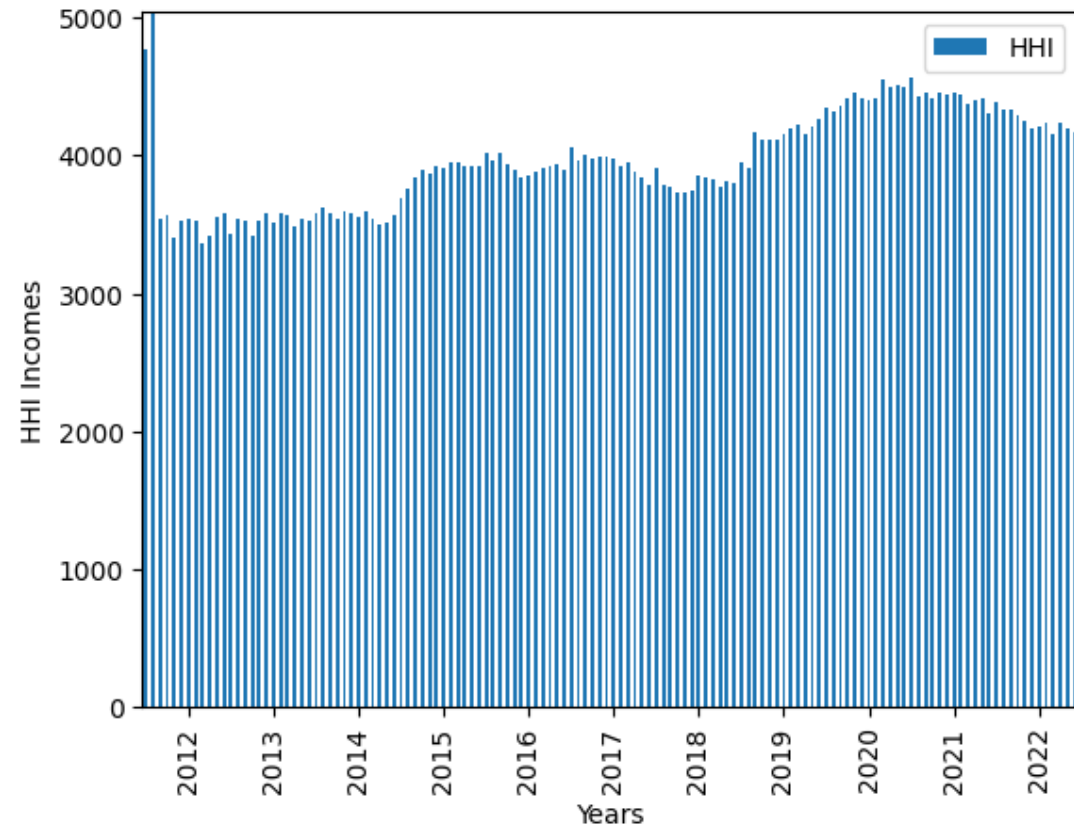




Results

The second variable to analyze in the same period is the mobile service incomes. The HHI for this can be seen in Figure 3.

In this case, HHI has been increasing and above 4000 in the last few years; results indicate a high concentration market and low competition in the income variable.





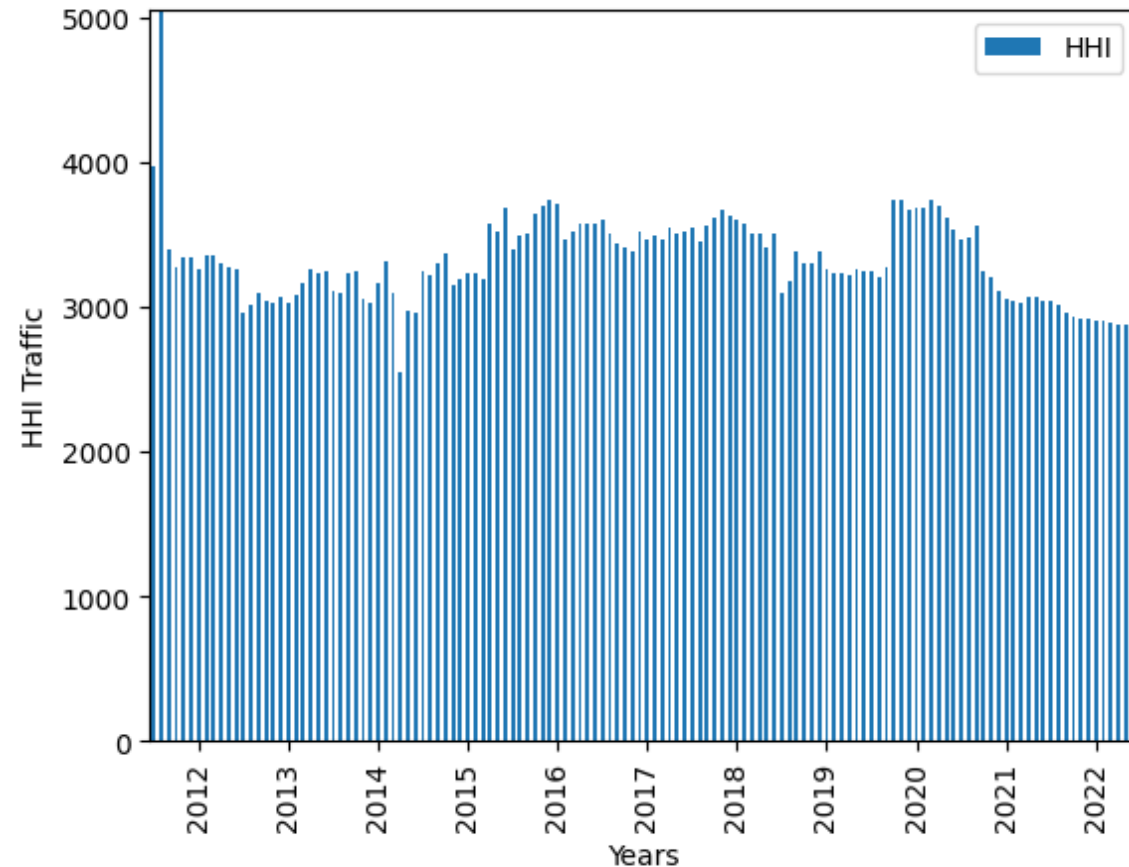
Results

The third variable to analyze is traffic; the HHI for this can be seen in Figure 4.

In this case, HHI has been increasing and above 4000 in the last few years; results indicate a high concentration market and low competition in the income variable.

In this case, HHI has been decreasing and close to 3000 in the last few years; results indicate a high concentration and low competition in income variables.

According to the results, HHI is decreasing for access and traffic, but it is increasing for incomes, in three cases.





Results

The descriptive statistics for the HHI in the three variables can be seen in Table I.

The descriptive statistics of the results show that all the HHIs are above 3000, which indicates low competition in the mobile services market and a high concentration. The results show a normal distribution shifted to the left with a maximum value higher than 5000 and a minimum value above 3000, except for the HHI traffic that achieves 2544.

Statistics	HHI Accesses	HHI Incomes	HHI Traffic
count	132.0	132.0	132.0
mean	4069.667986	3965.84294	3324.645533
std	434.219881	346.304808	295.487329
min	3561.64898	3361.149037	2544.321017
25%	3759.728876	3619.170630	3100.544183
50%	3971.499849	3923.637351	3288.328112
75%	4266.036144	4237.804731	3516.755919
max	5621.046372	5045.727214	5053.229637
Kurtosis	1.587545	-0.556497	7.743688
Skewness	1.315731	0.315892	1.396602

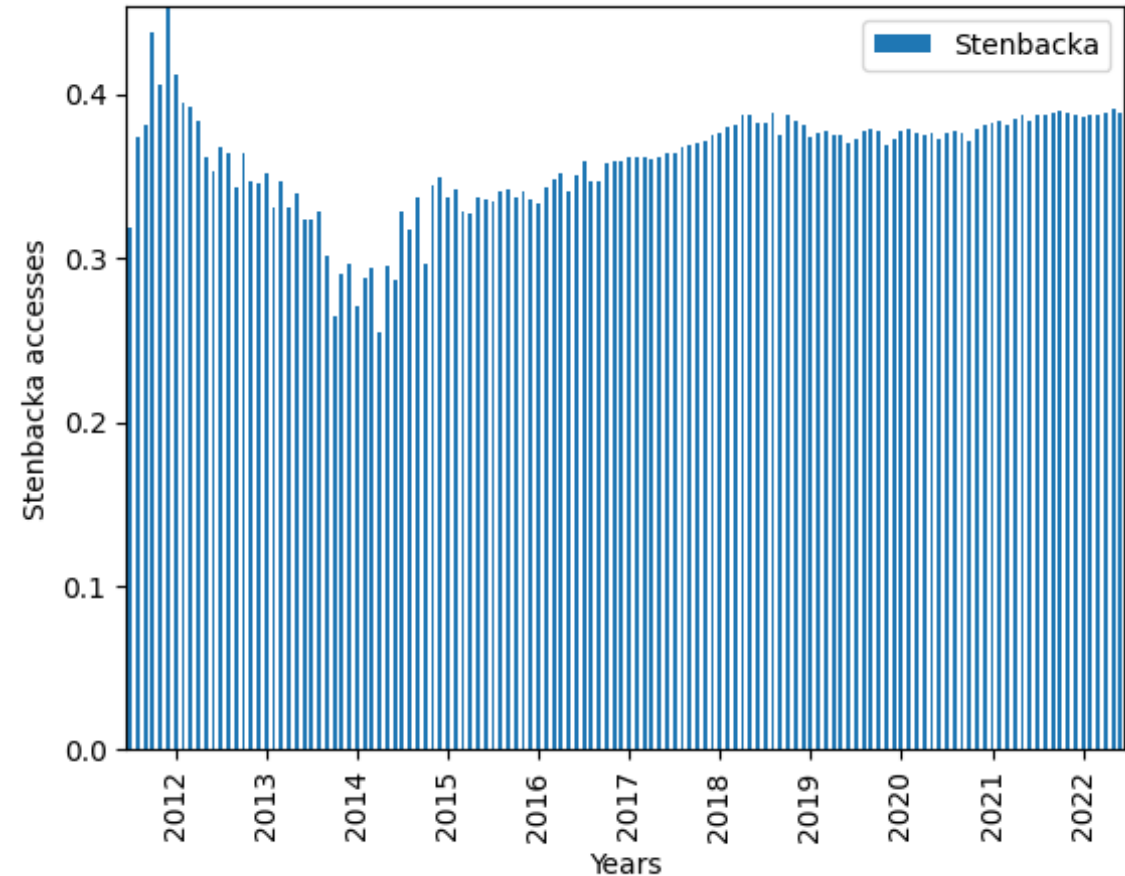


Results

Stenback Index Results:

The first variable to be used is accesses, referring to the users. The Stenbacka index for accesses can be seen in Figure 5.

Results show that this index is close to 0.37 and the S_1 value for the service provider is above 0.5, which means that there is a dominant position for this service provider because S_1 is the first service provider and $S_1 > S_D$.

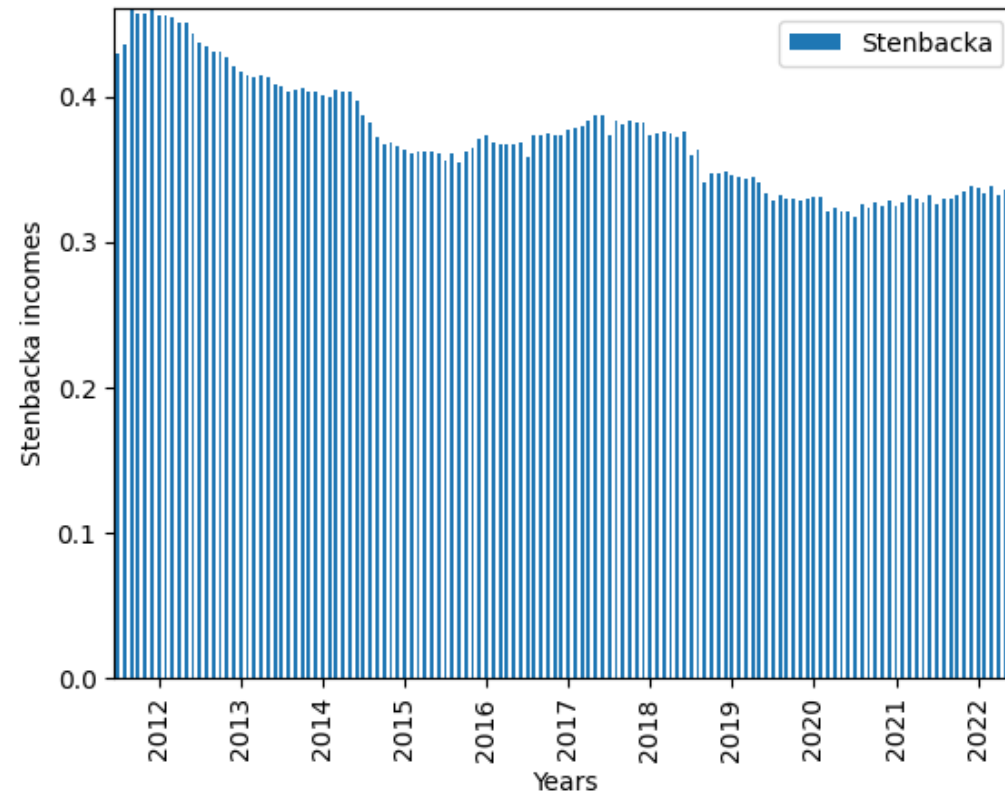




Results

The second variable to analyze is mobile service incomes. The Stenbacka index calculated for this can be seen in Figure 6.

Results show that this index is close to 0.34 and the S_1 value for the service provider is above 0.5, which means that there is a dominant position for this service provider in mobiles service incomes, because S_1 is the first service provider and $S_1 > S_D$.

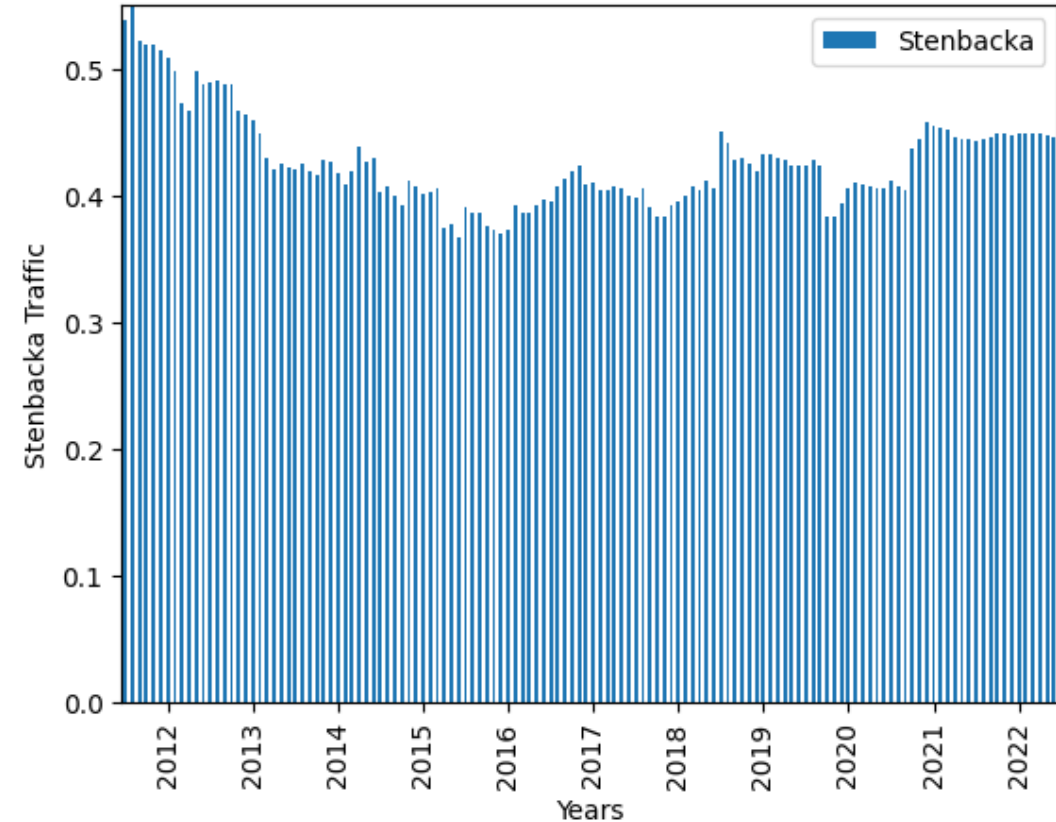




Results

The third variable to analyze is traffic. The Stenbacka index for this can be seen in Figure 7.

The Stenbacka index values, in this case, are higher than 0.4, and S_1 has been decreasing in the last years. The index has been very close to the S_1 value, and dominance level for this variable is decreasing.





Results

The descriptive statistics for the Stenbacka Index in the three variables can be seen in Table II.

The descriptive statistics of the results show that all the Stenbacka index values are above 0.35, and for all cases, it shows a dominant service provider in the mobile services market. The results show a normal distribution shifted to the left for incomes and traffic and shifted to the right for accesses, with a maximum value higher than 0.5 and a minimum value above 0.25.

Statistics	Stenbacka Accesses	Stenbacka Incomes	Stenbacka Traffic
count	132	132	132
mean	0.359569	0.372426	0.427974
std	0.031942	0.038746	0.036870
min	0.254502	0.316983	0.368424
25%	0.341244	0.336430	0.404884
50%	0.368436	0.368420	0.421389
75%	0.381526	0.401472	0.447730
max	0.453625	0.460762	0.551590
Kurtosis	1.425717	-0.475741	1.093329
Skewness	-0.798077	0.620616	1.057399



Conclusions and Future Work

- It is relevant for service providers and regulators to measure and detect the market conditions, regulations, and laws for mobile services in Colombia, to minimize monopoly practices and encourage the service provider's competition.
- The HHIs of mobile services accesses, income, and traffic demonstrate a high concentration, and low competition in this market in Colombia, which must be analyzed by government and regulatory authorities.
- The Stenbacka index results for mobile services accesses, income, and traffic show that there is a dominant service provider in Colombia, but it also shows that in the last few years, its level has decreased.



UNIVERSIDAD DISTRITAL
FRANCISCO JOSÉ DE CALDAS



Conclusions and Future Work

- In consequence, the mobile services market in Colombia has a dominant service provider and a low level of competition in a highly concentrated market. This must be analyzed by authorities and regulators to improve the conditions of the mobile service for end-users.
- In future work, more indexes can be calculated, and machine or deep learning techniques can be involved to predict market behavior and competition.



UNIVERSIDAD DISTRITAL
FRANCISCO JOSÉ DE CALDAS



Questions





References

- [1] C. Yang and Y. Kawashima, “Economic analysis of process innovation: The case study of the German telecommunication market,” *Innovation and Green Development*, vol. 3, no. 1, p. 100095, 2024.
- [2] M. A. Hajar, D. N. Ibrahim, M. R. Darun, and M. A. Al-Sharafi, “Value innovation activities in the wireless telecommunications service sector: A case study of the Malaysian market,” *Journal of Global Business Insights*, vol. 5, no. 1, pp. 57–72, 2020.
- [3] O. O. Akintokunbo, “Market focus strategy and organizational performance of telecommunication companies in Port Harcourt,” *International Journal of Innovative Research and Advanced Studies*, vol. 5, no. 3, pp. 258–263, 2018.
- [4] K. Bahia and P. Castells, “The dynamic effects of competition on investment: the case of the European mobile communications industry,” *Journal of Information Policy*, 2023.
- [5] A. Diallo and G. Tomek, “The interpretation of HH-Index output value when used as mobile market competitiveness indicator,” *International Journal of Business and Management*, vol. 10, no. 12, p. 48, 2015.
- [6] A. Schneider, “Credit cooperatives: Market structure, competition, and conduct. Exploring the case of Paraguay,” MPRA Paper 102309, University Library of Munich, Germany. 2020.
- [7] D. Bardey, D. Aristizábal, J. S. Gómez, and B. Sáenz, “Concentration of the mobile telecommunications markets and countries’ competitiveness,” *Telecommunications Policy*, vol. 46, no. 1, p. 102230, 2022.
- [8] M. Kostić and J. Živković, “Concentration of supply on the chosen markets of Serbian electronic communications sector,” *The European Journal of Applied Economics*, vol. 18, no. 2, pp. 76–94, 2021.
- [9] C. Gutiérrez-Hita, V. Zhukova, and S. Amassaghrou, “Evaluating Competitiveness in the Morocco’s Telecommunications Sector Through Market Concentration,” *Available at SSRN 4662493*, 2023.
- [10] A. S. George, A. Michael, and K. A.-P. Agyekum, “The Ghanaian Telecommunications Market Concentration-Applying the US DOJ’s HHI Criteria for Determining Market Power”, 2016.
- [11] D. Aguilar, A. Agüero, and R. Barrantes, “Network effects in mobile telecommunications markets: A comparative analysis of consumers’ preferences in five Latin American countries,” *Telecommunications Policy*, vol. 44, no. 5, p. 101972, 2020.



UNIVERSIDAD DISTRITAL
FRANCISCO JOSÉ DE CALDAS



References

- [12] Superintendencia de Industria y Comercio, “Estudio del Servicio de Internet en Colombia (Study of the Internet Service in Colombia),” *Available at SSRN 3552758*, 2015.
- [13] A. Melnik, O. Shy, and R. Stenbacka, “Assessing market dominance,” *Journal of Economic Behavior & Organization*, vol. 68, no. 1, pp. 63–72, 2008.
- [14] J. Confraria, T. Ribeiro, and H. Vasconcelos, “Analysis of consumer preferences for mobile telecom plans using a discrete choice experiment,” *Telecommunications Policy*, vol. 41, no. 3, pp. 157–169, 2017.
- [15] S. Araki, A. Bassanini, A. Green, and L. Marcolin, *Monopsony and concentration in the labour market*. 2022. doi: <https://doi.org/https://doi.org/10.1787/0ecab874-en>.
- [16] H. Hernández Lasso, “Diseño de una subasta multi-objeto: un método para maximizar el bienestar social en la asignación del espectro electromagnético en Colombia 2010-2022, (Design of a multi-object auction: a method to maximize social welfare in the allocation of the electromagnetic spectrum in Colombia 2010-2022),” *PhD Thesis, Universidad Nacional de Colombia*, 2022.
- [17] S. Ono, “Competition dynamics of the mobile network industry in Japan through the evolution of mobile network services: An empirical analysis.,” *Otsuma journal of social information studies*, vol. 28, pp. 63–76, 2019.
- [18] J. Brownlee, *Data preparation for machine learning: data cleaning, feature selection, and data transforms in Python*. Machine Learning Mastery, 2020.
- [19] H. Heidorn and J. P. Weche, “Business concentration data for Germany,” *Yearbooks for national economics and statistics*, vol. 241, no. 5–6, pp. 801–811, 2021.
- [20] D. E. Durán Preciado, “Aplicación de coeficientes de desvío para el análisis de integraciones empresariales, (Application of deviation coefficients for the analysis of business integrations),” *Master Thesis, Pontificia Universidad Javeriana*, 2015.
- [21] M. O. Ortiz and J. P. H. Saavedra, “El efecto de la intensidad de la Competencia en Colombia sobre la innovación: Un análisis para el periodo 2013-2016, (The effect of the intensity of Competition in Colombia on innovation: An analysis for the period 2013-2016),” *Universidad Externado de Colombia*, 2020.
- [22] “Mobile services data repository.” [Online]. Available: <https://www.postdata.gov.co/>, 2024.