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Managing the distributional effects of energy taxes and subsidy removal in Latin America and the Caribbean

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Abstract

Energy subsidies have been criticized due to their economic inefficiency and promotion of wasteful usage of energy and associated carbon emissions. Conversely, environmental taxes are advocated as efficient policy instruments. Nonetheless, removing subsidies and taxing energy can be politically challenging because vulnerable households rely on low energy prices. This study analyzes the impact of energy price increases on different income quintiles groups in eleven Latin American and Caribbean countries using an energy-extended input-output approach. Our results show that higher-income groups benefit more from low energy prices than low-income groups when tracing both the direct and indirect (supply chain) effects of energy price variations. Energy subsidies are a very expensive option to transfer income to poor households. Across the countries considered, using energy subsidies it would cost about $12 to transfer $1 of income to households in the poorest quintile. Recycling a small fraction of fiscal revenues from energy subsidy removal or energy taxation could be sufficient to compensate vulnerable households from the effects of price hikes. Our findings suggest that cash transfers to poor households and targeted subsidies for public transportation or food are the most effective measures to compensate households for welfare loss.

JEL Codes: H22, H23, Q01, N56, 013

Keywords: distributional impact, energy taxes, subsidy removal, input-output analysis, carbon taxes, environmental tax reform, political acceptability

Introduction

Energy subsidies are frequently used by governments to mitigate the impact of high and volatile oil prices on consumers, prevent inflation, boost competitiveness, and protect the standard of living of vulnerable segments of the population (Kojima, 2016; Marchan et al., 2017). Such subsidies come with high fiscal costs and introduce price distortions that promote wasteful usage of energy, increase greenhouse gas (GHG) emissions, and hamper the development of energy efficiency and renewable energy technologies (IEA, 2014).

Acknowledging these deleterious effects, governments around the world have committed to phasing out energy subsidies. In September 2009, for example, the leaders of the G20 – a group of the 20 largest economies including Argentina, Brazil and Mexico – pledged to "phase out and rationalize over the medium term inefficient fossil fuel subsidies while providing targeted support for the poorest" (Rentschler and Bazilian, 2016).

In addition, countries pledged in the 2016 Paris Agreement to stabilize global warming well below 2°C, which will require reducing fossil carbon emissions to net zero before the end of the century (Fay et al., 2015). Among the many policies that can be used to support this transition (Fay et al., 2015; OECD, 2017), carbon taxes increasing the price of fossil energy have received significant attention. Carbon taxes are also advocated as an efficient fiscal policy to reduce informality, finance investment in infrastructure, and fund social and environmental programs (Stiglitz and Stern, 2017; Vogt-Schilb and Hallegatte, 2017). Carbon taxes, together with fiscal gains from subsidy removal, can contribute to close three of the most prominent development gaps in Latin America and the Caribbean (LAC). On average, from 2008 to 2014, energy subsidies in Latin America and the Caribbean accounted for about 1.6 percent of their GDP (Marchan et al., 2017).

Energy price reform is often difficult, however, due to the potential adverse near-term economic and social impacts (Di Bella et al., 2016). From a political economy point of view, one reason subsidies exist is because they are a visible mechanism for governments to provide benefits to poor and middle-class voters, and sometimes to industrial interests, in exchange for political support (Victor, 2009; Vogt-Schilb and Hallegatte, 2017). Taxes on energy could harm those voters and special interests, reducing the likelihood that a reform succeeds. Understanding the effects of energy price increases across income groups can help in the design and implementation of more effective energy pricing policies.

Many studies have found that attempts to reform subsidies are likely to fail in the absence of a clear understanding of the effects of subsidy removal on the welfare of households and other key stakeholders, specific steps to tackle these effects, and appropriate communication of those steps (Rentschler and Bazilian, 2016; Vagliasindi, 2012). Regardless of whether specific energy subsidies are regressive or progressive, phasing out subsidies may hurt poor and middle-class households and voters. This may be considered a problem on normative grounds, since many governments aim at improving, not worsening, the livelihood of poor and middle-class households. And it may translate into a *de facto* barrier to reform: these households may use their political power to bar reforms perceived as not in their best interest (Olson, 1977; Trebilcock, 2014).

On the other hand, studies found that governments which chose to recycle part of the budgetary savings gained from a reduction in subsidies into compensation measures for more vulnerable groups are more likely to successfully increase energy prices (Rentschler and Bazilian, 2016; Sdralevich et al., 2014). Such compensation measures can take the form of targeted social spending, for instance using cash transfer programs, or, when this is not feasible, subsidizing services used by vulnerable households such as public transportation, education, health, or school meal programs. Tax exemptions to certain households or sectors of the economy have also been used (Vagliasindi, 2012).

In this study, we estimate the minimum fraction of government proceeds from subsidy removal or energy taxation needed to compensate households for the short-term effects of energy price hikes. We show that in principle, only 19 percent of the potential savings from an increase in gasoline and diesel prices would be needed to neutralize the welfare impacts of the price shock on the bottom 40 percent of households. Roughly 27 percent of government savings resulting from subsidy removal or tax increases on natural gas and LPG would sufficiently compensate the two bottom quintiles. Finally, approximately 21 percent of the savings gained from a flat increase in electricity prices could compensate the bottom 40 percent of households for their welfare losses. Table 8 at the end of this paper provides a breakdown per energy type and country of the share of the savings needed to compensate households across income quintiles. In addition, we identify the vehicles through which households are indirectly impacted by price increases for various energy types in each country, providing insight into how poor households could be compensated for potential welfare loss, if necessary. In general, public transportation and food are two important channels through which poor households are affected by gasoline price hikes, while the direct impact is most important for electricity and gas price hikes.

We estimate the direct and indirect welfare impacts across income quintiles of increasing fuel and electricity prices in eleven Latin America and the Caribbean countries. The direct impact measures how much households' direct spending on energy is affected by the price hikes. The indirect impact measures how much the price of all other goods and services depending on energy inputs along the supply chain increase given the increase in energy prices, and how this affects households. The price rises are modeled for all fuels and electricity in each country, whether or not the country actually subsidized energy, in order to provide a sense of the population's vulnerability to energy price increases.

For countries that subsidize fuels or electricity, this study provides an understanding of which households capture the most benefits from subsidies and how each would be affected if these were reduced. For countries that do not currently subsidize energy, the study reveals how future price shocks or other price increases – due to carbon taxes, for example – would affect households across the income spectrum.

Contribution to the literature

Many previous studies have assessed the direct and indirect impact of energy price shocks on consumer welfare in various countries. The simplest approach to investigate this question is to use input-output tables (using a simple Leontief model to propagate energy price rises to indirect consumer price rises for all goods and services), and then use consumption surveys to determine the incidence of the price shock on household budgets. In its most recent study of 32 developing countries that subsidize fuels, the IMF found (using this approach) that for $100 saved by removing fuel subsidies, only $18 would be paid by the bottom 40 percent (Coady, Flamini, and Sears 2015).

In a recent study, the World Bank uses a simpler approach, without input-output tables, to assess the direct incidence of electricity subsidies in Central America (Hernández Oré et al. 2018). They find that electricity subsidies reach wealthy households more than poor ones, so there is an opportunity to better spend the budget currently allocated to electricity subsidies.[1]

[1] The World Bank neglects the indirect impact of electricity price variations – our results show that the indirect impact of electricity price hikes represents about half of the impact and tend to have a neutral incidence.

More sophisticated approaches to assess the distributional impact of price increases, use a computable general equilibrium model around the input-output tables (to capture some of the mid-term response to price rises in the economic system), or even more detailed energy-economy models to project the response of the economy to price changes, sometimes taking into account that wages and rents may also be affected by price changes. These methods have been used mainly in the literature on the incidence of carbon prices (Dissou and Siddiqui 2014; Fullerton and Heutel 2011; Romero et al. 2015).

This literature is surprisingly separated from the literature on the incidence of subsidies but has reached the same conclusion (Symons, Speck, and Proops 2002; Cornwell and Creedy 1996; Bento et al. 2009; Burtraw, Sweeney, and Walls 2009; Parry and Williams 2010; Bach et al. 2002; Combet et al. 2010; Liang and Wei 2012). While their results are not necessarily framed this way, these studies confirm that (i) the final incidence of the reform depends on how the proceeds are used; and (ii) a fraction of the carbon proceeds is in principle sufficient to compensate for the incidence on poor and vulnerable households.

While these results are consensual at the qualitative level, quantitative assessments for specific Latin American and the Caribbean countries are scarce. The IMF provides assessment at the regional level but not for individual LAC countries (Coady, Flamini, and Sears 2015). Blackman, Osakwe, and Alpizar (2010) analyse both the direct and indirect impact of gasoline and diesel taxes in Costa Rica but only qualitatively discuss the use of government receipts. Gonzalez (2012) assesses the distributional impact of carbon taxes in Mexico, using a computable general equilibrium model, and discussing explicitly the use of fiscal receipts. Agostini and Jiménez (2015) analyze the incidence of existing gasoline taxes in Chile, but they focus on the direct impact and omit discussion of the fiscal proceeds. Da Silva Freitas et al. (2016) use an input-output model in Brazil to analyse a carbon tax, omitting analysis of the government recycling carbon receipts.

To fill this gap, this study provides assessments of the incidence of energy price rises for three energy types in eleven LAC countries, most of them for the first time in the published literature. This study also operationalizes the qualitative result that the final incidence depends on how the government uses the fiscal receipts by showing what fraction governments would need to recycle in order to compensate households, up to different quintiles of income.

Methods and Data

Input-output Analysis

Input-output analysis has been frequently used to study the distributional effects of energy subsidies and carbon pricing on different household groups (Choi et al., 2016; Feng et al., 2010; Kerkhof et al., 2008; Ogarenko and Hubacek, 2013; Wang et al., 2016; Wier et al., 2005). In this study, we use input-output analysis to model the impacts of energy subsidy removal and/or energy price shocks on household quintiles via induced price changes in household expenditure items. This method captures both direct and indirect effects, i.e., the direct price increase for energy products, and the indirect price increases triggered by energy inputs to all final consumption items. In this study, input-output analysis was selected due to its simplicity and transparency, compared with other economic system accounting methods such as computational general equilibrium models (CGE) (Duarte et al., 2016; Feng et al., 2010; Kerkhof et al., 2008; Rausch et al., 2011). The input-output model gives an upper-bound estimate of the short-term impact of energy price hikes on the price of other consumption goods, before firms can adjust production processes. The IMF (Coady et al., 2015) notes that the short-term estimate provided by simple input-output analysis may also be closer to the perceived impact by the public, making it a good indicator for public policy focused on the social acceptability of energy price rises.

Input-output analysis relies on national or regional input-output tables. A country's input-output tables show the flows of goods and services and thus the interdependencies between suppliers and consumers along the production chain across upstream and downstream industries within an economy (Miller and Blair, 2009). The model consists of *n* linear equations depicting the production of an economy:

$$x_i = \sum_{j=1}^{n} z_{ij} + y_i \tag{1}$$

where *n* is the number of sectors in an economy; $\boldsymbol{x_i}$ is the total economic output of the i^{th} sector; $\boldsymbol{y_i}$ is the final demand of sector *i*. $\boldsymbol{z_{ij}}$ is the monetary flow from the i^{th} sector to the j^{th} sector.
In matrix notation and for the economy as a whole, the Equation (1) can be written as:

$$x = Ax + y \tag{2}$$

Technical coefficient matrix $A = (a_{i,j})$ is derived by dividing the inter-sectoral flows from sectors *i* to *j* (z_{ij}) by total input of sector *j* (x_j).

To solve for *x*, we get total output driven by final demand

$$x = Ax + y \tag{3}$$

$(I - A)^{-1}$ is known as the Leontief inverse matrix, which shows the total production of each sector required to satisfy the final demand in the economy.

To estimate the direct and indirect effects of a price shock of energy *k* (Electricity, Natural Gas, Petroleum, LPG, and Kerosene) on income group *q*, we calculate the indirect and the direct effect separately. To calculate the indirect effect, we build a row vector of cost increase per unit of sectoral output e_k. Here, e_k is derived from the production cost increase in each economic sector due to the price shock of energy *k* divided by the total sectoral output. The cost increase in each economic sector is estimated using the total consumption of energy *k* multiplied by the price increase rate, p_k, e.g., 25 cents per kWh for electricity

$$c_{k,q}^{indir} = e_k * (I - A)^{-1} y_q \tag{4}$$

The direct effects of price shock on income group *i* is calculated using the household direct consumption of energy *k* of income group *i* multiplied by the price increase rate of the energy k.

$$c_{k,q}^{dir} = p_k * y_{k,q} \tag{5}$$

Therefore, the total effect of an energy price increase of energy *k* on group *i* is calculated by:

$$c_{k,q}^{tot} = c_{k,q}^{indir} + c_{k,q}^{dir} \tag{6}$$

Given an increase in energy prices, it would be more expensive for households to consume the same amount of energy. We call the *direct impact of energy price hikes* the additional share of a household's total budget required to consume the same amount of energy than before the price hike. This practice, common in the literature (Coady et al., 2015), provides a reasonable upper bound of the short-term impact of price rises on households, before they have had time to adjust their consumption behavior or take adaptive actions (such as investing in more energy-efficient cars or appliances).

Energy is also used by firms across the economic value chain to produce goods and services that households consume, such as public transportation, food, or clothing. We project by how much the price of goods and services consumed by households would increase if energy prices increased. For instance, if in a given country producing one dollar's worth of processed meat requires 20 cents of gasoline on average (e.g., to transport the meat), then doubling the price of gasoline would, on a first approximation, increase the price of meat by 20 percent. Combining input-output tables and household surveys, we are thus able to analyze the *indirect* impact of energy price increases on household welfare. In doing so, we can also identify through which consumption categories households are most hurt when an energy price hike occurs. Here again, our approach results in an upper bound of the short-term impact of energy price rises on consumers via other consumption goods, before firms invest in energy saving measures and/or household modify their consumption patterns.

Data

We used harmonized input-output tables describing the economic structure of eleven LAC countries in order to estimate the energy content of goods and services produced in each country. The eleven countries include Argentina, the Bahamas, Barbados, Chile, Costa Rica, Ecuador, Guatemala, Jamaica, Nicaragua, Paraguay, and Uruguay.

To calibrate the energy-extended input-output model, we applied the following data preparation steps: First, input-output (IO) tables were extracted from the Global Trade Analysis Project (GTAP) database version 9 (GTAP, 2016). For each country, the IO table includes intermediate and final consumption matrices, value added and total output in 2011, reported for 57 economic sectors in monetary terms. Second, we obtained energy balance tables from the International Energy Agency, which include physical quantities for a very large set of fuels and uses, to estimate sectoral energy consumption for 57 economic sectors for the eleven LAC countries. Third, following similar studies by the IMF (Di Bella et al., 2016) and the World Bank (Kojima, 2016), we choose the average price increase of gasoline, diesel, LPG, natural gas, and electricity. Table 1 below lists the modeled price increases by energy type.[2] Finally, we constructed a column vector of household consumption for each income group using the harmonized consumption survey data with 14 aggregate consumption item categories that are identical across countries provided by the Inter-American Development Bank (Jimenez and Yepez-Garcia, 2018). These 14 categories where

[2] LPG and natural gas are different fuels with different uses and prices across the LAC. The harmonized household surveys that we use, however, do not provide separate information on spending for both fuels, thus the modeled price shocks have to be combined. Nevertheless, only four countries in our sample consume both natural gas and LPG (Argentina, Chile, Ecuador, and Uruguay). For these countries, the welfare impact of price shocks includes both fuels. For all other countries, only the impact of LPG price shocks is included. 250 cents/MMBTU corresponds to 6 cents/liter of LPG.

matched to the 57 sectors in the IO tables. For each consumption item, consumption reported in surveys is scaled up so that total spending matches national spending as per the national accounts. We define welfare as the household's total annual expenditure reported in the household survey, expressed in US dollars purchasing power parity (PPP). This expenditure represents the household's budget constraint.

Table 1: Modeled price shocks

Energy type	Price increase (USD)
Electricity	5 cents/kWh (kilowatt hour)
Gasoline and diesel	25 cents/Liter
Natural Gas and LPG	250 cents/MMBTU (Million British Thermal Unit)

Unconditional and conditional Scenarios

In this study, we extend our analysis of the *direct* impact of raising energy prices on household welfare into two scenarios: *unconditional* and *conditional*. Unlike the indirect impacts of an increase in energy price, which affect all households by raising the prices of other goods and services consumed, the direct welfare effects only depend on how much and whether households consume a specific energy product. For example, the direct impact of raising electricity prices will be different for households who have electricity connections in their homes versus households who do not and therefore cannot purchase electricity. In the *unconditional* scenario, the direct effects of raising energy prices are analyzed for all households in an economy, whereas, in the *conditional* scenario, the impact of energy price shocks are only analyzed for households that directly consume a particular energy type. Consequently, the direct effects on household welfare of raising energy prices may vary between the conditional and unconditional scenarios.

Results

Our results show that price hikes on natural gas and LPG tend to be regressive, since these fuels are used largely for basic needs such as heating and cooking. The direct impact of price hikes on gasoline and diesel tend to be the least regressive, on the other hand, since transport fuels tend to be used more by wealthier households. The indirect impacts of gasoline price rises, however, affect poor households through higher public transportation, electricity, and food prices. Even when price rises are progressive, they can affect poor households significantly. In the last section of the paper, we thus assess how much government spending would be needed to compensate poor households for the direct and indirect energy price hikes, and present those results by country and energy types.

In principle, an average of only 8 percent of the revenues from energy price rises is necessary to compensate households in the bottom quintile and 21 percent is necessary to compensate the bottom two quintiles.

Gasoline and diesel

Unconditional welfare impacts

Exposure to gasoline and diesel price shocks varies among the LAC. Figure 1 shows the total (direct and indirect) impact of price increases for gasoline and diesel on household welfare across income quintiles.

Some countries including Argentina, the Bahamas, Barbados, and Jamaica exhibit a regressive impact of increased fuel, meaning that lower income groups would lose a higher share of their welfare than higher income groups as a result of increased fuel prices. On the other hand, raising gasoline and diesel prices Costa Rica, Ecuador, Nicaragua, and Paraguay produces a progressive impact, whereby higher income groups would be relatively more affected than lower income groups if prices rise. While, Chile, Guatemala, and Uruguay exhibit a somewhat neutral distributional effect.

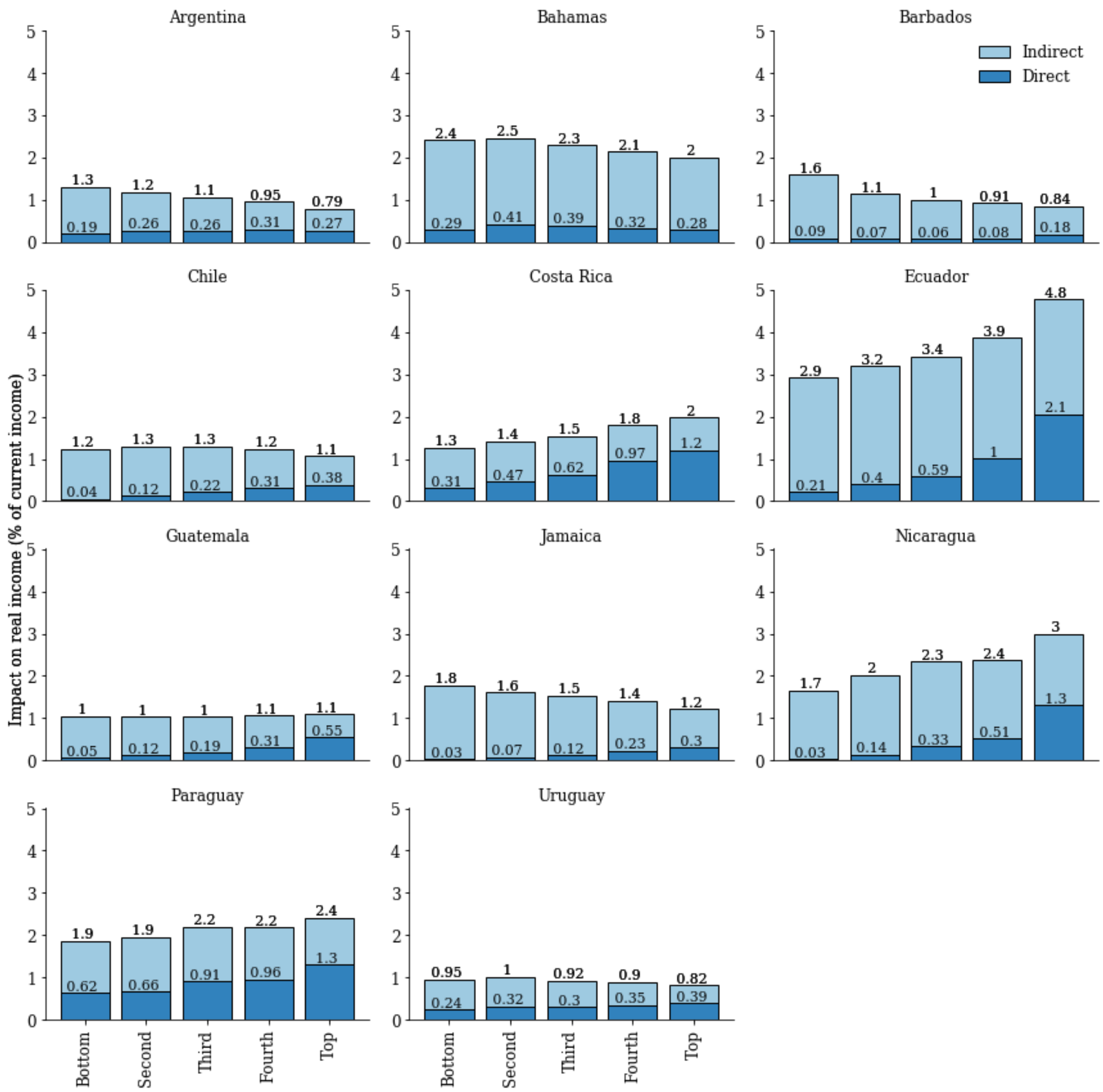

Figure 1: Direct and indirect welfare loss from a US$0.25/L gasoline and diesel price increase (in % of pre-shock expenditure)

The indirect impact of gasoline and diesel price rises on household welfare tends to be regressive. Apart from Ecuador and Nicaragua, where the incidence of price rises is almost neutral, increasing the cost of gasoline and diesel imposes a relatively higher welfare cost on poorer households than on wealthier ones in every country in our sample. The indirect effect of the price hike on the lowest quintile ranges from 0.7 percent of a household's budget in Uruguay to over 2 percent in the Bahamas. Barbados and Jamaica show the largest contrast between the poorest and richest quintiles. Increasing fuel prices would amount to 1.5 and 1.8 percent of the poorest households' yearly budget, respectively, while it would cost the top quintiles 0.7 and 0.9 percent, respectively.

Table 2: Price increase of goods and services triggered by increases of gasoline and diesel prices (% of current price)

	Argentina	Bahamas	Barbados	Chile	Costa Rica	Ecuador	Guatemala	Jamaica	Nicaragua	Paraguay	Uruguay	Median
Public transportation	6.0	7.9	3.1	6.3	7.9	13.0	51.0	7.5	16.0	12.0	5.7	7.9
Electricity	8.1	36.0	8.6	2.0	2.2	10.0	0.4	6.7	0.7	0.5	1.6	2.2
Durables	0.9	2.9	0.7	1.4	1.3	5.5	2.4	1.9	1.6	0.5	0.3	1.4
Food	1.4	1.7	0.4	0.6	1.0	1.1	1.0	0.9	0.5	0.9	0.6	0.9
Household services	0.2	2.3	0.6	0.6	0.8	1.1	0.3	0.8	0.6	0.9	0.2	0.6
Clothes	0.5	1.7	0.5	0.3	1.0	0.9	0.7	0.8	0.3	0.4	0.3	0.5
Water	0.5	3.9	1.0	0.2	0.1	4.9	0.3	0.8	0.4	0.8	0.2	0.5
Natural gas	0.1	1.5	0.4	1.1	0.4	0.7	0.0	0.1	0.1	1.9	0.1	0.4
Communication	0.2	1.3	0.4	0.2	0.2	0.8	1.0	0.3	0.9	0.4	0.2	0.4
Entertainment	0.2	2.2	0.5	0.3	0.3	0.3	0.1	0.4	0.5	0.2	0.1	0.3
Personal care	0.2	0.9	0.2	0.2	0.2	0.8	0.2	0.2	0.5	0.4	0.1	0.2
Education and Health	0.2	1.7	0.4	0.2	0.2	0.6	0.1	0.5	0.6	0.2	0.1	0.2
Other fuels	0.1	4.0	1.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Taken together, the total welfare effects of gasoline and diesel price increases are largely influenced by the indirect effects of those price rises. Across the eleven sample countries, the indirect effects account for 70 percent of the total welfare cost of a price increase. The size of these effects depends on the amount of gasoline and diesel used in the supply chains of household consumption items. Table 2 shows the simulated impact of a US$0.25/L rise on diesel and gasoline on the price of different consumption categories. As expected, public transportation is the most affected consumption category across countries, with a median price increase of around 8 percent and a wide distribution, ranging from 3 percent in Barbados to as much as 51 percent in Guatemala. Electricity is also significantly affected by the price increases,[3] especially in the Caribbean and other countries where power generation relies heavily

[3] In this analysis, fuel oil used in power generation is included in the "diesel and gasoline" category.

on petroleum products. For example, electricity prices increased by 36 percent in the Bahamas and 8.6 percent in Barbados.

These indirect price hikes affect different households differently, depending on how households spend their money. Figure 2 shows the budget of the top and bottom quintile households in Argentina, with a relatively regressive relationship between price increases and welfare, and Ecuador, with a relatively progressive relationship.

In Argentina, the indirect regressive effects of the price hike outweigh the more moderate progressive direct effects. The consumption categories of food and public transportation, both with a relatively higher gasoline and diesel content, are key spending categories for bottom quintile households and less significant for the highest quintile. On the other hand, the share of direct spending on gasoline and diesel for both the top and bottom quintiles is relatively modest. Thus, the higher regressive indirect effects of gasoline and diesel price shocks shift the total relative welfare burden to the poorer quintiles. In Ecuador, on the other hand, a high share of direct spending on diesel and gasoline by the top quintile relative to the bottom quintile means that the large, progressive effects of an increase in fuel prices outweighs the relatively neutral (though still large) indirect effects on the poorest quintiles. Similar illustrations of the budget shares for all the other countries in our sample are available in Figure S1 (Appendix).

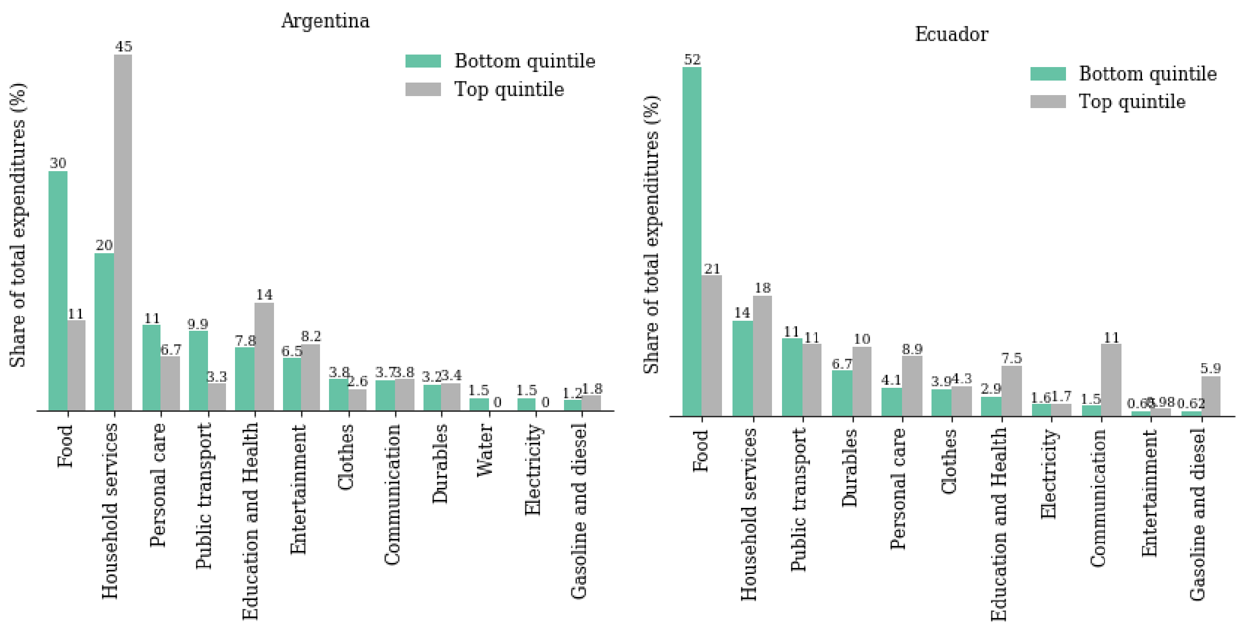

Figure 2: Budget distribution for the bottom and top income quintiles in Argentina and Ecuador (in % of current expenditures)

Given that the total welfare effects of gasoline and diesel price shocks are determined by each country's specific context, it is important to understand the channel through which higher gasoline and diesel prices affect the most vulnerable households, particularly if protecting these groups against price volatility motivates the government to regulate fuel prices. Table 3 provides the top five consumption categories that contribute most to the loss of household welfare in the bottom quintile when there is a rise in diesel and gasoline prices. In Argentina, for example, 39 percent of the total impact of a price rise on the poorest quintile is a result of an increase in the cost of public transportation; 28 percent is a result of food price increases; 14 percent is due to the direct impact of the increase in gasoline and diesel prices; 8 percent is due to an increase in electricity prices; and 3 percent is due to more expensive household services including rent and dwelling construction.

Table 3: Top five consumption categories for bottom quintile by country, ranked by their contribution to welfare losses resulting from a price increase in gasoline and diesel (in % of total welfare losses)

Argentina	Public transportation 39	Food 28	Gasoline and diesel 14	Electricity 8	Household services 3
Bahamas	Electricity 38	Household services 16	Gasoline and diesel 12	Entertainment 9	Public transportation 6
Barbados	Electricity 61	Education and Health 9	Public transportation 8	Household services 7	Gasoline and diesel 6
Chile	Public transportation 58	Household services 18	Food 12	Electricity 5	Gasoline and diesel 3
Costa Rica	Food 30	Gasoline and diesel 24	Household services 14	Public transportation 12	Durables 9
Ecuador	Public transportation 49	Food 18	Durables 12	Gasoline and diesel 7	Electricity 5
Guatemala	Food 63	Durables 12	Public transportation 10	Clothes 6	Gasoline and diesel 5
Jamaica	Public transportation 44	Electricity 23	Food 19	Household services 6	Education and Health 2
Nicaragua	Public transportation 67	Food 13	Household services 6	Personal care 4	Durables 2

In all countries except the Bahamas, Barbados, Costa Rica, and Guatemala, the main vehicle through which diesel and gasoline price hikes decrease the welfare of the bottom quintile is higher public transportation costs. In the Bahamas and Barbados, ensuing electricity price increases are the most important factor affecting the poorest households, while in Costa Rica and Guatemala it is food prices. Interestingly, the direct impact of diesel and gasoline never ranks first in the above table. In Paraguay and Nicaragua, the direct effect is not even in the top five channels through which the price rise affects households in the bottom quintile. In fact, over all quintiles, the indirect impact of gasoline and diesel price rises accounts for 70 percent of the impact on a household's welfare.

These results suggest that ways of compensating poor households for subsidy removal, or increased taxation on these fuels (for instance due to carbon taxes). Cash transfers targeted to poor people are, in principle, the most straightforward and efficient way to compensate poor households. If cash transfers are not feasible or desirable in a specific country, however, public spending on public transportation, cross-subsidizing electricity prices, or support for nutritional programs are possible compensatory measures to alleviate the impact of higher energy prices.

Conditional welfare impacts

The previous analysis established that the indirect impacts of increased gasoline and diesel prices tend to hurt poorer households most across our sample, while the direct impacts of a price rise tend to have a relatively larger effect on wealthier households. The reason is that wealthier households are more likely to consume a greater share of gasoline or diesel directly versus poorer households, because, for instance, they are more likely to own one or more cars. When looking at the household consumption survey for the bottom quintile household group across our sample, for example, only 8 percent of Chileans, 7 percent of Ecuadorians, 3 percent of Jamaicans, and 1 percent of Nicaraguans directly consume diesel or gasoline.

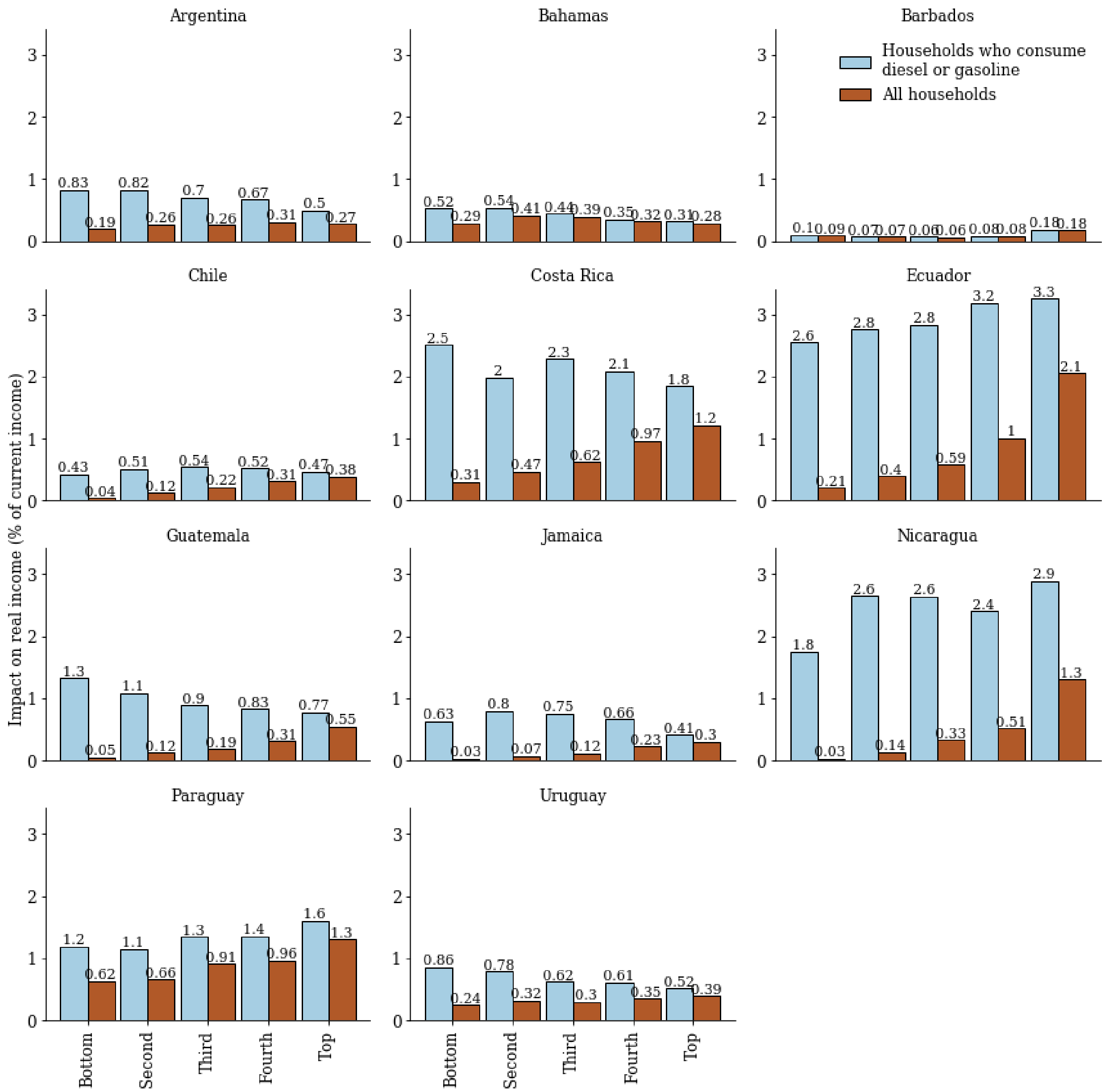

Figure 3: Conditional (blue) and unconditional (red) direct welfare losses from a US$0.25/L diesel and gasoline price increase (in % of current expenditure)

Yet, the welfare impacts of gasoline and diesel price increases on lower income households that consume gasoline and diesel directly may be important for governments to consider when planning subsidy removal (or increased fuel taxation) as they can affect the economic efficiency of the reform. Or, governments might find that protecting these more vulnerable households from price shocks is important in and of itself.

To shed light on this issue, we computed the direct impact of diesel and gasoline price hikes only on households that consume diesel and gasoline. As mentioned in the methodology section, this is the *conditional* analysis, in contrast to the *unconditional* analysis, which applies to all households, whether or not they consume fuels. Figure 3 compares the conditional and unconditional incidence of a US$0.25/L price hike on gasoline and diesel.

The conditional impact is less progressive in many countries in our sample. Specifically, in Argentina, Costa Rica, Guatemala, and Uruguay, the progressive impact witnessed in the unconditional scenario is regressive when focusing only on households that consume gasoline or diesel. In Chile and Jamaica, the progressive impact in the unconditional scenario becomes neutral when modeling conditional impacts. And, in the Bahamas and Barbados, the effect is small and closer to neutral.

On the other hand, in Ecuador, Nicaragua, and Paraguay, the unconditional impact is greater but less progressive. In Ecuador, the unconditional price increase amounts to only 0.2 percent of income for the bottom quintile, but it costs as much as 2.6 percent for bottom quintile households and 3.3% for top quintile households that consume diesel or gasoline. Thus, a rise conditional on consumption has less of a progressive impact on all households. In Nicaragua, focusing on consumers who consume gasoline or diesel yields the same result: a more moderate progressive effect, with costs ranging from 2 percent in the bottom quintile to 2.9 percent in the top quintile. The effect is similar in Paraguay.

Combined, the conditional and unconditional analyses show that – irrespective of the progressiveness of the price increase – the nominal impacts of gasoline and diesel price rises on the welfare of poor household can be significant. As the next sections show, a similar finding arises from the assessment of price rises on other fuels and electricity.

Natural gas and Liquefied Petroleum Gas

Unconditional welfare impacts

Natural gas and LPG have different uses and prices across Latin America. In our sample, only four countries use natural gas in their production system – Argentina, Chile, and, to a lesser extent, Ecuador and Uruguay. In Argentina, natural gas is the primary fuel used by households, industries, and in electricity generation. In Chile, two-thirds of natural gas is used in electricity production, while the rest goes to households and industry. Ecuador uses natural gas only for power generation. And, in Uruguay, natural gas consumption is almost negligible. LPG, on the other hand, is used in every country in our sample, primarily by lower income households for cooking and heating.

As mentioned in the methods section, the harmonized household surveys to assess the impact of price shocks dos not provide separate information on spending for natural gas and LPG, and thus the modeled price shocks are combined for both fuels in Argentina, Chile, Ecuador, and Uruguay. For all other countries, only LPG price shocks are included.

Figure 4 shows the total, direct and indirect, impact of natural gas and LPG price increases on household welfare across income quintiles. The total welfare effects of gas price increases tend to be regressive; in

Guatemala, Nicaragua, and Panama, however, the total welfare effects are relatively neutral or concentrated in the middle class.

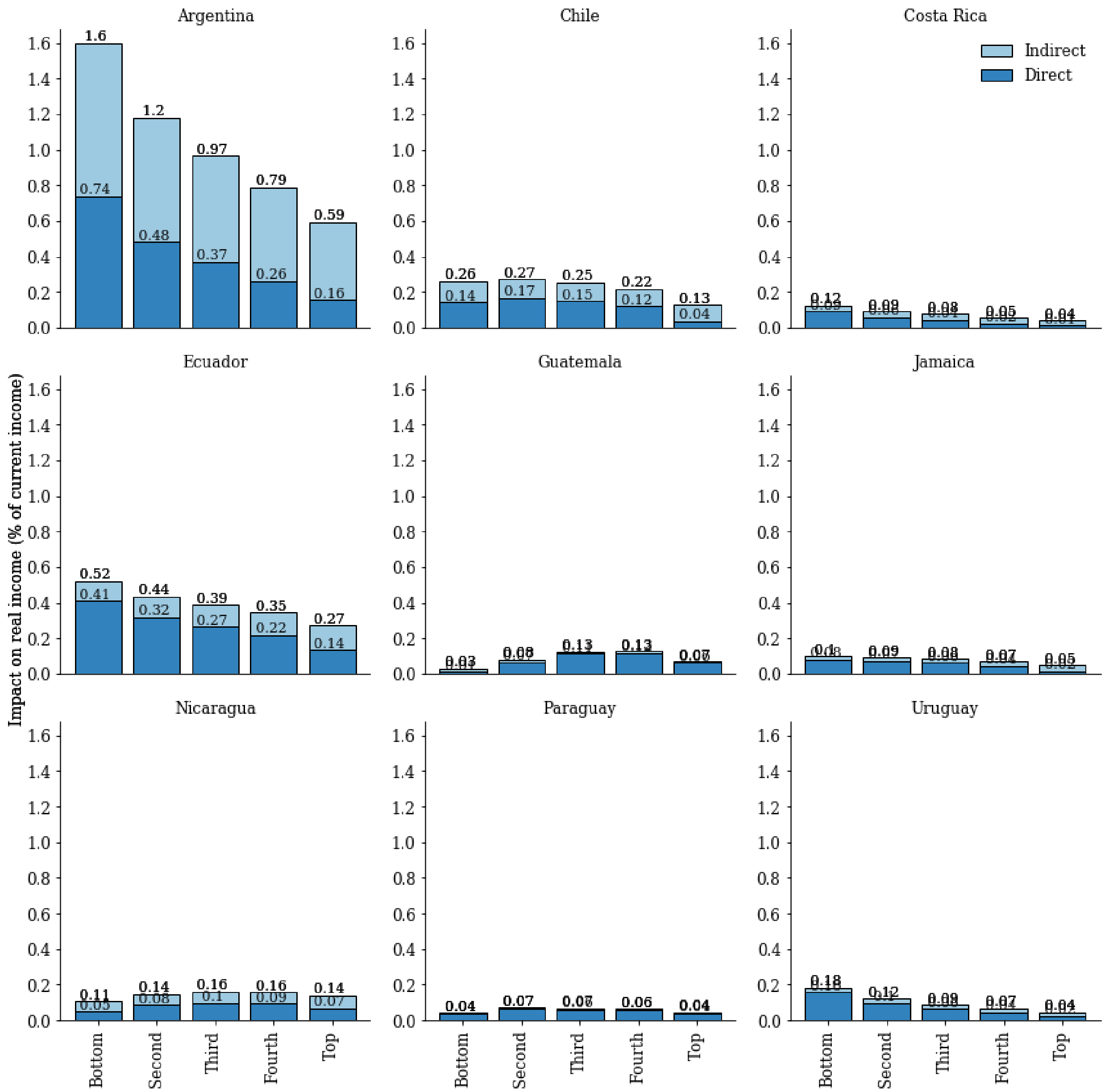

Figure 4: Direct and indirect welfare losses from a US$2.5/MMBTU natural price and LPG price increase (in % of current expenditure)

The direct welfare effects of price increases dominate the total welfare impacts in most countries as natural gas and LPG tend to be used directly by households for heating and cooking in our sample. The effects are also likely to be regressive. The most prominent exception is Argentina, with a heavy reliance on natural gas across all economic sectors.

The indirect impacts of price increases tend to be small or negligible in most countries except Argentina and Chile, where they account for, respectively, 65 and 51 percent of the welfare cost. Both countries use natural gas for power generation, thus driving price increases of goods and services across the economy, given a price shock. Table 4 compares the contribution of the direct and indirect impacts on welfare losses for the bottom quintile in order to understand the main drivers behind the overall regressive welfare effects of natural gas and LPG price increases in each country.

Table 4 Top five consumption categories for the bottom quintile by country, ranked by their contribution to welfare loss resulting from a price increase in natural gas and LPG (in % of total welfare loss)

Argentina	Natural gas and LPG 46	Electricity 22	Food 10	Public transportation 8	Household services 3
Chile	Natural gas and LPG 54	Electricity 20	Household services 9	Public transportation 6	Food 4
Costa Rica	Natural gas and LPG 75	Food 14	Durables 6	Household services 3	Entertainment 1
Ecuador	Natural gas and LPG 79	Electricity 9	Food 4	Durables 3	Household services 2
Guatemala	Natural gas and LPG 48	Durables 38	Food 9	Clothes 2	Household services 1
Jamaica	Natural gas and LPG 82	Household services 5	Food 4	Education and Health 3	Entertainment 2
Nicaragua	Natural gas and LPG 45	Household services 14	Food 12	Personal care 11	Public transportation 5
Paraguay	Natural gas and LPG 88	Public transportation 4	Food 4	Household services 2	Durables 0
Uruguay	Natural gas and LPG 85	Food 5	Electricity 4	Gasoline and diesel 3	Household services 1

In all countries, the direct welfare effects of natural gas and LPG explain most of the impact on households in the bottom quintile. In Argentina, Chile, and Ecuador – where natural gas is used for power generation – the indirect welfare impacts through an electricity price increase is the second-most important contributor to welfare loss. Food and household services play a significant role in many countries.

Conditional welfare impacts

Figure 5 shows the unconditional and conditional direct impact of a US$2.5/MMBTU price increase on LPG and natural gas on household expenditure. In all countries, the conditional impacts are regressive. In Chile and Guatemala, the relatively neutral unconditional welfare impacts obscure the fact that the consumption of LPG (and natural gas where applicable) is concentrated in a small proportion of poor households. For those households, a price rise would have significant impacts.

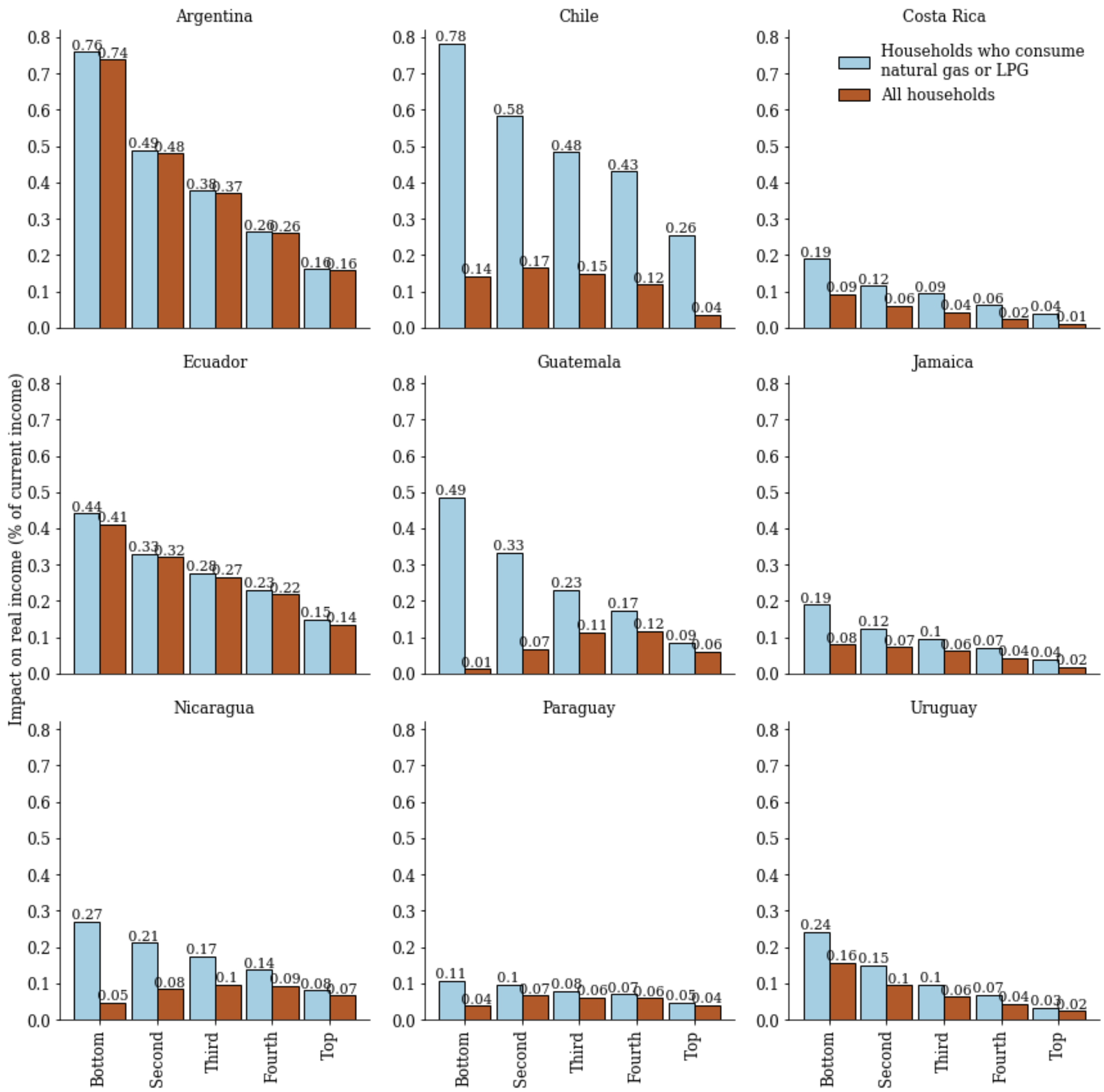

Figure 5: Conditional and unconditional direct welfare losses from a US$2.5/MMBTU natural gas and LPG price increase

Electricity

Unconditional welfare impacts

Electricity is a key input in many production and consumption activities and thus electricity price hikes directly and indirectly affect household welfare. As discussed before, petroleum products and natural gas price increases lead to higher electricity costs for many LAC countries that use thermal energy. Yet, electricity tariffs can also be raised independently of fuel prices, for instance if the government reforms tariffs or changes electricity taxes. This section examines the welfare impacts across households of a US$0.05/kWh increase in electricity prices.

One difficulty when analyzing the impact of electricity price hikes on household welfare is that households across income quintiles often face different tariff rates. Electricity tariffs can vary drastically across regions and income groups within each country; although, typically, lower income households, or households with lower consumption, tend to pay lower tariff rates.

Most official household surveys, however, only report consumption of electricity as expenses in monetary value rather than quantity consumed. This means that there is no clear relationship between the spending on electricity reported in household surveys and actual consumption of electricity. To work around this issue, we proceed in two steps.

First, we model the welfare impacts of raising electricity prices assuming that all households face a flat price per kilowatt hour of electricity consumed, which we assume is each nation's average electricity price. In this analysis, the direct impacts of price increases on household welfare across income quintiles should be interpreted with caution as average tariffs do not represent the actual tariff structure typically faced by households. Second, using more detailed original household survey data for the Buenos Aires region in Argentina, we test an alternative tariff schedule, fitted on actual data of household electricity consumption in physical units (see Figure S2 in the Appendix). In this scenario, the price of electricity increases with consumption. As it turns out, both assumptions lead to roughly the same result in terms of the welfare impacts of an electricity price rise. We take that as an indication that the average-price model yields relevant results.

Figure 6 shows the total, direct and indirect, impact of price increases for electricity on household welfare across income quintiles using the average-price method. Latin American and Caribbean countries' exposure to electricity price shocks varies among the LAC countries, although the welfare effects tend to be regressive in most of the countries analyzed. In Argentina, the Bahamas, Barbados, Chile, Costa Rica, Guatemala, Jamaica, and Uruguay, raising electricity prices has regressive impacts. On the other hand, raising electricity prices would have a slightly progressive effect in Ecuador and Nicaragua and a more pronounced progressive impact in Paraguay.

A US$0.05/kWh increase in electricity prices represents a different price shock for each country, not only because some countries subsidized electricity in 2014 while others did not, but also because electricity costs vary by country, reflecting many factors including the mix and age of technologies used in generation, and the efficiency and reliability of each country's transmission and distribution systems. In 2014, only Argentina, Ecuador, Barbados, and Nicaragua subsidized electricity (Table S3).

As was the case with gasoline and diesel price hikes, the country grouping above does not share specific characteristics that determine whether the total welfare impacts of increasing electricity prices will be regressive or progressive. Nevertheless, there are still important regional trends that can be established from the analysis.

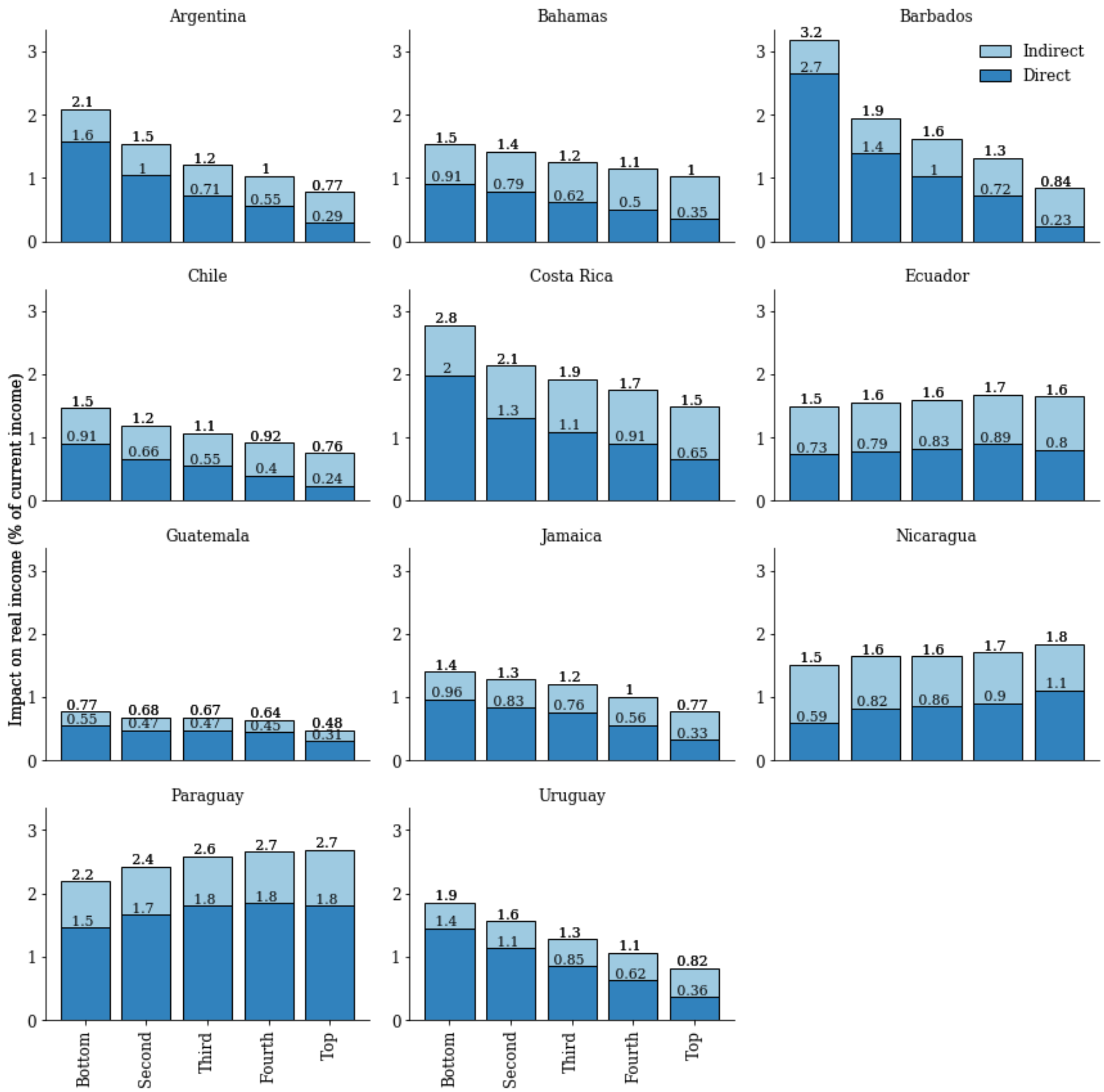

Figure 6: Direct and indirect welfare losses from a US$0.05/kWh electricity price increase

First, the direct distributional effects of electricity price increases on household consumption tend to be regressive. With the exception of Nicaragua and Paraguay, increasing electricity prices cost lower income households relatively more than wealthier households in every country in our sample. Argentina, Barbados, and Costa Rica show a large contrast between poor and rich households. The price hike has a relatively small effect on the top quintiles in these three countries – costing 0.3 percent, 0.2, and 0.7 percent of their budget, respectively – while costing the bottom quintile 1.6, 2.7, and 2 percent, respectively.

Second, across the eleven countries of our sample, the direct and indirect effects have a relatively equal weight in the total welfare effects of raising electricity prices. On average, the direct effects account for 54 percent of the total welfare cost of a price increase, while the indirect effects account for 46 percent.

Further, the indirect effect of electricity price hikes on household welfare tends to be neutral, because electricity is widely used in all economic sectors to produce all types of goods. The two exceptions are Nicaragua, where it is slightly regressive, and Paraguay, where it is slightly progressive.

Indeed, electricity price rises indirectly increase the price of other goods and services in an economy. Table 5 shows the simulated impact of a US$0.05/kWh hike on electricity on the price of different consumption categories in the 11 countries in our sample. The Table shows that water supply and durable goods tend to be most affected.

Table 5: Price increase of goods and services triggered by increase in electricity prices (in % of pre-shock price)

	Argentina	Bahamas	Barbados	Chile	Costa Rica	Ecuador	Guatemala	Jamaica	Nicaragua	Paraguay	Uruguay	Median
Water	3.3	0.5	0.4	1.2	0.3	17.0	5.7	3.4	3.3	2.0	1.4	2.0
Durables	1.7	0.3	0.2	1.3	0.5	1.3	0.9	4.6	0.8	1.6	1.1	1.1
Household services	0.5	1.2	0.6	0.7	0.7	0.7	0.1	0.5	1.4	1.1	0.5	0.7
Entertainment	0.4	3.2	1.2	0.6	2.5	0.2	0.1	0.4	0.5	0.8	0.8	0.6
Clothes	0.7	0.3	0.2	0.6	0.7	0.6	0.3	4.2	0.4	0.7	0.4	0.6
Food	0.6	0.4	0.6	0.6	0.8	0.8	0.2	0.4	0.9	0.4	0.4	0.6
Communication	0.4	0.5	0.3	0.7	0.3	1.6	0.2	0.3	1.3	1.4	0.6	0.5
Personal care	0.5	0.7	0.3	0.5	0.7	1.0	0.1	0.2	0.3	0.8	0.4	0.5
Public transportation	0.4	0.8	0.5	0.5	0.3	0.3	0.1	0.2	0.5	0.5	0.3	0.4
Education and Health	0.5	0.3	0.6	0.2	0.1	0.6	0.1	0.3	0.3	0.7	0.4	0.3
Other fuels	1.2	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Gasoline and diesel	0.2	0.1	0.0	0.4	0.0	0.7	0.1	0.0	0.2	0.7	0.0	0.1
Natural gas	0.1	0.2	0.1	0.2	0.2	0.5	0.0	0.1	0.1	0.2	0.1	0.1

Households are differently exposed to electricity price shocks depending on how they spend their money. Table 6 provides the top five consumption items that contribute most to the loss of household welfare in the bottom quintile when there is a rise on electricity prices. The direct impact on electricity is the most important channel through which electricity price rises affect households in the bottom quintile in all countries.

Table 6 Top five consumption categories for bottom quintile by country, ranked by their contribution to welfare loss resulting from a price increase in electricity (in % of total welfare loss)

Argentina	Electricity 75	Food 8	Household services 4	Durables 2	Personal care 2
Bahamas	Electricity 59	Entertainment 18	Household services 12	Personal care 5	Education and Health 1
Barbados	Electricity 83	Education and Health 7	Food 3	Household services 3	Entertainment 2

Chile	Electricity 62	Household services 17	Food 9	Public transportation 4	Personal care 2
Costa Rica	Electricity 71	Food 11	Entertainment 8	Household services 6	Durables 2
Ecuador	Electricity 49	Food 28	Household services 7	Durables 6	Personal care 3
Guatemala	Electricity 72	Food 15	Durables 6	Clothes 3	Household services 2
Jamaica	Electricity 69	Food 12	Household services 5	Durables 4	Water 3
Nicaragua	Electricity 39	Food 26	Household services 16	Water 11	Personal care 2
Paraguay	Electricity 67	Household services 16	Food 10	Durables 2	Communication 2

In all countries, households in the bottom quintile are mostly affected by the direct effect of the electricity price increase. Food and household services (including rents and dwelling construction) are usually in second and third position. This suggests that targeted interventions in these sectors could shield poor households from the impact of electricity price hikes.

Conditional welfare impacts

Compared to fuels, access to electricity is much more widespread and uniform across income quintiles in most LAC countries, so that the conditional and unconditional analyses do not yield dramatically different results for electricity price hikes. Indeed, much progress has been made in the region with respect to achieving universal access to electricity. In 2014, access to electricity in LAC was estimated at 97 percent (World Bank, 2018). Furthermore, some of the gap between the conditional and unconditional impacts come from limitations of the method used: we based our assessment of electricity consumption on electricity spending. In actuality, many poorer households in the region may consume electricity but not pay for it.

Correcting distributive impacts

Our analysis identifies the specific mechanisms through which different households are affected by price increases for various energy types in each country, providing insight into how, if necessary, poor households could be compensated for potential welfare loss with in-kind measures. For instance, public transportation is the main channel through which households in the bottom quintile are hurt by gasoline price hikes, suggesting that public spending on public transportation can shield them (e.g., through fee waivers for vulnerable households).[4]

While energy subsidies may *effectively* shield poor households from energy price hikes, they are very *inefficient*. Energy subsidies are an expensive way of redistributing income to poor households. On average across countries and energy types (whether the fuels are currently subsidized or not), our analysis finds that it would cost the government US$11.8 to transfer US$1 of income to households in the poorest quintile, if using energy subsidies.

[4] Exempting public transportation from energy taxes could be another option but one issue with such an approach is that tax exemptions would remove the incentive for public transportation operators to adopt more energy-efficient technologies.

Table 7: Energy products are very expensive vehicles for redistributing income to poor households: the fiscal cost of distributing 1$ to households from different income quintiles using subsidies on different energy types, per country.

		Bottom	Second	Third	Fourth	Top
Argentina	Diesel and gasoline	11.5	7.5	5.6	4.2	2.8
	Electricity	8.2	6.6	5.6	4.3	3.2
	Natural Gas and LPG	8.2	6.6	5.4	4.4	3.2
Bahamas	Diesel and gasoline	9.1	6.2	5.0	4.4	3.3
	Electricity	7.9	5.9	5.0	4.5	3.6
Barbados	Diesel and gasoline	18.9	11.4	8.5	6.2	1.7
	Electricity	11.8	8.3	6.6	5.4	2.2
Chile	Diesel and gasoline	11.8	7.7	6.1	4.5	2.5
	Electricity	8.0	6.7	5.9	4.9	2.8
	Natural Gas and LPG	9.2	6.0	5.1	4.2	3.4
Costa Rica	Diesel and gasoline	17.9	9.8	7.0	4.4	2.1
	Electricity	8.4	6.7	5.7	4.6	2.9
	Natural Gas and LPG	6.5	5.4	5.0	5.1	3.8
Ecuador	Diesel and gasoline	12.5	8.4	6.6	4.9	2.3
	Electricity	10.0	7.1	5.9	4.6	2.7
	Natural Gas and LPG	6.4	5.6	5.4	5.0	3.6
Guatemala	Diesel and gasoline	18.7	10.7	7.4	4.8	2.0
	Electricity	13.8	8.7	6.1	4.3	2.4
	Natural Gas and LPG	55.8	11.4	5.1	3.3	2.5
Jamaica	Diesel and gasoline	13.7	8.4	6.6	4.8	2.2
	Electricity	12.3	7.5	5.9	4.8	2.5
	Natural Gas and LPG	11.6	6.9	5.6	4.6	2.7
Nicaragua	Diesel and gasoline	15.6	9.0	6.1	4.6	2.3
	Electricity	11.9	7.7	6.0	4.5	2.5
	Natural Gas and LPG	14.2	7.3	5.2	4.1	2.8
Paraguay	Diesel and gasoline	11.9	8.2	5.6	4.7	2.5
	Electricity	11.8	7.7	5.6	4.5	2.6
	Natural Gas and LPG	13.2	5.6	4.7	4.0	3.5
Uruguay	Diesel and gasoline	19.7	9.9	6.9	4.5	2.1
	Electricity	12.1	7.8	5.9	4.6	2.5
	Natural Gas and LPG	7.9	6.5	5.6	4.7	3.0

Of the energy products researched in this paper, gasoline and diesel are the most inefficient means to provide income to the bottom quintile across every country in our sample, costing, on average, US$13.7 per dollar benefiting the bottom quintile. It costs about US$9.2 per dollar using gas or LPG, the most pro-poor fuels in our sample. Finally, using electricity as a tool for income redistribution is also very expensive, costing, on average, US$11.8 per dollar subsidy to the bottom quintile. Table 7 shows the cost of providing US$1 to households across the five income categories using gasoline and diesel, electricity, and LPG and natural gas in each of the eleven countries in our sample.

These figures compare unfavorably to the cost of other ways of providing income to poor households. For instance, direct cash transfer programs are recognized as one the most efficient ways for delivering social assistance to poor households in developing countries (Bastagli et al., 2016; Blattman and Niehaus, 2014; Cecchini et al., 2011). In Ecuador, for example, half the money spent on the *Bono de Desarrollo* (human development bond) cash transfer program goes to the poorest 40 percent of households. Although the targeting is imperfect, it costs the government only US$2 for each US$1 received by the bottom 40 percent of the population (Expresso, 2015). In fact, among 56 social assistance programs in Latin America and the Caribbean, cash transfers are the best performers in terms of targeting poor people (Lindert et al., 2006). An 18-country study from the Inter-American Development Bank found that, on average, it costs US$1.9 to transfer US$1 to poor households in LAC using existing cash transfer programs (Cavallo and Serebrisky, 2016).

Of course, cash transfers are not free from problems. Most importantly, the coverage of existing cash transfer programs among poor people is sometimes low. An Inter-American Development Bank study suggests that in the average Latin-American country, only 43 percent of poor people benefit from these schemes (Robles et al., 2015). In some countries, the benefits of low energy prices could reach more poor people than current social protection schemes.

Whether the total welfare effects on households of raising energy prices are progressive, regressive, or neutral, phasing out subsidies or taxing energy more substantially may hurt poor and middle-class households and voters. The fact that wealthier households are more affected by a tax or subsidy removal is not necessarily a consolation for vulnerable households faced with increasing prices for basic goods and services. The good news is that governments can protect poor and lower middle-class households from the direct and indirect impacts of energy price increases by redirecting only a fraction of the budgetary savings into targeted, more efficient compensation schemes.

Specifically, our analysis shows that, in principle, only 19 percent of the potential savings from an increase in gasoline and diesel prices could be redirected to well-targeted compensation schemes to neutralize the welfare impacts of the price hikes on the bottom 40 percent of households. Roughly 27 percent of government savings resulting from subsidy removal or tax increases on natural gas and LPG is sufficient to compensate the two bottom quintiles. Finally, roughly 21 percent of the savings gained from a flat increase in electricity prices would compensate the bottom 40 percent of households for their welfare losses.

Table 8 provides a country and fuel breakdown of the share of the savings needed to compensate households across income quintiles, although higher income households do not necessarily need to be compensated for welfare losses. Table 8 shows the amount governments would need to spend in compensating measures that effectively target and cover poor households. This, however, does not reflect what spending increase would be needed to compensate households using existing cash transfer programs or other existing social protection schemes. If governments use imperfect schemes to compensate households, they may need to spend more than what is reported in the Table. This issue is left to further research.

Table 8: Fraction of government proceeds from subsidy removal or energy taxation needed to compensate households

		Bottom	Second	Third	Fourth	Top
Argentina	Diesel and gasoline	8.7	21.9	39.7	63.7	100
	Electricity	12.2	27.4	45.3	68.5	100
	Natural Gas and LPG	12.1	27.2	45.8	68.6	100
Bahamas	Diesel and gasoline	10.9	27.0	47.1	69.8	100
	Electricity	12.7	29.6	49.6	71.8	100
Barbados	Diesel and gasoline	5.3	14.1	25.9	42.0	100
	Electricity	8.5	20.5	35.6	54.1	100
Chile	Diesel and gasoline	8.5	21.4	37.8	59.9	100
	Electricity	12.5	27.3	44.3	64.7	100
	Natural Gas and LPG	10.9	27.6	47.4	71.0	100
Costa Rica	Diesel and gasoline	5.6	15.7	30.1	52.9	100
	Electricity	11.9	26.7	44.2	65.7	100
	Natural Gas and LPG	15.4	33.9	53.7	73.4	100
Ecuador	Diesel and gasoline	8.0	20.0	35.0	55.6	100
	Electricity	10.0	24.2	41.2	62.8	100
	Natural Gas and LPG	15.7	33.6	52.2	72.4	100
Guatemala	Diesel and gasoline	5.4	14.7	28.2	48.9	100
	Electricity	7.3	18.7	35.1	58.2	100
	Natural Gas and LPG	1.8	10.6	30.2	60.3	100
Jamaica	Diesel and gasoline	7.3	19.1	34.3	55.0	100
	Electricity	8.2	21.4	38.3	59.3	100
	Natural Gas and LPG	8.6	23.2	40.9	62.6	100
Nicaragua	Diesel and gasoline	6.4	17.5	34.0	55.6	100
	Electricity	8.4	21.4	38.2	60.6	100
	Natural Gas and LPG	7.0	20.7	39.9	64.3	100
Paraguay	Diesel and gasoline	8.4	20.6	38.5	60.0	100
	Electricity	8.5	21.4	39.4	61.8	100
	Natural Gas and LPG	7.6	25.4	46.7	71.6	100
Uruguay	Diesel and gasoline	5.1	15.1	29.7	52.0	100
	Electricity	8.3	21.2	38.1	60.1	100
	Natural Gas and LPG	12.7	28.1	45.9	67.1	100

One possibility for governments to protect poor households from the effects of energy price rises is to expand existing social protection schemes such as cash transfers. Instead of the perverse incentives that energy subsidies create, conditional and unconditional cash transfers have been found to reduce poverty successfully (especially for women and girls); improve school attendance (with some evidence of improved cognitive development); increase the uptake of health services; improve dietary diversity and mass and weight indicators; reduce stunting and malnourishment; encourage savings and investment in productive assets and livestock; foster business creation, increase labor force participation for adults and reduce child work; and increase employment rates (Bastagli et al., 2016; Blattman and Niehaus, 2014; Cecchini et al., 2011). Moreover, as was previously mentioned, cash transfers programs in Latin America have also been found to be an efficient tool for redistributing income to poor households (Robles et al., 2015).

Comparing the cost of energy subsidies to cash transfers, it appears that governments could remove energy subsidies while putting in place cash transfer programs or expanding existing ones at a lower cost and with better outcomes. Doing so could reduce the onerous economic, sectoral, and environmental costs associated with cheap energy, while promoting several aspects of human development instead.

Making sure that all, or most, of the losers from a subsidy reform are compensated with cash transfers may require expanding existing programs or creating new ones. Most LAC countries have a conditional or unconditional cash transfer program in place (Honorati et al., 2015). Thus, compensation measures for welfare losses due to energy price increases would need to be designed carefully. To reach deserving populations comprehensively, some countries around the world have moved towards universal transfers to ensure that everybody is covered. Iran, for example, implemented a quasi-universal cash transfer (about US$45 per month per capita) as part of its energy reforms, and the Indian government is considering taking this path (Safi, 2017). Universal transfers may help with the fuel subsidy reform, since nobody is excluded from the benefits (even though some will remain net losers). In addition, if opposition to subsidy reforms is stronger in the middle-class than among the poorest, having the middle-class covered by the compensation – even partly – may make the reform more acceptable.

Conclusion

Energy subsidies are an expensive way of redistributing income to poor households. And carbon or energy taxes would be efficient climate policies. Yet, removing energy subsidies or taxing energy can hurt vulnerable households and make energy pricing reform politically unpalatable.

International experience with energy subsidy reform suggests that when countries replace subsidies with cash transfers their chance of success improves significantly. In fact, according to an IMF study of subsidy reform efforts in the Middle East and North Africa, all cases where cash and in-kind transfers were introduced as compensation measures were associated with successful outcomes, while only 17 percent of the cases where transfers were not introduced resulted in a successful reform (Sdralevich et al., 2014).

The analysis presented in this paper provides estimates of what fraction of fiscal revenues from energy pricing reform would need to be fiscally recycled to compensate vulnerable households for the direct and indirect impacts of price hikes. Across the eleven LAC countries, on average 19% of the proceeds of a gasoline tax, 21% of the revenues from an electricity price reform, and 27% of the revenues from natural gas and LPG prices would sufficiently compensate households in the two bottom quintiles of the population.

In-kind measures, such as subsidized public transportation, food stamps or school feeding programs, expansion of primary health care, electrification in poor and rural areas, and distribution of efficient light-bulbs, could complement cash transfers (Fay et al., 2015; IMF, 2013). Our results shed light on the specific channels through which energy price increases could affect poor households directly and indirectly, thus helping governments design such compensation measures. Broadly speaking, public transportation and food are the main channels through which poor households are affected by gasoline price hikes, while the direct impact of electricity and LPG increases are the most significant ones.

Whatever the compensation package, international experience of subsidy reforms and environmental tax reform suggests that effective communication about the savings and benefits of reform is essential (Dresner et al., 2006). In many cases, the general population does not know how much government spends on energy subsidies, or how to reduce them could provide more fiscal space for spending on social protection programs, health, public transportation, and education. Providing that information and communicating how complementary policy packages can transform losers into winners may facilitate the political economy of reform (Fay et al., 2015; Vogt-Schilb and Hallegatte, 2017).

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Supporting Tables

Table S1: Increase in gasoline and diesel prices (% of current price)

	Argentina	Bahamas	Barbados	Chile	Costa Rica	Ecuador	Guatemala	Jamaica	Nicaragua	Paraguay	Uruguay	Median
Diesel and gasoline	19	59	26	19	21	86	24	20	24	22	14	22

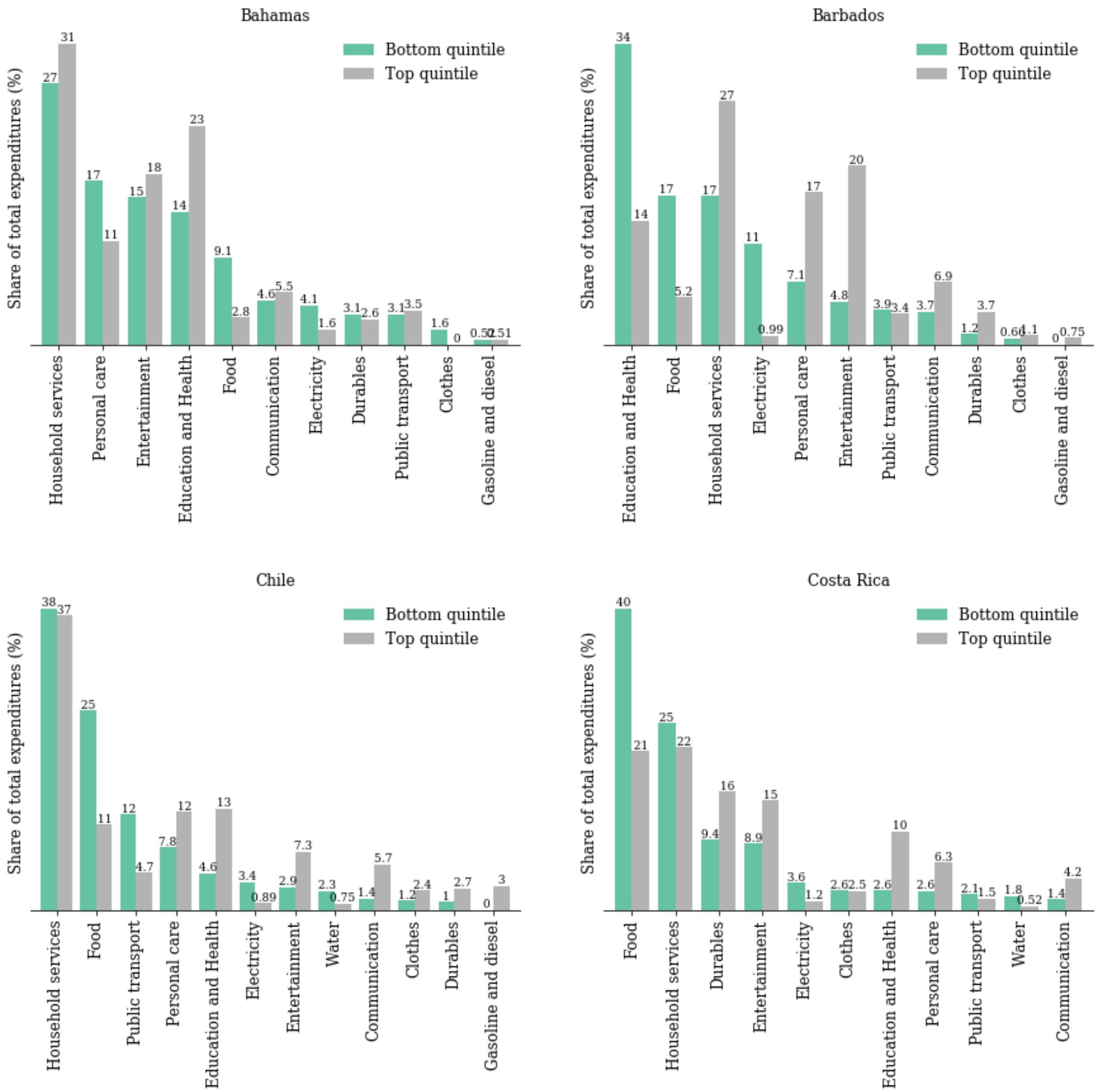
Table S2: Increase in electricity prices (% of current average tariff)

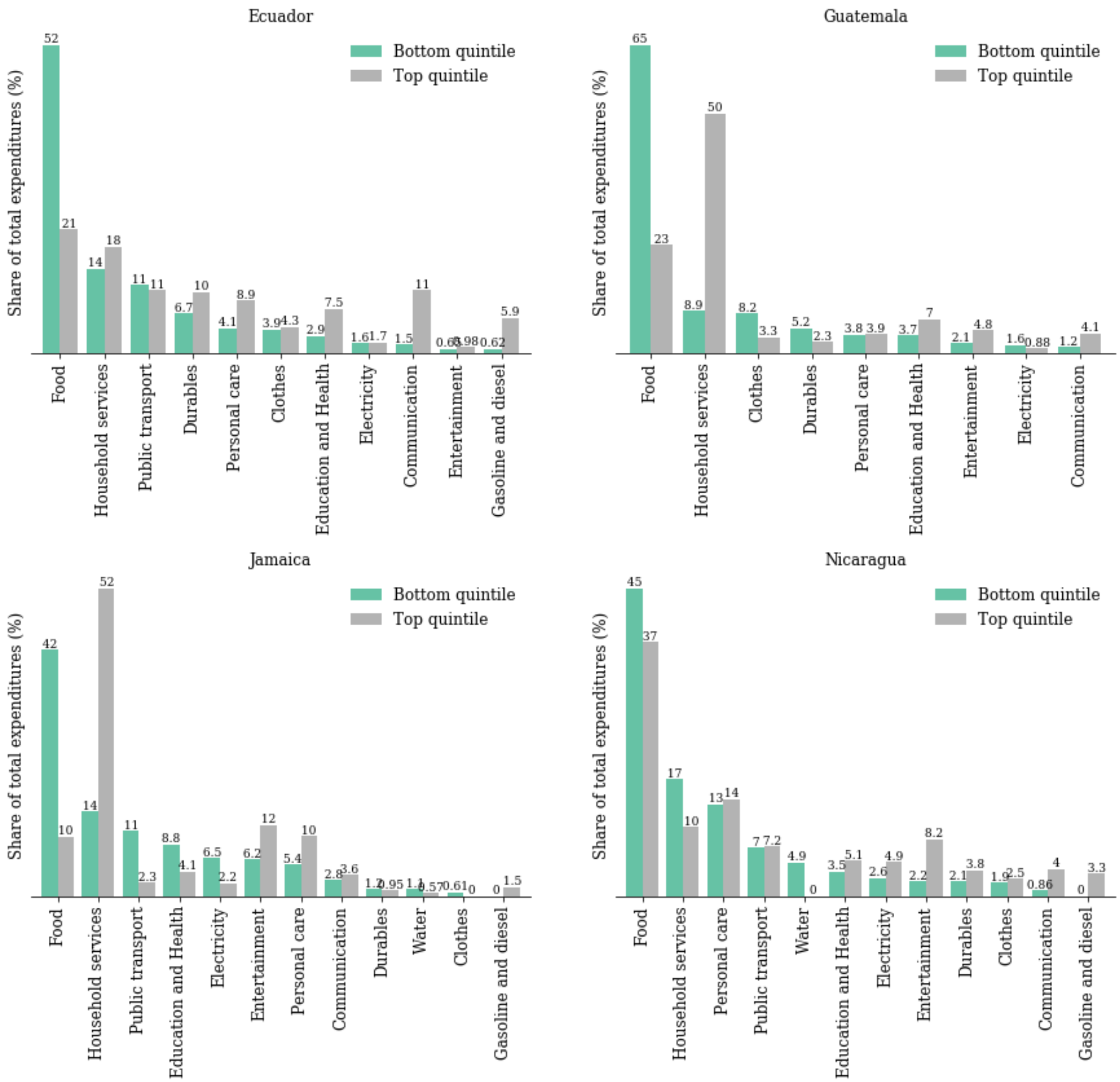
	Argentina	Bahamas	Barbados	Chile	Costa Rica	Ecuador	Guatemala	Jmaica	Nicaragua	Paraguay	Uruguay	Median
Electricity	120	47	24	33	59	62	43	18	27	130	36	43

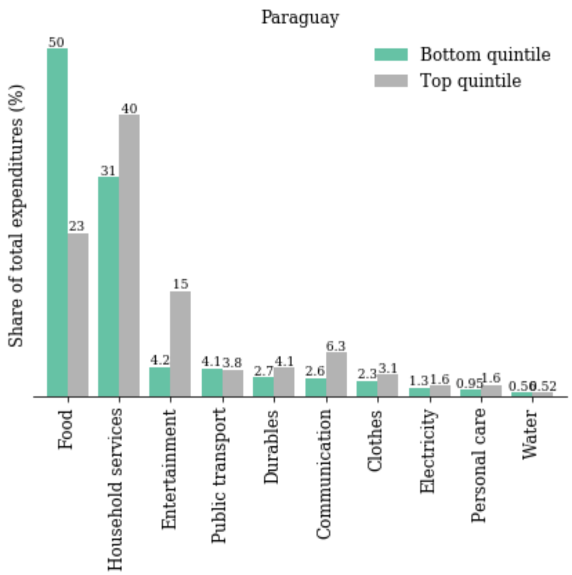
Table S3: Comparisons between increasing tariff and average-price scenarios

	Bottom	Second	Third	Fourth	Top
Increasing tariff schedule	1.68	1.09	0.72	0.53	0.28
Average price	1.57	1.04	0.71	0.55	0.29

Figure S1: Budget distribution for the bottom and top income quintiles in LAC countries (% of current expenditure)




Ecuador
Bottom quintile
Top quintile
Share of total expenditures (%)
Food
Household services
Public transport
Durables
Personal care
Clothes
Education and Health
Electricity
Communication
Entertainment
Gasoline and diesel
Guatemala
Bottom quintile
Top quintile
Share of total expenditures (%)
Food
Household services
Clothes
Durables
Personal care
Education and Health
Entertainment
Electricity
Communication
Jamaica
Bottom quintile
Top quintile
Share of total expenditures (%)
Food
Household services
Public transport
Education and Health
Electricity
Entertainment
Personal care
Communication
Durables
Water
Clothes
Gasoline and diesel
Nicaragua
Bottom quintile
Top quintile
Share of total expenditures (%)
Food
Household services
Personal care
Public transport
Water
Education and Health
Electricity
Entertainment
Durables
Clothes
Communication
Gasoline and diesel



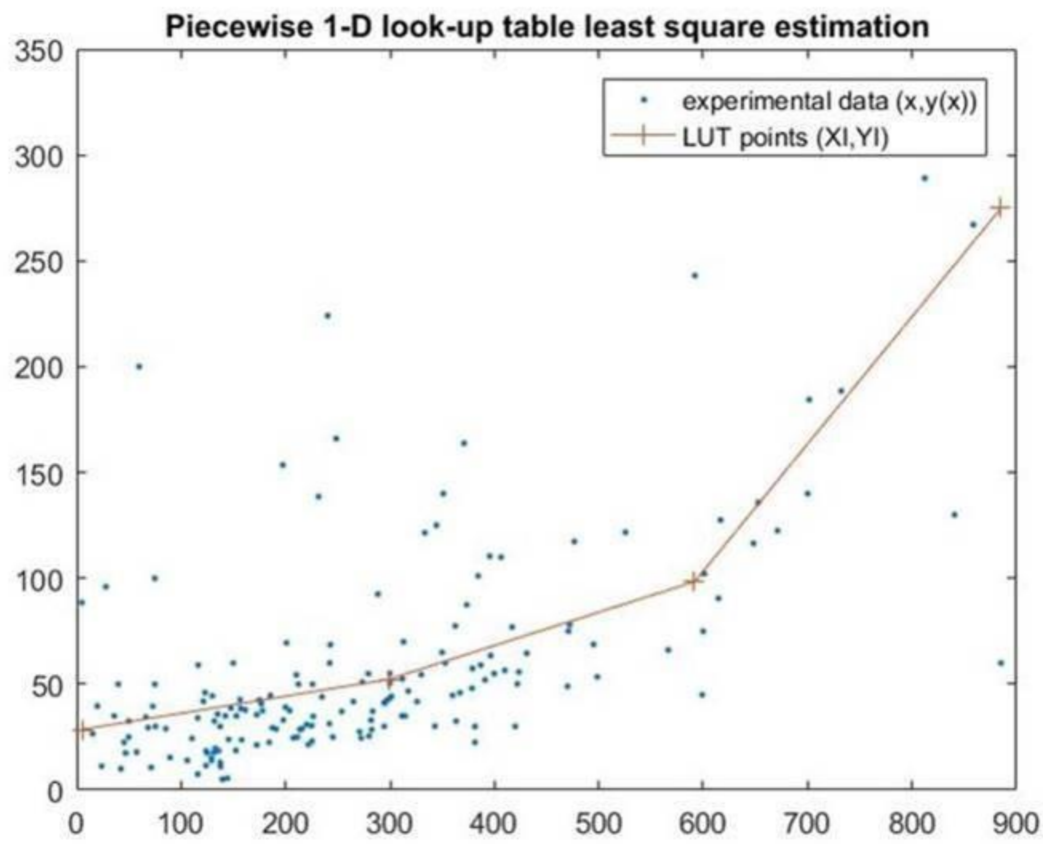


Figure S2: Electricity consumption based on increasing tariff schedule