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In Search of Efficiency Gains While Protecting Low-Income Households

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Abstract[1]

Prices transmit information and guide consumption and production decisions. In electricity markets prices usually do not reflect marginal costs of production, and therefore there are opportunities for efficiency gains by rebalancing tariffs. The objective of this paper is twofold. The first goal is to assess the inefficiencies of existing residential electricity tariffs in Uruguay, and some possible long-term consequences for the public electricity company's finances if they are not corrected. The second goal is to study alternative pricing mechanisms that avoid incentives for inefficient behavior, while protecting low-income households. The estimated deadweight loss under the current tariff structure and residential electricity consumption is estimated at 1.2 percent of the total consumer surplus (USD 37 million).

JEL classifications: L11, L13, L94
Keywords: Residential electricity tariffs, Efficiency, Income distribution, Distributed energy resources

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1. Introduction

Prices transmit information and guide consumption and production decisions. In perfect competitive markets, prices reflect the marginal cost of production of goods. This is not usually the case in electricity markets, where monopoly power, public policies and regulations coexist, generating a gap between prices and marginal costs. Even if some regulations and policies that distort prices could have good justifications, for example, on income distribution or energy poverty grounds, if prices do not reflect marginal costs, consumption decisions are nonetheless distorted, implying social losses.

In the first best-solution, prices should be determined by marginal costs, and distributive and other considerations should be dealt with by lump-sum transfers or taxes that do not distort decisions. However, sometimes only second-best solutions are available, for different reasons, including political economy considerations. In this case, it is important that the costs of the second-best solutions be made explicit.

The objective of this paper is twofold. First, we want to assess the inefficiencies of the existing residential electricity tariffs in Uruguay and some possible long-term consequences for the public electricity company's finances if they are not corrected. Second, we want to study alternative pricing mechanisms that avoid incentives for inefficient consumption and production behavior, while protecting low-income households, which might be vulnerable to energy poverty and exclusion.

This paper is organized as follows. In Section 2 a brief description of the electricity market in Uruguay is given. Section 3 describes the residential tariff structure in Uruguay. Section 4 evaluates the inefficiencies in the current tariff structure and proposes an efficient one. In Section 5 we perform an exercise to quantify the efficiency gains and the distributive effects of adopting the suggested efficient tariff scheme. Section 6 evaluates the possible consequences on the public company's finances of the adoption of distributed energy resources under the current tariff scheme. Finally, Section 7 concludes.

2. The Electricity Market in Uruguay

The electricity market in Uruguay has different market structures in different stages of the electric chain. The market is open to competition in the generation and commercialization stages, while it is a legal monopoly in the transmission and distribution stages.

It should be noted that the transmission and distribution stages evidence the typical characteristics of a natural monopoly. That is, high sunk costs associated with the construction and maintenance of the electricity network, which, added to the small size of the market, means that there is no possibility of a market with many companies competing profitably.

The legal framework does not seem to be an obstacle to competition in the electricity market. The public legal monopoly is defined only in the stage that can be characterized as a natural monopoly, while the other stages are open to competition.

The Unidad Reguladora de los Servicios de Electricidad y Agua (URSEA), the regulator, is responsible for setting the tariff for the use of the network in the distribution stage, that is, in the only stage where the monopoly is legal. Tolls are fixed with the support of international consultancy firms, following international standard methodologies. According to the URSEA, the tariffs are fixed in order to ensure that the public supplier company, the Administración Nacional de Usinas y Transmisiones Eléctricas (UTE), can recover its operating costs, the amortization of the capital required for production and a reasonable utility. In this sense, the established rates avoid the setting of monopoly prices, limiting the loss of market efficiency.

Considering the points mentioned above, the legal structure of the electricity market in Uruguay would seem to present an appropriate design, which seeks to avoid the extraction of monopoly rents and therefore a consumption level lower than the socially optimal.

However, in practice, there are some significant deviations from the desirable functioning of the market that lead to potential efficiency problems. In this sense, there is still a significant margin for improvements in the regulation.

First, in the stages of generation and commercialization, although there is no legal barrier to the free entry exit of companies, neither of the two cases shows the characteristics of a competitive market. Indeed, in the case of commercialization, there are no companies competing with the state-owned UTE, so in practice, there is a monopoly market. In the generation stage, although the entry of new generators is increasing, the market continues to display strong concentration.

Market power is magnified by an inelastic demand. Available estimations show that the price elasticity of electricity demand is within the 0.1-0.3 range (Fernández, 1997; Lanzilotta, Carlomagno and Sanromán, 2009; Lanzilotta and Rosá, 2012). This inelastic demand implies that the optimal monopolist price will deviate from the marginal cost.

Despite the strong concentration of the market in the stages of generation and commercialization, in both stages the URSEA has a rather testimonial role in setting prices.

Prices of commercialization of electricity of UTE to final consumers (residential, commercial or industrial), are proposed by the company itself, but ultimately defined by the Executive Power. In addition to UTE proposal, the Executive takes the final decision on pricing, considering a technical report from URSEA. Unlike the case of distribution tariffs, where URSEA sets prices, in the case of final consumer UTE tariffs the URSEA report is simply an input into the Executive's final decision.

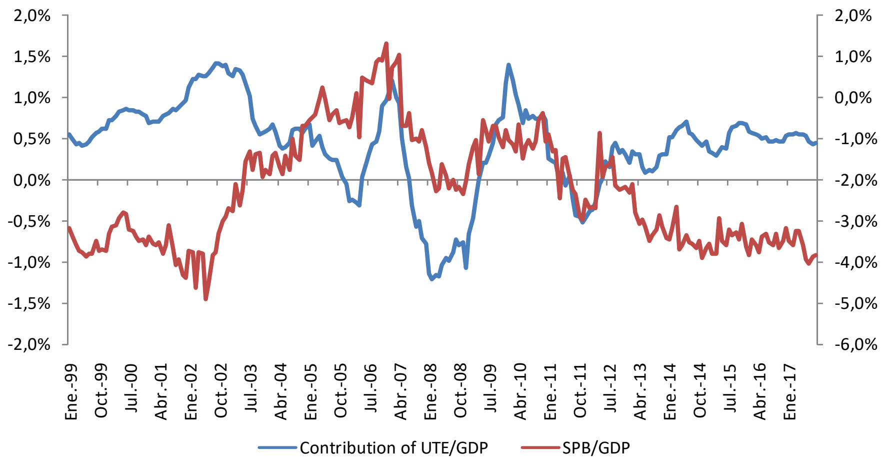
The interviews carried out with different relevant agents of the sector led us to conclude that in practice, neither the UTE proposal nor the URSEA report are definitive elements in setting the final prices. Indeed, prices are set according to several objectives pursued by the Executive Power in terms of contribution of public companies to the Central Government's finances and other strategic objectives linked to the competitiveness of the economy, inflation, etc.

The multiplicity of objectives of the public monopolist (in practice, the Executive Power) determines that, despite its strong market power at all stages of the chain, it often does not act as a pure profit maximizer. Consequently, the observed prices do not necessarily coincide with those that would arise from the solution of a pure monopolist. This could imply a lower extraction of monopoly rent and efficiency loss compared to the pure monopoly solution.

Evidence of this behavior, guided by multiple objectives, is that during the last two decades, there were several instances in which the contribution of UTE to the public sector was negative (see Figure 1). The existence of negative profits in a monopolistic market that faces a strongly inelastic demand could only be explained by a price-setting behavior with objectives other than profit maximization, such as inflation control (as was the explicit goal in several instances in Uruguay).

Still, it is interesting to analyze how the contribution of UTE to public finances shows a negative correlation with the result of the global public sector (see Figure 1). This negative correlation suggests two phenomena. In the first place, UTE has strong market power that allows it to increase prices and extract monopoly rents in certain periods. Second, when the fiscal situation shows weaknesses, the contribution to public finances seems to gain importance in the government's preference function.

Figure 1. Contribution of UTE to the Public Sector's Finances and Public Sector Balance (as % of GDP)



Source: Ministry of Economy and Finance (MEF) and Central Bank of Uruguay (BCU).

For instance, we can observe how, at the end of 2011 or 2008, when there was some fiscal space, but the growth of inflation was the main concern for the authorities, the contribution of UTE becomes negative. In this case, is clear that the Executive Power set the prices prioritizing objectives other than the benefits of UTE.

3. The Residential Tariff Structure in Uruguay

Tariffs for residential electricity consumers in Uruguay are regulated by the Executive Branch. Every end of the calendar year UTE submits a proposal for the adjustment of the applicable tariff scheme. This information is considered by the Executive Branch, which determines tariffs at the beginning of each year.

All residential tariffs are designed in a way such that the household that consumes more electricity is the one who pays more. Additionally, residential tariffs include incentives for the efficient use of the distribution network, encouraging the consumption of electricity off peak hours. Specifically, residential consumers have access to four different tariff schemes, according to their contracted power and variable consumption needs (see Table 1 for detailed information).

The residential tariff entails a fixed charge (composed of a monthly fixed charge plus USD 1.85 per kW of power contracted), and a variable charge tied to monthly consumption measured in kWh. Residential consumers pay USD 0.15 for the first 100 kWh, then USD 0.19 up until 600 kW, and finally USD 0.24 for consumption levels above 601 kWh. This tariff applies to residential consumers connected at tension levels between 230 V and 400 V, with contracted power less or equal than 40 kW.

The residential double schedule tariff is optional for residential consumers with contracted power of more than 3.3 kW and less than 40 kW. It has a higher monthly fixed charge than the previous tariff, although it still charges the same USD 1.85 per kW of power contracted. UTE provides a free service for residential consumers to check if it is worthwhile for them to switch to the residential double schedule tariff. Variable charges depend in this case of the time of the day at which electricity is consumed. Peak hours (5 pm to 11 pm) consumption is almost 2.5 times more expensive than non-peak hours (the rest of the day).

The residential triple schedule tariff, available since September 2018 (not included in the simulations of the next sections), follows the same principles as the double schedule tariff, and it is optional for the same type of residential consumers that apply to the previous scheme, but for contracted power of more than 3.7 kW. It has the same monthly fixed charge and charge per kW of contracted power than its double counterpart. However, this tariff breaks the off-peak hours into two time frames: valley hours (12 am to 7 am) and shoulder hours (7 am to 5 pm and 11 pm to 12 am). Peak hours are priced at the same level as the residential double tariff, USD 0.26 per kWh, whereas shoulder and valley hours are around one half and one fifth of the peak hour variable charge, respectively. This schedule is meant to optimize the use of the network considering the relative abundance of wind energy generated at night.

Finally, the residential basic tariff is optional for residential type consumers with contracted power of less than 3.7 kW. For customers to access and remain charged at this rate, they cannot exceed more than twice the threshold of 230 kWh per month during a year. If this were to happen, customers are automatically switched to the residential simple tariff. The monthly fixed charge, which includes 100 kWh per month, is set at USD 9.69. Variable charges according to monthly total consumption, penalize more heavily the consumption bracket in between 141 kWh and 350 kWh: 1.8 times the price set for the 101 kWh to 140 kWh and 1.5 times more expensive than the above 351 kWh interval.

Table 1. Residential Tariff Structure in Uruguay (August 2018)

Type	Price in US Dollars		Total Coverage		Average household (HH) consumption	
	Fixed charge	Variable per kWh	# of HH	MWh/year	kWh/month	Description
Residential	5.97 + 1.85 per kW of power contracted	0.15 0.19 0.24	956,703	263.625	23	Consumption between 1 and 100 kWh per month Consumption between 101 and 600 kWh per month Consumption above 601 kWh per month
Residential Double Schedule	10.8 + 1.85 per kW of power contracted	0.26 0.10	75,213	56.914	63	Peak hours: 17 to 23 Off peak hours
Residential Triple Schedule	10.8 + 1.85 per kW of power contracted	0.26 0.14 0.05	N/A	N/A	N/A	Peak hours: 17 to 23 Shoulder hours: 7 to 17 and 23 to 0 Valley hours: 0 to 7
Residential Basic	9.69	0.20 0.36 0.24	301,422	39.981	11	Consumption between 101 and 140 kWh per month Consumption between 141 and 350 kWh per month Consumption above 351 kWh per month

4. Addressing Inefficiencies in the Current Tariff Structure

This section discusses the existence of inefficiencies in the current structure of UTE's residential tariffs, their impact on social welfare and the possible distortions that these inefficiencies can generate on the consumption and production decisions of agents. Additionally, we study alternative pricing mechanisms that avoid incentives for inefficient consumption and production. In the next section we simulate the impact of adopting this alternative tariff scheme on consumption levels, welfare and income distribution.

The main source of inefficiency observed in UTE's residential tariffs arises as a result of the fact that current prices do not reflect the marginal costs of the generation, distribution, and commercialization of electricity. Efficient pricing for electricity (or any other good) is such that the price that consumer pays for one additional unit of consumption is equivalent to the cost of supplying that additional unit, that is, when the price coincides with the marginal cost.

When prices differ from marginal costs there will be distortions in the consumption and production decisions. Indeed, this mismatch between the tariff and cost structures could lead to inefficient allocation of resources. Particularly, these inefficient price signals could affect incentives for investment in the sector.

To address this type of deviation between tariffs and costs associated with production and distribution, a quantitative exercise focused on residential tariffs is carried out in this paper. This exercise describes and calculates the changes in the tariff schedule that would lead to a more appropriate price structure.

Currently, UTE applies a two-part tariff scheme, where consumers pay a fixed charge independent of the consumption level and an additional charge for each KWh consumed as described in Section 2.

This kind of tariff scheme is typically designed to establish a unit price per KW equal to the marginal cost, while a fixed fee is set to recover sunk costs, basically linked to network investments. Under this two-part tariff scheme, if the marginal price equals the marginal cost, and if the resulting charge does not cause any potential consumer to stop buying, the allocation of resources is almost efficient (Feldstein, 1972; Ng and Weisser, 1974; Auerbach and Pallechio, 1978).

The tariff structure in Uruguay shows a very different picture. Indeed, the fixed part in most of UTE's types of tariffs account for between 10 percent and 15 percent of the average total price charged to consumers (see Table 2), while our estimation suggests that fixed costs represent around 70 percent of total costs.[2] Moreover, the variable charge for KWh consumed is clearly larger than the marginal costs associated with its generation.

This tariff design clearly implies that part of the fixed costs is recovered in the variable part of the price. This tariff-setting strategy (informally referred to in UTE as “energizing the power”) was explicitly addressed in interviews with UTE management, where it was justified from two different perspectives.

On the one hand, it was argued that it is an imbalance that operates as a redistributive policy, allowing households with lower incomes and therefore lower consumption to access energy at a lower price. In this sense, a cross-subsidy is made from the largest consumers to small consumers. This again shows how public monopolies tend to pursue multiple objectives, in this case, linked to distributive equity, instead of pure profit maximization.

Table 2. Electricity Tariffs in 2017 (average by type of customer)

Type of Tariff	Fixed Charge Month (per consumer USD)	Variable Charge (USD/ MWh)	Avg. price (USD/ MWh)	Consumption (MWh per month per consumer)	Bill (per consumer per Month, USD)	# Consu mers (1,000)	Total Annual (GWh)	Total Annual Bill (Million USD)
Basic Residential	10.3	103.7	103.3	0.12	12.3	261	373	38.5
Residential	8.3	192.8	228.8	0.23	53.1	982	2,734	625.5
Residential double schedule	13.5	189.8	213.6	0.57	121.1	69	467	99.7
Total						1,311	3,574	763.7

Source: UTE, Ministry of Industry, Energy and Mining (MIEM) and authors’ calculations.
Notes: The number of customers (NC), fixed charges (FC), the average tariff (AT) and the total billed annually measured in MWh (TBA_MWh) for each type of tariff is reported by MIEM. Total billed annually in USD (TBA_USD) is computed as the product of the average tariff and the total billed annually measured in MWh (TBA_USD=TBA_MWh*AT). The variable charge (VC) is computed as: VC = (TBA_USD – NC*FC*12)/TBA_MWh. Finally, the average monthly billed (AMB) is computed as: AMB = FC + VC * AVCM, where AVCM is the average monthly consumption. The average monthly consumption is computed as AVCM=TBA_MWh/(NC*12). USD = US dollars.

[2] See Appendix 1 for details.

However, these types of cross-subsidies are not readily apparent to the general public, and one of the objectives of the regulator should be to make transparent all existing cross-subsidies in the tariff structure. Even in the case where the objectives pursued are relevant, it is necessary to make them explicit and their costs transparent for the public. Additionally, there may be better instruments to achieve these objectives without generating distortions in price signals.

On the other hand, it has been argued that this tariff structure represents strategic behavior from a dynamic point of view. Reduced fixed costs stimulate the connection to the network of a greater number of consumers, which in turn permits an increase in economies of scale by diluting the fixed costs among a larger number of customers. We will discuss this latter point in the price rebalancing exercise.

Even considering the arguments made above, the distortion in the tariff structure has at least two important consequences. First, it implies a distortion in the price signal that could induce inefficient consumption levels. Indeed, fixing prices above the marginal cost leads to a lower level of consumption in comparison with the social optimal one. This situation leads to the emergence of a deadweight loss in the market. Second, it could imply a distortion in the incentives to invest in small-scale solar and wind generation, usually identified as distributed energy resources (DER). For instance, the current tariff structure could incentivize larger residential consumers to invest in DER in order to avoid the cross-subsidy to small consumers.

Note that this rational decision for larger residential consumers could have important consequences. Indeed, if fixed charges are lower than fixed distribution costs, then residential users who invest in DER but continue to be connected to the distribution network will pay a lower price for distribution. This situation, in addition to generating a regressive distributive effect different from the one sought with the current pricing structure, could lead to a lower level of investment and maintenance of the network.

Therefore, there are good reasons in favor of a rebalancing of the current two-part tariff scheme. Here we make a numerical exercise proposing a price structure in the sense of Feldstein (1972). In what follows we will refer to the proposed rebalanced tariff scheme as the “efficient tariff.”

4.1 The Efficient Tariff

In this section we estimate and simulate the effects of an efficient two-part tariff, where the fixed charges allow recovering the fixed costs of UTE while the variable charge coincides with the marginal cost of supplying the electricity.

Since in this case the decisions on consumption will be taken based on the marginal cost of electricity, this type of tariff would eliminate the deadweight loss of the market. In addition, this design of the tariff avoids cross-subsidies from larger consumers to small consumers and therefore reduces the implicit incentives to invest in DER for the first type of consumers. As mentioned above, we focus on residential consumers.

The first step of the exercise consists of the identification of fixed and variable costs of the electricity chain. We use information from MEF, Administration of the Electricity Market in Uruguay (ADME) and URSEA in order to estimate the share of fixed and variable costs in the generation, transmission and distribution stages. Commercialization costs were assumed as variable costs. In Appendix 1 we present more details regarding the computation of fixed and variable costs.

Once we obtained an estimate of the total fixed costs, we distribute it among consumers in order to compute the fixed part of the efficient two-part tariff scheme. The proposed tariff included in Table 3 distributes 44 percent of UTE’s total fixed costs, which represent the share of MWh consumed by residential consumers in the total MWh billed by UTE in the year 2017, equally among all residential consumers. An alternative proposed tariff scheme, computed and presented in Appendix 2 of this document, was designed in a way that the fixed part of the tariff allows recovering 91 percent of UTE’s total fixed costs, which represents the share of residential consumers in the total number of UTE’s consumers.

Finally, we set the variable part of the optimal two-part tariff equal to the marginal cost. Marginal costs were aproximated from the spot price in ADME, which reflects the marginal costs of generation. We consider the average marginal cost for the year 2017.

The exercise presented in Table 3 implies a significant increase in the bill of basic residential customers (assuming constant the consumption in MWh) of 211 percent. On the other hand, it implies a reduction of the average bill for the residential and residential double schedule tariff of 22 percent and 57 percent, respectively.

This result makes evident the presence cross-subsidy from larger to smaller consumers. The consumers who choose the double schedule tariff are the group that would be the most favored by the adoption of this efficient tariff.

Nevertheless, the efficient tariff, based on an equal distribution of the fixed costs among all consumers could have at least two problems. First, as mentioned above, it implies a lower average price for larger consumers, which would affect the initial distribution of income, possibly in a regressive way. However, this kind of efficient tariff could be accompanied by other redistribution policies that do not affect efficiency in the electricity market.

Second, it would be necessary to study if the fixed charge is not too high for the smallest consumers. The fixed charge of a two-part tariff can never be higher than the consumer surplus associated with the variable price. Otherwise, the consumer will choose not to consume the good. In the presence of different types of consumers and only one fixed charge, the fixed charge should not be higher than the lowest surplus of the different consumers (the issue is discussed in more detail in Appendix 3).

However, if the fixed charge is determined by the lowest surplus of all consumers, it will be still relatively detrimental to small consumers in the sense that while small consumers could lose all their surplus (or an important part of it), larger consumers would lose only a small part of it in the payment of the fixed charge. This situation is inconsistent with the explicit objective of income redistribution expressed by UTE management in our interviews.

Table 3. Electricity Tariffs in 2017 If They Were Set Efficiently (average customer by type of tariff)

Type of Tariff	Fixed Charge Month (USD)	Variable Charge (USD/ MWh)	Avg. price (USD/ MWh)	Average consumption (MWh month)	Bill (per consumer per month, USD)	# of consumers (1,000)	% change with respect to actual tariff scheme		
							Monthly bill	Fixed charge	Variable charge
Basic Residential	34.76	29.7	321.3	0.12	38.3	261	211	237	-71
Residential	34.76	29.7	179.5	0.23	41.6	982	-22	317	-85
Residential double schedule	34.76	29.7	91.0	0.57	51.6	69	-57	158	-84
Total						1,311			

Source: MIEM and authors' calculations.
Notes: The exercise was carried out assuming that the MWh consumed by customers remain constant by type of tariff reported in Table 2. The new fixed charge was computed by dividing the 44 percent of the total fixed cost of UTE in USD among the total number of residential customers. Then it was divided by 12 to obtain a monthly measure. The new variable charges were computed equal to the marginal cost of electricity generation (by MWh) in 2017. The new Average tariff is computed as FC+VC/AVCM where AVCM is the average consumption monthly (see Table 2). The average monthly bill was obtained again as AVCM=AMB=FC+VC*AVM. Note that the average price is lower for larger consumers because they can distribute the fixed charge between a large consumption of MWh. The change in the average monthly bill is computed as the difference between the average monthly billed in the exercise and the average monthly billed in 2017 (see Table 2).

As discused above, the current design of the two-part tariff of UTE could also be stimulating larger consumers to invest in DER. For this group of consumers, investing in DER could mean a lower marginal price of energy by avoiding cross-subsidization to small consumers while allowing them to maintain the connection to the network at a lower price than the efficient one.

If the investment in DER of larger consumers become a reality, UTE will need to recover the lost revenue by increasing the fixed charge for connection to the network or applying an increase to the marginal price of energy. In the latter case, the incentives to invest in DER are increased, generating a vicious circle. From this point of view, UTE would have significant incentives to redesign their current two-part tariff, bringing them closer to the efficient level suggested above. In Section 6 we will simulate the possible revenue loses for UTE of such a situation.

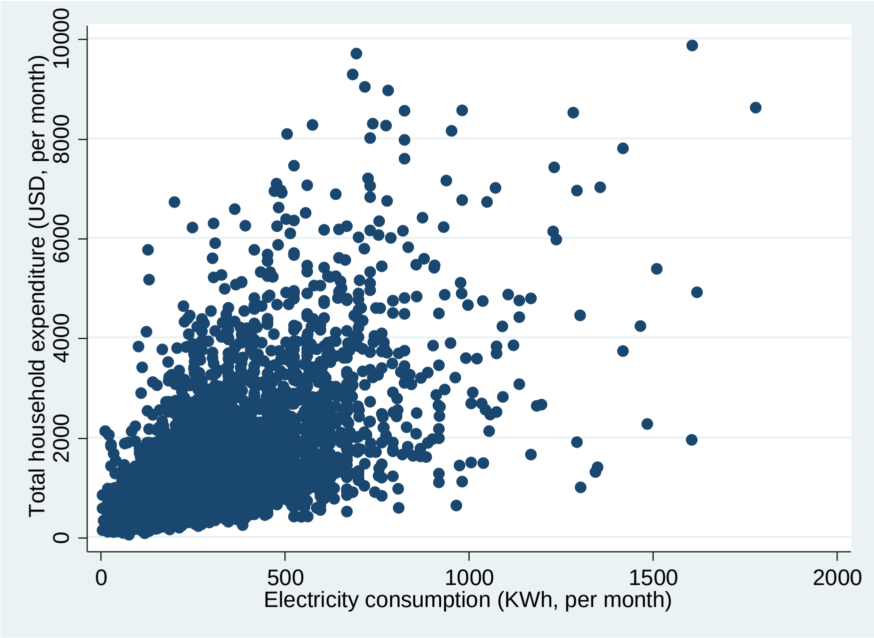
5. Impact Analysis of Adopting the Suggested Efficient Tariff Structure

In order to quantify the efficiency gains and the distributive effect of adopting the suggested efficient tariff scheme we carry out a quantitative impact exercise. The main objective of this exercise is to identify winners and losers from the adoption of an efficient tariff scheme as proposed above.

The exercise first identifies the pattern of household electricity consumption by deciles of income. To do that, we use the microdata from the National Household Expenditure and Income Survey (NHEIS) 2006-2007, the last one available in Uruguay. This characterization of electricity consumption by income deciles allow us to discuss the short-term distributive impacts of a change in the tariff scheme. Indeed, since we know that the suggested tariff benefits the largest consumers, we expect a negative distributive impact if electricity consumption correlates positively with household income.

To study the correlation between electricity consumption and income, we apply UTE’s tariffs of 2007 to the level of electricity expenditure reported by households in the NHEIS in order to estimate the KWh consumed by each household. Once the electricity consumption of each household was obtained, we compute its correlation with the aggregate level of household expenditure, which was used as a proxy for income. Actually, the NHEIS data indicate a high correlation of 0.66 between electricity consumption and aggregate expenditure level (see Figure 2). Finally, the structure of electricity consumption by income deciles obtained from the NHEIS 2007 data was extrapolated to the levels of consumption observed in 2017.

Figure 2. Electricity Consumption and Total Expenditure by Households



Source: NHEIS 2006-2007.

Secondly, we calibrate an electricity demand function for a representative household of each decile of income in order to evaluate the impact of adopting the efficient tariff in terms of household welfare (KWh consumed as well as consumer surplus) and market efficiency (deadweight loss). We assume a linear demand function for electricity.

The demand curve for the representative household of each decile was calibrated as follows. First, the slope of the demand function was set so that the average consumer has a price elasticity of 0.15, which represents the midpoint of the range of available previous estimates (Fernández, 1997; Lanzilotta, Carlomagno and Sanromán, 2009; Lanzilotta and Rosá, 2012). Second, the constant of the demand function for the representative household of each decile was fixed so that it was compatible with the calibrated slope and the level of consumption observed, according to the assumed linear functional form. More details regarding the calibration of the demand curves for each representative household are included in Appendix 3.

Finally, in order to compute the changes in consumer consumption and surplus, it was necessary to make assumptions about the tariff contracted by consumers in each decile of income. Considering the average consumption statistics for rates reported in Table 1, the following distribution was assumed: i) consumers located in the first two deciles of income contract the basic residential tariff; ii) households located from deciles 3 to 9 contract the residential tariff; iii) 50 percent of households in decile 10 contract the residential tariff while the other 50 percent choose the residential double shedule tariff.

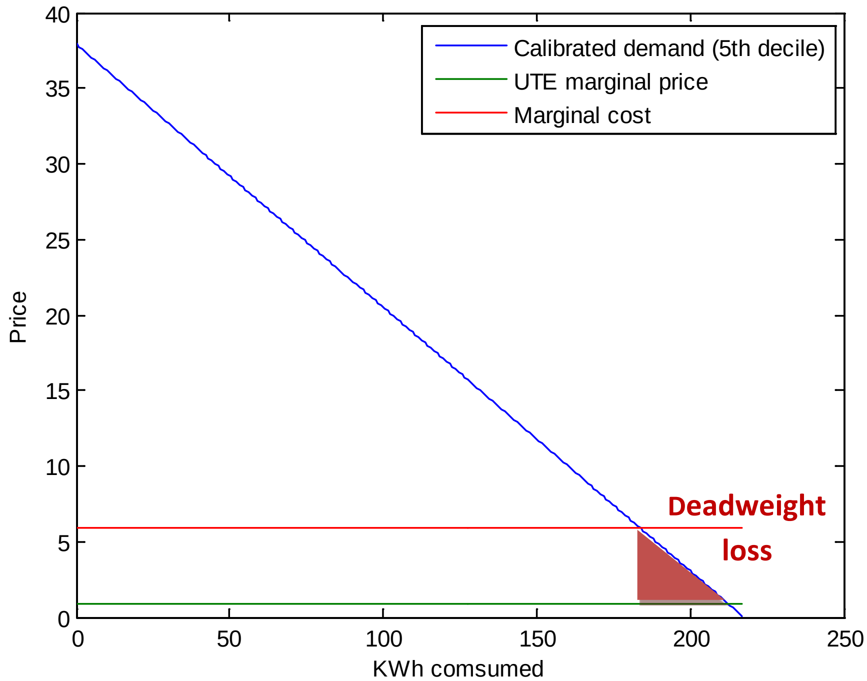
The exercise performed has two important limitations. First, the last NHEIS available corresponds to 2006-2007, which implies a structure of household consumption that might not be representative of the current situation. There was an increase in the total electricity consumption by residential consumers of approximately 15 percent between 2007 and 2017. Second, for the period in which the NHEIS survey was conducted, the basic residential tariff did not exist (currently it represents 20 percent of total residential consumers) and only 2 percent of the total residential consumers belonged to the double schedule tariff (currently it represents approximately 5 percent). Despite these limitations, we believe that the exercise can produce some useful results.

Regarding the impacts in efficiency of adopting the efficient tariff we find two important results. A first relevant result is the existence of a significant deadweight loss in the electricity market under the current tariff scheme of UTE. The deadweight loss represents on average 1.2 percent of the total consumer surplus, increasing to around 8.8 percent among households in the second decile of income. As we discussed in the previous section, the implementation of the efficient tariff scheme would allow eliminating the deadweight loss of the market.

The computation of the deadweight loss was based on the calibrated demand function for a representative household of each income decile, the observed marginal prices of UTE and the marginal costs of electricity. Figure 3 shows, as an example, the electricity market for households of the fifth income decile.[3]

[3]Note that in this exercise we use an estimation of the marginal cost from ADME, but we do not have the complete marginal cost function. Therefore, we assume a constant marginal cost function. Given this assumption, our computation of the deadweight loss is a lower bound estimation.

Figure 3. Deadweight Loss and Calibrated Demand in the Electricity Market (for households of the fifth income decile)



Source: Authors' calculations.

A second interesting result to highlight is that, with the sole exception of households in the first income decile, all households would increase their level of electricity consumption in case of adoption of the suggested efficient tariff. This is so because the marginal price of electricity (the price which is relevant for the consumption decision) will decrease for almost all types of residential consumers. The only exception are the households that contract the basic residential tariff and have a consumption of fewer than 100 KWh per month. In our exercise, these types of consumers are all located in the first income decile.

Regarding the impact on income distribution of adopting the suggested efficient tariff we also find several interesting results. The first important result is the clear positive relationship between the level of electricity consumption of households and their level of total expenditure, a proxy for their income level (see Table 4). This increasing and monotonic relationship between the level of electricity consumption and income level allows us to quickly conclude who will be the winners and losers, at least in the short term, if the suggested efficient tariff is adopted. As discussed in the previous section, we anticipated that the adoption of the efficient tariff would favor large consumers while it would harm the small ones. Therefore, taking into account the observed positive correlation between electricity consumption and income level, we can conclude that the adoption of the efficient tariff would have a regressive effect on the distribution of income in the short term, since it favors large consumers.

A second result of interest is obtained from the analysis of the change of the consumer surplus after the rebalancing. For consumers in the first income decile, the decrease of the consumer surplus is explained for both a reduction of the electricity consumption and the rise of the fixed charge included in the tariff. For deciles 2 to 10, the increase in the amount of electricity consumed implies an increase in the consumer surplus. However, the increase in the fixed charge, when adopting the efficient tariff, operates in the opposite way, reducing the surplus. The net result of both effects is different according to the level of consumption, and therefore the income level of the household.

To the extent that the fixed charge is of relative less importance while the level of consumption is higher, the variation of the consumer surplus is increasing with the level of household consumption. Actually, we can see how households in the second decile of income would experience a reduction in their consumer surplus, while households in deciles 3 to 10 would register an improvement of their welfare level if the efficient tariff were adopted.

Note that the percentage change in consumer surplus is increasing with the income decile of the consumers, with the sole exception of the tenth decile. This is because the exercise assumes, based on evidence presented in Figure 2, that consumers who contract the double schedule tariff and consume the most per household, which compared with the residential tariff face a lower reduction of the marginal price of electricity, are located in the last income decile. Therefore, consumers in that income decile register a relatively lower increase in electricity consumption.

It is important to note that, despite the reduction of the consumer surplus in the first two deciles, the global surplus increases by 8 percent. Part of this consumer improvement is explained by a 12.5 percent decrease in UTE’s revenue. In effect, UTE’s total annual billing falls from 764 million USD in the current situation to 668 million USD in the case of adopting the efficient tariff. However, another part of the consumer surplus gain arises as a result of greater efficiency in the market through the elimination of the deadweight loss.

Based on previous results, we conclude that, even though the adoption of the efficient tariff allows to increase the overall welfare by eliminating the deadweight loss of the market, it generates regresive distribution effects at least in the short term. Therefore, the rebalancing of the tariff should probably be accompanied by compensations (independent of consumption levels) for low-income households.

A third result of interest is that the consumer surplus in the case of households in the first decile of income would turn negative once we consider the fixed charge of the efficient tariff. That is, households with very low levels of consumption may have incentives to disconnect if fixed charges are distributed equally among all consumers.

This result could be in line with the concern raised by the managers of UTE that a higher fixed cost could imply the disconnection of the network of small consumers. Note that the exit of consumers from the first decile implies a clear loss of efficiency and global welfare. In effect, its exit from the market would imply the loss of the current surplus of the consumer that these households enjoy and the surplus of the producer that UTE obtains by supplying them with electricity.

Table 4. Impact on Consumption and consumer Surplus by Income Decile of the Adoption of an Efficient Tariff

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**TOTAL**
MWh consumed in 2017	115.7	184.2	218.4	262.0	289.0	330.8	382.2	463.5	542.1	786.1	3,574
Consumer surplus (Million USD)	10	49	79	119	148	198	269	401	554	1175	3,002
Deadweight loss (Million USD)	0.1	4.3	4.1	4.1	4.1	4.1	4.1	4.1	4.1	3.7	37
Deadweight loss (% of consumer surplus)	1.2%	8.8%	5.2%	3.4%	2.7%	2.1%	1.5%	1.0%	0.7%	0.3%	1.2%
MWh consumed in efficient tariff	108	232	264	308	335	377	428	509	588	830	3,979
Consumer surplus (efficient tariff, Million USD)	-32.4	48.5	79.8	128.0	161.3	218.7	298.6	445.7	612.0	1,273.4	3,233.5
% change in consumption (KWh)	-7%	26%	21%	18%	16%	14%	12%	10%	8%	6%	11%
% change in consumer surplus	-438%	-1%	1%	7%	9%	11%	11%	11%	11%	8%	8%

Source: NHEIS and authors' calculations.
Notes: Income deciles were approximated by the level of aggregate expenditure. Impacts on quantities and welfare were computed based on a linear electricity demand with a price elasticity of 0.15.

Consequently the efficient rebalancing of tariffs should either i) incorporate lump-sum compensation for low-income households in order to keep them within the market or ii) consider some alternative way of distributing fixed charges. Although in this paper we do not analyze alternative designs for the distribution of fixed costs, it is important to take into account the following considerations.

First, the setting of fixed charges should not be linked to recorded levels of electricity consumption. A design of this type would again determine that consumption levels are not based solely on the marginal cost of electricity and therefore would lead to inefficient levels of consumption.

Taking into account the previous point, an alternative distribution of the fixed charges that allows mitigating the regressive distributive effects of the adoption of the efficient rate while allowing all households to be connected to the network should be based on observable information that makes it possible to estimate the location of the household in the distribution of income. In particular, it is of interest to identify households located in the first income deciles, since they may have incentives to leave the market in the case of an equal distribution of fixed charges. As an example, existing indicators that are currently used to identify households as potential beneficiaries of public social plans could be useful.

Considering all the results of the quantitative exercise, we conclude that the adoption of the efficient tariff suggested in this paper would have regressive distributive effects, at least in the short term, which could be in contrast to the explicit redistributive objective proposed by UTE.

On the other hand, and apart from the efficiency considerations discussed above, the adoption of an efficient tariff would reduce incentives for households with higher consumption to invest in DER. As mentioned before, this could lead in the medium to long term to a tariff increase for households with lower levels of consumption that still buy electricity from UTE. Therefore the distribution effect in the medium-long term will depend on how many households effectively invest in DER.

How many residential consumers would be willing to invest in DER in the years ahead? What would be the impact on UTE's finances? In the following section some very preliminary calculations are made to provide a tentative answer to these questions.

6. Distributed Energy Resources and Possible Impacts on UTE's Finances

Currently in Uruguay there are approximately 600 low-voltage prosumers, most of which use photovoltaic panels. This number, representing 0.05 percent of total UTE residential consumers, reflects the still-marginal role of prosumers in the Uruguayan electricity market.

In this section we perform a numerical exercise that calculates the impact on UTE's finances in a scenario where UTE maintains its current structure of the two-part tariff and therefore, the incentive to invest in DER for the large consumers remains. Additionally, we assume that the investment in DER becomes increasingly accessible, which results in significant growth in the number of prosumers.

How much could the number of prosumers increase in the next five to 10 years? We consider European data with the purpose of constructing possible scenarios for the next few years. On average, in 2015 the percentage of households that invested in DER in European countries reached 1.5 percent.[4] Estimates for 2020 suggest that this proportion would increase to 1.8 percent. These percentages could be a reasonable starting point for the purpose of building a scenario that allows us to simulate impacts for the coming years.

To reach the European prosumer share of 1.5 percent, Uruguay would need to add 19,400 households—a dramatic increase over the current total of 600 prosumers. However, we will take this European share as a benchmark for the next 5-10 years in order to evaluate the possible impact on UTE's finances derived from a scenario characterized by a significant growth of prosumers.

Additionally, taking as reference the discussion of the previous section, we will assume that the 19,400 households that are candidates to invest in DER belong to the right tail of the consumption distribution (with an average consumption of 784 KWh monthly) – in other words, households with the highest levels of consumption. Therefore, our candidates for investing in DER are households that are all currently under the double residential tariff.

We will compute the impact on UTE's finances in two alternative cases: i) households who invest in DER remain connected to the network paying the current fixed charge and ii) households that invest in DER also opt for disconnecting from the network.

[4] The average is for the following countries (GfK Belgium, 2017): Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxemburg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom, Iceland and Norway. This data is for the year 2015.

In the first case, UTE annual revenue would fall by 5 percent, and in the second case, 4.9 percent. It is important to note that, given the consumption characteristics of households with greater incentives to invest in DER, the loss of income for UTE (around 5 percent) is substantially greater than the share of households that we assume would opt for this type of decentralized generation of electricity (1.5 percent).

Although simulated scenarios would seem not to represent a strong risk to UTE's finances, the redesign of tariffs towards an efficient structure that does not distort investment decisions could be fundamental if investment in DER becomes increasingly accessible. Indeed, as mentioned above, the threat to UTE's finances arises from the combination of two factors. First, the current structure of the electricity two-part tariff determines that a large proportion of the fixed costs are recovered through variable billing. Second, the current tariff structure determines that the households with the greatest incentive to invest in DER are those with the highest consumption.

Table 5. Impact on UTE's Annual Revenue in the Case of Growth in the Number of Prosumers

	Scenario 1 **Investors in DER remain connected to the network**	**Scenario 2** **Investors in DER opt for disconnecting from the network**
Average consumption of candidates to invest in DER (KWh monthly)	784	784
Number of candidates to invest in DER	19,400	19,400
Average Monthly Bill of households (USD)	162	162
Average monthly fixed charge (USD)	13.5	13.5
Reduction of UTE's annual revenue	5%	4.9%

Source: Authors' calculations based on NHEIS and MIEM price information.

Another result of interest from the exercise is the existence of a very small difference in the impact on UTE's finances between the two scenarios considered. Results suggest that, if consumers continue to pay the fixed charge for the use of the network, this will only very marginally mitigate the potential loss to UTE. That is, fixed charges currently included in the tariff are so small that the differences in impacts under scenarios 1 and 2 are very small. This last result highlights again the importance of rebalancing the tariff if investment in DER becomes increasingly accessible.

7. Conclusions

The legal structure of the electricity market in Uruguay would seem to present an appropriate design, which seeks to avoid the extraction of monopoly rents and therefore a consumption level lower than the socially optimal. However, in practice, there are some significant deviations from the desirable functioning of the market that lead to potential efficiency problems.

On the one hand, even when in the generation and commercialization stages the regulation allows free entrance of companies, these markets are not operating in competition. In the case of commercialization, there are no companies competing with the state-owned company UTE. In the generation stage, although the entry of new generators is growing, the market continues to show strong concentration. Contributing to the limited regulatory control exerted by the URSEA over UTE is the fact that UTE regulatory framework has constitutional rank. This implies that in practice there is little room for the URSEA to regulate matters other than the quality of the electricity service and some other very specific aspects of the business. Beyond the problem of extraction of monopoly rents and the loss of market efficiency associated with this type of behavior, regulation has other challenges associated with different inefficiencies observed in UTE tariff structures.

This study addressed the question of opportunities for rebalancing the current tariff scheme in order to improve efficiency. UTE's two-part tariffs account in their fixed part for only between 10 and 15 percent of the average total price charged to consumers. However, our estimations suggest that fixed costs represent around 70 percent of total costs.[5] Moreover, the variable charge for KWh consumed is clearly larger than the marginal costs associated with its provision. This implies potentially important distortions in the consumption behavior of consumers since they are receiving wrong price signals. In addition, the variable charge could generate incentives to invest in small-scale solar and wind generation, which in turn could have important consequences for the future revenue stream of UTE.

Our rebalancing of tariffs exercise indicates that indeed when the fixed part of the tariff is set in order to compensate for the sunk costs (mainly the network) and the variable part in order to reflect marginal costs, all types of consumers have an incentive to increase their consumption. However, if fixed costs are split uniformly across consumers this has the consequence of penalizing low-income consumers and favoring high-income ones. Therefore, it is a regressive

[5] See Appendix 1 for details.

policy, at least in the short term. In addition, it has the potential to generate incentives for dropping out of the network, particularly for consumers in the lowest income deciles. An optimal rebalancing policy would have to consider this trade-off.

Another element that UTE must take into account is that under the current tariff scheme consumers have greater incentives to become prosumers than under an efficient tariff, and this could imply a potential future loss of revenue. Even though this will depend on the future cost of micro generating energy, particularly solar PV technology, which is difficult to predict, we assumed a scenario where in a 5 to 10 years period 1.5 percent of consumers will became prosumers under the current tariff scheme (similar to the EU's situation in 2015). This scenario could cost UTE almost 5 percent of its current revenue. This is another potential incentive for UTE to adjust the current tariff scheme.

References

Auerbach, A., and A. Pellechio. 1978. "The Two-part Tariff and Voluntary Market Participation." *Quarterly Journal of Economics* 92(4): 571-587.

Feldstein, M. 1972. "Equity an Efficiency in Public Sector Pricing: The Optimal Two-part Tariff." *Quarterly Journal of Economics* 86(2): 175-187.

Fernández, A. 1997. "Desarrollo de un Modelo de Predicción de la Carga Diaria del Sistema Eléctrico Nacional Desarrollado para UTE." Montevideo, Uruguay: Universidad de la República, UTE-Interdisciplinary Group of Energy Studies. Consulting Report.

GfK Belgium Consortium. 2017. "Residential Prosumers in the European Energy Union." JUST/2015/CONS/FW/C006/0127, Framework Contract EAHC/2013/CP/04. Brussels, Belgium: European Commission.

Lanzilotta, B., G. Carlomagno and G. Sanromán. 2009. "Asesoramiento a Grupo de Demanda de UTE: Revisión y Mejora de los Modelos de Demanda de Energía Eléctrica: Generación y Potencia, de Corto, Mediano y Largo Plazo." Montevideo, Uruguay: Centro de Investigaciones Económicas (CINVE). Consulting Report for UTE.

Lanzilotta, B., and T. Rosá. 2012. "Modelos de Predicción de Energía Eléctrica con Datos Diarios para Uruguay." Montevideo, Uruguay: Centro de Investigaciones Económicas (CINVE).

Ng, Y., and M. Weisser. 1974. "Optimal Pricing with a Budget Constraint: The Case of the Two-Part Tariff." *Review of Economic Studies* 41(3): 337-345.

Silva, J. 2010. "Efficiency and Equity in the Pricing of Public Services: The Evolution of the Theory of Optimum Tariff in Two Parts and the Case of Drinking Water Service." *Revista CIFE* 16: 95-121.

Appendix 1. Structure of UTE's Costs

Table A1.1. Estimation of the Cost Structure of Electricity in Uruguay, 2017

	Share in total costs	Share of fixed costs	Share of variable costs
Generation	**34%**	**70%**	**30%**
Transmission and Distribution	**63%**	**74%**	**26%**
Commercialization	**4%**	**0%**	**100%**
Total	**100%**	**70%**	**30%**

Note: Share of costs in each stage of the electricity chain in total costs was approximated based on information reported by the Ministry of Economic and Finance in a public presentation in February 2019 in parliament: https://medios.presidencia.gub.uy/tav_portal/2019/noticias/AD_380/tarifasp%C3%BAblicas.pdf
The shares of fixed and variable costs within the stage of Transmition and Distribution was aproximated from data of URSEA (Energéticos Consultores (2012), Remuneración Annual de Redes de Trasmisión y Subtrasmisión Eléctricas y sus Formulas de Actualización). The shares of fixed and variable costs within the stage of Generation was aproximated from data of ADME. Commercializaton cost was assumed to be 100 percent variable.

Appendix 2. Alternative Efficient Tariff

This appendix presents an alternative version of the efficient tariff which is designed in a way that the fixed part of the tariff permits recovery of 91 percent of the total fixed costs of UTE, which represent the share of residential consumers in the total number of consumers of UTE. The variable part of the tariff is again established to coincide with the marginal cost of supplying an additional unit of electric power.

Table A2.1. Electricity Tariffs in 2017 If They Are Fixed Efficiently and Fixed Charges Recover 91 Percent of the UTE's Fixed Costs (average customer by type of tariff)

Type of Tariff	Fixed Charge Month (USD)	Variable Charge (USD/MWh)	Avg. price (USD/MWh)	Average consumption (MWh month)	Bill (per consumer per month, USD)	# of consumers (,000)	% change with respect to actual tariff scheme		
							Monthly bill	Fixed Charge	Variable charge
Basic Residential	72.21	29.7	635.5	0.119	75.7	260.7	515	600	-71.36
Residential	72.21	29.7	340.9	0.232	79.1	982.1	49	767	-84.60
Residential double schedule	72.21	29.7	157.1	0.567	89.0	68.6	-26	436	-84.35
Total Residential						1,311.4			

Source: MIEM and authors' calculations.
Notes: The exercise was carried out assumed constant the MWh consumed by customers by type of tariff reported in Table 2. The new fixed charge was computed by dividing 91 percent of the total fixed cost annually of UTE in USD among the total number of residential customers, which was then divided by 12 to obtain a monthly measure. The new variable charges were fixed equal to the marginal cost of electricity generation (by MWh) in 2017. The new Average tariff is computed as FC+VC/ AVCM where AVCM is the average consumption monthly (see Table 2). The average monthly bill was obtained again as AVCM=AMB=FC+VC*AVM. Note how the average price is lower for larger consumers because they can distribute the fixed charge between a large consumption of MWh. The change in the average monthly is computed as the difference between the average monthly billed in the exercise and the computed average monthly billed for 2017 (in Table 2).

The results obtained are basically the same as in the case discussed in the text. That is, the result shows a cross-subsidy from larger to smaller consumers. Again, the consumers who choose the double schedule tariff (who evidence a large level of consumption) would be the most favored by the adoption of this efficient tariff, while the consumers who contract the basic residential tariff (present a smaller consumption) would face a greater increase in the monthly bill.

The impact analysis also shows results similar to those presented in Table 4. However, the higher fixed costs established in this alternative tariff compared to the tariff suggested in Table 4 generate some differences. Because the way of computing the variable part of the tariff was not modified, there is no change in the impact on the quantities consumed with respect to the tariff in Table 4.

However, different to the exercise presented in Table 4, in this alternative case, the residential customers, who present an intermediate level of consumption, would face a 49 percent increase in the average bill.

Table A3.1. Adoption of an Efficient Tariff: Impact in Quantities and Consumer Surplus by Income Deciles

	1	2	3	4	5	6	7	8	9	10	TOTAL
MWh consumed in 2017	115.73	184.16	218.39	262.04	288.91	330.76	382.21	463.51	542.09	786.12	3574
Consumer surplus (Mill USD)	10	49	79	119	148	198	269	401	554	1175	3002
Deadweight loss (Mill USD)	0.1	4.3	4.1	4.1	4.1	4.1	4.1	4.1	4.1	3.7	36.6
Deadweight loss (% of consumer surplus)	1.2%	8.8%	5.2%	3.4%	2.7%	2.1%	1.5%	1.0%	0.7%	0.3%	1.2%
MWh consumed in efficient tariff	108	232	264	308	335	377	428	509	588	830	3979
Consumer surplus (efficient tariff, Mill. USD)	-91.1	-10.2	21.1	69.3	102.6	160.1	239.9	387.0	553.3	1214.7	2,646.6
% change in consumption (KWh)	-7%	26%	21%	18%	16%	14%	12%	10%	8%	6%	11%
% change in consumer surplus	-1049%	-121%	-73%	-42%	-31%	-19%	-11%	-4%	0%	3%	-12%
Total billed (efficient tariff, mill. USD)	116.84	120.51	121.49	122.78	123.58	124.82	126.35	128.77	131.10	138.29	1,255

Notes: Income deciles were approximated by the level of aggregate expenditure. Impacts on quantities and welfare were computed based on a linear demand with a price elasticity of 0.15.

Additionally, higher fixed costs determine a lower consumer surplus for deciles 1 to 8 compared to the current tariff scheme. Only households in deciles 9 and 10 would register an improvement if the efficient tariff were adopted and 91 percent of the fixed cost were distributed among residential consumers.

Finally, as in the exercise presented in the document, the consumer surplus in the case of households in the first and second decile of income would turn negative once we consider the fixed charge of the efficient tariff. That is, households with very low levels of consumption may have incentives to disconnect if fixed charges are distributed equally among all consumers.

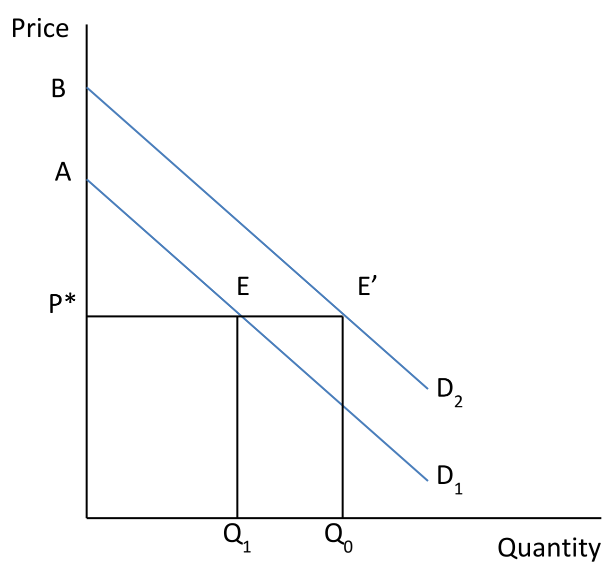
Appendix 3. The Fixed Charge in a Two-Part Tariff and the Consumer Surplus

We assume that there are two types of consumers (large and small, represented by demand curves D_1 and D_2, respectively in Figure A3.1) in the market that could be assimilated into industrial and residential consumers.

The two-part tariff scheme is typically designed to establish a unit price equal to the marginal cost, while a fixed fee is incorporated to recover the sunk costs. If the marginal price equals the marginal cost, and if the resulting charge does not cause any potential consumer to stop buying, the allocation of resources is almost efficient (Feldstein, 1972).

In order to be in the preconditions, the fixed charge cannot exceed the surplus of small consumers (the triangle AEP*). Otherwise, small consumers would not demand the good. The alternative option would be to set fixed charges to each type of consumer. In this case, each fixed charge should not exceed the surplus of the corresponding consumer (triangles AEP* and BE'P*).

Figure A3.1. The Fixed Charge of a Two-Part Tariff and the Consumer Surplus



The option of setting the same fixed charge for all consumers does not introduce distortions into the consumer's choice and therefore it does not impact on the optimal allocation of the economy. However, it leads to a modification of the initial income distribution because determines a different average price for each type of consumer. On the other hand, setting different fixed charges by type of consumer does not affect the initial income distribution but can affect the optimal decisions of agents. See Silva (2010) for a discussion and literature review regarding the optimal two-tariff design.

Appendix 4. List of Acronyms in Spanish

ADME	Administración del Mercado Eléctrico
BCU	Banco Central del Uruguay
MIEM	Ministerio de Industria, Energía y Minería
MEF	Ministerio de Economía y Finanzas
URSEA	Unidad Reguladora de los Servicios de Electricidad y Agua
UTE	Administración Nacional de Usinas y Transmisiones Eléctricas