Telecommunications expenditure in peruvian households

Aileen Aguero
This study was carried out with the help of funds provided to the IEP by the International Development Research Centre, Ottawa, Canada.
TELECOMMUNICATIONS EXPENDITURE IN PERUVIAN HOUSEHOLDS

2008

AGUERO, AILEEN
Telecommunications expenditure in peruvian households. Lima, DIRSI, 2008 – (Research Brief Series, Issue 3)
34 p. il.

TELECOMMUNICATIONS, HOUSEHOLD INCOME, PERU

This document is under a Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 Unported License. To see a copy of this license clic here
http://creativecommons.org/licenses/by-nc-nd/3.0/legalcode
TELECOMMUNICATIONS EXPENDITURE IN PERUVIAN HOUSEHOLDS

Aileen Aguero.
Index

Summary .................................................................................................................................................... 6

Introduction .............................................................................................................................................. 7

1. Current indicators for Peru ................................................................................................................ 8

2. Telecommunications and their importance ........................................................................................ 10

3. Sector indicators .................................................................................................................................... 15
   3.1 Fixed Telephony ........................................................................................................................... 15
   3.2 Mobile Telephony .......................................................................................................................... 16
   3.3 Internet .................................................................................................................................... 17

4. Engel’s law and curve: Concepts and applications ........................................................................ 18
   4.1 Hypothesis for the peruvian case ................................................................................................. 19

5. Empirical Analysis .................................................................................................................................. 20

Conclusions ................................................................................................................................................ 25

Annex .......................................................................................................................................................... 26

References .................................................................................................................................................. 32
Summary

This study evaluates the importance of telecommunications expenditure as a share of total household expenditures, including calculation of income elasticity and the likelihood that households will have telecommunications expenditures, when a limited supply of services is not a factor. This analysis involves examining evidence of the applicability of Engel's Law, comparing to food expenditure, and an estimate of the Engel curve, relating total expenditures to the share of telecommunications expenditure. For the three years studied (2003, 2004 and 2005), telecommunications have the characteristics of a luxury good, as expenditure on these services as a share of total expenditures increases in higher deciles of total household expenditure. The evidence supporting the fact that telecommunications are a luxury good is complemented by the results of the Engel curve for 2004, where parameters show an income elasticity of 1.97. These findings must be interpreted carefully, because telecommunications cannot be treated like other luxury goods, whose consumption is taxed. Given the potential and importance of telecommunications, measures implemented in this field must help make this service more affordable to all households.
Introduction

In countries such as Peru, income level significantly limits many people’s access to various services. This analysis will focus on telecommunications services, because of their great potential for improving living conditions and because of their growth in recent years. One needs look no further than the swift expansion of mobile telephony: density (lines per 100 inhabitants) was 44% in June 2007, compared to 25% one year earlier (June 2006).

In this study, the term telecommunications includes fixed and mobile telephone services and Internet, as in Ureta (2005), which evaluates the importance of telecommunications expenditure in relation to total household expenditures in four developing countries. A similar analysis is done for Peru, but adding the calculation of income elasticity and the probability that households have telecommunications expenditure, if there are no supply constraints. To examine these factors, the analysis seeks evidence based on Engel’s Law, comparing with food expenditure, and estimates the Engel curve, relating total expenditures with the share of telecommunications expenditure. Income elasticity is determined on the basis of these calculations.

The study first presents a brief section of country indicators, to establish a general context. It then describes the relevance of telecommunications services at both the aggregate and individual levels. This is followed by a description of the sector (fixed telephony, mobile telephony and Internet) and a section describing the concept and applications of Engel’s Law and the Engel curve. The paper ends with empirical analysis and conclusions.

---

1 I am grateful for the valuable comments provided by Roxana Barrantes, Heman Galperin and the IEP Economics area.
1. Current indicators for Peru

To frame the discussion, we will begin with a brief description of Peru. The country has slightly more than 27 million inhabitants, according to the 2005 Census; 65.2% of them live in urban areas and the remaining 34.8% in rural areas.

GDP per capita for 2007 was US$3,366, while average annual income per person for that year was US$1,041 (3,720 nuevos soles). Aggregate income (GDP) contrasts sharply with the Census figure for actual income per person. Because of factors such as taxes, capital depreciation, payment for external factors, etc., GDP per capita is much higher than actual income. In addition, GDP per capita does not take into account inequalities in terms of wealth and poverty. It is therefore necessary to compare and keep in mind both indicators when evaluating a country’s income level, which in this case is fairly low.

In 2006, Peru ranked 82nd out of 177 countries in the Human Development Index prepared by the United Nations Development Program (UNDP), putting it below the average for Latin America and the Caribbean.

The following figure shows the distribution of the Peruvian population in groups of poor, non-poor and extremely poor.

**Figure 1**
Poor, non-poor and extremely poor in Peru

Source: ENAHO 2006.
Prepared by author.

---

As the figure shows, a large percentage of the population (44%) is in the poor and extremely poor groups. This makes analysis of telecommunications expenditure behavior in household budgets more relevant. Given the problem of poverty and its impact on health, education, civic participation and social exclusion, among other things, access to and use of telecommunications services can play a role in poverty reduction, as described in the following section.

The indicators presented are summarized in Table 1.

**Table 1**
**Indicators for Peru, 2006**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population*</td>
<td>27,219,264</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>US$ 3,366</td>
</tr>
<tr>
<td>Percentage in urban area</td>
<td>65.2</td>
</tr>
<tr>
<td>Average monthly household income</td>
<td>US$ 347</td>
</tr>
<tr>
<td>HDI ranking</td>
<td>82 of 117</td>
</tr>
<tr>
<td>Percentage of population in poverty</td>
<td>44.2</td>
</tr>
</tbody>
</table>

* Data from 2005.
2. Telecommunications and their importance

It is often said that access to telecommunications is important for economic growth in developing countries. For example, Waverman et al. (2005) notes that in a typical developing country, an increase of 10 mobile telephones per 100 people could increase GDP growth by 0.6 percentage points.

Along the same line, Röller and Waverman (2001) suggest that there is a generalized idea that a modern communications system is fundamental for development, and they highlight the importance of and the need for an efficient, modern telecommunications sector as part of a country’s basic infrastructure and a condition for economic growth. These authors also discuss how telecommunications infrastructure has influenced the economic growth of 21 countries in the Organization for Economic Cooperation and Development (OECD) over a 20-year period and calculate a microeconomic model for telecommunications investment and a function of production at the macroeconomic level. They find evidence of a positive and significant causal relationship between telecommunications infrastructure and GDP, especially when a critical point in telecommunications infrastructure — universal access — is reached.

According to these authors, investment in telecommunications infrastructure spurs growth because its products (cables, switches, etc.) increase demand for the goods and services used in its production. The economic returns on this type of investment are also much greater than the return on the investment itself: with development of telecommunications, there is a reduction in the transaction costs of organizing, gathering information and seeking providers and services. As telecommunications improve, costs of doing business decrease, the income of individual firms, in individual sectors, increases, and there is greater efficiency. The ability to communicate at any time increases companies’ ability to become involved in new productive activities. The importance of this effect also increases as the intensity of information about the production process increases.

Estache et al. (2002) note that Latin America is counting on reforms in the telecommunications sector to yield increases in productivity. Countries such as Chile, Mexico and Argentina are optimistic and have great expectations of teledensity growth in fixed and mobile telephone services and Internet. This optimism is widespread throughout the region. Underlying assumptions include the idea that the expansion of these services will help narrow the gap between rich and poor both within countries and between countries.

---

4 The sources of economic growth have been widely analyzed. Using theoretical and empirical tools, Romer (1986) began to focus on the endogeneity of the growth process, which contrasts with neoclassical models (Solow), using a function of aggregate production and exogenous technical changes.

Similarly, Grace et al. (2001) notes that developing countries are concerned about what is called the “digital divide,” because places that lack access to newer tools and technologies will find it more difficult to compete in the global marketplace. To demonstrate the importance of telecommunications in the development process, these authors present evidence of the Chilean case, analyzing the willingness to pay of the poor for these services. Their study finds that poor people pay more for telecommunications than for water service. The average Chilean also spends more of his or her income on telecommunications than on electricity and water. This may reflect a perception of opportunities or benefits related to the use of telecommunications services.

The link between telecommunications and social and economic development is based on characteristics related to the production of information. Some of these characteristics, mentioned in Grace et al. (2001), are:

- **Knowledge is shared.** The simplest benefit associated with access to telecommunications is the increase in the supply of information. Decreases in the cost of producing and transmitting information increase its availability and accessibility, reducing uncertainty. That reduction, in turn, leads to better decision making and allows new forms of organizational innovation, lowering transaction costs and reducing inefficiencies. Productive capacity is now based not only on investment in plants and labor, but also on the adaptation of new technologies and forms of organization to existing forms of economic activity.

- **Overcoming geographic limitations.** Telecommunications can break down geographic boundaries, creating a more efficient global market. Production processes can be disseminated, and comparative advantages can become more productive. In developing countries, this can increase access to global supply chains.

- **Openness.** Information sharing creates demand for greater openness and transparency. For example, information about a government’s decision-making process or a central bank’s level of reserves can be found by using the Internet. This demonstrates the potential of telecommunications for consolidating and expanding democratic regimes.

While telecommunications have the potential for increasing income and the rate of economic growth, as indicated in the papers mentioned above, more detailed analysis reveals other effects. For example, in developing countries, mobile telephony has offered, mainly in low-income sectors and rural areas, the principal opportunity for access to telecommunications. Jensen (2007) shows that the use of mobile telephones by fisher folk and wholesale merchants in India was associated with a great reduction in price dispersion, the elimination of waste and nearly perfect adherence to the law of one price, improving conditions for both consumers and producers. In addition, through the Drumnet project in Kenya, thanks to the use of cellular phones and the Internet, farmers have access to markets and credit, as well as information about prices, all of which helps them produce more and get higher prices for their products. This is reducing rural poverty, and it is apparent that these services can improve market conditions.

---

Another example is found in Bridges (2005), which evaluates a project that used cellular phones to improve the treatment of tuberculosis patients in South Africa. The project was an example of how innovative applications of low-cost information and communications technologies can be useful in providing health-care services in developing countries.

Finally, a demonstration of the way in which telecommunications facilitates the provision of public services can be seen in the implementation of a project in the European Community that was designed to enhance electronic government services via mobile technologies and Internet. In Africa, there is also a successful system for verifying the status of applications for identity documents and passports using text messaging (SMS).

In Peru, the telecommunications sector is one of the most dynamic parts of the economy. In 1994, when the state-owned telecommunications companies were privatized, there were large investment flows that facilitated the expansion of the telephone network. The number of fixed lines rose from 760,000 in 1994 to 2,495,953 in 2007.

In 2005, the sector registered growth exceeding 5% and revenues of some US$2,111 million. The sector also received the greatest amount of foreign direct investment (FDI), amounting to US$4,953 million, which represented 35% of total FDI stock.

**Figure 2**

**Foreign direct investment in telecommunications in Peru**

![Graph showing foreign direct investment in telecommunications in Peru from 2000 to 2005.]

Note: Figures in millions of current dollars.
Source: OSIPTEL.
Prepared by author.

---

7 For more examples, see De Silva et al. (2007) and Souter et al. (2005).
9 Includes revenues from telephone service, circuit rental and Internet access. Source: Digiworld America Latina (Fundación Telefónica 2007).
10 These figures correspond to foreign direct investment in the form of capital for companies or contractual joint ventures in the country, as well as amounts paid for transfer of shares of state-run companies' property to foreign owners. Source: Organismo Supervisor de la Inversión Privada en Telecomunicaciones (OSIPTEL).
The following is a description of the state of the components of telecommunications in Peru, as we have defined them: fixed telephony, mobile telephony and Internet, at the household level, based on the most recent information (first quarter of 2007).

According to a report by the National Institute of Statistics (Instituto Nacional de Estadística e Informática, INEI) (2007), communications density is heterogeneous by medium: 28% of households have a fixed line, 36% have a cellular phone, 13% have cable TV and only 5% have Internet access in the home. The greatest growth, compared to the same quarter of 2006, is in mobile telephony.

**Figure 3**
Telecommunications services in households

The same report notes that incorporation of ICTs does not occur equitably. There are great differences in access to these technologies between urban and rural households, which can be attributed to installation costs or factors related to geography, infrastructure or population. Except for fixed telephony, ICTs show greater growth in Metropolitan Lima. In rural areas, households have only fixed and mobile services, with growth of the latter eclipsing growth trends for fixed telephony (6.2%, compared to 0.3%).

Few households in Peru have computers (12%); nevertheless, 26% of the population age 6 years and up uses the Internet. There are also gender inequalities: 30% of the male population uses the Internet, compared to 23% of women. The age group that makes the greatest use of the Internet is between ages 19 and 24 (50% of this group), followed by those between ages 12 and 18 (45%); in contrasts, only 3% of the 60-and-up age group use the Internet, as the following figure shows.
Among the main Internet activities are electronic mail communication, chat, etc. (76%); obtaining information (63%); entertainment, such as video games, films, music, etc. (31%); and formal education and training (6%).

As noted above, the definition of telecommunications that we use is analogous to that of Ureta (2005). One important reason for the decision to concentrate expenditure on fixed and mobile telephony and Internet lies in the current trend toward convergence, which is reducing differences among services. One example of this is the passage of the Single Concession Law (Law 28737), which grants the right, after notification of the Ministry of Transportation and Communications (MTC), to provide all public telecommunications services (local carrier, national and international long distance, trunk lines, PCS, mobile telephony, mobile satellite telephony, fixed telephony regardless of technological base, wireless telephony, cable television). In a single concession contract, the MTC will grant the right to provide all public telecommunications services. This reflects an effort to facilitate the provision of more services.

The importance of telecommunications services is also recognized by the government through the promotion and financing of universal access, through the Telecommunications Investment Fund (Fondo de Inversión en Telecomunicaciones, FITEL). This fund is used to expand telecommunications services in rural areas and preferential areas of social interest. The main projects implemented with this fund have focused on development of public telephony and Internet access through public Internet booths.

11 To a lesser extent, electronic banking and other financial services (3%), transactions (interaction) with government agencies and public officials (2%) and the purchase of products or services (1%).

12 The government also has the obligation to promote the convergence of networks and services to facilitate the interoperativity of various network platforms, as well as the provision of diverse services and applications on the same technological platform.
3. Sector indicators

The following are the principal characteristics of telecommunications markets as we define them in this study.13

3.1 Fixed telephony

In this industry, because of its multi-product nature, it is possible to find economies of scope. In addition, the services that are offered cannot be stored and imply a considerable investment in fixed assets. This creates significant economies of scale in production, which is why there is a tendency toward a natural monopoly or oligopoly.14

According to Mitchell and Vogelsang (1991), demand for fixed telephone services is a demand for conversation between two parties (the person who calls and the person who receives the call) and a demand for an exchange of information. These authors note that individual demand is stochastic, but market demand appears to have daily and weekly patterns. Similarly, this demand is price-sensitive to varying degrees, and the network’s value to the consumer increases with the number of users who have access to it.

Along the same line, Pascó-Font et al. (1999) point out that demand is both seasonal and stochastic. In estimating demand, they find a variable measuring seasonal consumption in December, at a medium income level in Lima, to be significant. They also note that the strong stochastic component of demand could imply high variation in monthly consumption.

One key characteristic of local fixed telephony in Peru is the availability of a large number of tariff plans designed for users with different consumption patterns. Miravete (2002) notes that the introduction of tariff plans with measured service occurred globally, with two initial objectives. First, these plans were seen as a way of facilitating universal service. Second, they were implemented to reduce the economic distortion created by the use of local service that did not take the time of day into account.

In the economic literature, tariff plans imply a two-part tariff scheme. The availability of these plans, therefore, is known as second-degree discrimination. Monopoly holders know that there are different consumption demands or profiles, and based on users’ differing preferences they will offer different specific packages for each consumer in an effort to obtain a greater surplus (Tirole 1988). This will create self-selection mechanisms such as tariff plans.

---

13 For more detail, see the Annex.
14 The industry characteristics presented here are taken from Shy (2001).
Currently, Telefónica del Perú S.A.A. provides local fixed telephony through a total of 49 tariff plans. The plans fall into two main categories: open or unlimited plans, which include a certain number of minutes, and controlled or measured plans, which also include a certain number of minutes. In the latter, once the number of minutes is reached, the user can only place calls by using prepaid phone cards. Other companies also provide this service, but they target corporate customers; these companies have a 4% market share, while Telefónica del Perú holds the remaining 96%.

Since September 2001, local fixed-line telephone services have been regulated by a price-cap scheme. In this type of regulatory framework, the regulator establishes a minimum level of tariff reductions with which the company must comply. The level is based on estimates of productivity.

Fixed telephony services are classified into three baskets, depending on the concession contract between the state and the Empresa Nacional de Telecomunicaciones S.A. The three baskets are C, which contains the one-time installation fee; D, which includes the monthly fee and local calls; and E, which consists of national and international long-distance calls.

### 3.2 Mobile telephony

The mobile telephony market is the most dynamic in the sector. It is marked by the presence of three operators: Movistar (Telefónica Móviles), Claro (América Móvil) and Nextel; the latter has the smallest number of subscribers (4%) and is dedicated to the business of digital trunking and telephone interconnection. Telefónica Móviles has a 58% market share, while Claro has 38%, according to figures from December 2006. These two operators offer prepaid, post-paid and controlled post-paid services. As in the rest of Latin America, the predominant form is prepaid service (Mariscal 2007).

As with fixed telephony, there is a great variety of tariff plans for each type of service, but unlike fixed telephony, mobile services are not regulated; instead, they are “supervised” by the telecommunications regulatory agency, the Organismo Supervisor de la Inversión Privada en Telecomunicaciones (OSIPTEL). The General Tariff Rules establish the existence of both supervised and regulated tariff schemes. In the former, companies can set their tariffs freely, based on supply and demand; in the second, tariffs must take into consideration the price cap set by the regulating body. Price caps will be set according to the operating company’s concession contract or when there is a dominant operator or a lack of effective competition in the market.

There has been significant, rapid growth in mobile telephony services. In June 2007, there were more than 12 million lines, and the density indicator rose from 1.8 in 1997 to 43.7 in June 2007.

---

15 Of these, 21 are open and 28 are controlled plans. Only 31 of the total number of plans are commercialized.
17 In May 2007, a draft resolution was published that would eliminate national and international long-distance service from the rate-ceiling formula.
18 “This regimen is generally applicable to the provision of public telecommunications services, without prejudice of the application of the Regulated Rate Regimen, current legal and contractual provisions, and the supervisory functions of OSIPTEL.” Source: General Rate Rules (Reglamento General de Tarifas) (January 2006).
3.3 Internet

More specific information about the Internet, one of the components of telecommunications according to our definition, can be found in the *Digiworld América Latina* study (Fundación Telefónica 2007). According to this study, Internet penetration in Peru was 16% in 2005, slightly above the average for Latin America. Peru is one of the countries with the greatest penetration of telephone-line broadband service (15%). Public Internet booths are the most popular form of access, constituting the current form of access for nearly 70% of Internet users. In access technology, ADSL\(^{19}\) has been gaining ground over cable; in 2005, ADSL accounted for 94% of access and cable for only 5%.\(^{20}\) In 2005, the government launched the PC Peru program, in partnership with Intel, to enable people to purchase computers at a more affordable price. It was estimated that the program would create additional demand for 140,000 units between 2005 and 2006.

Telefónica del Perú is the main Internet service provider, offering service under the brand name Speedy. This is permanent high-speed Internet connection with a flat tariff, using broadband ADSL technology.\(^{21}\) It is important to note that this service guarantees users a data transfer rate of only 10% of the speed indicated in the contract.\(^{22}\)

Tariffs for Internet service via *Speedy* have decreased over time. The company also increased its customers’ speeds three times, with no change in tariffs.

The regulatory agency document justifying the ADSL tariff review\(^{23}\) mentions the ways in which competition occurs in this market. It notes that companies interested in entering this business can compete on two levels: by establishing an alternative network or by using the network operated by the incumbent (Telefónica del Perú). The former scenario would imply higher costs for newcomers, but would give them greater autonomy over the type of services they could offer their customers. If they used the incumbent’s network, they would need a smaller investment, but would sacrifice the ability to differentiate their products from those of the established company.

---

19 Asymmetric Digital Subscriber Line.
20 The latter was 36% in 2002.
21 With this technology, telephone service is not interrupted.
22 This is due to the number of users that the network can support.
23 Review of data transmission provision rates on virtual ATM circuits with ADSL access (*Revisión de Tarifas de Prestaciones de Transmisión de Datos mediante Circuitos Virtuales ATM con Acceso ADSL*), OSIPTEL, March 2007.
4. Engel’s law and curve: concepts and applications

Differences in consumption between wealthy families and poor families have been debated for centuries, but according to Stigler (1954), it was only relatively recently in England, in the 1790s, that a quantitative analysis was done. Two researchers, David Davies and Frederick Morton Eden, looking at working-class poverty at the time, did compilations of workers’ budgets.

Stigler also notes that two main events led to further studies of budgets. First, there was a wave of unrest in Europe in the 1840s, which ended in 1848 with revolutions in Paris, Berlin, Vienna, Prague, Budapest and Rome. This led to awareness of the economic conditions in which working classes lived; studies were published in 1848 in Saxony and Prussia, and in 1855 in Belgium, the latter by Ducpetiaux, who analyzed approximately 200 budgets.

The second development was the more widespread use of statistical analysis of social data. Contributions were made to the mathematical theory of probability, which led Quetelet to be the first to apply statistical techniques to social data. Quetelet did not focus on economic problems, however; it was Ernest Engel who applied advances in statistics to the study of consumer behavior.

In 1857, based on Ducpetiaux’s work, Engel classified 153 Belgian families into three socio-economic groups: (1) families dependent on public assistance; (2) families capable of surviving without that assistance; and (3) well-to-do families. Based on that study, he proposed a law of consumption: “The poorer the family, the greater the share of income devoted to food.” He also proposed that the wealthier the country, the lower the share of food expenditure in relation to total expenditures. This was the first empirical generalization about budget data.

Subsequently, in 1875, Carrol Wright reconsidered and interpreted Engel and concluded that: (1) the higher the income, the lower the relative percentage of expenditure for subsistence; (2) the percentage of clothing expenditure is approximately the same at all income levels; (3) the percentage of housing, fuel or electricity expenditure is the same, regardless of income level; and (4) as income increases, the percentage of expenditure on various items increases. Of these hypotheses, Wright ultimately accepted the first and fourth. He noted that negative savings could be a proof of poverty, and based on this, recommended the implementation of a minimum wage.

More studies followed in this field. In 1868, Hermann Schwabe proposed another law: the poorer the person, the greater the relative amount of income that must be spent on housing. In 1916, Ogburn calculated the relationship between each expenditure category and total expenditure, and between family income and family size. Based on these calculations, he found evidence for rejecting Wright’s second and third conclusions. It was not until 1930, however, that income was systematically analyzed in economic theory. According to Stigler (1956), this lag was due to the belief that real income did not fluctuate much in the short run.

24 The Case of Labourers in Husbandry.
Besides Engel’s law, the Engel curve, which compares the amount of expenditure on an item with total household expenditures, is an important tool for analyzing welfare. There are different specifications for this curve, in which it is assumed that the shares of budget are linear functions (Lesser 1963), but other authors, such as Banks et al. (1997), use non-linear specifications depending on the type of item being analyzed.

In general, the Engel curve evaluates the share of expenditure dedicated to a good or service, mainly food, and its relationship to total household expenditure. Using quadratic Engel curves with measurement errors, Girma (2002) identifies the proportion of urban households in Ethiopia in which food has the characteristics of a luxury item. The main objective of this study is to estimate the total consumer expenditure level beyond which food is no longer a luxury, taking the measurement error into account. The author uses non-linear errors in estimators of the variables.

Another study that uses Engel curves to evaluate the importance of food in total household expenditure is Gong et al. (2000), which analyzes households in rural areas of China and finds economies of scale in families’ consumer expenditure patterns, as well as some differences in consumer patterns that are related to sex differences in children.

It is difficult to find papers that analyze telecommunications expenditure in relation to total household expenditure using Engel curves. Ureta (2005) evaluates households’ telecommunications expenditure in four countries (Albania, Mexico, Nepal and South Africa), considering the share of family income devoted to these services. Monthly expenditure deciles are used, and the percentage of telecommunications expenditure is found to increase more as the highest decile is approached; in other words, the more households spend, the greater the telecommunications expenditure as a share of overall household expenditure. In the countries in the sample, Engel’s law applies to food: higher expenditure indicates lower relative importance of this item in the family budget (food is a necessity). In the case of telecommunications, the situation is different: higher expenditure means greater relative importance of communications, so it can be said that this is a luxury item.

4.1 Hypothesis for peruvian case

Isolating supply-side constraints, the hypothesis is that Peru will display a situation similar to that observed in the four countries evaluated by Ureta (2005); in other words, telecommunications represent what is known as a luxury good.

To find evidence to support this hypothesis, the importance of telecommunications expenditure was analyzed in relation to total household expenditure. This analysis focused on 2003, 2004 and 2005, comparing telecommunications expenditure with food expenditure. An Engel curve was also estimated, to determine the income elasticity of telecommunications services. Finally, a complementary analysis was done of the factors determining the likelihood that a household would show expenditures on these services.
5. Empirical analysis

In the first stage of the analysis, the importance of telecommunications expenditure in relation to total household expenditure was analyzed for 2003, 2004 and 2005, using the National Household Survey (Encuesta Nacional de Hogares, ENAHO) for each year. It is important to note that we decided not to include households with supply constraints — those that probably lack access to telecommunications services because such services are not available — so as to focus on the demand side. Similarly, it must be remembered that this analysis does not focus solely on households that actually have telecommunications expenditure. It also includes those that do not register expenditure on these services. The following are the results for only the year 2004; the other years show the same pattern.

Figure 5
Expenditure deciles and telecommunications and food expenditures shares 2004

The horizontal axis of the graphs shows deciles of monthly household expenditure, while the vertical shows the percentage of expenditure on telecommunications and food, respectively, in comparison to total household expenditure. As the graphs show, there is evidence to support Engel’s law: the

25 This alternative was based on the selection of households in provincial capitals, a total of approximately 7,000 each year.
importance of food expenditure decreases as household expenditure (income) increases,\textsuperscript{26} this is therefore considered a necessary good. For the three years analyzed, however, the relative importance of telecommunications expenditure as a share of total expenditure increases as we approach the highest expenditure decile, which seems to indicate that telecommunications constitutes a luxury good.

As indicated above, the Engel curve is really useful for areas related to welfare, as it shows how consumption of different goods and services changes with changes in the consumer’s income. This provides an idea of income elasticities, or consumer responses to changes in income. For more in-depth analysis of telecommunications expenditure in Peru, therefore, it is necessary to estimate the Engel curve in order to calculate elasticities. This calculation was done for 2004, for 6,954 households:\textsuperscript{27}

\[ s_i = \alpha + \beta \ln G + \gamma (\ln G)^2 \]  \hspace{1cm} (1)

Where \( s_i \) is telecommunications expenditure as part of total household expenditure, and \( G \) is monthly expenditure.

The resulting parameters are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>-1.815559</td>
</tr>
<tr>
<td>( \gamma )</td>
<td>0.210774</td>
</tr>
<tr>
<td>( \alpha )</td>
<td>3.491044</td>
</tr>
</tbody>
</table>

Table 2
Estimated Engel curve parameters

With these values, resulting from the estimation of the curve described above, elasticity is calculated as follows:

\[ \varepsilon_i = 1 + \frac{\beta_i}{s_i} + 2\gamma \ln G / s_i \]  \hspace{1cm} (2)

The result is an elasticity of 1.97,\textsuperscript{28} which indicates that telecommunications have the characteristics of a luxury good.

\textsuperscript{26} There are various reasons for using expenditure data instead of income data, especially in developing countries. First, neither household income nor needs are constant over time, and a certain income for a particular period may be a poor indicator of living standards. As Girma et al. (2002) note, in light of this theory, spending reflects not only what a household can acquire with a certain income, but also what that household can acquire either because it has access to the credit market or because it has savings that it can use if its income drops. Spending therefore constitutes a better indicator of a household’s standard of living over a longer term than income measurements.

\textsuperscript{27} As in Ramirez et al. (2005) and Gamboa (2007).

\textsuperscript{28} The same calculation, done for households in urban areas, produced a fairly similar income elasticity of 1.82. This supports the choice of households located in provincial capitals to eliminate supply constraints.
The next step in the analysis is to determine which factors increase or decrease the likelihood that a household will have telecommunications expenditures. The decision was made to calculate a Probit model for 2004 with the nearly 7,000 households used to calculate the Engel curve for this expense.

Monthly telecommunications expenditure averages 22 nuevos soles for a total of 6,954 households. The maximum amount spent is approximately 2,000 nuevos soles.

To get an idea of the importance of this expenditure, it should be noted that the minimum wage was 460 nuevos soles in the year studied; telecommunications expenditure, therefore, represented 5 % of the minimum wage. Average household expenditure, meanwhile, was approximately 1,300 nuevos soles, and average telecommunications expenditure constituted 2 % of that amount.

In urban areas, telecommunications expenditure averaged 28 nuevos soles, while in rural areas barely one nuevo sol was spent on telecommunications. In households in which the head of household was literate, spending was also 28 nuevos soles, while in those where the head of household was illiterate, telecommunications expenditure was 6 nuevos soles.

The results are more uniform when head of household is broken down by sex. Telecommunications expenditure was 22 nuevos soles for male heads of households and 21 nuevos soles for women.

A breakdown of results by poverty level shows that extremely poor households spend an average of 0.3 nuevos soles on telecommunications, while households in non-extreme poverty spend an average of four nuevos soles and non-poor households an average of 33 nuevos soles.

Finally, at the departmental level, households in Lima, Arequipa and La Libertad spend an average of 48 nuevos soles; expenditure is lowest in Pasco (9 nuevos soles).

The next step was to calculate the likelihood that a household would have telecommunications expenditures. It was determined that the dependent variable would have a value of one if the household had expenditures and zero if it did not.

\[
Gasto_{telecom} = \begin{cases} 
1 & \text{If household spends on telecommunications} \\
0 & \text{other case}
\end{cases}
\]

Factors that were included to explain this probability were the head of household’s years of schooling, the fact that the head of household could read and write \((\text{dummy} = 1 \text{ if affirmative})\), the number of members in the household, the head of household’s age, whether this person is male \((\text{dummy} = 1 \text{ if affirmative})\), whether the household is located in an urban area \((\text{dummy} = 1 \text{ if affirmative})\), whether the home is owned \((\text{dummy} = 1 \text{ if affirmative})\), whether the head of household worked the previous week \((\text{dummy} = 1 \text{ if affirmative})\) and whether the head of household had migrated \((\text{dummy} = 1 \text{ if affirmative})\).

The effect of supply constraints was isolated by selecting households located in provincial capitals, because it is highly likely that operators provide services in those areas. If households do not have telecommunications expenditures, therefore, it will not be because the services are not available.
Based on the calculations, as the following table shows, all of the variables are significant, with a level of 0.01, and all except the head of household’s sex increase the probability that a household will have telecommunications expenditures.

The fact that education has a positive influence on this probability is a standard result, since it is reasonable to think that the more education the head of household has, the greater his or her knowledge of the benefits of telecommunications, which will translate into expenditure in this area. This variable can also be considered a proxy for income level. The greater the income, therefore, the greater the likelihood of telecommunications expenditure. This is related to the positive effect of having had work the previous week, since it is likely that telecommunications expenditure occurred because telecommunications were used for work.

Owning a home and living in an urban area increase the probability that a household will have telecommunications expenditure, because households with these characteristics have more resources and can therefore allocate part of their income to this type of service. Households in rural areas, in general, tend to be poorer and will therefore have different priorities.

### Table 3
Results of calculation of Probit model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Marginal effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of education</td>
<td>0.129680</td>
<td>0.039652</td>
</tr>
<tr>
<td></td>
<td>(0.0067)</td>
<td>(0.0021)</td>
</tr>
<tr>
<td>Number of people in household</td>
<td>0.043896</td>
<td>0.013427</td>
</tr>
<tr>
<td></td>
<td>(0.0116)</td>
<td>(0.0035)</td>
</tr>
<tr>
<td>Male head of household</td>
<td>-0.214191</td>
<td>-0.068349</td>
</tr>
<tr>
<td></td>
<td>(0.0579)</td>
<td>(0.0192)</td>
</tr>
<tr>
<td>Age of head of household</td>
<td>0.024634</td>
<td>0.007535</td>
</tr>
<tr>
<td></td>
<td>(0.0019)</td>
<td>(0.0006)</td>
</tr>
<tr>
<td>Household in urban area</td>
<td>1.646295</td>
<td>0.329856</td>
</tr>
<tr>
<td></td>
<td>(0.1448)</td>
<td>(0.0118)</td>
</tr>
<tr>
<td>Own home</td>
<td>0.196052</td>
<td>0.058313</td>
</tr>
<tr>
<td></td>
<td>(0.0550)</td>
<td>(0.0158)</td>
</tr>
<tr>
<td>Head of household worked the previous week</td>
<td>0.146323</td>
<td>0.044748</td>
</tr>
<tr>
<td></td>
<td>(0.0581)</td>
<td>(0.0178)</td>
</tr>
<tr>
<td>Head of household migrated</td>
<td>0.182289</td>
<td>0.055405</td>
</tr>
<tr>
<td></td>
<td>(0.0481)</td>
<td>(0.0146)</td>
</tr>
<tr>
<td>Constant</td>
<td>-4.738090</td>
<td>0.0146</td>
</tr>
<tr>
<td></td>
<td>(0.2089)</td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>6,490</td>
<td></td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.25450</td>
<td></td>
</tr>
</tbody>
</table>

*** Indicates significance at level of 0.01.
Note: Standard errors in parentheses.
If the head of household is male, the probability that a household will have telecommunications expenditures decreases. On the topic of the head of household’s sex, Rodini et al. (2002) note that women value safety highly, and therefore subscribe to mobile telephone services. Generalizing this fact, it is understandable that if the head of household is male, the probability of having telecommunications expenditures tends to be lower. In contrast, the older the head of household, the greater the likelihood that the household will spend money on these services.

Finally, the more people in the household, the greater the probability of having telecommunications expenditures. Similarly, if the head of household has migrated, there is a greater likelihood that the household will have telecommunications expenditures, possibly because of the need to communicate with family members in the place of origin.

Examining marginal effects, we find that, on average, the factor that most influences the probability that a household will have telecommunications expenditures is location in an urban area. In this case, the probability increases by 33%. Having a migrant head of household and home ownership both have a 6% impact on this probability. The number of people in the household and the head of household’s age have only a 1% effect on the probability of having telecommunications expenditures.
Conclusions

Because of the great potential and importance of the telecommunications sector, both at the aggregate level and at the individual or household level, it is interesting to analyze the share of the total household budget that families allocate to services such as fixed and mobile telephony and Internet. As noted above, for the three years studied, telecommunications have the characteristic of being a luxury good, since the percentage of these services as part of total household expenditure increases in higher deciles of total expenditure. The percentage of expenditures that households allocate for telecommunications as part of total expenditures is nearly 3% in the highest expenditure decile. This data was compared to the percentage allocated for food, which decreases as the expenditure decile increases, and which has a value of 30% in the highest decile. This provides evidence that Engel’s law applies; in other words, food is a necessary good.

The evidence that telecommunications are a luxury good or service is complemented with the findings based on the calculation of the Engel curve for 2004, since the parameters result in an income elasticity of 1.97 (elasticities greater than one indicate that a good is a luxury item). A 10% increase in household income would therefore generate an increase of 19.7% in telecommunications expenditures.

These findings must be carefully interpreted, because telecommunications cannot be treated like other luxury goods, such as automobiles and jewelry, which are subject to consumption taxes. Because of the potential and importance of telecommunications, measures implemented with regard to these services should help make them more affordable to all households. It is important to keep in mind the role they play as an input in production; the importance for a country of having widespread basic infrastructure for communication; production of information; development of social networks; and the potential of telecommunications to provide public health, government administration and educational services to the poorest sectors of the population.

As a complement, the study considered factors that increased or decreased the probability of households having telecommunications expenditures in 2004. Factors such as the head of household’s years of schooling, whether the head of household had worked the previous week, home ownership and location of the household in an urban area had a mainly positive influence on the probability. In contrast, the fact that the head of household was male had a negative effect on the probability of having telecommunications expenditures.

Access to these services has increased notably in recent years, with mobile telephony leading teledensity growth. This has led to a certain decrease in telecommunications prices, but only in access, not in per-minute price for either fixed or mobile telephony. We must keep in mind that price level is an important factor to consider, since it will greatly influence a household’s decision to use telecommunications services. It is also important to note that income in Peru is very low and poverty levels are high, factors that also play a role in decisions about spending money on these services.

Given the characteristics of markets for fixed and mobile telephony and Internet, we should emphasize that it is necessary that the appropriate authorities maintain and intensify efforts to promote competition, expand coverage, reduce transaction costs for companies entering the field, disseminate new technologies that will make it possible to reduce costs, and adequately supervise the quality of these services for the benefit of the users.
Annex

Fixed telephony

Figure A.1
Market share of fixed telephony operators, 2006

Source: Osiptel.
Prepared by author.
Table A.1
Fixed lines in service and teledensity by department

<table>
<thead>
<tr>
<th>Departament</th>
<th>Lines in service</th>
<th>Lines in service per 100 inhab.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazonas</td>
<td>6,219</td>
<td>1.49</td>
</tr>
<tr>
<td>Ancash</td>
<td>62,248</td>
<td>5.75</td>
</tr>
<tr>
<td>Apurímac</td>
<td>6,940</td>
<td>1.58</td>
</tr>
<tr>
<td>Arequipa</td>
<td>119,416</td>
<td>9.98</td>
</tr>
<tr>
<td>Ayacucho</td>
<td>16,647</td>
<td>2.49</td>
</tr>
<tr>
<td>Cajamarca</td>
<td>31,908</td>
<td>2.25</td>
</tr>
<tr>
<td>Cusco</td>
<td>49,107</td>
<td>4.02</td>
</tr>
<tr>
<td>Huancavelica</td>
<td>3,937</td>
<td>0.83</td>
</tr>
<tr>
<td>Huánuco</td>
<td>15,267</td>
<td>1.98</td>
</tr>
<tr>
<td>Ica</td>
<td>53,948</td>
<td>7.62</td>
</tr>
<tr>
<td>Junín</td>
<td>63,624</td>
<td>5.37</td>
</tr>
<tr>
<td>La Libertad</td>
<td>138,857</td>
<td>8.63</td>
</tr>
<tr>
<td>Lambayeque</td>
<td>83,115</td>
<td>7.29</td>
</tr>
<tr>
<td>Lima y Callao</td>
<td>1,588,819</td>
<td>17.48</td>
</tr>
<tr>
<td>Loreto</td>
<td>38,799</td>
<td>4.10</td>
</tr>
<tr>
<td>Madre de Dios</td>
<td>3,550</td>
<td>3.35</td>
</tr>
<tr>
<td>Moquegua</td>
<td>12,052</td>
<td>7.16</td>
</tr>
<tr>
<td>Pasco</td>
<td>5,368</td>
<td>1.91</td>
</tr>
<tr>
<td>Piura</td>
<td>92,512</td>
<td>5.40</td>
</tr>
<tr>
<td>Puno</td>
<td>24,458</td>
<td>1.87</td>
</tr>
<tr>
<td>San Martín</td>
<td>24,637</td>
<td>3.46</td>
</tr>
<tr>
<td>Tacna</td>
<td>23,571</td>
<td>7.96</td>
</tr>
<tr>
<td>Tumbes</td>
<td>10,717</td>
<td>5.17</td>
</tr>
<tr>
<td>Ucayali</td>
<td>20,237</td>
<td>4.67</td>
</tr>
<tr>
<td><strong>Total from Peru</strong></td>
<td><strong>2,495,953</strong></td>
<td><strong>9.04</strong></td>
</tr>
</tbody>
</table>

Note: Data for June 2007.
Source: OSIPTEL.
Mobile telephony

Figure A.2
Types of mobile telephony plans, 2006

Source: OSIPTEL.
Prepared by author.

Figure A.3
Evolution of mobile lines in service, by operator

Source: OSIPTEL.
Prepared by author.
Figure A.4
Evolution of mobile density

Source: OSIPTEL.
Prepared by author.
Table A.2  
Mobile telephone lines in service and teledensity by department

<table>
<thead>
<tr>
<th>Departament</th>
<th>Lines in service</th>
<th>Lines in service per 100 inhab.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazonas</td>
<td>36,936</td>
<td>8.87</td>
</tr>
<tr>
<td>Ancash</td>
<td>302,425</td>
<td>27.93</td>
</tr>
<tr>
<td>Apurímac</td>
<td>48,227</td>
<td>11.00</td>
</tr>
<tr>
<td>Arequipa</td>
<td>704,324</td>
<td>58.83</td>
</tr>
<tr>
<td>Ayacucho</td>
<td>124,268</td>
<td>18.57</td>
</tr>
<tr>
<td>Cajamarca</td>
<td>238,519</td>
<td>16.79</td>
</tr>
<tr>
<td>Cusco</td>
<td>321,528</td>
<td>26.29</td>
</tr>
<tr>
<td>Huancavelica</td>
<td>19,550</td>
<td>4.14</td>
</tr>
<tr>
<td>Huánuco</td>
<td>103,865</td>
<td>13.47</td>
</tr>
<tr>
<td>Ica</td>
<td>350,377</td>
<td>49.49</td>
</tr>
<tr>
<td>Junín</td>
<td>341,942</td>
<td>28.83</td>
</tr>
<tr>
<td>La Libertad</td>
<td>637,799</td>
<td>39.60</td>
</tr>
<tr>
<td>Lambayeque</td>
<td>454,563</td>
<td>39.87</td>
</tr>
<tr>
<td>Lima y Callao</td>
<td>6,742,621</td>
<td>74.05</td>
</tr>
<tr>
<td>Loreto</td>
<td>121,084</td>
<td>12.77</td>
</tr>
<tr>
<td>Madre de Dios</td>
<td>34,547</td>
<td>32.55</td>
</tr>
<tr>
<td>Moquegua</td>
<td>101,356</td>
<td>60.19</td>
</tr>
<tr>
<td>Pasco</td>
<td>53,504</td>
<td>19.04</td>
</tr>
<tr>
<td>Piura</td>
<td>482,544</td>
<td>28.14</td>
</tr>
<tr>
<td>Puno</td>
<td>335,700</td>
<td>25.59</td>
</tr>
<tr>
<td>San Martín</td>
<td>106,488</td>
<td>14.94</td>
</tr>
<tr>
<td>Tacna</td>
<td>203,625</td>
<td>68.72</td>
</tr>
<tr>
<td>Tumbes</td>
<td>96,969</td>
<td>46.79</td>
</tr>
<tr>
<td>Ucayali</td>
<td>110,130</td>
<td>25.41</td>
</tr>
<tr>
<td><strong>Total from Peru</strong></td>
<td><strong>12,072,891</strong></td>
<td><strong>43.69</strong></td>
</tr>
</tbody>
</table>

Note: Data for June 2007.  
Source: OSIPTEL.
Table A.3
Mobile companies and district-level coverage

<table>
<thead>
<tr>
<th>Company</th>
<th>Total districts served</th>
<th>Percentage of total districts (1,832)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movistar</td>
<td>807</td>
<td>44</td>
</tr>
<tr>
<td>Claro</td>
<td>1,015</td>
<td>55</td>
</tr>
<tr>
<td>Nextel</td>
<td>252</td>
<td>14</td>
</tr>
</tbody>
</table>

Note: Data for June 2007.
Source: OSIPTEL.
Prepared by author.

Figure A.5
Fixed and mobile density by department

Source: OSIPTEL.
Prepared by author.
References

BANKS, James, Richard BLUNDELL and Arthur LEWBEL

BRIDGES

ESTACHE, Antonio, Marco MANACORDA and Tommaso M. VALLETTI

FUNDACIÓN TELEFÓNICA

GAMBOA, Luis Fernando

GIRMA, Sorafel and Abbi M. KEDIR

GONG, X., A. VAN ZOEST and P. ZHANG

GRACE, Jeremy, Charles KENNY and Christine QIANG

INSTITUTO NACIONAL DE ESTADÍSTICA E INFORMÁTICA
JENSEN, Robert

LESSER, C. E. V.

MARISCAL, Judith

MIRAVETE, Eugenio

MITCHELL, Bridger and Ingo VOGEISANG

ORGANISMO SUPERVISOR DE LA INVERSIÓN PRIVADA EN TELECOMUNICACIONES

PASCÓ-FONT, Alberto, José GALLARDO and Valery FRY
1999 La demanda residencial de telefonía básica en el Perú. Lima: Organismo Supervisor de la Inversión Privada en Telecomunicaciones-Grupo de Análisis para el Desarrollo.

RAMÍREZ, Manuel, Manuel MUÑOZ and Andrés ZAMBRANO

RODINI, Mark, Michael WARD and Glenn WOROC

RÖLLER, Lars-Hendrik and Leonard WAVERMAN


Web pages
Electronic government program in Africa:

Results of the “Use-me” program:

34