

Low socio-economic status and customer churn respect to Home Internet service in the intra-city context

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Abstract. Home Internet is important and even more so since the beginning of the COVID-19 pandemic. Internet enables communication with co-workers, family, basic services providers, etc. Customer churn means that a customer has left their service provider for some reason. Scientific literature addresses customer churn in various business areas from different perspectives, however, it focuses very little on the socio-economic factor as a possible cause for the customer churn from residential Internet service. The objective is to determine if the socio-economic factor influences the customer churn from the residential Internet service in the intra-city context. The percentage of customer churn associated with the economic factor is important (38 %). This case study is focused to the phenomenon of customer churn due to economic reasons affects low-income areas of the city. This study reaffirms that it is necessary to study the barriers for Internet adoption in different contexts and socio-economic groups.

Keywords: Internet home · Customer churn · Internet Service Provider
· socio-economics · Digital city

1 Introduction

Scientific literature about the evolution of Internet in countries around the world indicates that Internet service providers (ISP) and customer usage behavior are among the most important aspects to study [1].

The evolution of the Internet is studied from different social perspectives[2]. The socio-economic perspective is one of them, it is studied in many digital fields. In e-tourism for example, Szopinski T. and Waldemar M. [3] finds a relationship between the frequency of use of e-tourism and socio-economic variables such as age, sex, level of education, professional position. Athanassopoulos A. [4], in the

banking sector indicates that the client's sociodemographic profile can be used to explain customer churn.

Although ICTs promise new opportunities for the integration of people and companies, especially in low-income countries in the world economy, there are problems related to the socio-economic aspect that have not been shallow studied [5]. In the scientific literature related to the telecommunications area, the socio-economic aspect is not highlighted as an important factor that influences customer churn, the main factors are associated with the service quality. In mobile telephony field, it is indicated that the socio-economic factor does not influence the customer churn [6].

However, in the present study we have been found evidence that indicates the socio-economic aspect is an important factor related to customer churn from residential Internet. An important cluster of customers who terminate their service for economic reasons has been identified and it has been studied with respect to the electrical energy consumption in kilowatts hour as a socio-economic variable. The study would allow a better understanding of customer needs and take actions to overcome the problems related to the evolution of residential Internet in cities.

In a study conducted in a city in the USA, Reddick C. et al. [7] indicates that the Internet access is not exclusively a rural/urban problem, it occurs in an intra-city context. The study shows that low-income areas have substantially lower broadband adoption rates, which is attributed to factors of geographic disparity, income, implementation costs, and socio-economic factors. Is necessary to study the barriers to Internet adoption in different country contexts and in all socio-economic groups [8].

We conducted this case study in the Telecommunications Company of Cuenca. This is the main company that offers residential Internet service in the city. Cuenca is located in Ecuador. Cuenca has about 73,000 clients by the time of submission of this paper. The Telecommunications Company of Cuenca has approximately 70% market share of Internet service users at home. Internet penetration in the city of Cuenca is approximately 80%, one of the highest in Ecuador.

This paper is structured as follows. Section 2 reviews the customer churn in telecommunications. Section 3, presents the research questions and explains the procedure used to conduct the study. Section 4 presents the results of the study. Sections 5, 6 and 7 present the discussion, conclusions and future work respectively.

2 Background

One of the main concerns for companies is customer churn, since customers are the main source of income. There are several definitions of customer churn:

- Is the movement of existing customers from one service provider to another [9]

- The inclination of a customer to leave a service provider [10, 11]

In the scientific literature there are a large number of studies that address the prediction of churn, which are methods that helps to identify possible churners in advance [12]. Churn management is a process that involves building a prediction model using historical data and looking for key factors that affect churners [9]. The prediction of customer churn in the telecommunications area is studied in several papers, for example, [13, 14], use techniques such as machine learning classification [15], data mining [12, 16, 17], neural networks [18], among others.

Researchers select the models and work with the data that they believe are most important [13], for example:

- Customer information, for example: type of service, bandwidth, payment history, etc.
- Customer usage, for example: type of connection, time of connection, date of disconnection, modem type, etc.
- Data from customer service activities, for example: records of incoming and outgoing customer calls, satisfaction surveys, etc.

Other studies analyze customer churn from other approaches such as the influence of the frequency of word exposure in online news based on the heuristic concept of availability [19]. Phadke C. et al. [20] research social networks to identify possible churning.

The literature review [6], indicates that many factors and their complex relationships influence customer churn. Price, call rate, service quality and network coverage are the most important factors for customer churn. Sociodemographic characteristics such as age, gender, education and income are secondary churning factors. In the field of mobile telecommunications, Mahajan V. et al. [6] indicates that demographic and socio-economic parameters doesn't have effects on the customer's decision to leave the service provider [4, 21–23].

There are various reasons why Latin Americans are not regular Internet users. Galperin H. [8] stated that users are affected by high costs and limited service availability. Older age, low levels of education and income are factors that negatively affect Internet use in developed countries [24, 25]. However, these results cannot be generalized to all countries of the world. There may be distinct reasons for the differences between countries in Internet inequality use [25].

There aren't studies about socio-economic factors related to ISP customer churn. As we mentioned before, socio-economic aspects determine a very important set of factors influencing the evolution of the Internet [1], which is necessary to understand for a deeper research.

This paper was inspired by technical reports that indicates economic reasons for churning. It tries to test if a group of customers who indicate churning for individual reasons related to their household economy or do not pay for the service is indeed associated with a socio-economic factor, or otherwise if it is a random phenomenon that affects to all customer churns in all areas of the city.

3 Methodology

In this study, we aim to answer the following question:

- Q1. Is the customer churn of ISP service related to the socio-economic factor in the intra-city context?

This case study was carried out in the main ISP of Cuenca, Ecuador. Customer churns indicate the reason because they leave. The churners are classified in two clusters: 1. customers who terminate their service for economic reasons and 2. customers who terminate their service for other reasons (usually related to service low quality).

We determine if there is a statistical difference between clusters respect to the household energy use (kWh/month) [26]. We use a random customer churn sample and its electrical energy consumption. The normality of the data has been verified and the hypothesis test has been carried out with the non-parametric Mann-Whitney test for independent samples.

Finally, a descriptive analysis is carried out with respect to telecommunications closets. In the field of telecommunications, a closet is a room or cabinet that holds the hardware needed to connect the building wiring to the back-bone wiring. The network comes from the inside plant to this element and from there, the network is distributed to its geographical area of influence with approximately 200 clients per closet. Then we obtain the churn rates and identify 4 clusters of closets.

4 Results

4.1 Descriptive analysis of churning

We use data of 56,273 active clients and 40,412 clients who have canceled the service during the period 2014-2018. The study has been carried out in the intra-city context.

Churners indicate the reason for leave the service, which may be speed, service drops, among other reasons related to the service quality. These churn causes represents 62%.

However, there are high percentage of churning due to reasons related to the economic aspect (38%). Within this group are customers who state that they cannot afford to keep paying for basic residential Internet service, which is approximately 24 USD per month or customers whose service has been canceled because they have not paid for more than 3 months and have not asked to reconnect their service. It is unknown if this group of churners is affected by a socio-economic factor.

As shown, the churn rate related to a customer's economic reason is high and represents 38% of cases. Next, we aimed to analyze whether this churning had to do with the socio-economic factor. To this effect, in the following subsection a socio-economic variable was used.

4.2 Relationship with the socio-economic aspect

When customers indicate that they terminate their service for socio-economic reasons or have had their service canceled due to non-payment, it is unknown whether this group of customer churns have a socio-economic factor in common that it could be cause of that behavior.

To test if the churning is associated with a socio-economic factor, we used the variable electrical energy consumption measured in kilowatts hour (kWh) . The consumer's monthly electrical energy consumption was obtained from the Electricity Company. Riva F. et al. [26] indicates that electricity use is connected through complex causal relationships with multiple dimensions of socio-economic development. The socio-economic variable monthly income of households has an influence on energy consumption [27].

Churners have been classified into two groups, those that state withdrawal for economic reasons or have their service canceled due to non-payment and do not reconnect (G1) and those that indicate other causes for churning, usually related to service quality (G2). A sample of 4,000 churners has been obtained.

Table 1 shows the comparison between the mean values, median and standard deviation. It is observed that the average value, mean and deviation of monthly energy consumption of customers who have churned for various reasons related with bad quality service (G2) are higher than group of customers churned for economic reasons (G1).

Table 1. Monthly energy consumption (KWH) by group of churners

	Median	Mean	Stand. dev.
G1	112.00	133.29	105.55
G2	119.00	146.50	124.11

Now the hypothesis is raised to determine if there is a statistically significant difference between the groups G1 and G2.

- Null hypothesis H_0 : The electricity consumption of the G1 customers is equal to the electricity consumption of the G2 group.
- Alternative hypothesis H_1 : The electricity consumption of the G1 customers is higher than the electricity consumption of the G2 group.
- Alternative hypothesis H_2 : The electricity consumption of the G1 customers is lower than the electricity consumption of the G2 group.

The data normality test has been performed using Kolmogorov-Smirnov. The significance value is 0.000, therefore it can be stated that the sample doesn't meet the normality condition. The Mann-Whitney nonparametric test has been applied to contrast hypothesis with independent measures, since a client can be in a single group (G1 or G2).

After performing the Mann-Whitney hypothesis test, the result indicates that there is sufficient evidence to reject the null hypothesis (p-value = 0.000).

Given that the p-value is lower than 0.05, there is a statistically significant difference. The energy consumption of customers G1 is lower than the electricity consumption of group G2, therefore, the alternative hypothesis H_2 is accepted.

We affirm that the group of churners who indicated that they churn due to economic reasons or churn without paying (G1) have a different behavior compared to the group G2 in relation to the electrical energy consumption. It appears that low income is the common characteristic of the group G1. G2 has a higher socio-economic level than group G1. Therefore, the answer to the research question Q1 is customer churn of residential Internet services is influenced by a socio-economic factor.

The percentage of Internet penetration in the city is high, but an important group of churners indicate economic reasons although they have the lowest Internet plan. The results of this research indicate that the behavior is associated with a lower socio-economic level.

In the following subsection, we present more information characterizing the group of customers whose churning is influenced by socio-economics level.

4.3 Clustering the telecommunication districts

With the purpose of observing how churners by economic reasons are distributed geographically in the city, customer churn has been clustered in their respective telecommunications closet. Then we obtained the churn rate associated with economic reasons in each closet.

The copper network covering the city is composed by approximately 604 closets, which have between 30 and 200 connected customers. In the section 3 we explained about a closet in the field of telecommunications.

Closets' churning rates for economic reasons vary between 0% and 45% over a period of 4-years, it vary widely. There are telecommunications closets having 0% churning for economic reasons and other closets having 45% churning in 4 years.

The closets have been clustered into 4 groups using the quartiles, each group containing 25% of the total number of closets. The churn rates are shown in Table 2 and have been called: High (yellow), Medium High (dark brown), Medium Low (light brown) and Low (red). The ranges of churn rate in each group have also been described.

The clusters shown in Table 2 have been displayed on a city map (Fig. 1) and it is observed that the closets of cluster 4, are located in the areas known as the poorest of the city and those of the cluster 1 are located in the most richest areas of the city.

There is a relationship between churning of Internet service and the socio-economic aspect. An important group of clients within a low socio-economic level residing in poor areas of the city have Internet service, however, cannot remain with the same Internet service provider. At the same time, the churn associated to the closets with greater purchasing power is not affected by the socio-economic aspect and their churning is affected mainly for demanding a better service quality.

Table 2. Socio-economic clusters of telecommunication closets

ID	Colour	Description
1	Yellow	The percentage of customers associated to a closet who have churned of Internet service due to economic reasons in a period of 4 years is between 0% and 11.11%
2	Dark brown	11.12% and 15.28%
3	Light brown	15.29% and 19.12%
4	Red	19.13% and 40%
0	White	Data not available

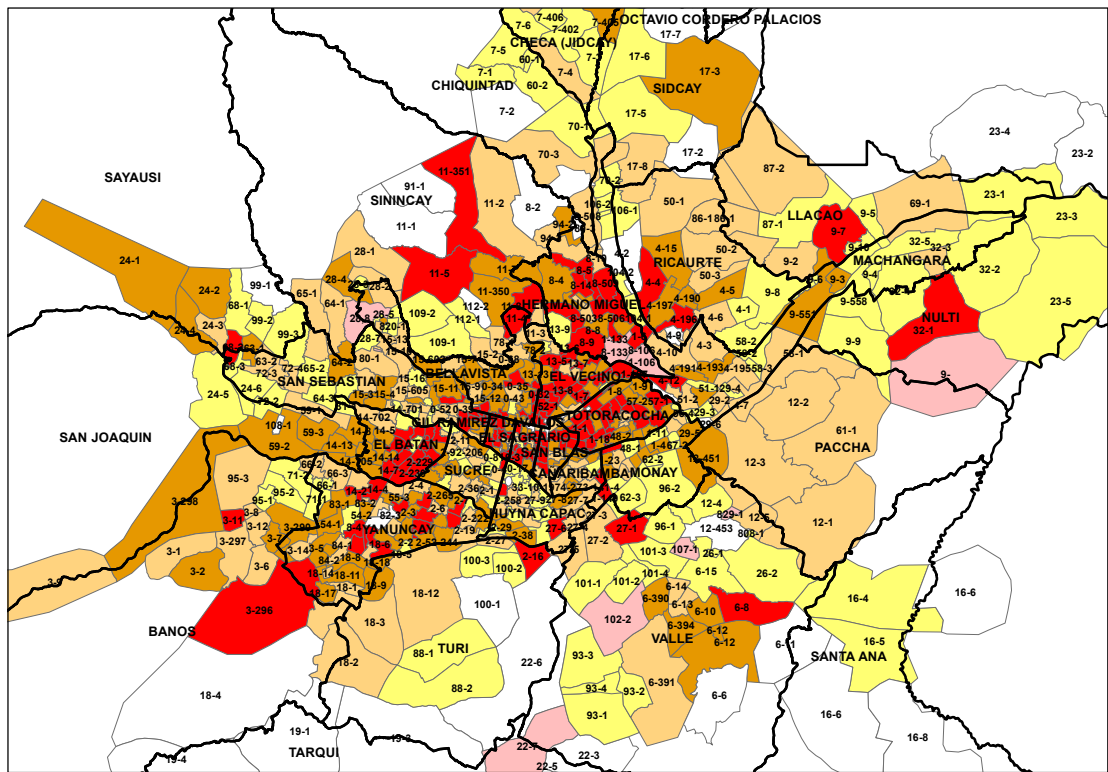


Fig. 1. Map of the city

Apparently, a high penetration of the Internet hides a phenomena that occur in economically depressed intra-city sectors, where customers churn of Internet service because they do not have money to pay or have other priorities. We don't know the time that elapses for the customers to contract the service again with another provider or contract with the same provider. The churners' behavior in areas with less income suggests that this intermittent access to Internet service is a behavior that should be studied and addressed as a type of digital divide in intra-city sectors.

5 Discussion

The scientific literature considers the socio-economic factor a minor factor regarding customer churn, churning for economic reasons or churning without paying are phenomena associated with the socio-economic characteristics of clients from disadvantaged urban areas. There is evidence that customers can access to Internet service but do not remain with the same provider for economic reasons. This form of churning is clustered in the intra-city context in the poorest areas of the city.

In the areas of the city with lower income, the service quality may not be as important as the price of the Internet. The group of churners from these areas does not churn due to a lack of service quality but rather demands a low cost Internet access that is economically adjusted to their needs.

The economic factor does not only influence Internet access in rural areas, but also affects intra-city areas with less economic incomes. Taking into account that the price in this case study is among the lowest in the residential Internet market, to maintain a high penetration of the Internet in the population, a social service with a free or lower-cost Internet focused on poor areas of the city could be suggested.

Customer churning data come from before the COVID-19 pandemic. During the pandemic, the problem should have deepened even more in areas with less income in the intra-city context.

6 Conclusions

In the scientific literature the socio-economic aspect doesn't has an important influence on the churning from the residential Internet service, in this study we present this evidence that it is an important factor. This study reaffirms that is necessary to study the barriers to Internet adoption in different contexts and socio-economic groups.

In this case study, churning for economic reasons and churning without paying corresponds to 38% of total churning. The churning is influenced by the socio-economic factor because there is a statistically significant difference between the energy consumption of the cluster of users that claims to churn of Internet service for economic reasons and the cluster of rest of churners.

The telecommunications closets have a churning ratio for economic reasons between 0% and 40%, the lowest percentages corresponding to the areas of the city with greater economic capacity and the highest percentages to the poorest areas of the city and with less economic capacity in the intra-city context. Users can access to the Home Internet service, however, they have difficulties to remain with the same provider.

7 Future work

Once the clients and geographic areas of the different socio-economic clusters have been identified, as indicated in [8], the study must be carried out in the different contexts and in the different socio-economic groups. In the future we expected to study the behavior of Internet clients regarding different aspects such as the use of electronic portals, the payment of services, the perception of the service quality.

In the ISPs the bandwidth is being permanently increased, that is to say, improving the quality of the network, therefore in the future we study the effect that the increase in the quality of the network has on the different socio-economic groups.

In this study, a new socio-economic variable has been generated, such as the percentage of customers who churn of the residential Internet service for economic reasons. This factor will be used to carry out new studies related to the behavior of Internet customers of the different socio-economic groups.

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