Is mobile telephony more affordable today?

A methodological note on the comparison of the value of service baskets between 2006 and 2009

Roxana Barrantes – Instituto de Estudios Peruanos

Aileen Agüero – Instituto de Estudios Peruanos

César Huaroto – Instituto de Estudios Peruanos

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Roxana Barrantes – Instituto de Estudios Peruanos

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Summary

Given the rapid technological changes occurring in telecommunications – the main sign for the users being the diversity of possible features of terminal equipment – it is relevant to wonder how affordability has changed between 2006 and 2009. By means of this brief research, we will try to answer this question for five Latin American countries – Argentina, Brazil, Colombia, Mexico and Peru – by using the baskets methodology promoted by the OECD for international comparisons, and comparing different methodologies for constructing index numbers – Laspeyres, Paasche and Fisher methods. During the period of comparison, the OECD changed the makeup of the mobile telephony low-usage basket, increasing the number of calls and the number of SMS messages, as well as the relative weighting of traffic during peak hours and on the mobile network.

The results of the exercise yield several lessons. Firstly, the magnitude of reductions in the value of the basket is significantly greater when using the Laspeyres methodology, that is, when quantities from the early period of comparison are taken as a basis. Secondly, we regard as robust changes those that can be observed when using all three index number methods, both in the same direction of change (increase or decrease) and whether they exceed the unit or not. This is the case of reductions in the value of the basket in Argentina, Colombia and Peru. In all three cases, these reductions have also been accompanied by significant increases in mobile density that do not depend on the initial level of teledensity in 2006, when the comparisons started.

In the third place, where the value of the prepaid basket decreased, the relationship between the value of the prepaid basket and the value of the post-paid basket decreased too. In other words, the prepaid service became cheaper compared to post-paid.

In the fourth place, the cases of Mexico and Brazil are noteworthy for two reasons. Firstly, in both cases, mobile teledensity increases despite increases in the value of the prepaid basket. Secondly, while in Mexico relative changes in the value of the prepaid basket depend on which methodology is used, for Brazil, any method finds increases in the order of 20% in the value of the basket.

In the fifth place, in the case of Brazil, whatever the methodology used, the value of the basket has increased, and the trend towards equal values between prepaid and post-paid services has not occurred.

These results draw attention to two issues that the dynamic comparison of tariffs should address. Firstly, it is important to provide as much detail as possible about the methodology being used to make comparisons over time. Secondly, due to rapid technical changes in telecommunications, which cause major changes in the various features of terminal equipment and the telecommunications services themselves, it is advisable to take as a basis for comparison either the latest basket, i.e. the Paasche methodology, or the Fisher index, which uses both the Paasche and Laspeyres indices.

Finally, on the methodological front, several international affordability studies or tariff comparisons use the basket proposed by the OECD, which reflects the reality of telecommunications in those countries. It is important to draw attention to the need for studies providing a profile of the use of telecommunications services in several developing countries, particularly in Latin America.

Introduction[1]

The use of telecommunications services by lower-income, marginalized or poor sectors depends on how affordable they are. If people find the services they want to consume are too expensive, they will do without them or seek alternative mechanisms to minimize their costs, thus reaching lower levels of welfare.

In previous papers (Barrantes and Galperin, 2008; Galperin, 2009), the baskets methodology was used to find out how expensive the use of mobile telephony is, based on the OECD's usage basket. As we know, the OECD estimates the costs of mobile telephony services by considering three possible baskets: high usage, medium usage and low usage. Barrantes and Galperin (2008) took the basket proposed by the OECD in 2006 and calculated its value in six countries in Latin America. Instead, Galperin (2009) took a new version of the basket to construct a comprehensive comparison of 20 countries in the region, and 43 others, including OECD countries and countries in South East Asia. These two studies were cross-cutting, with a focus on a comparison of the value of the mobile telephony basket between countries.

Between 2006 and 2009, the OECD changed the makeup of the basket of mobile telephony services. Compared to that used in 2006, the 2009 basket considered a larger number of calls (25 vs. 30) and a larger number of text messages (30 vs. 33). The weighting of calls during peak hours changed too, from a weight of 38 percent in the 2006 basket to 48 percent in the basket 2009. Similarly, the destination of calls on the home mobile network (on-net) also increased its relative weighting from 40 percent to 48 percent between 2006 and 2009, respectively. Finally, in the 2009 basket the weighting of calls to the fixed local network or long distance calls decreased.[2]

A natural question that arises after the change in the makeup of the baskets is whether these changes are neutral when looking to compare how much the value of the basket has changed over time. The answer is yes if – regardless of the basket considered

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[1] We the authors would like to thank Hernán Galperin (University of San Andrés, Argentina) and José Rodríguez (Pontifical Catholic University of Peru) for their comments. Any errors or omissions are our responsibility.

[2] Annex 1 shows both baskets and highlights the differences between them. For more information on the makeup of the baskets, see OECD (2006) and OECD (2010).

– the value of the basket changes in the same direction in the countries included in the comparison. A neutral change means that the price changes shown through different index number calculation methods have the same direction and magnitude in relation to the unit. This paper compares the results of calculations of the value of the low-usage basket in 2006 and 2009 for five Latin American countries analyzed by Barrantes and Galperin (2007): Argentina, Brazil, Colombia, Mexico and Peru. The tariffs of both post-paid and prepaid services are considered.

The exercise in historical comparison will lead us to a discussion of the fundamental ideas underpinning the construction of price indices. Paasche, Laspeyres and Fisher indices are used and the results compared. In particular, it will be clear how the results for the value of the baskets and – and, therefore, in the affordability of the service – do depend on which basket is taken as a basis for valuation.

The results will show that price changes have been very different between the countries concerned, depending on the basket being considered – whether the 2006 or 2009 basket – and the changes are neutral for only three countries in the basket under study. However, it is clear that in all cases, the magnitude of change differs depending on the basket used.

These results draw attention to two issues that dynamic comparisons of tariffs should address. Firstly, it is important to provide as much detail as possible about the methodology being used to make comparisons over time. Secondly, due to rapid technical changes in telecommunications, which cause major changes in the use of telecommunications services, it is advisable to take as a basis for comparison either the latest basket, i.e. the Paasche methodology, or the Fisher index, which uses both the Paasche and the Laspeyres indices.

The plan of the paper is the following. The next section explains the use of the concept of affordability, which is complemented by a brief discussion about the limits of the Laspeyres, Paasche and Fisher price indices. This is followed by comparisons of the value of the baskets. The conclusions bring the paper to a close.

1. Basic concepts: affordability and index numbers

Before presenting the comparisons, we think it important to have a brief discussion of two fundamental concepts that justify the study. One of them is the concept of affordability, and the other is the use of index numbers.

1.1. The notion of affordability

The economic theory of demand is built on a very simple premise: a consumer will be willing to pay to consume a certain good if its Use Value is greater than or equal to its exchange value or price, in the light of his/her level of income and considering his/her tastes. Under this model, if income is very low, a consumer may want to consume a good but not do so because the exchange value is too high.

In a world of lexicographic preferences, i.e. where there is a categorization of preferred goods based on a criterion used by the consumer, the fact that a consumer does not have the income to consume a good that is at the top of his preferences may significantly undermine his welfare. In other cases, he/she may have the income, but may stop short of consuming the product because it is relatively expensive. These situations can be studied through the concept of affordability, i.e. how much of the income it is reasonable for an individual to allocate for the consumption of a good or service.

The concept also contributes to the development of public policies. For example, when it comes to designing a social tariff (Urbiztondo 2008), it is possible to determine the percentage of a household's income that can be set aside for the purchase of certain necessary goods, with the State covering the difference. This applies in particular to the case of privatized utilities when companies are required to achieve profitability levels in line with market risks, which may make the consumption of public services not very affordable.

In telecommunications, it has been found that the accepted affordability threshold (Milne, 2006) lies at 5 percent of total household income. Furthermore, in developing countries, it has been observed that these services have the characteristics of a luxury good (in economic terms), since the proportion of spending on them increases as

income increases. This pattern is observed, for example, in Peru (Agüero 2008) and Colombia (Gamboa 2007). In this regard, Milne (2006) mentioned that for lower-income households, mobile phones have become an "essential luxury" or a "costly necessity".

Galperin (2009) estimated the affordability gap with the indicator of the cost of the low-usage basket as a percentage in the income of the third lowest-income decile in 18 countries in Latin America. He bases this decision on two facts. Firstly, the level of affordability in this decile is an approximation to lower-income sectors that do not actually fall into the marginalized or extreme poverty category.[3] Secondly, because the empirical evidence produced by this research shows that this decile provides a better explanation of the level of penetration that mobile telephony has reached in countries in the region. The findings are unequivocal: only in Costa Rica can mobile telephony services be considered affordable for this decile. In other countries, this service is rather a "necessary luxury" for at least the last three deciles of their population.

1.2. The use of index numbers

The measurement of economic activity requires the construction of indices that will help estimate the actual evolution of the variables under study. Of particular significance are the variables measuring GDP, which are typically constructed by multiplying a price by a quantity. If the intention is to measure growth, prices must remain fixed. If the intention is to measure inflation, the quantities must remain fixed. This is the only way to evaluate growth, inflation or changes in people's welfare as the economy grows and the country develops.

There are a number of approaches to constructing index numbers, whether for changes in quantities or price changes. The three most widely used are the Laspeyres, Paasche and Fisher methods. The Laspeyres price index takes as a basis the quantities of the year when the comparison started and measures changes in prices. The Paasche price index takes as a basis the quantities of the current year and values them at past

[3] This detail is a rough approximation to the Latin American reality, which shows significant differences in the incidence of poverty and extreme poverty across countries. Having said that, the third decile threshold is relevant to Peru, for example (one third of households are considered poor).

prices and current prices. So the Laspeyres index takes the past as a basis, while the Paasche index takes the present as a basis. The Fisher price index is the geometric mean of the two indices above.

Therefore, it is clear that the index numbers resulting from each methodology may be different, and the greater the change in the consumed quantities of the goods whose values are to be compared, the greater the difference. For instance, for a property with a certain number of people, it hardly makes a difference whether we consider the amount of water this year or five years ago if the purpose is to measure the change in the value of the bill.[4]. It is seasonal differences, rather than any changes in water uses, that best account for changes in per capita consumption of drinking water. Instead, when it comes to a good or service whose consumption has varied greatly over time due to technology features or effects such as network externalities – as is the case with mobile telephony –, which index to use will be a very important decision.

This very obvious observation is one more that adds to the usual criticism of the methodologies. For example, in the case of the Laspeyres index, the implicit assumption is that, faced with changes in relative prices, consumers will not change the quantities consumed. It is as if the demand for the goods or services being assessed was completely inelastic. As for the Paasche index, the amount consumed today might not have been available in the past because the service did not exist at the time – as is the case of automatic roaming for mobile telephony.

A possible solution to the potential biases of both methodologies is the Fisher index, which is a geometric mean of the two indices above. The mathematical formulae of all three indices are listed in Annex 2.

2. Comparison of 2006-2009 basket values

The exercise in Barrantes et al (2007) took the 2006 prices in the mobile telephony markets of five countries and used them to calculate how much it would cost a user to consume the so-called "low-usage basket", as defined by the OECD (2006). This basket consists of 25 one-minute calls and 30 text messages (SMS) per month which are

[4] Unless there has been an exogenous shock such as an epidemic that has caused substantial changes in water use patterns (e.g., having a bath three times a day rather than one).

weighted according to whether they were made during peak hours, whether the destinations were fixed telephony networks or they were mobile on-net or off-net calls, or whether they were long distance calls. The discussion of these results is in Barrantes and Galperin (2008).

Today, the OECD has changed the level that is considered low usage, increasing both the number of calls (from 25 to 30) and the number of text messages (from 30 to 33), and modifying the weighting of calls to mobile networks (on-net and off-net), and for usage during peak hours. This basket is used because there is no estimate of the consumption of telecommunications services for the region – either at the individual or household level – which is representative of Latin America. The value of the 2009 basket, with the prices offered by operators in Latin America and other regions, was analyzed by Galperin (2009).

We now present three kinds of comparisons. The first compares the 2006 basket at 2006 and 2009 prices and is a typical price index calculated with the Laspeyres methodology. The second exercise takes the 2009 basket as a reference and values it at 2006 prices and 2009 prices. This is therefore the calculation of the Paasche index. The third exercise will involve using the Fisher index, which will average the two indices above.

This section focuses on the prepaid service because it is the service preferred by people on a low income. Finally, there is a discussion of the discrepancies between the value of the prepaid and postpaid baskets.

It must be stressed that the indices are developed by using the values of the baskets in the local currency at current prices. If the comparison of the baskets in different places was made using the exchange rate, we would assume it would be possible for a user in, for example, Mexico to buy the basket in Colombia and Argentina. This would be incorrect due to the non-tradable nature of mobile services, stemming from the legal and physical entry barriers in the unlikely event that someone in any of the countries in the study wanted to use the mobile service provided by an operator in another country.

In addition, the exchange rate is subject to pressures for several reasons other than simple trade between countries. This might not be a problem if we were sure that the exchange rate is consistent with the Purchasing Power Parity (PPP) assumption that the exchange rate only depends on price changes in these countries, but for the assumption to be true it must be assumed that the goods are tradable and, as mentioned above, that

is not the case with mobile telephony. For all these reasons, the work in this paper uses the variations in current prices in local currencies. The disadvantage of this decision is that the values of baskets in different countries cannot be compared, rendering comparisons between countries impossible.[5] On the other hand, there is a better approximation to changes in the prices of a basket of mobile services within each country at two points in time, and it is possible to emphasize the particularities of the methodologies used. It must be noted that prices are not used on a real-value basis because the development of the price index (CPI) is actually a Laspeyres- or Paasche-like index number depending on the country that uses it. Including the CPI in the price of mobile services would distort the price variation analysis. Furthermore, the CPI does not necessarily include mobile services in its comparison basket and, in addition, this basket may not be homogeneous (and it need not be) across the countries studied.

However, it is important to note how the consumer price index (CPI) has evolved in the countries as this could partially account for the dynamics observed in the prices of mobile services and the level of affordability. It is for this reason that Annex 3 shows how the CPI has evolved in each country during the study period (2006-2009). In the countries compared, cumulative inflation has ranged between 10% (Peru) and 25.6% (Argentina), with 14% in Mexico, 15% in Brazil and 17% in Colombia. As regards the GDP per capita ratio in 2009 compared to 2006, at steady dollars, which is an approximation to the change in people's purchasing power in 2009 compared to 2006, it experienced a significant increase in all the countries (about 30%), with the exception of Mexico, where, in 2009, it fell to 89% of the value it had in 2006.

2.1. The 2006 low-usage basket

As noted, in 2006, the OECD considered 25 calls and 30 text messages (among other details such as duration, time of day, etc.) to be a low level of consumption of mobile services. Chart 1 shows how the value of this basket evolved between 2006 and 2009, considering what we call "effective basket", i.e. one that allows micro-refills, and therefore optimizes value for the consumer, since it means that all the money goes to

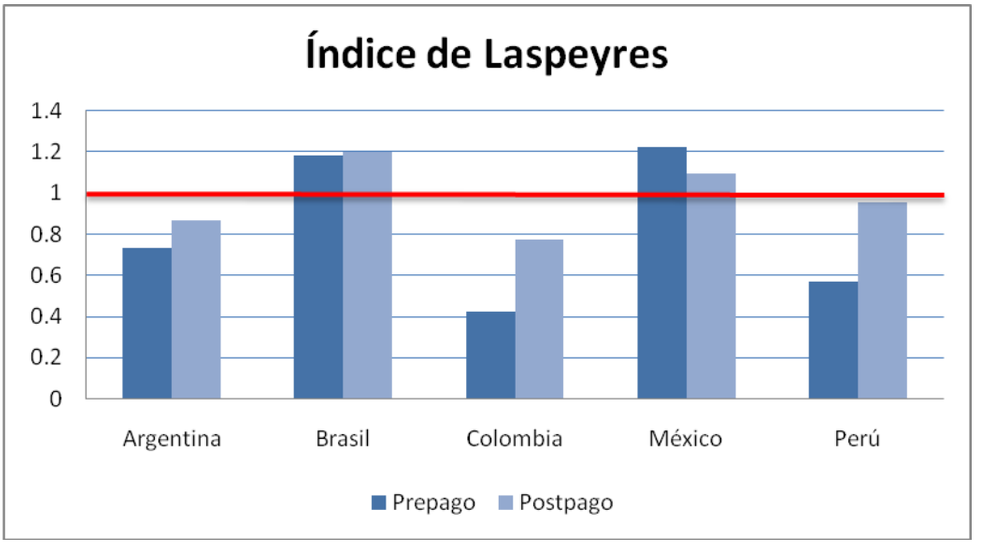
[5] Galperin (2009) does make comparisons between countries, because he takes a point in time. Our study seeks to make comparisons at two points in time (2006 and 2009).

buying traffic and is not lost in rounding up to a higher consumption unit. Annex 2 gives further details of the makeup of this basket.

Chart 1 shows the Laspeyres index value for the 5 countries in the study, both for the mobile service basket at the prepaid tariff and the same basket at the post-paid tariff. The results will show, according to the Laspeyres methodology, if there are differences between the two tariffs within the same country. In other words, if an index number is less than the unit, it means that the value of the basket fell during the study period, while if it is greater than the unit, the value has risen.

It must be remembered that since we have not converted the prices to a comparable currency, it is not possible to make comparisons between countries in terms of which has the lowest basket price or value. Our calculations only show which of them has improved the most in terms of affordability over the same period of time.

CHART 1. 2006 Prepaid and postpaid basket with the variation in prices between 2006-2009 (Laspeyres Index)



Prepaid Post-paid

Source: Tariffs reported by operating companies.

Devised by the authors.

The first conclusion emerging from chart 1 is that Argentina, Colombia and Peru experienced a decline in the value of the basket, Colombia being the most striking case, with the value of this basket dropping by almost 60% from the value it had in 2006 in the case of the prepaid service and 20% in the case of the post-paid service. It is followed by Peru, where the basket for the prepaid service fell to about half its value, and the post-paid service experienced only a slight reduction. Finally, there was a fall in Argentina too, with the cost decreasing to about 80% of the previous value both for prepaid and post-paid services. It should be pointed out that in the 3 countries where the basket price fell, prepaid services experienced a greater reduction compared with the value of the post-paid service basket.

The second observation is the increased value of the basket in Brazil and Mexico. The former experienced an increase of about 20 percent, both for prepaid and post-paid services. As regards Mexico, it experienced an even greater increase in the case of the prepaid service, and an increase in the order of 10% in the case of the post-paid service.

These findings invite explanations inspired by the existence of a duopoly at the regional level (Marshall, 2007). Firstly, one might think that competition has moved from a Cournot-style attribute competition to a Bertrand-style price competition. This explanation is plausible if the reductions in the value of the basket are accompanied by significant increases in the penetration of mobile telephony; that is, if there is certain aggregate elasticity. Indeed, increases in penetration do not occur in a vacuum; they actually start from a level of mobile teledensity at the time the comparisons begin. One might then think that countries that have already reached a high mobile teledensity will have a lower teledensity increase rate than countries with a low teledensity rate at the beginning of the comparisons.

In contrast to this hypothesis, the following chart shows the relationship between the decline in the value of the basket and changes in mobile phone penetration. Chart 2 only shows changes in prepaid service prices, as the post-paid service variations follow the same direction as those observed for the prepaid service, according to chart 1.

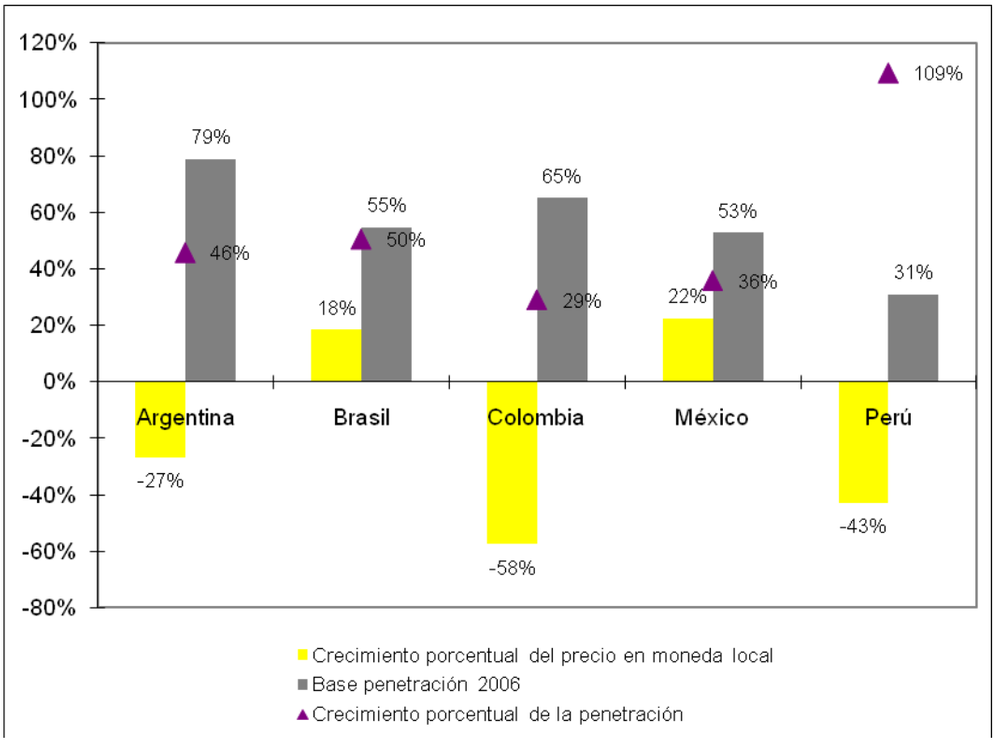
The interesting thing about this chart is the actual absence of a relationship between percentage changes in the value of the basket and penetration increases. The most striking case is Brazil, where the value of the basket increases as mobile teledensity increases. On the other hand, in Colombia, where the value of the basket falls by 58 percent expressed in the local currency, the penetration percentage increases

less than in Argentina (29 percent vs. 46 percent, respectively). One might think that this depends on the level of penetration from which the comparison starts, expecting higher percentage increases where penetration is lower. This is not the case in the comparison between Argentina and Colombia, since in Argentina, which has a higher level of penetration in 2006, penetration increased by a greater percentage than in Colombia, which started at a lower level of penetration. It can be inferred from this case that changes in penetration are not necessarily limited by the level of teledensity at the start.

The cases in which increases in the value of the basket go hand in hand with significant increases in penetration clearly indicate that it is only now that the edges of the market boundary are being reached. That is the case with Mexico and Brazil, which start with similar levels of penetration in 2007. It comes as no surprise that these are the largest countries in Latin America, with cities that are among the most populous in the world (Mexico City and Sao Paulo, respectively), and where the expansion of the supply of mobile telephony is therefore faced with significant costs when it comes to providing services across the country, not just in large cities.

The case of Peru stands out in all this landscape, with a significant reduction in the value of the basket (about 43 percent) coinciding with a doubling in the level of penetration (a 109 percent increase over a period of three years). This finding is in line with the result discussed in Barrantes and Galperin (2008), which placed Peru as one of the countries with the most restricted affordability in mobile telephony services. The case of Peru is evidence that not only is it possible to increase the penetration of telephony and reduce the cost of the service at the same time, as did Argentina and Colombia, but the increase in penetration can also be significant and bridge gaps in ICT access.

CHART 2. Changes in the value of the 2006 low-usage basket between 2006 and 2009, mobile penetration level and changes in 2006-2009



Percentage of price growth in the local currency

Penetration base 2006

Percentage of penetration growth

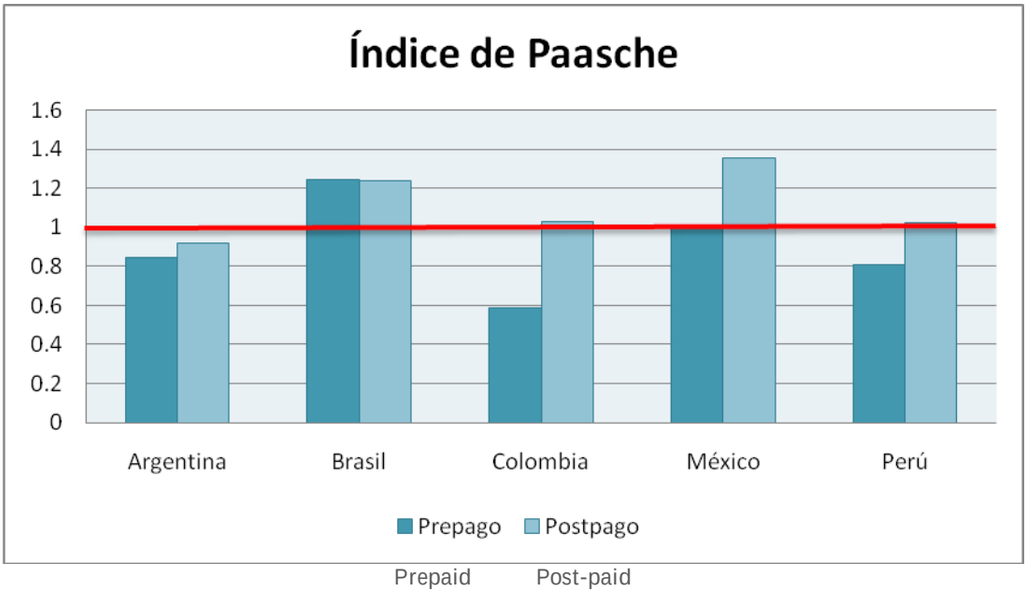
Source: Tariffs reported by operators, ITU.

Devised by the authors.

2.2. The 2009 low- usage basket

As noted in the introduction, the quantities of the 2009 basket were also valued at 2006 prices for a comparison with the prices in 2009. In this case, the quantities are significantly larger than those of the 2006 basket, as explained in Annex 1. If the prices of the services have not experienced significant changes, then the basket value is likely to be much higher when using this methodology.

CHART 3. 2009 Prepaid and Post-paid Basket with 2006-2009 price variation (Paasche index)



Source: Tariffs reported by operating companies.

Devised by the authors.

The first observation is that the behaviour is virtually the same as that in the previous case (Laspeyres methodology), especially as regards the prepaid service. However, the reductions are considerably less significant, since they are in the order of 42 percent in the case of Colombia and 19 in the case of Peru for the prepaid service. Curiously enough, the variation in the cost of the basket in the post-paid service for both countries is even reversed, with an increase of 3%.

The case of the prepaid service in Mexico is remarkable in that the value of the basket experiences a 22% increase when considering the 2006 basket, and the value remains unchanged when considering the 2009 basket. Instead, the increase in the case of Brazil is more significant for both services – 24% for both prepaid and post-paid – than in the case of the Laspeyres-method basket (18 and 20 percent, respectively).

This chart is a ratification of what was observed in the analysis in section 2.1 about Brazil and Argentina: Laspeyres and Paasche yield exactly the same behaviour, both for prepaid and post-paid. The results also confirm the reduction in tariffs for the prepaid service in Colombia and Peru. In the case of Mexico, the results confirm the increase in

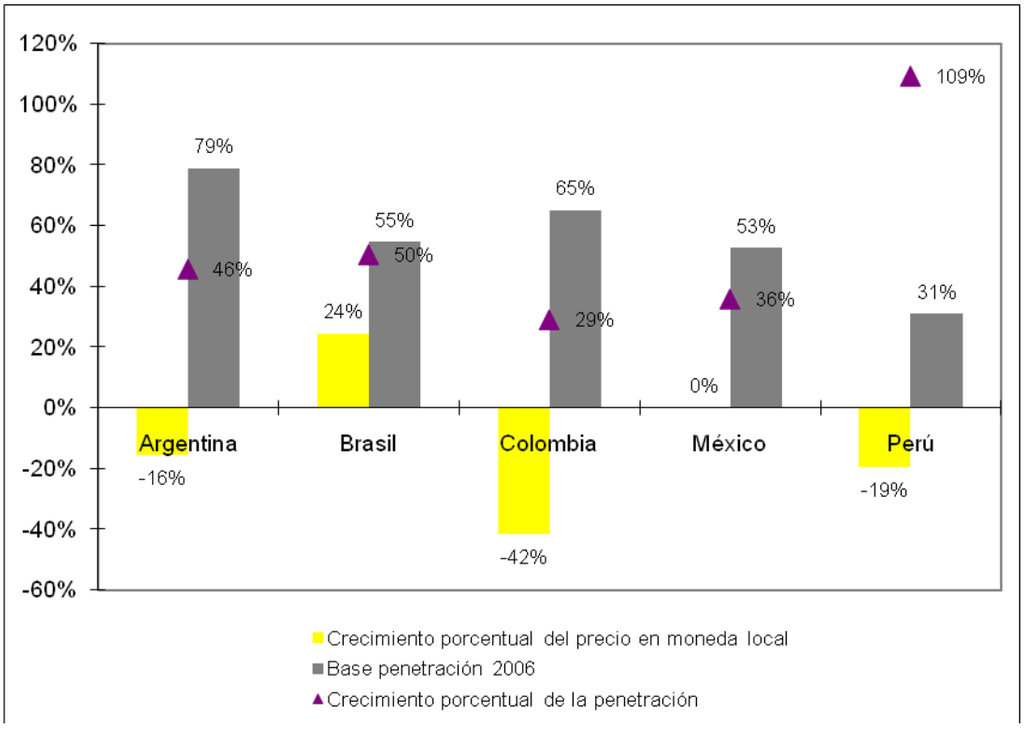
the cost of the post-paid service. Interestingly, the increases are more significant than those observed when a basket involving smaller quantities was considered, while the reduction percentages are less significant. For example, as mentioned earlier for the case of the prepaid service in Brazil, when the 2009 basket is taken as a basis, the increase is 24.3 percent, but when the basis is the 2006 basket, the increase is only 18.3 percent. Then, in the case of Colombia, the 57.5 percent reduction when considering the 2006 basket falls to 41.5 percent when considering the 2009 basket.

Returning to the exercise in chart 2, which seeks to illustrate the relationship between increases in mobile phone penetration and changes in the value of the basket when considering the 2009 quantities, the results for both the increase in Brazil and the reductions in Argentina, Colombia and Peru are similar to those found by using the Laspeyres methodology. The case with a change in the opposite direction is Mexico, where the variation goes from positive to neutral.

As regards Argentina, Colombia and Peru, it is clear that the increase in the quantities and changes in the weighting of some traffic affect the value of prepaid mobile services as perceived by users. The Laspeyres-method measurements show us greater reductions in the tariffs accompanied by significant increases in mobile teledensity.

Mexico is a different case: with the 2006 basket, the value of the basket increases between 2006 and 2009; if usage is higher, like that considered with the 2009 basket, the value of the basket does not vary for the same comparison for the same period, which is an unusual result. However, since we consider current prices, i.e. we do not take inflation into account, the basket retaining the same current value would actually mean that the value of the basket has declined, but the construction of the indices precludes the introduction of deflators to control this effect. This is a case that clearly shows the limitations of both indices as far as the substitution effect is concerned. The result obtained with the Laspeyres methodology, which assumes that the substitution effect is zero, is reduced welfare, while the Paasche methodology, which assumes that changes in relative prices result in substitution effects, shows no loss in welfare.

Chart 4. Changes in the value of the basket between 2006 and 2009, mobile penetration level and changes in 2006-2009



Percentage of price growth in the local currency

Penetration base 2006

Percentage of penetration growth

Source: Tariffs reported by operators, ITU.

Devised by the authors.

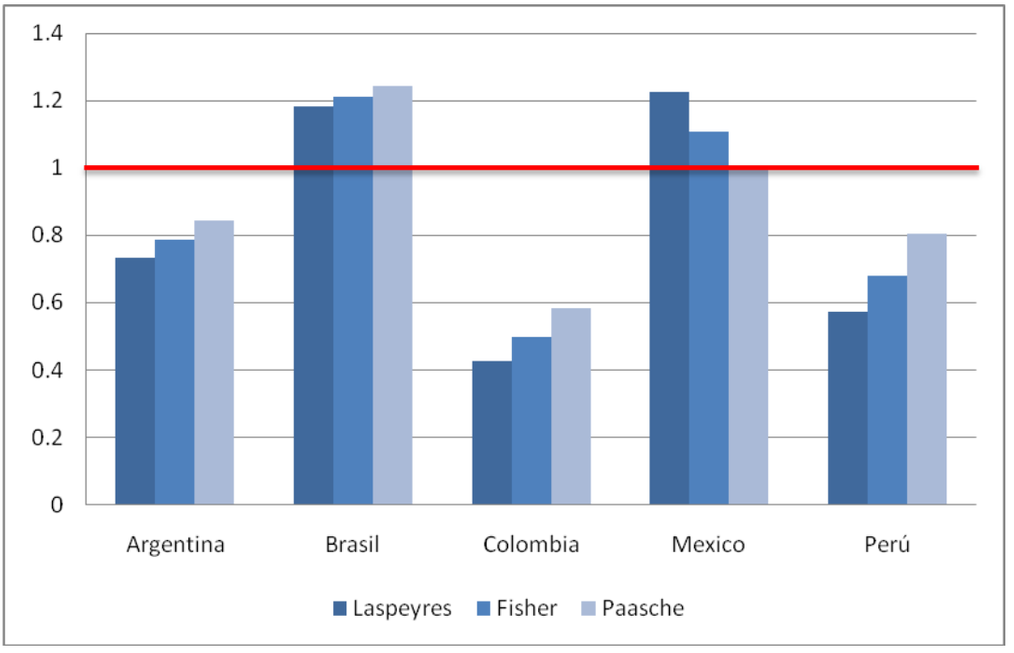
2.3. Discrepancy between index numbers

As expected, the two index numbers used show discrepancies in the results. One way to harmonize these potential differences is by using a third index. The Fisher index, which averages the Laspeyres and Paasche indices, can be used to tone down the possible biases in both indices. The Fisher index is constructed as the geometric mean of the Laspeyres and Paasche indices.

Chart 5 shows the results of the 3 indices for the case of the prepaid service. In this regard, when all 3 indices show the same results, both in terms of direction of change

and whether the index exceeds the unit or not, we have a statistically robust result of better or worse affordability.

CHART 5. Price Indices for Prepaid Service 2006-2009



Source: Tariffs reported by operators.

Devised by the authors.

It is then clear that only in the case of Mexico does the Paasche index (price variation using the 2009 basket as a basis) point to a different result from that of the other 2 indices. On average, then, it may be said that in Mexico the basket of mobile services has increased by 10.6% (compared with an increase of 22.3% in the Laspeyres index and 0% using the Paasche index).

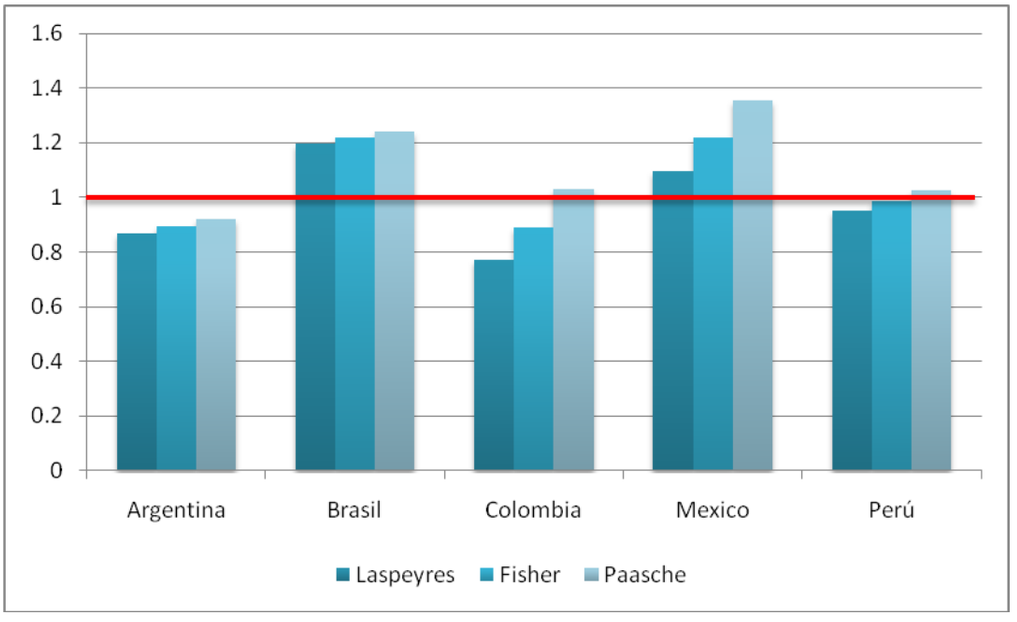
In the other countries where there was a fall in the price of the basket, the Laspeyres index shows a greater reduction than the Paasche index does. So, on average, the variations in these 3 countries are 32% for Peru, 21% for Argentina and 50% for Colombia. It must be pointed out that Colombia has experienced a more significant reduction in any of the 3 indices than the other countries.

Finally, it can be observed that in the case of Brazil the three indices show a positive change in the value of the basket. With all three methods, the percentage of change

borders on 20%. This is interesting since, as shown in Annex 3, neither a greater growth in GDP per capita nor a greater increase in inflation (compared to the other countries in the study) would account for the increase in mobile service prices.

However, in the case of the post-paid service, the results are slightly different from those shown in chart 5. The results can be seen in the chart below.

CHART 6. Price Indices for the Postpaid Service 2006-2009



Source: Tariffs reported by operators.

Devised by the authors.

The first observation is that, on average, the trend in price variations for the prepaid service is the same for the post-paid service, but the variations are less robust in the case of Colombia, Peru and Argentina.

In particular, the cases of Peru and Colombia show that by using the Paasche method (using the 2009 basket for comparison) it is even possible to see a 3% increase in the price of the basket for both. While this is only a slightly positive variation, it is an indication that, unlike what is observed in the price of the prepaid service, the post-paid service has not experienced the same trend towards more affordability. The average reduction for Peru and Colombia is only 1.2% and 10.9% respectively. It must be remembered that in the case of the prepaid service, the reductions were approximately

32% and 50% respectively. The case of Argentina is similar to that of Colombia and Peru, showing a reduction of only 10.6%, which is lower than the 21.3% reduction in the case of the prepaid service.

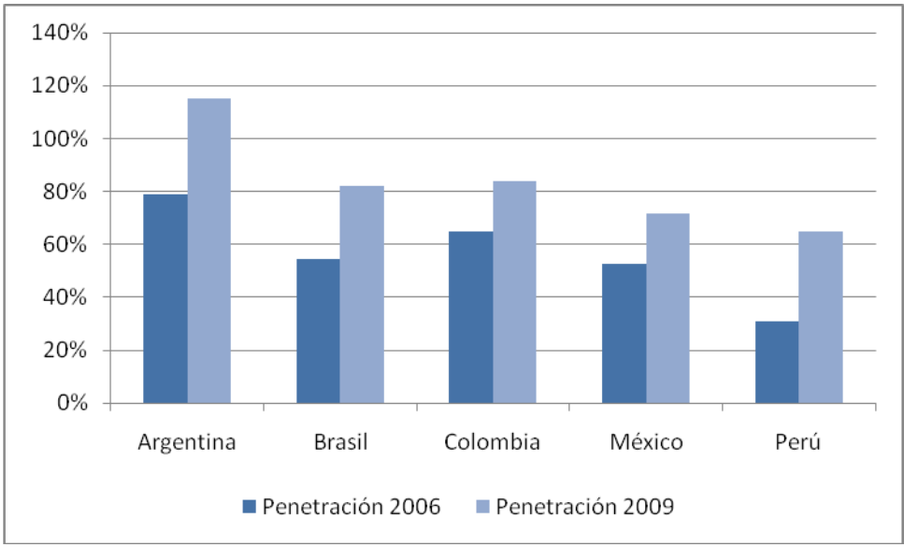
The case of Mexico is different because now the three indices show an increase in the cost of the basket – 22% on average. This average increase is the same as that experienced by Brazil. However, these results do not vary compared to those observed in the prepaid service. It is evident then that in Brazil, the prices of post-paid and prepaid services have varied in a very similar way, unlike the other countries in the study.

2.4. Evolution of the Prepaid/ Postpaid discrepancy

One of the most salient features of the analysis in Barrantes et al (2007) was the discrepancy in value between the pre- and post-paid baskets: the former was much more expensive than the latter in all the markets, except for Chile, which had a higher level of penetration. After three years of spectacular growth in mobile teledensity, we thought we should return to the subject of the discrepancies. Was it the case that the discrepancy was due to limited mobile penetration? What is the threshold in the level of teledensity at which the relationship between the value of the prepaid basket and the value of the post-paid basket starts to be reversed?

The first thing to look at is growth in penetration. Between 2006 and 2009, mobile penetration in Argentina had already exceeded 100%, followed by Colombia and Brazil, which had reached a level close to 80%. At the end of the line are Mexico and Peru – the countries where the duopoly is more intense, with Telmex dominating the Mexican market, and Telefónica dominating the Peruvian market. Another significant detail in comparing these two countries in this period is that Mexico's economic growth was not as dynamic as that of Peru, which may have affected the level of adoption of mobile services among the poorest.

CHART 7. Changes in teledensity 2007-2009



Source: ITU

Devised by the authors.

This is the context in which the discrepancies in value between the pre- and post-paid baskets are compared. Chart 8 shows the cost of the low-usage basket at prepaid tariffs as a percentage of the cost at post-paid tariffs. Using the Laspeyres methodology, i.e. using the 2006 basket as a constant for comparison, the result is that, as expected, the percentage decreased considerably in the cases of Argentina, Colombia and Peru. In Argentina, the prepaid basket went from 141% of the value of the same basket in the post-paid service in 2006 to 119% in 2009.

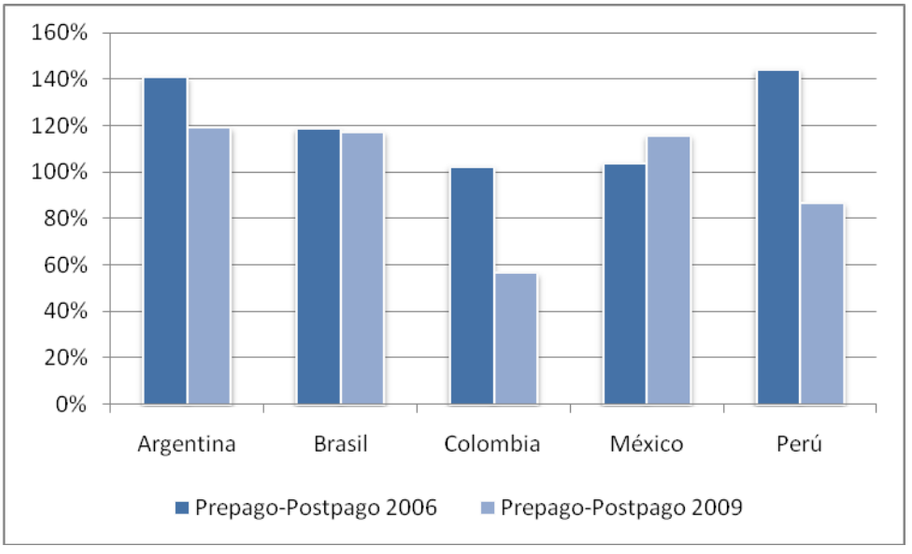
The cases of Colombia and Peru are the most remarkable because for both of them, the value of the post-paid basket in 2006 became more affordable in 2009. While in 2006 the cost of the basket in Colombia and Peru was 102% and 144% respectively, the values changed to 56% and 86% of the value of the basket in 2009. In both countries, the reduction in tariffs reversed the trend towards the prepaid service being more expensive than the post-paid service. These are the leading countries in tariff reduction, but Colombia is the country where teledensity has grown least. The fact that those on a lower income subscribe to the prepaid service is a clear sign of an improvement in the welfare of the poor in Peru, Colombia and, to a lesser extent, Argentina. The opposite occurs in Mexico, where the relationship worsens for prepaid services.

Another clear conclusion to be drawn from the chart is that this relationship has remained virtually unchanged for Brazil, which was to be expected in the light of what

was observed in previous sections, where it became apparent that variations in prepaid and post-paid tariffs go in the same direction and have the same magnitude.

Finally, it must be pointed out that in Argentina and Mexico, where teledensity has increased, the change in the composition of the prepaid service as a percentage of the post-paid service went in the opposite direction. In Argentina, the percentage of the prepaid basket in relation to the post-paid basket decreased from 141% in 2006 to 119% in 2009. By contrast, in Mexico, the opposite occurred: while in 2006 this percentage was 104% – a sign that prepaid and post-paid tariffs were similar –, the percentage rose to 116% in 2009. Mexico is the only country with this trend.

CHART 8. Laspeyres comparison of post-paid and prepaid tariffs (2006 Vs. 2009)



Prepaid-Post-paid 2006 Prepaid-Post-paid 2009

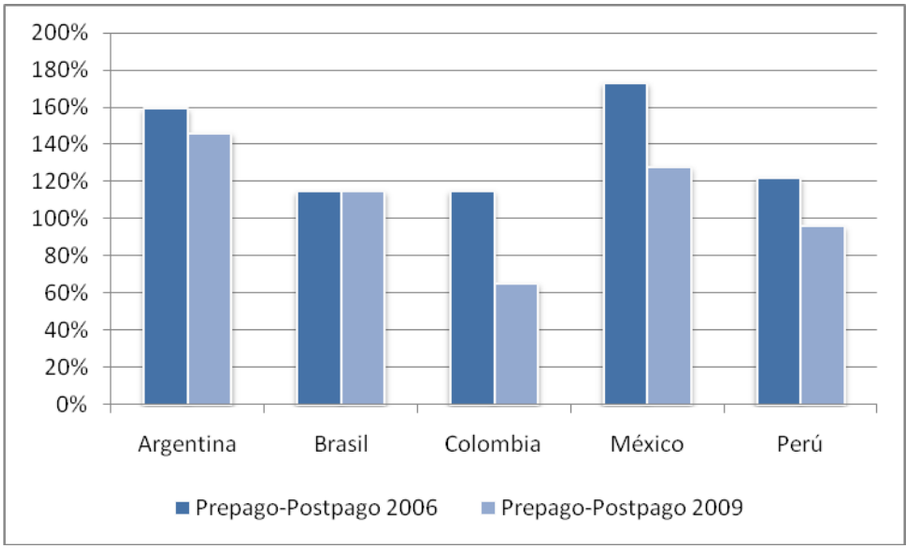
Source: Tariffs reported by operators.

Devised by the authors.

When considering the Paasche comparison, the results are confirmed, except for Mexico. While with the Laspeyres methodology, the ratio increases, with the Paasche methodology, the ratio decreases, which is a sign of improved welfare.

This, in turn, is a sign that both indices are imperfect and it is advisable not to use only one of the two but both, so as to avoid major misinterpretations. This requires, again, resorting to the Fisher index to reduce this discrepancy.

CHART 9. Comparison of prepaid/post-paid tariffs (2006 vs. 2009)



Prepaid-Post-paid 2006 Prepaid-Post-paid 2009

Source: Tariffs reported by operators.

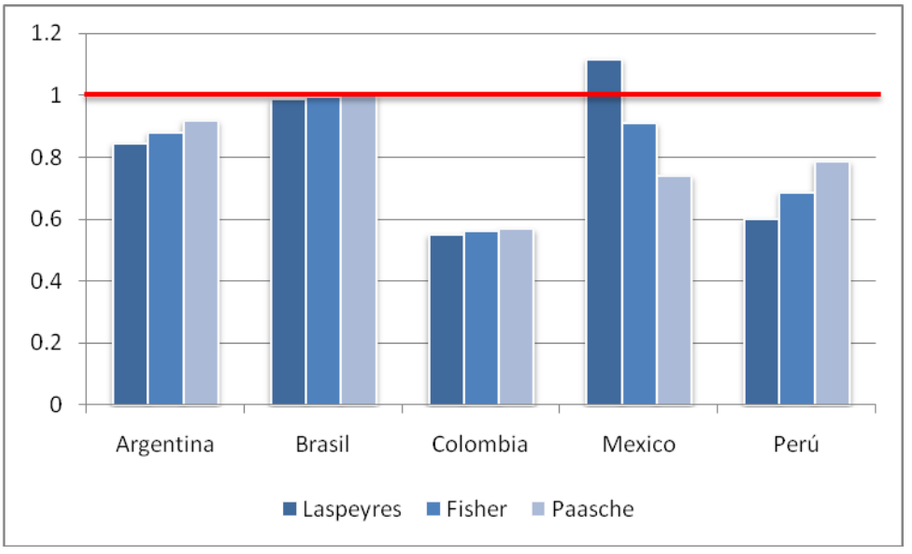
Devised by the authors.

Chart 10 shows the value of the 3 indices for the 5 countries in the study. So, instead of using the variation in costs as we did in Section 2.3, in this case we will use the variation in ratios as values for the construction of indices. The first two indices (Laspeyres and Paasche indices) can be constructed from the information provided in Charts 8 and 9, respectively, by dividing the second by the first column for each country. These indices can then be used to construct the geometric mean, which is defined as the Fisher index. We can then see that in all 5 countries, on average, the basket at prepaid prices has become more like the same basket at post-paid prices. The countries where this ratio has experienced the most significant reductions are: Colombia (44.1%) and Peru (31.3%). It must be remembered that these are the two countries that managed to reverse the trend towards prepaid being more expensive than post-paid.

Once again, Brazil is the country where this ratio has been reduced the least. This goes to show that no matter whether we take the year 2006 or 2009, and regardless of the methodology (Laspeyres, Paasche or Fisher), the value of the mobile services basket

at prepaid tariffs will always be approximately 115% to 120% of the value at post-paid service tariffs.

Chart 10. Price Ratio Indices (prepaid/post-paid) 2006-2009



Source: Tariffs reported by operators.

Devised by the authors.

3. Conclusions

Telecommunications services have undergone dramatic changes in the various features they offer. From this perspective, it would be reasonable to expect them to become more expensive as they are upgraded. At the same time, these are services that people regard as necessary, so it is also reasonable to expect them to be affordable for the majority. To complicate the picture further, they present three economic characteristics that drive prices in different directions. One of them is networking externalities, i.e. the larger the number of people that are connected, the more the services are valued. Another characteristic is that economies of scale reduce the costs of providing the services as the number of connected users rises. Finally, economies of scope contribute to significant savings by offering more features from one single network.

In this context, it is relevant to wonder how affordability varies over time. This brief research seeks to answer this question for five Latin American countries –Argentina,

Brazil, Colombia, Mexico and Peru – by using the baskets methodology promoted by the OECD for international comparisons, and comparing various methodologies for constructing index numbers (Laspeyres, Paasche and Fisher methods).

Apart from the different approaches to constructing index numbers, the interesting thing about this exercise is that the OECD changed the makeup of the mobile telephony low-usage basket, increasing the number of calls and SMS messages and the relative weighting of traffic during peak hours and on the mobile network. It is therefore possible to compare basket values, considering a possible substitution effect or the possible extension of network externalities.

The results of the exercise yield several lessons. Firstly, the magnitude of reductions in the value of the basket is significantly greater when using the Laspeyres methodology, i.e., when the quantities of the early period of comparison are taken as a basis. Since this index includes no substitution in the face of price changes, the result is to be expected.

Secondly, we describe as robust changes those observed when using the three index number methods, both in the same direction of change (increase or decrease) and whether they exceed the unit or not. This is the case of reductions in the value of the basket in Argentina, Colombia and Peru. Additionally, in all three cases, these reductions have been accompanied by significant increases in mobile density that do not depend on the initial level of teledensity in 2006, the year when the comparisons started.

In the third place, where the value of the prepaid basket decreased, the relationship between the value of the prepaid basket and the value of the post-paid basket decreased too. In other words, the prepaid service became cheaper compared to post-paid.

In the fourth place, the cases of Mexico and Brazil are noteworthy for two reasons. Firstly, in both cases, mobile teledensity increases despite increases in the value of the prepaid basket. Secondly, while in Mexico relative changes in the value of the prepaid basket depend on which methodology is used, for Brazil, any method finds increases in the order of 20% in the value of the basket.

In the fifth place, in the case of Brazil, whatever the methodology, the value of the basket has increased, and the trend towards equal values between prepaid and postpaid services has not occurred.

These results draw attention to two issues that the dynamic comparison of tariffs should address. Firstly, it is important to provide as much detail as possible about the methodology being used to make comparisons over time. Secondly, due to rapid technical change in telecommunications, which cause major changes in the various features of terminal equipment and the telecommunications services themselves, it is advisable to take as a basis for comparison either the latest basket, i.e. the Paasche methodology, or the Fisher index, which uses both the Paasche and the Laspeyres indices.

Finally, on the methodological front, several international affordability studies or tariff comparisons use the basket proposed by the OECD, which reflects the reality of telecommunications in those countries. It is important to draw attention to the need for studies providing a profile of the use of telecommunications services in several developing countries, particularly in Latin America.

Another line of work that opens up in the light of the analysis presented is on the regulation of mobile services. Recently, there have been changes in regulatory frameworks that impact on affordability, the effect of which will be observed in the medium term and should be included in the analysis of future comparisons. Number portability has recently been introduced in Peru, Mexico and Brazil and as yet there are no known studies on the effects it has had on tariff competition. In Mexico, the Fundamental Technical Plan for Interconnection and Interoperability, which sets terms and conditions for promoting both, was published in February 2009. In Brazil, there were several regulations regarding the following topics: the value of taxes on the production of mobile terminals, percentage of production of cellular terminals receiving ISDB-T (digital TV), economic index for the updating of tariffs, new allocation of spectrum for trunking systems, limits to interference in maritime mobile services and court decisions regarding the transition from SMC (old mobile service) to SMP (the Brazilian equivalent to PCS). In Colombia, the mobile-to-mobile access charge has been reduced by almost 50%. The impact of these measures on improvements in access and use of mobile services by the poor is yet to be analyzed.

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Annex 1 – The Makeup of Baskets

The table below shows the makeup of the 2 baskets used for this study[6] in 4 major areas: The volume of calls and text messages, time of day, destination of calls and their duration.

1. Volume of calls and text messages. The new basket has introduced a larger number of calls. The old and new quantities on a monthly basis are as follows:

	Voice (in number of calls)	SMS (in number of messages)
New Basket	30	33
Old Basket	25	30

2. Time of day. The distribution of calls during the day has been modified, with the introduction of a higher percentage of peak-hour calls and a lower percentage of off-peak-hour calls.

	Peak	Off-Peak	Weekend
New Basket	48%	25%	27%
Old Basket	38%	35%	27%

3. Destination of calls and SMS messages. The distribution in the new basket according to destination includes a higher percentage of on-net and off-net calls

[6] For further details, see OECD (2006) and OECD (2010).

compared to the "old" basket (reducing local and national calls in the new one). New categories are added for on- and off-net SMS.

	Local	National	On-net mobile	Off-net mobile	On-net SMS	Off-net SMS
New Basket	15%	7%	48%	22%	65%	35%
Old Basket	28%	14%	40%	18%		

4. Call duration. The duration of calls to landlines is slightly reduced.

	Fixed	On-net mobile	Off-net mobile
New Basket	1.5	1.6	1.4
Old Basket	1.6	1.4	1.4

Note: The durations are given in minutes and fractions of a minute (1.4 is 1 minute and 24 seconds).

Annex 2: Price Index Formulae

Mathematical Formula

$$IP_{Laspeyres} = \frac{\sum p_1 q_0}{\sum p_0 q_0} = \frac{\text{Pr}eciosNuevos * CanastaVieja}{\text{Pr}eciosViejos * CanastaVieja}$$

$$IP_{Paasche} = \frac{\sum p_1 q_1}{\sum p_0 q_1} = \frac{\text{Pr}eciosNuevos * CanastaNueva}{\text{Pr}eciosViejos * CanastaNueva}$$

(Translator's Note: *Precios Nuevos* = New Prices; *Precios Viejos* = Old Prices; *Canasta Nueva* = New Basket; *Canasta Vieja* = Old Basket)

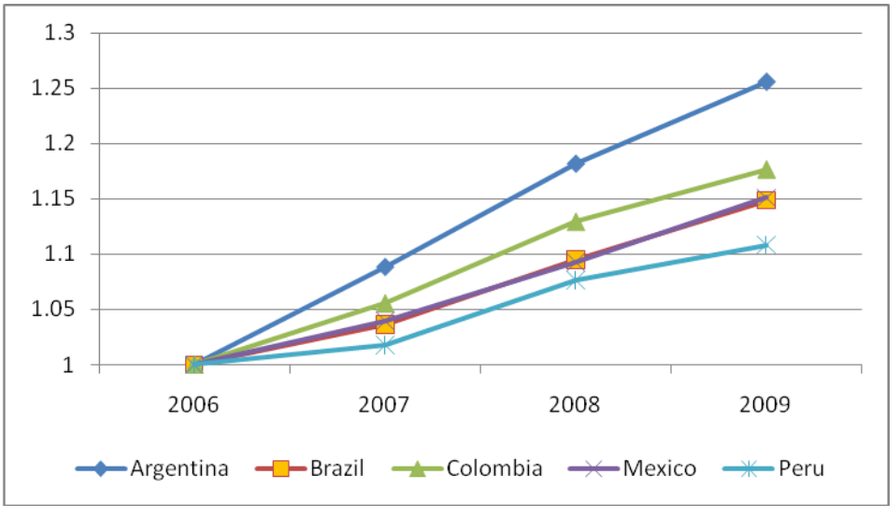
$$\Delta IP_{Fisher} = \sqrt{(IP_{Laspeyres} - 1) * (IP_{Paasche} - 1)} \text{ OR } \Delta IP_{Fisher} = \sqrt{\Delta IP_{Laspeyres} * \Delta IP_{Paasche}}$$

Annex 3 – Evolution of Inflation and Real Income

Evolution of the Price Index (CPI)

Chart A3.1 shows how the prices of the basic usage basket have increased, as measured by the Consumer Price Index (CPI).

Chart A3.1 – Cumulative Inflation for the period 2006-2009



Source: World Development Indicators - World Bank

Devised by the authors.

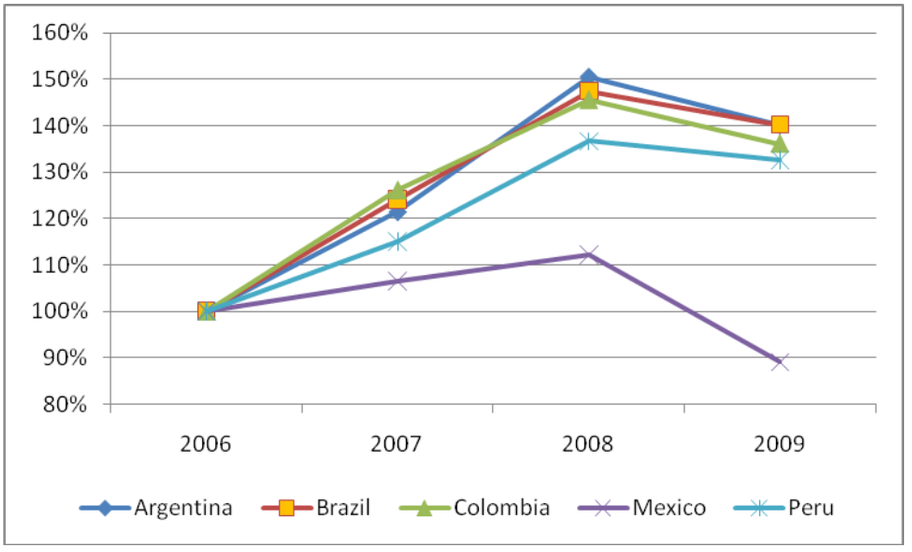
The chart shows that in Argentina there was a significantly greater increase than in the other countries studied. Indeed, if we compare the prices of the basic basket between 2009 and 2006 we find that they are 25.6% higher. This value is significantly lower in Colombia, Brazil and Mexico, where prices rose by 17, 15 and 14% respectively. The country with the lowest cumulative inflation is Peru, where prices rose by only 10% over that period.

Based on this information, we can safely say that affordability has improved in the countries where prices have increased less.

Evolution of purchasing power

While indicators of price evolution give us an overview of how other prices in the economy are evolving, income indicators will tell us how purchasing power has evolved in these countries during the study period. Chart A3.2 shows the national GDP per capita ratio for the years 2006-2009.

Chart A3.2 – Evolution of National GDP per capita in constant dollars in 2007-2009 compared to 2006 (percentage)



Source: World Development Indicators - World Bank

Devised by the authors.

Under the assumption that the growth of GDP per capita has been redistributed among all the inhabitants of the country, the purpose of the chart is to try to show how GDP changed in 2009 compared to 2006 to understand whether the increased or reduced affordability of prices of mobile services is a result of the increased or reduced purchasing power of households. If they have higher incomes, households will be willing to pay more for a better service. The opposite might be observed in countries where income growth has been lower because the operators in these countries might reduce the price of the service in order to increase the number of users.

According to the chart, the dynamics of GDP per capita is similar in Argentina, Brazil, Colombia and Peru, where GDP in 2009 is 40, 40.2, 36 and 32% higher than it was in 2006. The behaviour in Mexico was different, with GDP falling to 89% of the value it had in 2006. This would mean that there have been no major differences between countries with different behaviours as regards the operators' prices or strategies. However, the demand for mobile phones could be expected to experience an "income effect" which would push up prices, but this phenomenon is only observed in Brazil and Mexico.

However, one must take into account the shock experienced by the economies in 2009 as a result of the financial crisis, which changed the trend in the 5 countries in the study. This can clearly be seen in the observations for the last year and could give us an

incorrect view of household income that year since the crisis largely hit the financial and export sector rather than all the economy to the same extent.