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Distributional effects of reducing energy subsidies: Evidence from recent policy reform in Argentina*

Fernando Giuliano Maria Ana Lugo Ariel Masut Jorge Puig

Abstract

We analyze the distributional effects of the reduction in energy subsidies in Argentina since 2016. As the policy reform also includes the introduction of a scheme to protect less well-off families (social tariff), we also review how well the targeting mechanism works. We apply traditional benefit-incidence analysis using household surveys and administrative data, focusing on residential subsidies to natural gas and electricity in the Buenos Aires Metropolitan Area. We find that the social tariff is relatively pro-poor, with significantly higher coverage among the poorest households. There are some exclusion errors in the low-income deciles and large inclusion errors in the medium- and high-income deciles. The distributive incidence of subsidies does not appear to have changed substantially. Energy subsidies in Argentina (lower in aggregate terms) continue to be, although progressive, pro-rich. The distributional effect is explained by the fact that generalized subsidies to all categories of consumption coexist with a relatively well targeted social tariff. Regarding energy budget shares, monthly spending on electricity has increased from 1.1 percent of total household income to 3.4 percent. Monthly spending on piped gas rose from 1.3 percent to 3.3 percent. These shares are in line with many other countries in the region. Naturally, there has been a convergence of tariffs toward service provision costs.

JEL Codes: H22, D31, D78, Q48.
Keywords: distributive incidence, subsidies, energy, policy reform.

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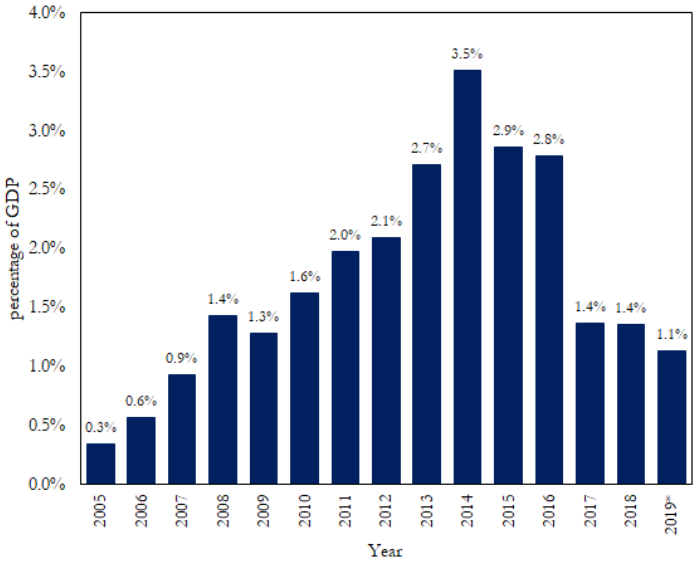
1 Introduction

Energy subsidies played a critical role in protecting poor households from rising inflation in Argentina in the wake of the 2001-02 crisis. An emergency arrangement was introduced to freeze residential gas and electricity tariff while maintaining the provision of public services, and thus protecting the real purchasing power of the poor. However, even after the crisis was over, the cost of these subsidies quickly increased due to a rise in international energy prices and the increasing demand of subsidized goods in the context of a fast-growing economy. Thus, energy subsidies were a key driver behind the growth of public expenditure. They increased tenfold as a share of GDP in less than a decade, from 0.3 percent in 2005 to 3.5 percent in 2014 (Figure 1), representing the second most important component of current expenditure in 2014 after social security.

Figure 1: Energy subsidies in Argentina. Evolution between 2005-2019. In percentage of GDP



Source: Own elaboration based on National Institute of Statistics and Census (INDEC), Argentine Budget Association (ASAP) and Ministry of the Treasury.
Notes: (*) Estimated.

During this period, energy subsidies had detrimental effects on sectoral sustainability and efficiency. The discretional management of energy prices resulted in distorted signals that led to overconsumption and underinvestment in the sector. Barril & Navajas (2015), for example, find that distorted price signals due to price controls contributed significantly to the drop in investment and production of natural gas between 2003 and 2013. In addition, energy subsidies also had negative distributional effects. Several studies that focused on its distributive incidence highlight that subsidies were markedly pro-rich since the non-poor sectors were receiving the largest shares (Hancevic *et al.*, 2016).[1] This allocation was because subsidies were granted universally without any targeting mechanism.

[1]See also Lustig & Pessino (2013), Puig & Salinardi (2015) and Lakner *et al.* (2016).

As a consequence, public debates during the electoral campaign at the second semester of 2015 emphasized the need to rethink the current subsidy scheme at that time.

At the end of 2015, a new administration created the Ministry of Energy and leaded off a process of rationalizing energy subsidies so as to enhance the climate for private investment, to improve the quality and availability of the energy supply, and to avoid fiscally costly and distortive subsidies (in a context of fiscal tightening). In early 2016, the government announced a series of measures to reduce energy subsidies that would impact on tariffs of residential natural gas and electricity across the country. First, the seasonal price of electricity and the regulated margin of electricity service concessionaries in the Buenos Aires Metropolitan Area (AMBA[2]) were increased. Second, the government established a path for the wellhead gas price beginning in 2016 and ending in 2020 (assuming convergence to a market price) with the objective of providing clear signals regarding the reduction of fiscal subsidies. Third, by the end of 2016 the government called for public audiences to determine the increase path in the regulated component of the natural gas tariffs (transmission and distribution).[3] Fourth, a social tariff was established as a targeting mechanism to protect the less well-off families from the upcoming tariff increases in electricity and natural gas. The eligibility criteria was based on the level of income and socioeconomic condition of the main service holder.

In mid-2018, a drastic change in macroeconomic conditions affected the subsidy reduction path. Argentina's financial markets came under sudden pressure, leading to a sharp depreciation of the Argentinean peso with a high pass through to prices, and a fall in economic activity.[4] This episode triggered changes in the subsidy reduction schedule, but the commitment endured despite social and political pressures. In this context, and during a strong fiscal consolidation effort, energy subsidies fell 60 percent as a share of GDP since 2015, to an estimated 1.1 percent in 2019 (Figure 1). In terms of prices, the evolution of those related to energy practically doubled the evolution of the reminding items of the consumer price index during the whole period. While the general price level increased 171 percent between December 2016 and November 2019, energy prices increased 377 percent (Figure 2).

The objective of this paper is to study the distributional impact of the energy subsidy reduction scheme, and the effectiveness of the social tariff as a targeting mechanism.[5] For this purpose, we focus on residential energy subsidies to electricity and piped gas

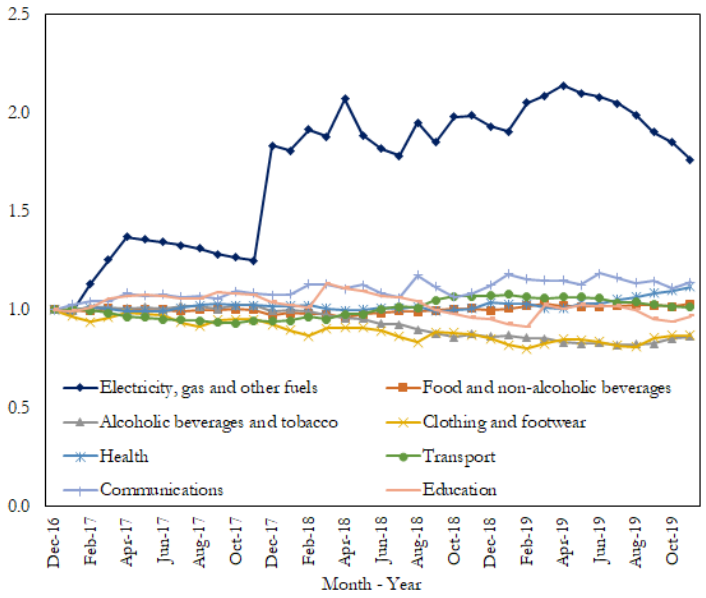
[2]AMBA is a geographical area including the Ciudad Autonoma de Buenos Aires and its surrounding areas, containing 40 municipalities of the Province of Buenos Aires. It covers 13,285 km2. According to the 2010 census, it accounts for 14.8 million of inhabitants, representing 37 percent of Argentina's total population.

[3]Public audiences are a participation procedure that allows citizens to inform themselves and express their position before issuing a decision that may affect their rights. See here and here.

[4]See IMF (2018) for more background on the factors leading to the financial pressure on Argentine assets.

[5]We refrain from evaluating the efficiency of social tariffs vis a vis other assistance mechanisms in this context, such as direct transfers to those eligible.

Figure 2: Consumer prices index in Argentina (December 2016 = 100). Main items for Buenos Aires region. Evolution December 2016 – November 2019. Relative to general level



Source: Own elaboration based on National Institute of Statistics and Census (INDEC).
Notes: The official consumer price index (CPI) of Argentina became widely discredited after January 2007 and INDEC ceased its production in December 2015. After a deeply technical revision, a new CPI has been published since December 2016.

in AMBA, using the traditional benefit-incidence analysis (van de Walle, 1998; Demery, 2000) combined with microdata from Argentina households' surveys and sectoral administrative data. We analyze the overall period between the second quarter of 2016 and the second quarter of 2019.[6]

Our main results can be summarized as follows: (i) although the social tariff is relatively pro-poor, with a significant higher coverage rate of poorest households and significant lower coverage among the richest decile, there are some exclusion errors in the low-income deciles and large inclusion errors in the medium- and high-income deciles; (ii) the distributive incidence of subsidies does not appear to have changed substantially. Energy subsidies in Argentina (lower in aggregate terms) continue to be, although progressive, pro-rich. Our measures of concentration and progressivity find similar values between 2016.Q2 and 2019.Q2. The distributional effect is explained by the fact that generalized subsidies to all categories of consumption coexist with a relatively well targeted social tariff; (iii) on average and considering that spending may fluctuate seasonally, monthly spending on electricity as a share of total household income has increased from 1.1 percent to 3.4 percent. Monthly spending on piped gas did from 1.3 percent to 3.3 percent. These shares have increased relatively more among the poorest households. The share that households currently allocate to electricity and gas seem to be in line with many other countries in the region; and (iv) naturally there has been a convergence of

[6]The last one with availability of microdata at the time of the elaboration of this paper.

tariffs towards service provision costs. On average, during 2016.Q2 the electricity tariff represented 29.1 percent of the provision costs. Piped gas covered 30.9 percent. In 2019.Q2 tariffs covered 79 percent and 83 percent, respectively.

We believe that our contribution to a better understanding of the distributional effects of energy subsidies removal is accurate and timely. We contribute to the empirical literature by providing evidence about the effects of a recent policy reform implemented in Argentina. According to the best of our knowledge, there is no work that inquiries about the reforms recently carried out in the country. Conclusions from the Argentine experience could be useful for other developing countries dealing with not-well-targeted energy subsidies. They also contribute to understand the consequences that Argentina faced in its attempt to reverse "energy populism", elaborated in Hancevic *et al.* (2016).

Our paper is closely related to several contributions on the impact of energy policy reforms on income distribution. Rosas-Flores *et al.* (2017) use households surveys microdata to simulate several changes in energy prices as a result of partial or total energy subsidy removal in Mexico. The simulations respond to the need for an assessment of economic and environmental impacts of this policy reform. In line with our results, find that subsidies in electricity are progressive. Krauss (2016) and Ersado (2012) recently analyzed distributional effects of a significant natural gas tariff reform in Armenia that increased the country's residential tariff by about 40 percent and show that poor households are more prone to experience economic distress due to energy tariff increases.[7] In 2010 the government of Iran removed energy subsidies in the context of an aggressive energy price reform. This reform is analyzed by Moshiri (2015) which emphasizes on the cash handouts given to all households to compensate for higher prices. This aspect fostered public acceptance of the reform and was initially successful. However, many difficulties followed, like excessively large national budget deficit to extraordinary inflation and devaluation, raising questions about the feasibility and sustainability of the direct compensation mechanism, and even of the policy reform itself (Breton & Mirzapour, 2016). [8]Dartanto (2013) emphasized the need to phase out the energy subsidy in Indonesia as it was inefficient as well as worsening the fiscal balance, even though the removal of the subsidy would increase the incidence of poverty. To ameliorate the negative effects of the reforms, sug-

[7]Zhang (2011) and Baclajanschi *et al.* (2006) find similar results analyzing the energy price reform in Turkey and Moldova respectively. Mitra & Atoyan (2012) provide evidence in the same line for Ukraine. Siddig *et al.* (2014) have also come up with similar results from Nigeria, where the removal of the energy subsidy of imported petroleum products has resulted in higher prices. It would also cause a structural shift in the energy consumption of the people in favor of the domestically produced petroleum products causing a rise in its price too. All these will lead to a decrease in the level of consumption as well as of the household welfare in Nigeria.

[8]Also, the government of India has initiated several measures since 2010 to reform its non-renewable energy subsidy program. Acharya & Sadath (2017) find support for the hypothesis that the impact of the reforms on the measured general price level is to be lower the lower the crude oil price, and vice-versa. This finding essentially underlines the fact that the majority of the poor citizens of India will have some leeway to spend their income on the necessities of life such as health care and education.

gested higher social spending with the saved resources. Also, about subsidy removal and targeting mechanism to protect the less well-off families, Gelan (2018) simulates a subsidy reduction in Kuwait accompanied with cash transfers to energy users to compensate welfare loss, indicating that such transfers would reduce the adverse effects of the policy reform.

The paper proceeds as follows. Section 2 describes the background of energy subsidies and their reduction path in Argentina. Section 3 details the social tariff design as a targeting mechanism and provides estimates for it. Section 4 presents the empirical examination on the distributional impact of energy subsidies reduction. Section 5 concludes with the lessons of the Argentinean experience.

2 Background of energy subsidies in Argentina

From 2003, Argentina's government started to strongly intervene the energy sector by adopting a leading role as an investor and by playing a key role in the decision-making process of natural gas and electricity prices. Regarding public services' tariffs, the intervention was formalized through the noncompliance of natural gas and electricity regulatory frameworks which determined pricing reviews every 5 years and passthrough of eventual increasing costs.[9] This generated a tariff freeze that diminished incentives towards investment in the sector, reducing the production and reserves of hydrocarbons and pushing the demand for natural gas and electricity. As a consequence, the cost of energy subsidies rose significantly and more than 80 percent of them were used to close the gap between the energy supply cost and demand prices. These subsidies were provided through public companies, ENARSA and CAMMESA.[10] The remaining 20 percent covered infrastructure investment.[11] Therefore, during this period most of the energy subsidies reached directly residential and non-residential consumers in the form of lower natural gas and electricity tariffs. Within residential consumers, most of the subsidies benefited families living in AMBA.

The residential gas and electricity tariffs have three components that are covered by different actors: (i) the wholesale price of energy paid to producers; (ii) the (regulated) transport and distribution costs; and (iii) national and municipal taxes (i.e., VAT and other taxes). Since 2003, the wholesale price has increasingly diverged from the economic cost, leading to increase fiscal subsidies managed by ENARSA and CAMMESA. In addition, transport and distribution costs have been frozen with the aforementioned sus-

[9] See Law 24.076 and Law 24.065.

[10] ENARSA is a public enterprise in charge of importing natural gas and reselling it at subsidized prices in the internal market. CAMMESA is a state-owned enterprise in charge of the electricity supply. It bought fuel at subsidized prices and sold electricity to industries and distributors at a price lower than the production cost.

[11] In the absence of public intervention, the subsidy to cover energy-related investment would not exist as the cost of these investments would be internalized in the tariff paid by consumers.

pension of the regulatory framework.[12] This latter part of the subsidy is referred to as a cross-subsidy since implies a transfer from the private providers' companies to consumers with no impact in public spending.

The tariff structure contains a fixed and a variable component and is ruled by regulatory authorities of gas and electricity (ENARGAS and ENRE, respectively). The fixed component is largely associated with transport and distribution costs, and typically represent a sizeable part of consumers spending. The variable cost incorporates the wholesale cost of energy and the passthrough.

The new administration that took office in December 2015 envisioned a gradual reduction of the fiscal deficit on the back of a positive macroeconomic outlook. Following the normalization of exchange-rate markets, which depreciated the peso 36 percent, the stage was set in early 2016 for an inflation reduction, economic recovery and a steady improvement in the primary fiscal balance. This view was shared by market participants. Inflation expectations in January 2016 (as surveyed by Consensus Forecast) predicted a sharp reduction from an estimated 31 percent in 2016 to 18.3 percent in 2017. GDP was expected to remain constant in 2016 and to grow 3.7 percent in 2017. Projections beyond 2017 were optimistic, with inflation still declining gradually to a single digit by 2021. An average growth of 3 percent between 2018 and 2021 was expected according to projections in the IMF's Article IV consultations. The primary fiscal deficit of the National Government was expected to improve from 5.6 in 2016 to 1.3 in 2021 (IMF, 2016). The fiscal subsidies' policy for the energy sector aimed to reduce, on a four-year path, the gap between the wholesale cost of energy (supply price) and the price paid for energy demand. This gap had generated strong expenditures to the National Treasury which, towards the end of 2015, reached 2.9 percent of the GDP.

The main concern while reducing energy subsidies was centered on the consumption of natural gas and electricity. In the previous context and with the aim of rationalizing subsidies, the new administration planned increases in wholesale prices for all segments of energy consumption (i.e., residential, commercial, industries and electricity generators in the case of natural gas consumption). The planned path contemplated prices and tariffs hikes which were mostly dollarized. In practice, this implied that wholesale costs would increase and the natural gas price system for local producers would tend to import parity, given the country conditions of net importer of natural gas and hydrocarbons. In the case of households, the effort would be greater than for other segments of consumption, given the greater delay in both wholesale prices and distribution and transmission tariffs.

The sudden financial turmoil in the second quarter of 2018 triggered a sharp depreciation of the peso (which lost over half of its value in five months) and accelerated inflation,

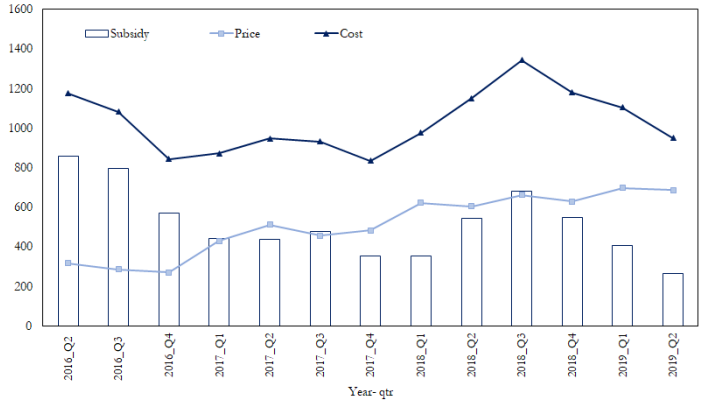
[12]This was not the same for the electricity distribution in the rest of the regions of the country, were the National Electricity Regulatory Office (ENRE) has no authority to fix such component but are the different provincial companies that oversee doing so. In the case of natural gas, National Gas Regulatory Office (ENARGAS) has authority across the whole national territory and its intervention has frozen the regulated component of tariffs throughout the country.

from an annual average of 24 percent in the year before May 2018 to 43 percent the year after. The resulting fall in real wages (minus 15 percent in the year following the devaluation) and heightened uncertainty negatively affected consumption and investment, pushing the economy into recession. In this context, Argentinean government acceded to a financial program with the International Monetary Fund (IMF). The agreement established that the IMF would assists Argentina with its debt payments while the country promised to continue with the ordering of the public accounts. Specifically, Argentina committed to reduce the primary deficit to 1.3 percent of GDP in 2019 (from 2.7 percent in 2018) and achieve primary fiscal balance in 2020. The expected reduction in energy subsidies was 0.3 percent of GDP in 2018 and 0.4 percent of GDP in 2019 and 2020.

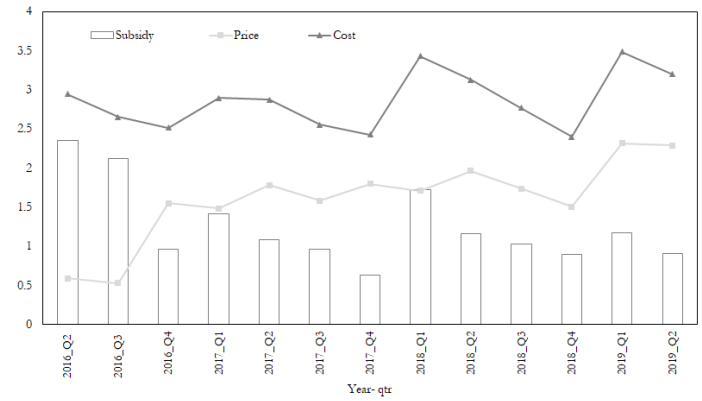
Figure 3 presents the quarterly evolution in prices, costs and subsidies to residential consumption of energy in Argentina. All variables are expressed in constant (2016.Q2) pesos. Panel A shows subsidies to electricity in pesos per kilowatt hour (kWh) and B does for piped gas in pesos per cubic meter (m3). Trends are very clear. Despite the inherent seasonality to energy consumption (more pronounced in piped gas), energy subsidies decreased during the period despite changing macroeconomic contexts.

Figure 3: Prices, costs and fiscal subsidies to residential consumption of energy in Argentina. Quarterly evolution 2016.Q2 – 2019.Q2. Constant (2016.Q2) pesos

Panel A. Electricity



Panel B. Piped gas



Source: Own elaboration based on Ministry of Energy, Edesur, Edenor, Metrogas and Gas BAN.
Notes: In Panel A subsidy is defined by the difference between the seasonal price of electricity (simple mean for the nine categories of consumption) and the monomic cost. In Panel B subsidy is defined by the difference between the Gas Price in Boca de Pozo (simple mean for the eight categories of consumption) and the supply cost. All series are expressed in constant terms by using the GDP deflator. We do not use the CPI given the lack of information for 2016.Q2 and 2016.Q3.

3 Protecting the poor: the federal social tariff

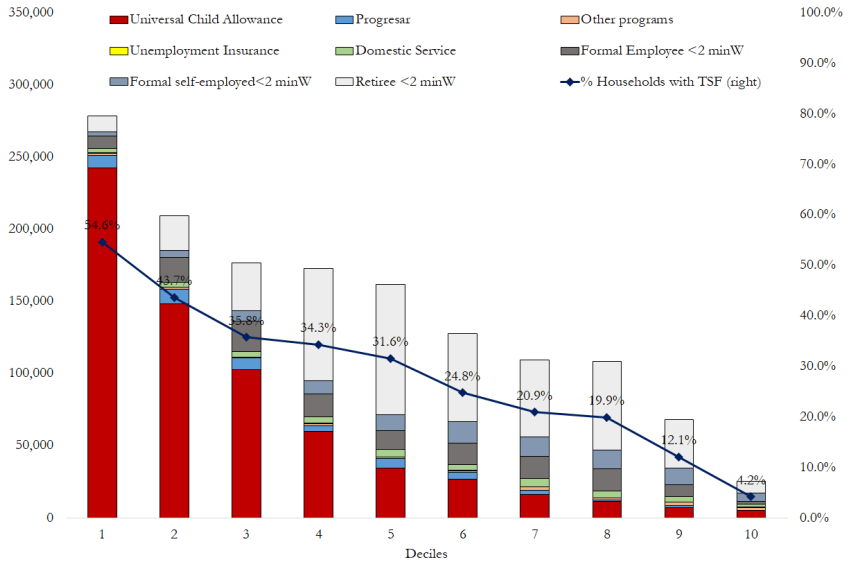
The gradual reduction of residential energy subsidies was accompanied by the establishment of a federal social tariff scheme. The scheme offered discounts to residential energy public services tariffs to specific customers. The objective was to cushion the negative effects of a reduction of subsidies on the purchasing power of the most vulnerable population. The eligibility criteria for the social tariff was categorical. Beneficiaries who qualified for these reduced tariffs were linked to social programs, had incomes from pensions or salaries below two minimum wages or had specific health condition, among others (see Table A1 in the Appendix). To this inclusion criteria, exclusion criteria was added related to property ownership of cars and immovable assets. The selection of beneficiaries was performed by combining account holders' information (from network gas and electricity) with administrative records from the social security administration (ANSES) on formal incomes and pensions, as well as social programs, and land and automobile registries.

Figure 4 presents the potential distributional incidence of the social tariff for AMBA, simulated using the Permanent Household Survey (EPH) for the period between 2016.Q2 and 2019.Q2. The simulation is based on the characteristics of the head of household (proxy for service account holder), with the exception of beneficiaries of the Universal Child Allowance for which also the spouse is also considered.[13] Exclusion criteria are simulated on the basis of administrative records information on the proportion of beneficiaries excluded by category. Distinct exclusion probabilities are calculated for four groups: wage-employees, pensioners or retirees' beneficiaries of universal child allowance, and the rest of beneficiaries (mostly associated with other social programs or unemployment insurance). The underlying assumption throughout the analysis is that all families that are expected to be beneficiaries of the social tariff -according to inclusion and exclusion criteria- are so. Yet, in practice, this might not be the case because the records of service holders are outdated or correspond to the owner rather than tenants. Indeed, according to administrative records, there is a non-trivial proportion of service accounts whose main service holder was linked to people recorded as passed away.

Although the scheme is relatively pro-poor, with a significantly higher coverage rate among the poorest households and lower coverage among the richest decile, there are some sizeable exclusion errors in the low-income deciles and large inclusion errors in the medium- and high-income deciles. Slightly over half the households in the first deciles of the per capita income distribution (in the distribution of households) are expected to be receiving social tariff. This means that among the extreme poor (extreme poverty is approximately 6.7 percent of households) coverage is highest. The large majority of them (92 percent) would be receiving it through the Universal Child Allowance program.

[13] The following criteria could not be simulated because of insufficient information on the household survey: persons with disabilities, electricity-dependent persons, and war veterans.

Figure 4: Federal social tariff for residential energy services in AMBA. Distribution of beneficiaries by per capita household income deciles. Average for the period 2016.Q2 and 2019.Q2



Source: Own estimates based on Permanent Household Survey (EPH).

Notes: Beneficiaries are simulated according to the characteristic of head of household (except for AUH in which spouse is also allowed). In addition, the simulation uses administrative records to estimate probability of exclusion according to asset related exclusion criteria (more than one property, and vehicle not older than 10 years old). All values are weighted using the population expansion factor.

However, among the second and third deciles -including moderately poor (up to 23 percent of households) and vulnerable families- the exclusion remains severe, as almost two-thirds of households would not qualify for this benefit. In addition, coverage remains high around 34-20 percent up to the eight decile, and only declines substantially after that. The main reason for the inclusion among the middle and upper groups are the retirees, and to a lesser extent, formal workers with registered income below two minimum wages.

To better understand the reason behind the inclusion errors related to pensioners and formal workers, it is useful to review the income threshold set for these groups, and how they stand relative to the group specific distribution. As mentioned, formal workers (wage employees and own-account workers) and pensioners qualify for the social tariff if their income fall below the two minimum wages. For example, between June and August 2016, the minimum wage was set at ARS $ 6,810 per month for a full-time employee (equivalent to approximately of USD 460). For reference, the average formal wage, as reported by the Ministry of Labor was around ARS $19,000 (USD 1288). This means that a two minimum wage threshold (ARS $ 13,600) set for the social tariff was equivalent to two-thirds of the average wage for formal employees.

How are workers and pensioners/retirees distributed across these thresholds? In AMBA, 54.8 percent of all wage employees fall below the two minimum-wage threshold set as inclusion criteria for the social tariff, with the large majority receiving earnings

between one and two minimum wages (see Table A2 in the Appendix).[14] If we restrict the sample to only those that are declared as head of household, the proportion of those receiving a salary below two minimum wages falls to 43.9 percent. In the case of pensioners, because their distribution is significantly more compressed, around 91 percent of them receive pensions below the established social tariff threshold, with two thirds of them earning a pension that falls below one minimum wage.[15]

While the rationale for setting the income threshold at two minimum wages is not made explicit in any official document, one possible explanation could be that the threshold is equivalent to the value of the basic baskets of goods and services for a family of two adults and three children, a typical family conformation in Argentina.[16] But there are many reasons why the set income threshold does not directly indicate the position of individuals in the distribution of per capita household income, the welfare measure used for measuring poverty in the country. First, the size of the household may differ from the typical one, with some families being larger than 5, particularly among the lower part of the distribution. Indeed, 25 percent of households in the bottom quintile are larger, compared with almost zero among the richest quintile. The differences in family size are due not only to fertility rate but also to the fact that extended family arrangements are more prevalent among the worse off families, as a strategy to share dwelling related costs. Second, families may have more than one formal income earner, and thus even for the typical size family whose head of household (as proxy of service account holder) earns less than two minimum wages, the combined income results in a per capita level that is above the poverty line. In AMBA, among the poorest quintile on average households have one formal income earner (including labor income in the formal sector as well as pensions or social programs). Instead, among the richest quintile the average number of formal income earners is 1.54. Finally, individuals earn income that is not accounted for in administrative records. Approximately a third of wage employees are informal workers in the sense that they do not contribute to the social security system. Among self-employed, the degree of informality is estimated to be closer to two-third. Beyond labor income, people may have other sources of non-labor incomes, such as rents from capital or property, that are not accounted for by the social security agency.

[14] Minimum wages are set for full-time employees, but some of them are not employed full time, hence the share of wage employees for who, while formal, have a monthly income fall below the established minimum wage.

[15] It should be noted that the minimum pension is lower than the minimum wage (around ARS 5,000 in July 2016). Also, because of the moratoria on pension payment, some of the retirees are earning below the minimum retirement benefit, to account for the number of years that they did not contribute to the social security system relative to the required ones. Initially, the ST set the threshold at two minimum pensions, but was later modified to be the same the threshold applied to other income earners.

[16] The example that is provided in INDEC's poverty report is of a household composed of one male around 40 years old, a female of the same age, and three children aged 5, 3, and 1 years old. These are equivalent to 3.25 adult equivalent. With a basic food and non-food basket for AMBA of ARS $4,033, the value of the relevant basket for this household equals ARS $ 13,107.

The implication of the reasons argued before, is that the share of formal workers and retirees that belong to the poorest deciles of the per capita income distribution is relatively small. Instead, the poorest deciles most typically have larger family sizes, and have labor income from the informal sector. In the absence of complete information about household income from both registered and non-registered sources the exclusion criteria can be thought as a mechanism to exclude those whose registered income fall below the threshold of two minimum wages but through other sources, such as combined family income, lower household size, returns from investment not registered or other, are better off in per capita terms. Indeed, administrative records suggest that the exclusion related to property of dwellings or vehicles tend to exclude a larger share of formal wage employees, than retirees, and these to a larger extent to recipients of social programs.

What are the characteristics of the families that while vulnerable, are not eligible to receive the social tariff? The excludes families in the lower four deciles are, to a larger extent, characterized by having head of households in central ages (20 to 40 years old), with formal wage employees with incomes higher than two minimum wages but in large families, and informal workers that do not have children under 19 years of age.

4 Distributional effects of energy subsidies reduction

4.1 Methodology and data

The distributive effects of subsidies are estimated combining the most updated information of the two main household surveys in Argentina: the Permanent Household Survey (EPH) and the Household Income and Expenditure Survey (ENGHo). First, we derive the households' quantity consumption patterns of electricity (in kWh) and piped gas (in m3) from the ENGHo 2012-13. Following Navajas (2008) we do not use quantities as reported in the survey because they tend to underreport when compared with administrative data. It is often argued that the underreporting is due to measurement error as individuals are more likely to know with precision how much they paid for the utility bill than how much many units they consumed. Thus, quantities are derived from the reported expenditures after deducting taxes[17] and using the companies' tariff charts for AMBA.[18] Second, since EPH is published quarterly, we impute derived quantities for each quarter between 2016.Q2 and 2019.Q2 (the last round available at the elaboration of this paper). We estimate a prediction model based on household characteristics, including households sociodemographic variables.[19] Finally, to account for changes in consumption

[17]We updated information reported in Cont (2007). Overall taxation, including include national (i.e., VAT) and subnational taxes (i.e., turnover tax, municipal taxes), in electricity is about 29 percent while in piped gas is approximately 39 per cent.

[18]For electricity we use information from the two providers in AMBA: Edenor and Edesur. For piped gas data come from the two providers in AMBA: Metrogas and Gas BAN.

[19]The variables included in the model are: whether the household is located in a slum, type of household, type of stove, head of household occupation, age, sex, education, and marital status, number

across time and to reflect real monetary figures, imputed quantities are scaled up based on the effective quarterly total consumption of electricity and piped gas, as reported by administrative data.[20] Figure A2 of the Appendix presents the distribution by deciles of derived quantities from ENGHo and imputed quantities in EPHs. Since consumers are classified into specific consumption categories of electricity and piped gas, we then compare our distribution by categories with those resultants from administrative data (see Figure A3 in the Appendix). It can be appreciated that our survey-obtained distributions accurately reflect the administrative data distributions.

The incidence analysis is performed using the traditional benefit-incidence analysis. This methodology involves three basic stages: (i) order individuals or households by a welfare indicator (i.e., per capita household income in our case); (ii) adopt identification assumptions and estimate the beneficiaries of subsidies (consumers of each service and beneficiaries the social tariff); and (iii) measure the distribution of the subsidies according to the distribution of beneficiaries obtained in (ii). We calculate for each household the expenditure on electricity and piped gas, according to the consumed quantities and the current tariff charts during each quarter of our sample.[21] , [22]

4.2 Results

Figure 5 shows the distributional incidence of subsidies to residential consumption of energy in Argentina, by per capita household income deciles. Absolut incidence (i.e., the share of subsidy received by each decile of income distribution) is presented in Panel A. Our starting point at 2016.Q2 shows the well-established middle to high income bias (Hancevic *et al.*, 2016).[23] The bottom 20 percent of income distribution received 14.4 percent of total residential subsidies to electricity while the top 20 percent appropriated a 26.1 percent. Regarding piped gas, the poorest received 9.7 percent of all the residential subsidies to gas, whereas the richest obtained 31.7 percent respectively. Over time the difference between both shares has slightly reduced. By 2019.Q2 the bottom 20 received 16.8 (10.4) percent of total residential subsidies to electricity (piped gas) while the top 20 appropriated 22.9 (29.0) percent. To note, there is large variability over quarters (more pronounced in the case of piped gas) which is the result of the seasonality in the consumption patterns and the variability in prices and costs.[24]

of household earners. See Table A3 in Appendix for the estimated regression to impute quantities.

[20] For electricity we use information from ENRE. For piped gas data come from ENARGAS. See Figure A1 in the Appendix.

[21] Programa Hogar (the subsidy to bottled gas) was not considered in our analysis. However, its pro-poor focalization is well established by the literature (Puig & Salinardi, 2015; Lakner *et al.*, 2016). Figure A4 in the Appendix presents the distribution on its beneficiaries across income deciles. Households were identified based on the official program description and targeting mechanism. See here.

[22] Tariff charts were obtained from providers mentioned in footnote 20. Tariff charts report separately the different prices for families that are beneficiaries of the ST and those that are not.

[23] See also Lustig & Pessino (2013), Puig & Salinardi (2015) and Lakner *et al.* (2016).

[24] See Figure A1 in the Appendix and Figure 3 in the main text.

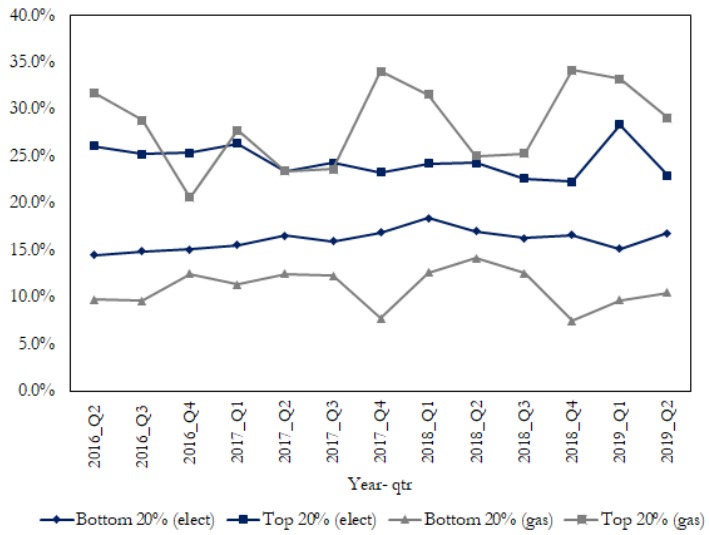
Panel B reports some standard distributive indicators. The subsidy concentration coefficient, measures the degree of concentration of benefits in the lower deciles of income distribution. A negative value indicates a pro-poor subsidy. That is, as poorest households receive a higher share of the subsidy, the absolute value of the concentration coefficient increases. The concentration coefficient for electricity subsidies results positive for all the analyzed period. The corresponding to piped gas show positive and negatives values but is always positive when comparing the extremes of the period. A second distributive indicator is presented to measure the progressivity of the subsidy. The Kakwani coefficient measures the difference between subsidies concentration coefficient and the Gini coefficient of income before subsidies. Negative (positive) values represent a progressive (regressive) subsidy, and therefore a more equitable income distribution. For both electricity and piped gas, the Kakwani coefficient is negative. In addition, the distributive incidence of subsidies does not appear to change substantially over the time. Therefore, energy subsidies in the Metropolitan Area of Buenos Aires in Argentina (lower in aggregate terms) continue to be, although progressive, pro-rich.

The elimination of subsidies other than social tariff had the expected effect of increasing households' spending on residential energy services, as utility tariffs increased. Figure 6 presents the median spending on electricity and piped gas in AMBA. On average, and beyond seasonality of spending, monthly expenditure on electricity bills as a share of total household income has increased from 1.1 percent in early 2016 to 3.4 percent in early 2019. Monthly expenditure on piped gas rose from 1.3 percent to 3.3 percent, during the same period. Among the poorest households the share of spending on electricity grew from 1.5 percent to 5.1 percent, while spending on piped gas did from 0.9 percent to 5.9 percent. The share that households currently allocate to electricity and gas seems to be in line with many other countries in the region. Jimenez Mori & Yépez-García (2017) document for a pooled sample of 13 Latin-American countries that the third quintile of the income distribution spends on average 3.6 percent of its total household expenditure in electricity and 2.4 percent in piped gas. In countries such as Brazil (Uruguay) these shares are 4.1 (7.7) percent and 1.6 (3.6) respectively.

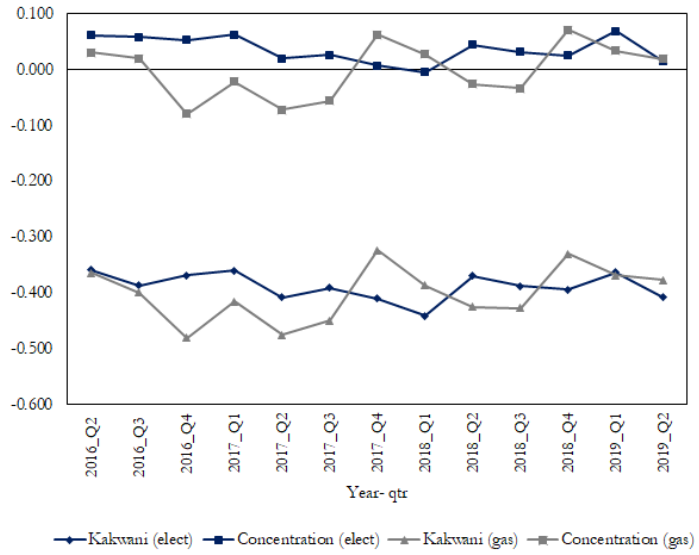
How much of the cost of electricity and piped gas is covered after the subsidy reduction? The answer is provided in Figure 7. At 2016.Q2 consumers were paying on average 29.1 percent of the cost of electricity. After the subsidy reduction, the coverage had increased up to 79 percent in 2019.Q2. This coverage for the top (bottom) 20 percent of the income distribution represents 83.6 (74.1) percent. In the case of gas, the initial cost coverage was 30.9 percent and after the reduction of subsidies was 83.0 percent of the cost. Again, the existence of differences across income distribution is established. The top (bottom) 20 percent covered 86.8 (77.2) percent.

Figure 5: Distributional incidence of subsidies to residential consumption of energy in Argentina. Quarterly evolution 2016.Q2 – 2019.Q2

Panel A. Absolute incidence



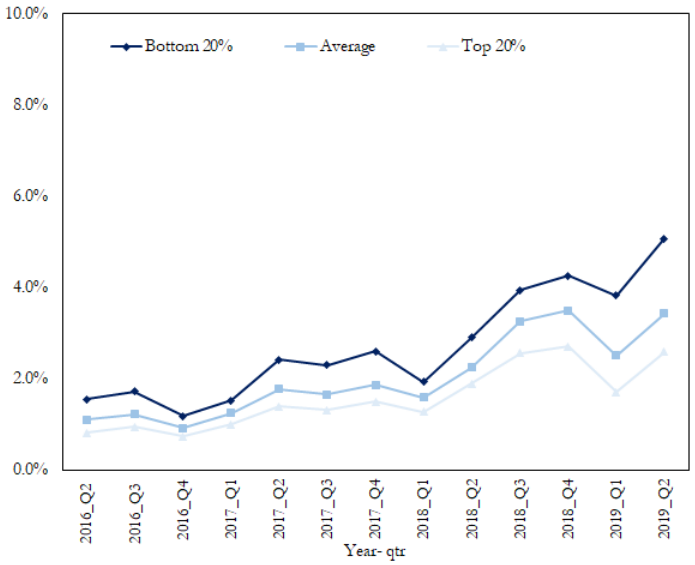
Panel B. Concentration index and progressivity



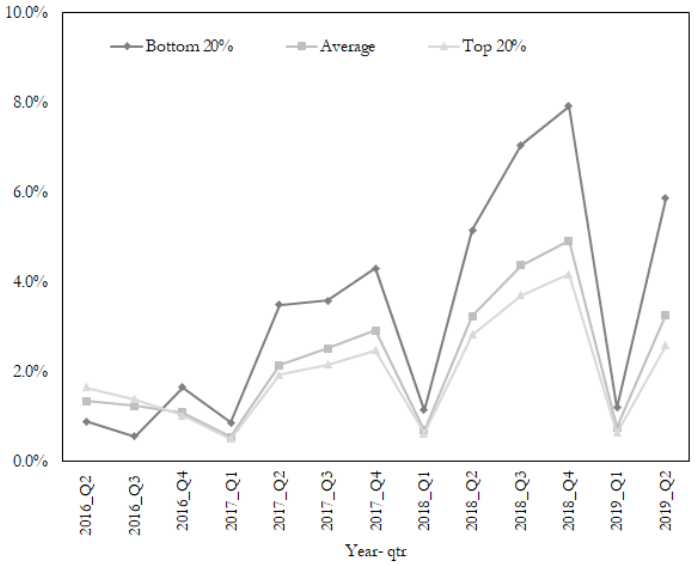
Source: Own elaboration based on Permanent Household Survey (EPH), Household Income and Expenditure Survey 2012-13 (ENGHo 2012-13) and specific information of the energy sector.
Notes: Excludes zero reported energy expenditures. All values are weighted using the population expansion factor.

Figure 6: Monthly spending on residential consumption of energy in Argentina. Quarterly evolution 2016.Q2 – 2019.Q2. As percentage of total familiar household income

Panel A. Electricity



Panel B. Piped Gas



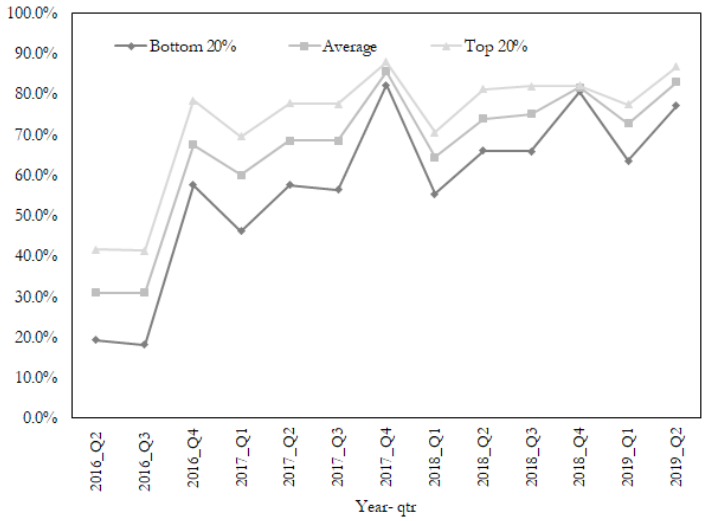
Source: Own elaboration based on Permanent Household Survey (EPH), Household Income and Expenditure Survey 2012-13 (ENGHo 2012-13) and specific information of the energy sector.

Notes: For each quarter the reported monthly share corresponds to the median one. Excludes zero reported energy expenditures. All values are weighted using the population expansion factor.

Figure 7: Tariff cost coverage of residential consumption of energy in Argentina. Quarterly evolution 2016.Q2 – 2019.Q2

Panel A. Electricity

Panel B. Piped Gas



Source: Own elaboration based on Permanent Household Survey (EPH), Household Income and Expenditure Survey 2012-13 (ENGHo 2012-13) and specific information of the energy sector.
Notes: For each quarter the reported monthly share corresponds to the median one. Excludes zero reported energy expenditures. All values are weighted using the population expansion factor.

5 Conclusions

The recent Argentinean experience in the reduction of energy subsidies needs to contemplate the key role of the macroeconomic context through which subsidy reduction was carried out. Argentina's reform went through periods of good economic expectations (pre-May 2018) as well as hostile macroeconomic contexts (post-May 2018) that could affect its timing. Regardless of the situation the government stood firm in the reduction path.

The balance includes auspicious results in terms of convergence from tariff to service provision costs, which becomes central in order to incentive sectoral investment and stimulate a good provision of electricity and gas. In terms of budget share of energy consumption, the reform led Argentine households to similar levels to that of several countries in the region. Regarding distributional incidence, it does not appear to have changed substantially. Energy subsidies in Argentina (lower in aggregate terms) continue to be, although progressive, pro-rich. Finally, the implementation of the social tariff provides interesting insights. Although is relatively pro-poor, with a significant higher coverage rate of poorest households and significant lower coverage among the richest decile, there are some exclusion errors in the low-income deciles and large inclusion errors in the medium- and high-income deciles.

The distributional effect is explained by the fact that generalized subsidies to all categories of consumption coexist with a relatively well targeted social tariff. One policy recommendation in terms of achieving more pro-poor subsidies suggests a better focus on the social tariff, working on inclusion and exclusion errors. For this, the target population should be reviewed based on the identification of those households that really need support. Also maximize targeting accuracy through the applicability of eligibility criteria.

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Appendix

Table A1: Inclusion and exclusion criteria for Federal Social Tariff estimation

Inclusion criteria
Retiree, pensioner or beneficiary of non-contributory pension with incomes below two minimum wages
Wage employee or self-employed with incomes below two minimum wages
Beneficiary of social programs, including Universal Child Allowance (AUH), Pregnancy allowance, Jefes y Jefas, PROGRESAR, and Social Income with Employment programs
Domestic services
Social self-employed (monotributo social)
Unemployment insurance
Person with disability
Electricity-dependent person
War veteran
Exclusion criteria
More than one property
Vehicle newer than 10 years
Plane or luxury boat

Source: Ministry of Energy.

Table A2: Distribution of formal wage employees and retirees. Based on minimum wage thresholds. Average for the period 2016.Q2 and 2019.Q2

	Formal wage employees	Retirees (or pensioner)
All individuals	100%	100%
Earnings (pensions), less than one minimum wage	11%	68%
Earnings (pensions), between one and two minimum wage	44%	23%
Earnings (pensions), more than two minimum wage	45%	9%
Among head of households	100%	100%
Earnings (pensions), less than one minimum wage	7%	59%
Earnings (pensions), between one and two minimum wage	37%	29%
Earnings (pensions), more than two minimum wage	56%	12%

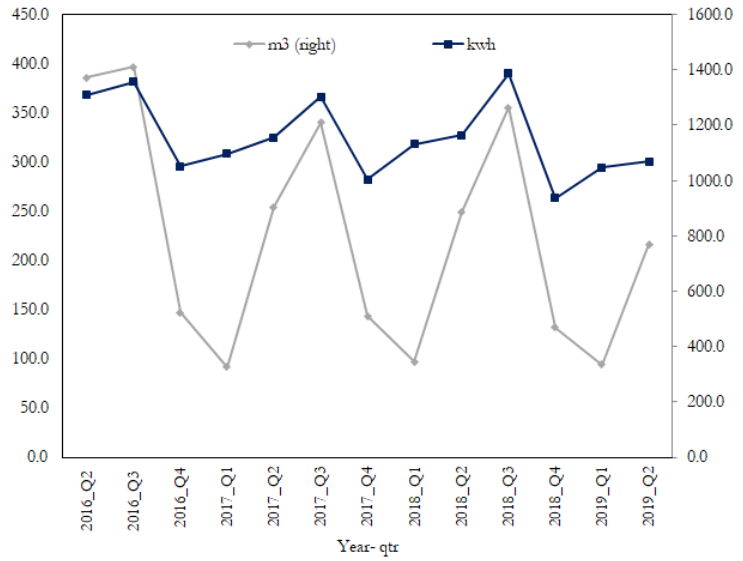
Source: Own estimates based on Permanent Household Survey (EPH).

Table A3: Imputation model. Prediction model based on household characteristics, including household characteristics and sociodemographic variables of its members

	[1]	[2]
	kWh	m3
House	-22.78***	14.71***
	(4.750)	(4.629)
N of rooms	10.65***	12.16***
	(2.566)	(2.995)
Poor Neighborhood	-29.66***	-6.721
	(7.191)	(12.98)
Piped Gas for cooking	-2.783	10.19
	(4.192)	(11.33)
Piped water	-3.421	-6.921
	(4.907)	(9.692)
Head Household employed	0.402	0.795
	(5.412)	(5.649)
Head Household secondary school	-1.088	2.229
	(4.119)	(5.999)
Head Household university	17.17**	-1.656
	(8.266)	(9.048)
Head Household age	0.637	-0.485
	(0.721)	(0.876)
Head Household age squared	-0.00469	0.00330
	(0.00702)	(0.00801)
Head Household married	5.843	11.14*
	(4.995)	(5.682)
N income perceptors	-1.372	-0.193
	(8.535)	(10.15)
N income perceptors squared	-1.513	0.357
	(1.831)	(2.221)
Head Household gender	7.743	7.588
	(4.839)	(5.184)
N members	12.74***	5.056**
	(2.479)	(2.393)
Quarter 2	5.154	10.94
	(5.862)	(7.003)
Quarter 3	4.394	15.95**
	(5.289)	(7.315)
Quarter 4	5.507	6.930
	(5.735)	(5.253)
Decile 2	10.15	-10.23
	(6.590)	(9.265)
Decile 3	22.42***	-4.534
	(7.468)	(9.005)
Decile 4	20.65***	10.55
	(7.682)	(9.669)
Decile 5	34.09***	7.879
	(9.111)	(10.22)
Decile 6	30.21***	19.68*
	(8.352)	(10.59)
Decile 7	45.03***	35.50***
	(9.972)	(13.13)
Decile 8	53.65***	22.41*
	(10.33)	(12.33)
Decile 9	50.29***	52.27***
	(12.79)	(16.52)
Decile 10	47.27***	33.72***
	(12.19)	(11.23)
Observations	1,670	938
R-squared	0.115	0.125

Source: Own estimates based on Permanent Household Survey (EPH), ENGHo 2012-2013 and specific information of the energy sector.
Notes: Robust standard errors in parentheses. Statistical significance *** p¡0.01, ** p¡0.05, * p¡0.1.

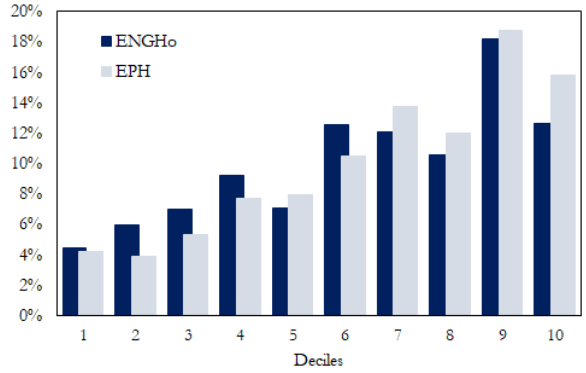
Figure A1: Quarterly consumption of electricity and gas in AMBA. Administrative quantities. In kWh and m3



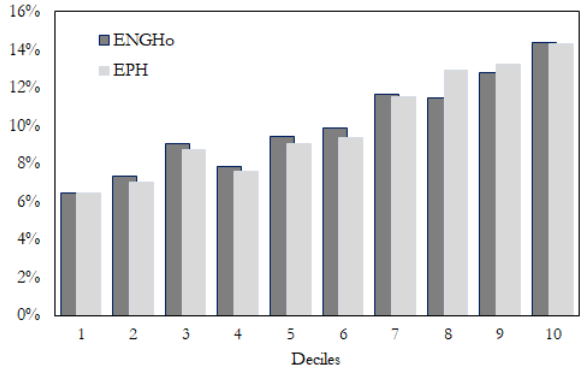
Source: Own elaboration based on Association of Electric Power Distributors of the Argentine Republic (ADEERA) and National Gas Regulatory Entity (ENARGAS).

Figure A2: Estimated quantities from Household Income and Expenditure Survey 2012-13 (ENGHo 2012-13) and imputed quantities in the Permanent Household Survey (EPH). Electricity (Panel A) and gas (Panel B). Share over total consumption by per capita household income deciles

Panel A. Electricity

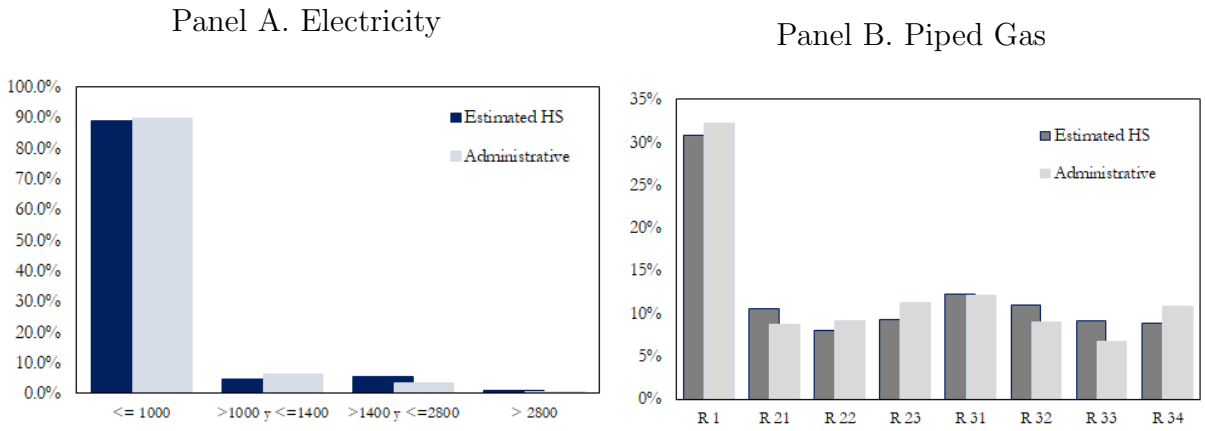


Panel B. Piped Gas



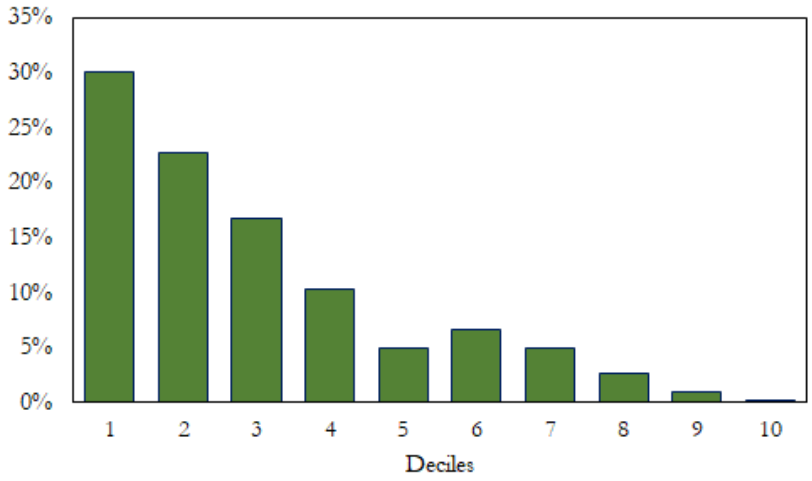
Source: Own elaboration based on Permanent Household Survey (EPH), Household Income and Expenditure Survey 2012-13 (ENGHo 2012-13) and specific information of the energy sector.

Figure A3: Imputed quantities in the Permanent Household Survey (EPH) and administrative data. Electricity (Panel A) and gas (Panel B). Distribution of households by categories of consumption



Source: Own elaboration based on Permanent Household Survey (EPH), Association of Electric Power Distributors of the Argentine Republic (ADEERA) and National Gas Regulatory Entity (ENARGAS).
Notes:electricity consumption categories are presented in four groups for comparability purposes with ADEERA's information.

Figure A4: Beneficiaries of Programa Hogar (subsidy to bottled gas). Distribution of households by per capita household income deciles. Average for the period 2016.Q2 and 2019.Q2



Source: Own elaboration based on Permanent Household Survey (EPH).