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Fuel subsidies and income redistribution in Ecuador

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Abstract: This paper aims to evaluate the progressivity of different fuel subsidies in Ecuador as well as the budgetary and distributional effects of a potential elimination of such subsidies. Our analysis makes use of ECUAMOD, the tax-benefit microsimulation model for Ecuador, together with representative household microdata from ENIGHUR 2011–12. Our results show that domestic gas subsidy tends to be progressive, whereas gasoline and diesel subsidies tend to be regressive. Our simulations show that eliminating all fuel subsidies would increase poverty and inequality due to the importance of domestic gas subsidy for low-income households. Eliminating only gasoline and diesel subsidies would not impact poverty and inequality, while allowing to reduce government expenditure. We further show that using part of the budget saved from the elimination of fuel subsidies to increase social assistance payments in Ecuador, could be a mechanism to compensate low-income families for their loss following fuel subsidy elimination.

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1 Introduction

Subsidies in Ecuador are an important expense in the State General Budget. According to the 2015 budget, one sixth of the State budget was destined to the payment of at least 17 different subsidies.[1] Out of the budget of those subsidies, around 58 per cent was for fuel subsidies that include liquefied petroleum gas (LPG), gasoline and diesel. In that year, the imported diesel subsidy, which tends to be the costliest item, was estimated at 1,750 million US dollars, followed by gasolines and liquefied petroleum gas. The latter is ubiquitous in Ecuadorian households, and a highly sensitive subject that had cost the presidency of at least two heads of states in the past two decades (Acosta 2008). Then, from a policy perspective, it is important to assess the redistributive role of fuel subsidies since some subsidies might favour richer households more than others.

Over the last years, there has been increasing political debate about the possibility of eliminating fuel subsidies, as a way to reduce government expenditures. The aim of this paper is twofold. First, we assess the progressivity/regressivity of different types of fuel subsidies and their relative importance across the income distribution. Then, we make use of ECUAMOD, the tax-benefit microsimulation model for Ecuador, to evaluate the effect of eliminating fuel subsidies on poverty and inequality. The advantage of microsimulation techniques is that they allow looking at the effect of policy reforms at the household level and therefore assess the distributional effects of policy reforms. Moreover, tax-benefit microsimulation allows us to assess the effect of a combination of policy reforms. For instance an elimination of fuel subsidies accompanied by an increase in social assistance, as analysed in this paper.

Our results show that the progressivity and relative size of fuel subsidies vary depending on the type of fuel considered. The total budget allocated to domestic gas subsidies is evenly distributed across the population and this type of subsidy represents an important share of households' income at the bottom of the distribution. On the other hand, gasoline and diesel subsidies are highly concentrated at the top of the distribution and represent an important share of households' income and expenditures for richer households. Kakwani indices of progressivity show that domestic gas subsidies are progressive, whereas gasoline and diesel subsidies are regressive. Moreover, our counterfactual reform scenarios show that eliminating all fuel subsidies would increase income inequality and poverty due to the importance of domestic gas subsidies for low income households. Eliminating gasoline and diesel subsidies only would have little effect on income inequality and poverty while at the same time would reduce government expenditures. Finally, we show that increasing the amount of the Human Development Transfer could help compensate low income households for their loss following the elimination of fuel subsidies.

Microsimulation represents an important tool for the distributional analysis of fuel subsidy reforms. However, it is only a first step to provide empirical evidence for public policy on the topic. Ideally, static tax-benefit microsimulation models should be complemented with behavioral and general equilibrium components. These seem particularly relevant in the case of fuel subsidies, as an income loss following the elimination of subsidies could change consumption patterns or could result in increased labour supply to keep consumption patterns unchanged. Moreover, eliminating fuel subsidies could translate in an increase of transportation costs, which in turn would

[1] Besides fuel subsidies, there are also agricultural subsidies and non-potable water subsidies (Ministerio de Finanzas y Economia 2015). A broader definition of subsidies also includes social development programs that include the Human Development Transfer, cash transfer to disabled and senior citizens, but also the government contribution to social security for the Military and the Police (ISSFA, ISPOL), and the general working public (IESS).

translate in high prices of goods and services. The results presented here abstract from such effects but discuss the importance of incorporating them as part of the assessment of public policies.

The remainder of this paper trails the following structure. The second section presents a brief history of fuel subsidies in Ecuador and discusses previous studies analysing methodologies and the potential effect of eliminating fuel subsidies. Section 3 presents the data sources and the model used to perform simulations of fuel subsidies. Section 4 presents and discusses the results of the analysis. In the last section, we conclude and discuss the challenges of simulating fuel subsidy reforms.

2 Fuel subsidies in Ecuador

2.1 A brief history of fuel subsidies

In the 1970s, during Ecuador's first oil boom, military-led governments increased fuel subsidies with the aim of benefiting disadvantaged social groups, and strengthening their own popular support. The most significant subsidies were assigned to natural gas and gasoline, whose prices were kept frozen throughout that decade, and rose only in 1982. In the following decades (80s and 90s), and with Ecuador's return to democratically elected governments, a market economy approach that sought a small and efficient State took force. Subsidies were gradually reduced, reflecting a progressive increase in the price of gasoline, liquefied petroleum gas (LPG), electricity, and other forms of energy consumption (MCPEC 2010).

In the second half of the 1990s, significant social outbreaks were associated with government attempts to suppress fuel subsidies, which destabilized governments and shook Ecuadorian democratic foundations. Towards the end of the 90s decade, fuel and other social subsidies were mostly eliminated. In 1998, the Ecuadorian government sought to alleviate this loss of welfare by implementing the welfare assistance program, popularly known as the 'poverty bonus' or 'solidarity bonus', which later became the Human Development Transfer (*bono de desarrollo humano BDH*). However, the president in power was overthrown by a popular uprising in January 2000, mainly attributed by his intention to raise the price of domestic gas by 500 per cent.[2] Three years earlier, the former president had suffered the same fate when he tried to increase the price of LPG by more than 300 per cent. Facing this political adversity, the succeeding presidents, were able to react in time and reduce the prices of fuels, or reverse decrees to reduce subsidies.

Since the turn of the 21st century, fuel subsidies in Ecuador are deeply rooted in government policies and state budgets. The price of the domestic gas cylinder, for example, has not changed since 2001, and currently the subsidy of LPG represents more than an 80 per cent of the import/production plus transportation costs. On the other hand, the prices of regular gasoline and diesel have remained unchanged since February 2003. After the second oil 'boom' that lasted from 2004 to 2014, international oil prices suffered a price drop and increased the fiscal imbalance. In an attempt to reduce the price differential faced by the State, in October 2015, gasoline, diesel, and gas subsidies were withdrawn from the industrial and commercial sectors, like airlines. Additionally, beginning October 2015, gasoline state distributors implemented a progressive monthly increase of 2 US cents per gallon to premium gasoline until it reached a retail price of USD2.30 (Petroecuador E. P. 2017; MF 2016). In August 2018 (during the preparation of this

[2] Ecuador´s political situation was exacerbated by a public and private financial crisis, low oil revenues and a government response that lead to the economy being dollarized (see Acosta 2008)

study), the current government implemented a reduction of the 92-octane gasoline subsidy or rather an increase in the official price of this type of gasoline to USD2.98 (Presidencia de la República 2018). We considered this an important fact and study the effects of this reform as part of our simulations.

2.2 Eliminating fuel subsidies: a review of the literature

As discussed in the previous section, eliminating fuel subsidies, even if advocated by environmentalists and economists, is not always a popular policy to the interested parties. Most antagonist opinions argue that disadvantaged groups are unable to bear the market prices of fuel and energy, and that private enterprises facing higher production costs would partially pitch the burden on to consumers. Besides the case of Ecuador, Bacon and Kojima (2006) make explicit the case of Malaysia where the government raised the petroleum prices by 23 per cent in February 2006, and the public expressed their displeasure and irritation through violent manifestations. Additionally, Shi and Kimura (2013) observe that fuel subsidy elimination is also often exploited as a weapon in domestic politics.

Alongside the extensive chain of debates and practices, most research on energy subsidy related issues were initiated and developed by international organizations such as the International Energy Agency (IEA), OECD, World Bank and United Nations. These studies began with the estimation of energy price and energy subsidy price distortions (IEA 1994, 1995; Larsen and Shah 1995), and later developed to measure different types of energy subsidies such as consumer and producer estimates, and aggregate measures of support (Porter 2002).

Implementing energy subsidy reforms throughout the world has led qualitative literature to focus on past experiences and country-specific challenges for reform and design of optimal strategies (OECD 1996, 1998, 2005 and 2008; UNEP 2004, 2008; World Bank 2010). Meanwhile, quantitative literature has made use of statistical models to analyse economic and welfare impacts of energy subsidies (e.g. Anderson and McKibbin 2000; OECD 2000; Burniaux et al. 2011; Liu and Li 2011; UNDP 2012; Rentschler 2016).

Due to the assortment of scopes, methodologies and time frames, the literature quantifying the impact of energy subsidies is extensive. Among other methodologies, CGE modeling is one of the most common approaches used to quantify the impacts of fuel subsidy reforms on the whole economy. Dartanto (2013), using CGE modeling, found that reducing fuel subsidies increases poverty incidence in Indonesia, however if this reduction is funneled towards government spending the poverty incidence is reduced. Another CGE modeling study by Yusuf and Resosudarmo (2008) look at mitigating the distribution of reducing fuel subsidies and suggest that the distribution of fuel subsidies could be more progressive if urban and rural cash transfers are differentiated. For Latin America, recent studies, like Lustig (2017) and Bucheli et. al (2013), have used simulation approaches where information about the quantity of different types of fuels consumed in household survey data has been used to analyse the redistributive impact of fuel subsidies, together with that of other policy instruments. Lustig (2017) shows that in all Latin American countries used in her analysis indirect subsidies are progressive and reduce inequality.

Quantitative studies on energy subsidies relevant to Ecuador are relatively scarce. Moreover, these kinds of studies are mostly tangential (del Granado 2012; Dennis 2016, Cuesta et al. 2004). However, one of the studies by Chanatásig (2017) uses a regression model to simulate scenarios for the most affected population. This document concludes that eliminating LPG consumption will affect the wealthiest three deciles of the population the most, and the best simulated scenario is the one where the State partially subsidizes the richest population, and redistributes this surplus to the rest of the poorer households. Llerena et al (2013), put attention on direct as well as indirect subsidies in Ecuador using microsimulations from household surveys. By looking at concentration shares they conclude that indirect subsidies (to gasoline, LPG, diesel fuel, electricity, and housing) are regressive. Results for Ecuador by Lustig (2017) show, however, that indirect subsidies are progressive (have a positive Kakwani index) and reduce inequality. Our study draws comparable intuitions from these works but provides a more detailed analysis by looking separately at different types of fuel subsidies, and simulating different counterfactual reform scenarios. It also contributes to the limited literature of fuel subsidy reform and redistribution based on quantitative methods.

3 Data and methodology

3.1 ECUAMOD and the data

Our study makes use of ECUAMOD, the tax-benefit microsimulation model for Ecuador.[3] ECUAMOD combines detailed country-specific coded policy rules with representative household survey data to simulate direct and indirect taxes, social insurance contributions, as well as cash transfers, and in our particular case, indirect transfers such as fuel subsidies for the household population of Ecuador. ECUAMOD is a static model in the sense that tax-benefit simulations do not take into account behavioral reactions and no adjustments are made to account for population changes. Simulation results for ECUAMOD have been validated against external statistics (see Jara and Varela 2018).

The underlying microdata used in ECUAMOD comes from the National Survey of Income and Expenditures of Urban and Rural Households (*Encuesta Nacional de Ingresos y* Gastos de Hogares Urbanos y Rurales, ENIGHUR) 2011–12. ENIGHUR 2011–12 is a nationally representative cross-sectional survey on income and expenditures of households in Ecuador. The survey is executed every eight years and contains detailed information on labour and non-labour income, direct taxes and SICs, public pensions, cash transfers, private transfers, expenditures, as well as personal and household characteristics. ENIGHUR 2011–12 data used for the simulations in our analysis contains information for 39,617 households and 153,341 individuals.

For this study, 2017 policies are considered as the starting point. To account for time inconsistencies between the input data year and the policy year in the simulations, market incomes and non-simulated tax-benefit variables in the data are adjusted using source-specific updating factors (see Jara et al. 2017).

[3] ECUAMOD has been developed as part of UNU-WIDER's project on 'SOUTHMOD—simulating tax and benefit policies for development' in which tax–benefit microsimulation models have been built for selected developing countries.

[3] ECUAMOD and other country models from the SOUTHMOD project are openly accessible, and run on the EUROMOD software, which enables users to analyse the effect of tax-benefit policies on the income distribution in a comparable manner. For more information about SOUTHMOD see: https://www.wider.unu.edu/project/southmod-simulating-tax-and-benefit-policies-development. For more information about EUROMOD see Sutherland and Figari (2013).

3.2 Simulating fuel subsidies in ECUAMOD

ECUAMOD's main purpose is to simulate the main tax and benefit instruments in Ecuador. The simulation of tax-benefit instruments depends on the relevant information being available in the underlying dataset used in the simulations, in this case ENIGHUR 2011–12. This study exploits the availability of information about the quantity of different types of fuels purchased by the household in order to expand the functionalities of ECUAMOD and simulate fuel subsidies based on official information about fuel costs and official sale prices.

Table 1 provides official information from Petroecuador EP (2017) on the cost of production, official sale prices and the amount of subsidies for different types of fuels in Ecuador. Three main categories of fuels have been considered for the simulation of subsidies: domestic gas, diesel and gasolines. The latter is divided in three subcategories: gasoline *Extra*, *Eco* and *Super*.[4] Table 1 shows for instance that in 2017, for each gallon of diesel purchased by a household, a subsidy of USD1.008 is covered by the government.

Table 1. Cost of production, official prices, and subsidies of the most common fuels in Ecuador in USD, 2017

	Diesel (per gallon)	Extra (per gallon)	Eco (per gallon)	Super (per gallon)	Domestic gas (per Kg)
Cost of production	2.045	2.084	2.084	2.652	0.718
Official Price	1.037	1.480	1.480	2.260	0.107
Subsidy per unit	1.008	0.604	0.604	0.392	0.611

Source: Authors illustration based on public data from Petroecuador EP (2017).

In our simulations, we calculate the total subsidy received by each household in the data, based on information about the quantity (per unit) of type of fuel product that is consumed by the household according to ENIGHUR data, together with the amount of subsidy per unit from official sources. It is important to bear in mind that ENIGHUR data contains information for years 2011–12. Therefore, the implicit assumption made in this study is that households have not changed their expenditure patterns, as our simulations are based on policy year 2017. The simulation of fuel subsidies in ECUAMOD allows us then to evaluate the redistributive effect of such instrument and assess the impact of a potential elimination of fuel subsidies, as discussed in the next section.

An alternative way to approach the problematic of fuel subsidies in Ecuador could have considered differences in fuel prices between Ecuador and its neighbouring countries. Figure A.1 in the appendix shows differences in prices of gasoline, diesel and domestic gas between Ecuador, Peru and Colombia as well as global prices for these types of fuels. The difference in prices between Ecuador and its neighbouring countries is substantial. The price of a gallon of gasoline and diesel is around 2.5 times higher in Colombia and 3 times higher in Peru, compared to Ecuador. The price of a kilogram of domestic gas is around 10 times higher in the two countries compared to Ecuador. This large difference in fuel prices has created contraband problems, with an estimated 20 per cent of consumption of these fuels going to Peru and Colombia. Simulating increases in fuel prices to match those of neighbouring countries goes beyond the scope of this paper because

[4] The gasolines Extra and Super differ in their levels of octane: Extra has a level of 80 octanes, whereas Super has a level of 92 octanes. The gasoline Eco is composed of 95 per cent of gasoline Extra and 5 per cent of anhydrous ethanol. It still has a level of 80 octane but produces a better combustion.

they would represent a large change in prices, which would most likely result in behavioral and general equilibrium changes, not considered in the analysis.

4 Empirical results

This section starts with a discussion about the relative size of fuel subsidies across decile groups and the progressivity or regressivity of fuel subsidies. Then, using ECUAMOD, we simulate five hypothetical reform scenarios. The reform scenarios are based on the growing debate of eliminating fuel subsidies in Ecuador and take into account potential ways to compensate low-income households by increasing the amount of the main cash transfer in the country, the Human Development Transfer, in case of elimination of fuel subsidies.

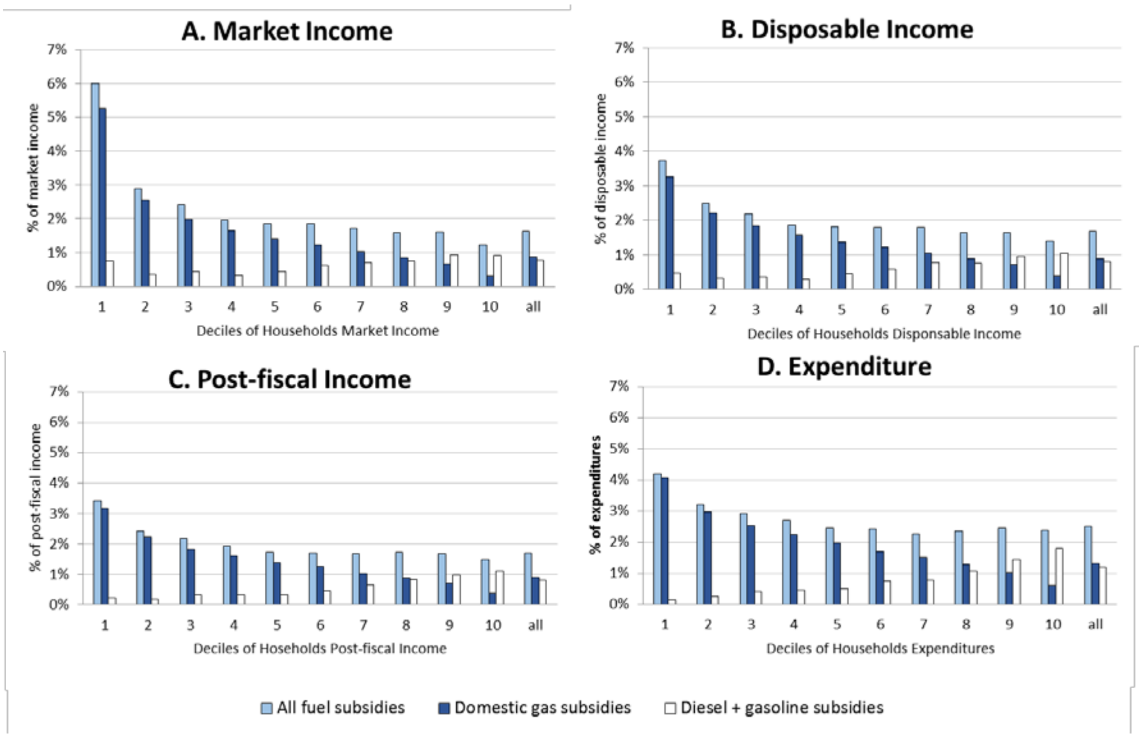
4.1 Relative size of fuel subsidies

In order to have a first impression of the potential effect of reforms on fuel subsidies, it is important to analyse their relative size across decile groups. In order to provide a thorough discussion of the importance of fuel subsidies in households' budgets, we study their relative size with respect to four different concepts: market income, disposable income, post-fiscal income, and expenditures. Market income is defined as the sum of employment and self-employment income, self-consumption, capital and property income and private transfers. Disposable income is defined as market income plus cash transfers, net of income taxes and social insurance contributions. Post-fiscal income is disposable income minus indirect taxes plus indirect subsidies. Expenditures refers to household expenditures in goods and services, as reported in the survey data.

Figure 1 shows the average size of fuel subsidies as a percentage of average (market, disposable, or post-fiscal) income or expenditure by decile groups, distinguishing between domestic gas subsidies, and diesel and gasoline subsidies. Our results show that under the three income concepts considered and expenditures, the relative size of domestic gas subsidies is always the largest for the bottom decile group and decreases with income or expenditures. On the other hand, the relative size of diesel and gasoline subsidies is the largest at the top of the distribution of all concepts. The results highlight the importance of analysing the effect of fuel subsidies differentiating between different categories of fuels. Overall, when all fuel subsidies are considered (domestic gas, diesel and gasoline), they represent the largest share of income or expenditures for households at the bottom of the distribution (due to the effect of domestic gas subsidies), with the relative size of fuel subsidies broadly similar from deciles 5 to 10 (due to the effect of diesel and gasoline subsidies).

Some interesting findings are observed when we compare results across the four concepts used to evaluate the relative size of fuel subsidies. First, the relative size of fuel subsidies in the bottom decile is the largest when the assessment is made with respect to market income (panel A in Figure 1), representing 6 per cent of household market income. The results are related to the fact that when moving from market income to disposable and post-fiscal incomes, cash transfers and subsidies are taken into account (in the denominator) decreasing the share of household income that fuel subsidies represent. The relative size of fuel subsidies is 4.9 times larger for the bottom decile than the top decile when we look at market incomes (panel A in Figure 1), whereas it is 1.75 times larger when household expenditures are considered (panel D in Figure 1). This relates to the fact that there is a clear decreasing pattern of the relative size of fuel subsidies across market income deciles, whereas the relative size of fuel subsidies is broadly the same from the 5th decile of household expenditures. The relative size of diesel and gasoline is the largest for the top decile when expenditures is used as the concept of assessment, representing around 1.8 per cent of household expenditures.

Figure 1. Relative size of fuel subsidies in terms of market, disposable and post-fiscal income and expenditures



Notes: Market income is defined as the sum of employment and self-employment income, self-consumption, capital and property income and private transfers. Disposable income is defined as market income plus cash transfers, net of income taxes and social insurance contributions. Post-fiscal income is disposable income minus indirect taxes plus indirect subsidies.

Source: Authors' elaboration based on ECUAMOD version v1.4.

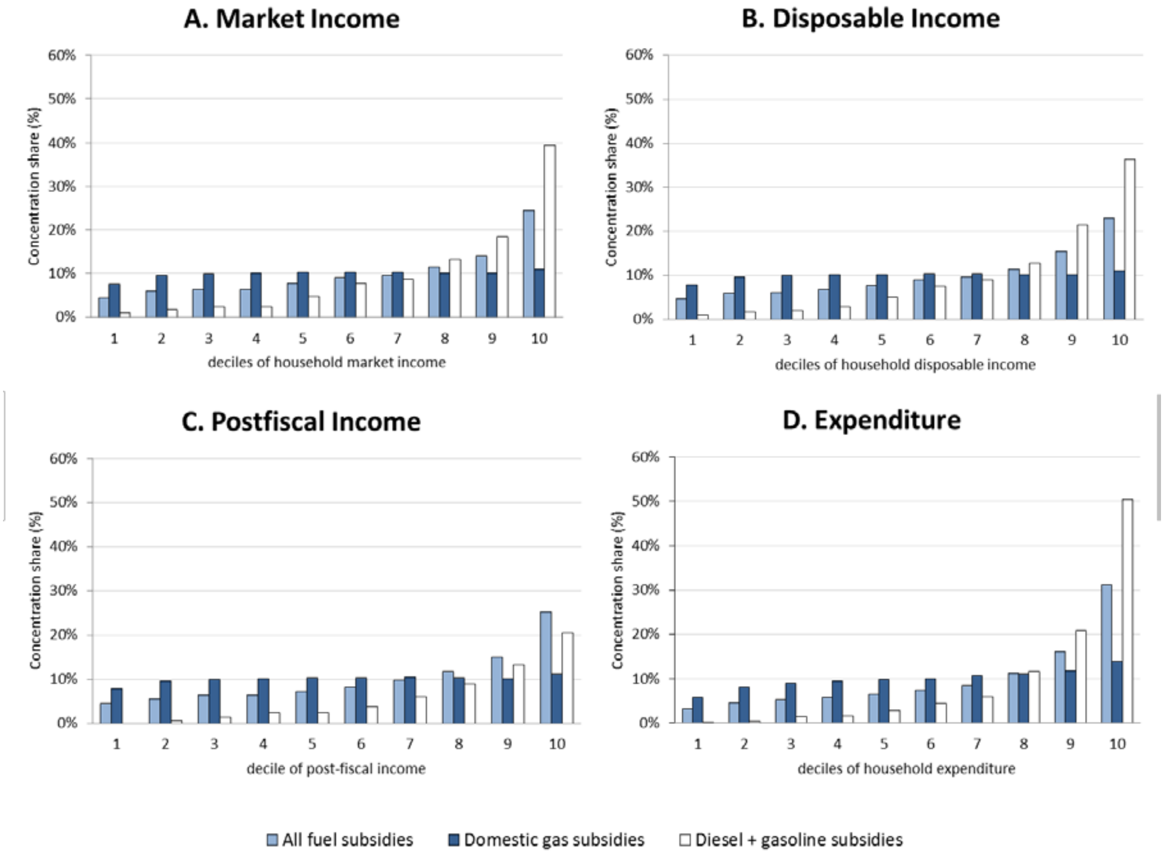
The assessment of the relative size of fuel subsidies across decile groups of income and expenditure enables us to have an idea of the distributional effect of a potential elimination of fuel subsidies. Eliminating all types of fuel subsidies would mostly affect the lowest deciles groups, due to the importance of domestic gas subsidies at the bottom of the distribution. On the other hand, eliminating diesel and gasoline subsidies would affect mostly households at the top of the distribution. The following section analyses more in detail the progressivity/regressivity of fuel subsidies by looking at concentration shares and progressivity indices.

4.2 Concentration shares of fuel subsidies

In contrast with the analysis presented in the previous section which focused on the relative size of fuel subsidies out of households' income and expenditures, we now examine how the overall government budget allocated to fuel subsidies is distributed across income and expenditure deciles. We do so by looking at concentration shares, which depict the total budget allocated to fuel subsidies that is received by each decile group. Concentration shares are often used to assess the progressivity of tax-benefit instruments. In order to provide a full discussion about the progressivity of fuel subsidies, this section also presents Kakwani indices of progressivity for the different categories of subsidies.

Figure 2 shows concentration shares of fuel subsidies with respect to market income, disposable income, post-fiscal income and expenditures. Given the contrasting pattern observed between domestic gas subsidies and diesel and gasoline subsidies, in terms of their relative size across decile groups, here we also distinguish between the two categories of fuels.

Figure 2. Concentration shares of fuel subsidies in terms of market, disposable and post-fiscal income and expenditures



Notes: Market income is defined as the sum of employment and self-employment income, self-consumption, capital and property income and private transfers. Disposable income is defined as market income plus cash transfers, net of income taxes and social insurance contributions. Post-fiscal income is disposable income minus indirect taxes plus indirect subsidies.

Source: Authors' elaboration based on ECUAMOD version v1.4.

Our results show that under all concepts considered (i.e. market, disposable, post-fiscal income, and expenditure), fuel subsidies as a whole increase with the level of income and expenditure and are largely concentrated on the highest decile group. Around 25 per cent of the total government budget allocated to fuel subsidies is concentrated on the top decile of market, disposable and post-fiscal income. The concentration of fuel subsidies on the top decile amounts to over 30 per cent with respect to household expenditure. The observed pattern is driven by the high concentration of diesel and gasoline subsidies at the top of the distribution, with around 50 per cent of the government budget on diesel and gasoline subsidies concentrated on the 10th decile of household expenditure. On the other hand, the domestic gas subsidies are broadly evenly distributed under our four concepts, with only a slightly lower (higher) concentration in the bottom (top) decile.

The analysis of concentration shares together with the analysis of the relative size of fuel subsidies highlights the importance of distinguishing between domestic gas subsidies and diesel and gasoline subsidies. Table 2 therefore presents Kakwani indices of progressivity for domestic gas only, gasoline plus diesel, and all fuel subsidies, with respect to our four concepts of interest: market income, disposable income, post-fiscal income, and expenditure arrangements. Our results show that when we consider fuel subsidies as a whole, they are slightly progressive with a Kakwani index between 0.08 and 0.15 with respect to our three income concept, and with an index of 0.01 with respect to expenditure. Our results confirm the contrasting pattern between domestic gas subsidies and gasoline plus diesel subsidies. On the one hand, domestic gas subsidies are progressive with respect to our four concepts, although slightly less so with respect to expenditure. On the other hand, gasoline and fuel subsidies are regressive and particularly so with respect to expenditure.

Table 2. Progressivity of fuel subsidies: Kakwani index

	Market Income	Disposable Income	Post-fiscal Income	Expenditure
Domestic gas	0.39	0.34	0.33	0.08
Gasoline + Diesel	-0.03	-0.07	-0.11	-0.23
All Fuels	0.15	0.1	0.08	0.01

Notes: Market income is defined as the sum of employment and self-employment income, self-consumption, capital and property income and private transfers. Disposable income is defined as market income plus cash transfers, net of income taxes and social insurance contributions. Post-fiscal income is disposable income minus indirect taxes plus indirect subsidies.

Source: Authors' elaboration based on ECUAMOD version v1.4.

4.3 Assessing the effects of eliminating fuel subsidies

The analysis from the previous sections has presented two main findings. First, fuel subsidies represent an important part of households' income and expenditures at the bottom of the distribution, in particular domestic gas subsidies. Second, whereas gasoline and diesel subsidies are regressive, domestic gas subsidies are progressive. Based on these results, it becomes evident that eliminating fuel subsidies will not only affect households at the top of the income/expenditure distribution but also those in the lower part of the distribution. Moreover, from a policy perspective, it becomes clear that any potential policy reform aiming at reforming fuel subsidies should distinguish between domestic gas, and gasoline and diesel subsidies. For this reason, in this section we consider five hypothetical reform scenarios related to the elimination of fuel subsidies. Given the potential negative impact of fuel subsidies elimination on poor households, we consider under some scenarios the possibility that part of the budget saved after the subsidies elimination could be used by the government to increase the amount of the Human Development Transfer, the main social assistance benefit for poor households in Ecuador.[5] The different scenarios are

[5] The Human Development Transfer (HDT) is a proxy means-tested conditional cash transfer. Three population subgroups are eligible for HDT: (i) poor families with children younger than 18 years, (ii) vulnerable elderly adults

described in section 4.3.1. The following subsections discuss the budgetary and distributional effects of the counterfactual reforms.

4.3.1 Description of counterfactual scenarios

This section describes the five counterfactual scenarios related to the elimination of fuel subsidies simulated with ECUAMOD. It is important to note that all reform scenarios in this study are simulated without considering potential changes in behaviour or general equilibrium effects. These potential second order effects are discussed in the conclusion.

Scenario A: elimination of all fuel subsidies without increase in social assistance

The first scenario represents the most extreme case in which all fuel subsidies (domestic gas, gasoline and diesel) in Ecuador would be eliminated without any additional policy to compensate poor households from the negative impact of the reform. This counterfactual scenario aims at illustrating the extent to which inequality and poverty would be affected by an elimination of all fuel subsidies, given the increasing debate about government needs to reduce budget expenses.

Scenario B: elimination of all fuel subsidies with an increase in social assistance

The second scenario also simulates an elimination of all fuel subsidies but analyses the effect of using 50 per cent of the budget saved by the government to increase the amount of the Human Development Transfer in Ecuador. The additional amount of the HDT is calculated by dividing the savings generated by the subsidy elimination equally between all HDT beneficiaries. This scenario would result in an additional payment of USD31 per month to HDT recipients. Fuel subsidies are usually criticized because they fail to target poor households. Findings from the previous sections showed that although fuel subsidies represent an important part of income and expenditure at the bottom of the distribution, household at the top of the distribution also benefit largely from them, in particular from gasoline and diesel subsidies. The aim of this scenario is therefore to illustrate the effect of redirecting part of the budget used in fuel subsidies to target poor households.

Scenario C: elimination of gasoline and diesel subsidies without increase in social assistance

The third scenario draws from the results obtained in the previous sections and illustrates the effect of eliminating only gasoline and diesel subsidies, while keeping in place domestic gas subsidies. Sections 4.1 and 4.2 showed that gasoline and fuel subsidies represent a larger share of income and expenditure at the top of the distribution, and are characterized by being regressive. The elimination of gasoline and diesel subsidies only would therefore have a less negative impact on poor households, while allowing the government to make savings.

Scenario D: elimination of gasoline and diesel subsidies with an increase in social assistance

The fourth scenario represents a similar reform to counterfactual C but where 50 per cent of the budget saved by the government from the elimination of gasoline and diesel subsidies is used to increase the amount of the HDT by USD14.5 per month per beneficiary. As in scenario B, the

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who do not receive any pension, and (iii) vulnerable disabled persons. In 2017, the benefit amount was fixed at USD 50 per month.

aim is to illustrate how part of the budget could be used to improve social protection of poor households.

Scenario E: increase in price of gasoline 'super' from USD2.26 to USD2.98 with no increase in social assistance

Contrary to the previous hypothetical scenarios, our final counterfactual considers an actual reform taken by the Ecuadorian government in August 2018, which increased the price of gasoline Super to USD2.98 per gallon (Presidencia de la República 2018). Gasoline Super is the most expensive type of gasoline used by most new car models and is therefore likely to be concentrated at the top of the distribution. As such, our study is the first to provide an ex-ante evaluation of the recent reform taken by the government.

4.3.2 Budgetary effects

We first assess the budgetary effects of our counterfactual scenarios. Table 3 presents total government expenditure in fuel subsidies in our baseline and counterfactual scenarios. According to ECUAMOD baseline results, the total government expenditure in fuel subsidies directed to households amounts to USD839,236,205 in 2017. The official figure for the same year was USD1,982,764,163, meaning that our simulations capture over 40 per cent of the government expenditure in fuel subsidies. This seems a relatively good approximation considering that our simulation only considers household expenditure in fuels based on household survey data, excluding expenditure in fuels by firms and fuel contraband to neighbouring countries, where higher prices apply.

In order to provide an idea of the relevance of government expenditure in fuel subsidies, Table 3 compared it to the total expenditure in the Human Development Transfer, the main social assistance program in Ecuador. Our results show that the budget for fuel subsidy directed to households is around 20 per cent higher than the budget for the HDT program. The comparison is particularly relevant because, whereas the HDT is a program targeting the poorest population in Ecuador, fuel subsidies represent government expenditures which are also benefitting households at the top of the income distribution.

Table 3. Total expenditure in fuel subsidies and the Human Development Transfer (in 2017 USD)

	Fuel subsidies	Human Development Transfer
Baseline	839,236,205	687,231,330
Scenario A	-	687,231,330
Scenario B	-	1,106,849,432
Scenario C	644,758,145	687,231,330
Scenario D	644,758,145	881,709,389
Scenario E	736,872,390	687,231,330

Source: Authors' elaboration based on ECUAMOD version v1.4.

By construction, under scenarios A and B the government has no more expenditure on fuel subsidies as they are all eliminated. Under scenario B, 50 per cent of the savings from the elimination of fuel subsidies is redirected to the HDT program. This would represent a 62 per cent increase in the HDT budget, which would translate into an additional USD31 payment per month to HDT beneficiaries, amounting to a total transfer of USD81 per month.

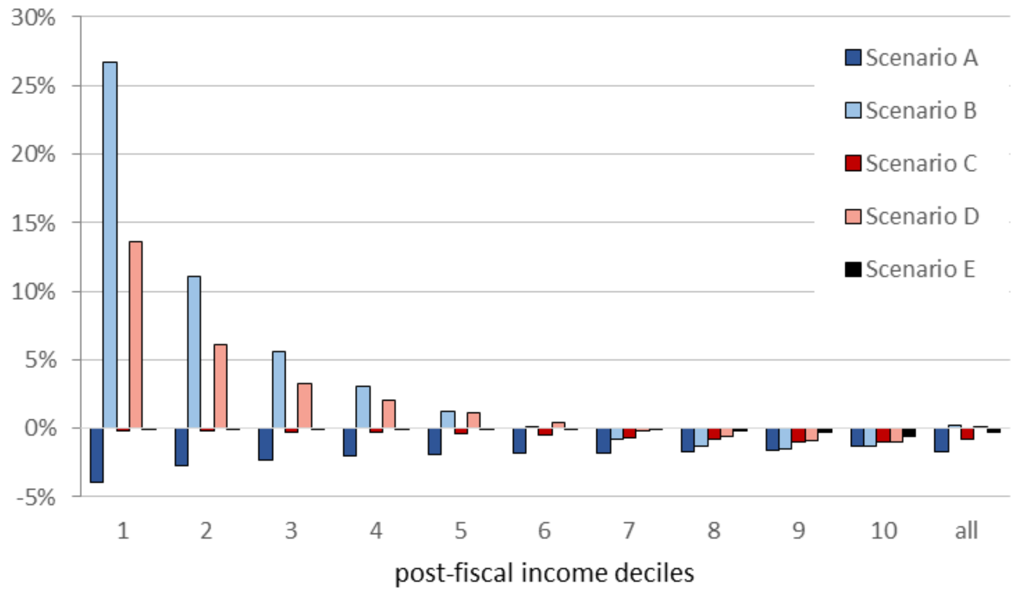
Under scenarios C and D, gasoline and diesel subsidies are eliminated which results in a 25 per cent reduction in government expenditure in fuel subsidies. Redistributing 50 per cent of government savings under scenario D would result in a 28 per cent increase in the HDT budget, which would provide an extra USD14.5 per month to each HDT beneficiary. Finally, the increase in the price of gasoline super simulated under scenario E would result in the smallest reduction in government expenditure, amounting to 12 per cent.

4.3.3 Distributional effects

We now turn to the distributional effects of our counterfactual reforms. In this section, we focus on the concept of post-fiscal income (disposable income minus indirect taxes plus indirect subsidies). We start by looking at the percentage change in household income across the distribution of post-fiscal income following our reform scenarios. We then analyse the effect of the reforms on income poverty and inequality.

The effects of our reforms over the whole population are presented in Figure 3. The figure depicts the gains and losses in terms of household post-fiscal income by income decile groups. Negative effects (downward pointing bars) reflect losses from the elimination of fuel subsidies, whereas positive effects (upward pointing bars) represent gains from the increase in the HDT amount.

Figure 3. Percentage change in post-fiscal income by income decile group



Notes: Results are based on post-fiscal income defined as disposable income minus indirect taxes plus indirect subsidies.

Source: Authors' elaboration based on ECUAMOD version v1.4.

Our results show that under scenario A, eliminating all fuel subsidies (dark blue bars) would result in a 1.7 per cent reduction in post-fiscal income on average. In the absence of any compensating policy, all income decile groups will be affected by the elimination of fuel subsidies. The distribution of losses across the income distribution reflects the relative importance of fuel subsidies across the population. The bottom income decile would suffer the most from the elimination of fuel subsidies with a 4 per cent reduction in post-fiscal income. The graph further shows that under scenario B (light blue bars), where 50 per cent of the budget previously allocated to fuel subsidies is used to increase the amount of the HDT, there would be significant gains at the bottom of the income distribution. The first decile group will gain the most, experiencing an increase of 26.7 per cent in post-fiscal income. The top income decile groups would still experience a loss in post-fiscal income because they do not benefit from the increase in the HDT amount. Overall for the whole population, this second reform scenario would represent only a 0.3 per cent increase in post-fiscal income.

Under scenario C (bright red bars), the elimination of gasoline and diesel subsidies would result in a 0.75 per cent reduction in post-fiscal income. Contrary to reform A, eliminating gasoline and fuel subsidies affects mostly the top of the income distribution, where expenditure on these fuels is concentrated. Our results show that scenario C would result in a 1 per cent reduction in post-fiscal income for the top income decile group, whereas the bottom decile would suffer only a 0.18 per cent reduction. Turning to scenario D (light red bars), the redistribution of 50 per cent of the budget previously allocated to gasoline and diesel subsidies via the HDT, would result in gains equal to 13.6 per cent increase in post-fiscal income for the bottom decile group, whereas on average for the whole population this scenario would represent only a 0.14 per cent increase in post-fiscal income.

Finally, our simulations of the increase in prices of gasoline super implemented in August 2018 show that on average such reform would represent a decrease in post-fiscal income of only 0.29 per cent. The largest losses would be observed at the top of the income distribution, where expenditure on this type of gasoline is concentrated. The top income decile group would experience a 0.57 per cent decrease in post-fiscal income, whereas the bottom five decile groups would experience a decrease smaller than 0.05 per cent.

As such, our results provide some interesting insights into the effect of eliminating fuel subsidies in Ecuador. Eliminating all fuel subsidies would necessarily affect the most the bottom of the income distribution due to the importance of domestic gas subsidies to low income households. A potential way to compensate low income households from losses resulting from fuel subsidies elimination would be to increase the amount of HDT payments. On the other hand, eliminating gasoline and diesel subsidies would have only a minor effect at the bottom of the distribution as expenditure on these types of fuels is concentrated at the top of the distribution.

We now turn to the effect of our reforms on income inequality and poverty in Ecuador. As before, the results are based on household post-fiscal income per capita. For the poverty headcount, we use the national poverty line and extreme poverty line in 2017, which were USD84.72 and USD47.75, respectively. We choose the Gini coefficient to assess any changes in income inequality. The effects are summarized in Table 4.

Our results show that under scenario A, inequality and poverty would increase. This is consistent with the results presented in Figure 3, which showed that eliminating all fuel subsidies would affect the most the bottom part of the income distribution. On the other hand, under scenario B where 50 per cent of government savings following the elimination fuel subsidies is redistributed via the HDT program, poverty and inequality would decrease substantially. Under this scenario, the Gini coefficient from post-fiscal income would fall from 48.2 to 46.8. Poverty and extreme poverty would decrease by 3.3 and 1.2 percentage points, respectively. The additional cash transfer, therefore, more than compensates for the adverse effect of eliminating fuel subsidies on the income distribution.

Table 4. Income poverty and inequality by policy reform scenario (%)

	Baseline	Scenario A	Scenario B	Scenario C	Scenario D	Scenario E
Gini coefficient	48.2	48.5	46.8	48.1	47.3	48.1
Poverty headcount	12.7	13.5	9.4	12.7	10.8	12.7
Extreme poverty headcount	3.3	3.6	2.1	3.3	2.4	3.3

Notes: Results are based on post-fiscal income defined as disposable income minus indirect taxes plus indirect subsidies.

Source: Authors' elaboration based on ECUAMOD version v1.4.

Eliminating only gasoline and diesel subsidies, as simulated in scenario C, has very little impact on income inequality and has no effect on income poverty. The results are expected due to the fact that eliminating gasoline and diesel subsidies would have very little impact at the bottom of the income distribution and would mostly affect the top, as shown in Figure 3. Redistributing part of the budget previously allocated to gasoline and diesel subsidies, under scenario D, would reduce both income inequality and poverty. The Gini coefficient and extreme poverty headcount would decrease by around 0.9 percentage points, whereas the poverty headcount would fall by around 1.9 points.

Finally, our assessment of the recent policy reform implemented by the Ecuadorian government, under scenario E, shows very little effect on income inequality and poverty, as it was the case for scenario C. As such, this policy seems to have correctly differentiated between the existent types of fuel subsidies in order to achieve a reduction in government expenditures with a minimal effect for low income households.

5 Conclusions

Fuel subsidies represent an important part of government expenditures in Ecuador. Following the fall in prices of petrol, one of the main sources of government revenue in the country, the political debate about the regressivity and potential elimination of fuel subsidies has regained increasing importance. In 2018, words turned to action and the Ecuadorian government eliminated the subsidy allocated to the 92-octane gasoline, the most expensive type of gasoline in the country.

The present paper makes use of ECUAMOD, the tax-benefit microsimulation model for Ecuador, together with official information on the cost of production, official sale prices, and the amount of subsidies for different types of fuels. Our study provides empirical evidence about the relative importance of different types of fuel subsidies across the income distribution and their progressivity/regressivity. Microsimulation techniques are then used to analyse the effect of different counterfactual reforms aiming to eliminate fuel subsidies, including the recent reform implemented by the government in 2018.

Our analysis provides a number of important findings. First, we highlight the importance of distinguishing between different types of fuel subsidies in order to assess their relative importance and progressivity. In particular, government expenditure in domestic gas subsidies is broadly evenly distributed across the population and this type of subsidies represent an important share of households' income at the bottom of the distribution. On the other hand, gasoline and diesel subsidies are highly concentrated at the top of the distribution, representing a large share of households' income for richer households. The contrasting pattern is reflected in the Kakwani indices of progressivity which show that domestic gas subsidies are progressive, whereas gasoline and diesel subsidies are regressive.

Second, our hypothetical reforms show that eliminating all fuel subsidies would mostly affect the bottom of the distribution, increasing income inequality and poverty due to the importance of domestic gas subsidies for low income households. On the other hand, eliminating gasoline and diesel subsidies only, would have little effect on income inequality and poverty while at the same time reducing government expenditures. These two objectives seem to have been achieved by the recent reform implemented by the Ecuadorian government.

Finally, we show that increasing the amount of the Human Development Transfer could help overcome the adverse effect of fuel subsidy elimination for low-income households.

From a policy perspective, there is an important issue of political feasibility of fuel subsidy reforms in Ecuador. As evidenced by the history of fuel subsidies in the country, a hike in fuel prices tends to lead to political instability. The recent decision by the Ecuadorian government to eliminate only gasoline super subsidies might evidence this tension. Our study shows that eliminating other gasoline and diesel subsidies would also have little impact of poverty and inequality. However, such reforms might be considered less popular and result in social unrest, in particular the elimination of diesel subsidies, which would affect the transportation sector.

We should emphasize two important limitations from our analysis. First, our simulations are static, in the sense that behavioral reactions and general equilibrium effects are not considered in the simulation of our counterfactual reforms. Eliminating fuel subsidies could for instance affect labour supply, as individuals might want to compensate the loss of subsidies by working more. In the same line, a substantial increase in the amount of the Human Development Transfer could create incentives to work less. Eliminating fuel subsidies could also result in general equilibrium reactions, as an increase in fuel prices could translate into an increase in transportation costs and therefore an increase in prices of goods and services. General equilibrium studies like Solaymani and Kari (2014) suggest that when fuel subsidies are cut, the cost of production in the transport sector is significantly influenced due to an increase in the prices of intermediate inputs.

Second, our study did not consider the problem of fuel contraband to neighbouring countries due to the substantial differences in fuel prices. The elimination of fuel subsidies simulated in this paper would still result in fuel prices lower than those of neighbouring countries and therefore in ongoing fuel contraband.

Our model allows simulating fuel price increases to match those of neighbouring countries. However, the aforementioned problems of accounting for second order effects or potential social unrest due to such reforms would become even more relevant due to the important differences in prices. Future work should aim to incorporate labour supply effects of potential reforms to subsidies and link micro models to general equilibrium models in order to assess the effects of more complex reforms in the economy.

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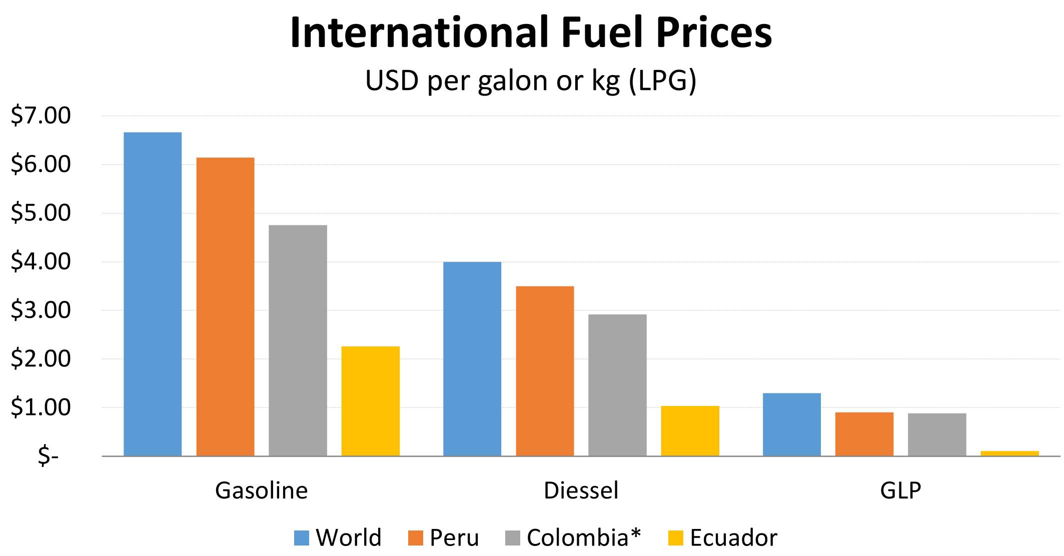
Appendix

Figure A.1. Comparative of International Fuel Prices (final 2017)



Source: Authors' elaboration based on Global Petrol Prices.