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

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HIGHLIGHTS

- Energy subsidies are an expensive way of redistributing income to poor households.
- Higher-income groups benefit more from low energy prices than low-income groups.
- Energy subsidies would cost $12 to transfer $1 of income to poorest households.
- Cash transfers or targeted subsidies could be more efficient to protect the poor.

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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. But 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 hikes on different income groups 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 direct and indirect (supply chain) effects of energy price variations. Energy subsidies are a very expensive option to transfer income to poor households. For example, in Latin America and the Caribbean, using energy subsidies 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. Cash transfers to poor households and targeted subsidies for public transportation or food are the most effective measures to compensate households for welfare loss.

1. 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 to protect the standard of living of vulnerable segments of the population [1,2]. These policies come with high fiscal costs and introduce price distortions that promote wasteful usage of energy, increase greenhouse gas emissions, and hamper the development of energy efficiency and renewable energy technologies [3].

Acknowledging the inefficiency of energy subsidies, their high fiscal cost, and the perverse incentives they create to emit pollutants in general and greenhouse gases (GHG) in particular, 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." [4].

In addition, countries have pledged in the 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 [5]. Among the many policies that can be used to support that transition [5,6], carbon taxes that would increase the price of energy have received significant attention. Carbon taxes are also advocated as an efficient fiscal policy that could contribute to reduce informality, finance investment in infrastructure, and fund social and environmental programs [7,8]. Carbon taxes together with fiscal gains from subsidy

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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 in the Caribbean accounted for about 1.6% of their GDP [1].

However, energy price reform is often difficult due to the potential adverse near-term economic and social impacts [9]. 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 [8,10]. Taxes on energy could harm those voters and special interests, reducing the likelihood that a reform succeeds. Understanding the effects of energy price hikes across income groups can help to design and implement more effective energy pricing policies.

Many studies found that governments will likely be unsuccessful at reforming subsidies if they lack an understanding of the effects of subsidy removal on the welfare of households and other key stakeholders, take specific steps to tackle these effects, and appropriately communicate them [4,11]. 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 they perceive would not serve their best interest [12,13].

On the other hand, studies found that governments that 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 [4,14]. Such compensation measures can take the form of targeted social spending, for instance using cash transfer programs, or, when this is not feasible, providing subsidized 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 [11].

In this study, we estimate for the first time the minimum fraction of government proceeds from subsidy removal or energy taxation that would need to be redirected to households in 11 Latin America and the Caribbean countries to compensate them for the short-term effects of energy price hikes. 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, if necessary, poor households could be compensated for potential welfare loss. In general, public transportation and food are two important channels through which poor households could be affected by gasoline price hikes, while the direct impact is most important for electricity and gas price hikes.

To achieve these aims, we estimate the direct and indirect welfare impacts across income quintiles of raising fuels and electricity prices in 11 Latin America and the Caribbean countries. The direct impact measures by how much households' direct spending on energy is affected by the price hikes. The indirect impact measures by how much the price of all other goods and services depending on energy inputs along the supply chain would increase if the increase in energy prices was fully passed on to households. The price hikes 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 populations' vulnerability to energy price increases.

For countries that subsidize fuels or electricity, the study provides an understanding of which households capture the most benefits from subsidies and how each would be impacted 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.

2. Materials and methods

2.1. Input-output analysis

Input-output analysis has been frequently used to study distributional effects of energy subsidies and carbon pricing on different household groups [15–20]. In this study, input-output analysis is applied to model the impacts of the energy subsidy removal and/or energy price shocks on the five household quintiles via induced price changes in household expenditure items. This method captures both direct and indirect effects of energy price hikes on household expenditure, i.e., not only the price increase for energy products but also the price increase triggered by energy inputs to all final consumption items. In this study, input-output analysis is selected due to its simplicity and transparency, compared with other economic system accounting methods such as computational general equilibrium model (CGE) [16,19,21,22]. 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 had a chance to adjust production processes. The International Monetary Fund [23] 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 hikes.

Input-output analysis is a modeling approach that 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 [24]. 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 ith sector; $\boldsymbol{y_i}$ is the final demand of sector i. $\boldsymbol{z_{ij}}$ is the monetary flow from the ith sector to the jth sector.

In matrix notation and for the economy as a whole, Eq. (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

$$x = (I-A)^{-1}y \tag{3}$$

$(I-A)^{-1}$ 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, Nature Gas, Petroleum, LPG, and Kerosene) on income group q, we calculate the indirect and the direct effect separately. To calculate the indirect effect $c_{k,q}^{indir}$, 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 $c_{k,q}^{dir}$ of a price shock to an income group q is calculated using the household direct consumption of energy k of income group q multiplied by the price increase rate of energy k.

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

Then, the total effect of an energy price increase of energy k on group q is calculated by: