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Incidence and Impact: A Disaggregated Poverty Analysis of Fossil Fuel Subsidy Reform

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Incidence and Impact: A Disaggregated Poverty Analysis of Fossil Fuel Subsidy Reform

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Abstract

This study uses household expenditure data from Nigeria to understand energy consumption patterns with respect to income levels, different energy goods, urban and rural livelihoods, and geographical distribution. Using the empirical subsidy simulation model by Araar & Verme (2012), this paper simulates 50% and 100% reductions of subsidies on petrol, electricity and kerosene. It presents the estimated effects of such reforms on consumption, poverty, and government revenue. This analysis also determines the minimum level of universal cash transfer that is required to achieve "poverty neutrality" of subsidy removal; i.e. the threshold at which direct cash compensation offsets increasing energy prices, such that the national poverty headcount rate is unchanged after the subsidy removal. By disaggregating this analysis to the state level, it is shown that poverty effects (and thus the required poverty neutral cash compensation) can vary significantly across states. Poverty is estimated to increase particularly strongly in urban, industrial and higher income states, which were in fact hotspots of civil unrest during Nigeria's attempted subsidy reform in 2012. Understanding these differences in vulnerability, and designing tailored compensation and social protection policies is critical for ensuring public and political support for subsidy reforms.

Keywords: Fossil fuel subsidies, reform, cash transfers, poverty

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1. Introduction

At least since the G20 Summit in 2009, fossil fuel subsidy reform has been high on the international policy agenda, with widespread acceptance of the notion that fossil fuel subsidies are fundamentally unsustainable.[2] This emerging consensus follows from a number of concerns over the subsidies' adverse effects, including market distortions, underinvestment in infrastructure and efficiency measures, escalating fiscal burdens, climate change, poverty, and income inequality. Depending on country specific circumstances, these environmental, social, and economic side-effects of fossil fuel subsidies can be severe, and have been documented extensively (IMF, 2013).[3]

Despite the lack of a coordinated international approach, several countries – primarily driven by fiscal imbalances – have made significant progress in phasing out fuel subsidies. The IEA (2014) reports that around the world there were 27 countries in 2014 actively pursuing fossil fuel subsidy reforms. However, political interests, short-sighted planning, weak institutions, and other political economy challenges have proven to be strong barriers for more comprehensive reform action (Commander, 2012; Fattouh & El-Katiri, 2015; Kojima et al., 2014; Strand, 2013).

The recent case of Nigeria's attempted fuel subsidy removal illustrates just how politically challenging reforms can be in practice: In 2012 the government's decision to remove subsidies on fossil fuel imports caused fuel prices to more than double. Strikes and public protests followed, prompting the government to immediately reintroduce subsidies (Bazilian & Onyeji, 2012; Siddig et al., 2014). Similarly, governments of Bolivia (2010), Cameroon (2008), Venezuela (1989), and Yemen (2005 & 2014) were all forced to abandon reform attempts following heavy public protests, particularly by low-income population groups (IEA, 2014; Segal, 2011).

However, country case studies of past reforms suggests that success is possible with proper planning: Strong government commitment and credibility, thorough preparation, careful reform design, effective communication, and timing can significantly improve the success rate (IMF, 2013; Vagliasindi, 2012). In particular, it has proven critical to understand the incidence of existing subsidy benefits, and the potential welfare impacts of a reform. Identifying vulnerable households and mitigating energy price shocks through adequate compensation is critical for ensuring the affordability of fuel for households, and thus securing public support for subsidy reform (Ruggeri Laderchi et al., 2013). In addition, energy price increases are likely to adversely affect businesses, which may have further adverse effects on employment and economic activity – and thus indirectly on household welfare.

This paper focuses on Nigeria, and uses the statistical simulation model by Araar & Verme (2012) to estimate the short term (direct) welfare effects of reducing or removing fuel subsidies. It considers different compensation strategies and investigates their effect on poverty rates. Besides considering reform consequences for national welfare and poverty figures, this paper also provides estimates for effects at the state-level. It shows that, due to varying energy consumption patterns, poverty impacts can differ substantially across states. Crucially, it shows that compensation measures (e.g. uniform cash compensation) that appear effective when considering national averages, can fail to adequately mitigate price shocks in certain states – thus raising the risk of shocks to livelihoods, and thus provoking strong public opposition. The analysis shows the need for a thorough, disaggregated analysis of subsidy reforms, and tailored reform strategies.

The remainder of this paper is structured as follows: Section 2 provides more detailed information about Nigeria's fossil fuel sector and subsidy program. Section 3 presents a disaggregated analysis of energy

[2] For a more comprehensive review on fossil fuel subsidies see Rentschler & Bazilian (2016), on which the brief overview in this section is based.

[3] Note that for the purpose of this paper the IEA's definition of fossil fuel subsidies is used: i.e. subsidies are active fiscal actions by a government to lower the consumer price of certain fossil fuel products. It does not account for the failure to impose a price on externalities.

consumption patterns in Nigeria, thus highlighting underlying inequalities. Section 4 presents an empirical subsidy simulation: Section 4.1 presents the methodology, followed by an outline of the (hypothetical) reform scenarios in Section 4.2. Section 4.3 presents the results both at the national level (4.3.1) and disaggregated to the state-level (4.3.2). Section 5 concludes.

2. Fuel Subsidies in Nigeria

As a developing country with substantial fossil resource wealth and a mixed track record of fiscal prudence and transparency, Nigeria is a frequently cited case for studying fossil fuel subsidies, and natural resource management more generally.

Nigeria extracts 2.5m barrels of oil a day, which account for 70% of government revenues and 95% of total exports. These oil exports make Nigeria the fifth largest oil exporter in the world. Despite abundant energy resources, only 55% of Nigerians have access to electricity (34% in rural areas); annual per capita electricity consumption in 2012 was 155 kWh (compared to 4,405 kWh in South Africa). And electricity supply is not only elusive, but also unreliable: chronic underinvestment and corruption in the electricity sector mean that the average Nigerian enterprise experiences over 36 power outages a month, wiping out 4% of annual GDP. Similar problems plague the country's four national oil refineries, which operate at just 20% to 30% capacity. While over 70% of fuel consumption is met by imports, shortages are endemic (IMF, 2013; World Bank, 2015).

Through the Petroleum Products Pricing Regulatory Agency, Nigeria maintains artificially low energy prices – most notably for kerosene and petrol. The gap between fuel import costs and regulated prices are financed through the Petroleum Support Fund, which administers fuel subsidies.[4] Figure 1 provides estimates of the overall volume of the subsidy program, as well as fuel prices per litre; the reliability of these figures remains uncertain due to conflicting information from different national authorities and large-scale subsidy theft (GSI, 2012; also see section 4.2).[5]

This subsidy scheme is a significant expense for the government – costing nearly 5% of GDP in 2011 (IMF, 2013); and in more than one sense subsidies fail to even reach Nigerians: As with all fossil fuel subsidy schemes, the direct financial benefits to households are concentrated on the rich, thus failing to benefit the absolute poor (which constitute 61% of the population).[6] In addition, a complex and opaque system of intermediary dealers and political influence means that, instead of lowering the market price, subsidies are often privately appropriated before the fuel reaches the market. For kerosene, for instance, anecdotal evidence suggests that the subsidised rate of N50 per litre is in fact only available to privileged individuals, while regular consumers often pay prices between N120 and N250 (Udo, 2015). Finally, rampant fuel smuggling means subsidy benefits are leaking out of the country. The IMF (2013) estimates that 80% of petrol consumed in Benin in 2011 was smuggled from Nigeria.

[4] The Petroleum Support Fund is managed by the Petroleum Products Pricing Regulatory Agency, and receives a set allocation in the federal budget. Contributions to the fund are made by the federal, state, and local governments. Moreover, the fund is supplemented by subsidy "surpluses", which essentially occur when international market prices exceed the government-set fuel price (GSI, 2012).

[5] For instance, there is conflicting information on the amount of subsidies provided following a 2009 government decision to remove kerosene subsidies (GSI, 2012). The Nigeria National Petroleum Corporation maintains that N310 bn in subsidies have been paid out, but disputes between different authorities persist.

[6] This figure is based on the absolute poverty definition, using an absolute poverty line of N54,401 (NBS, 2010).

Figure 1: Fossil fuel subsidies in Nigeria

Note: Upper panel: Estimated annual fossil fuel subsidies, primarily for oil and oil derivatives, in millions of Naira. Uncertainty persists over the amount of subsidies paid after a presidential directive in 2009 to suspend kerosene subsidies; the amount in question is N310 bn. Lower panel: Prices for diesel, petrol and kerosene in Naira per liter. (IEA, 2014; IMF, 2013)

Facing mounting fiscal pressures and recognising the inefficiencies of its subsidy scheme, Nigeria attempted a radical subsidy reform in 2012. While the need for such reform was evident, this attempted removal of the fuel subsidy demonstrated just how politically challenging reforms can be in practice. In one instant, the government removed subsidies on fossil fuel imports, thus causing domestic fuel prices to more than double. The extensive strikes and violent public protests that followed prompted the government to reintroduce the subsidies (Bazilian & Onyeji, 2012; Siddig et al., 2014).

Nigeria's experience mirrors reform attempts in Bolivia (2010), Cameroon (2008), Venezuela (1989), and Yemen (2005 & 2014), which all abandoned fuel subsidy reforms following heavy public protests, particularly by low-income population groups (IEA, 2014; Segal, 2011). In all of these cases, the failure to implement subsidy reforms reflected inadequate reform design (in particular ill-designed compensation systems), and a poor understanding of the needs and vulnerability of affected energy consumers.

3. Understanding energy demand

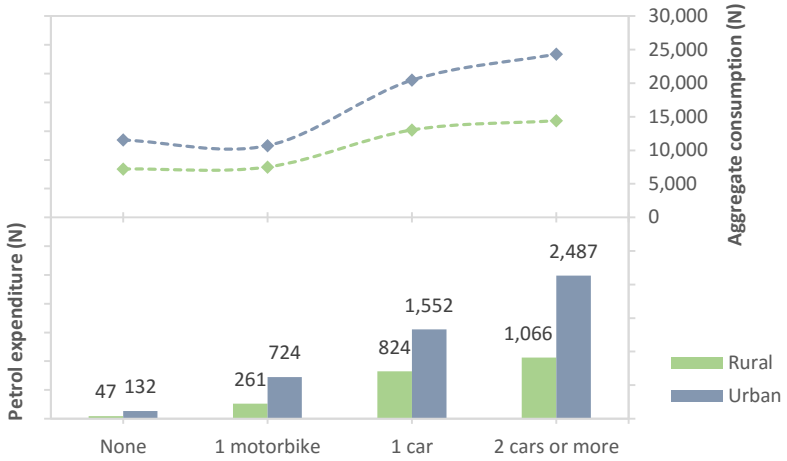
Besides environmental and fiscal strains, one of the key criticisms of fossil fuel subsidies is that they disproportionately benefit the rich, who are the main consumers of energy. Thus, understanding the patterns of energy consumption is crucial to understanding who stands to lose most from subsidy removal. The design of fuel subsidy reforms must take these patterns into account, as they are key to mitigating adverse welfare effects, and thus garnering public support for reforms. This paper uses the Harmonized Nigeria Living Standard Survey of 2009/2010, which provides consumption data for 33,775 households (or 149,261 individuals) across all 36 federal states (National Bureau of Statistics, 2013). The survey provides a detailed breakdown of household expenditure on food, education, health, energy and other goods.

Especially in countries, such as Nigeria, where existing subsidy schemes are justified as a mechanism for redistributing natural resource revenues and for supporting poor households, it is critical to understand the scale of regressivity. Various studies have highlighted how energy subsidies fail to reach poor households: Arze del Granado et al. (2012) analyse a sample of 20 developing countries from

around the world and find that on average the richest 20% benefit six times more from fuel subsidies than the poorest 20% (in absolute terms).

The reason that the rich predominantly reap the financial rewards of subsidies is simply that they consume more energy. This is easily illustrated when considering the correlation between vehicle ownership and spending on consumption goods, including energy. Using total consumption expenditure as a proxy for income, Figure 2 illustrates that richer households Nigeria tend to own more and bigger motorised vehicles, and thus consume more petrol.

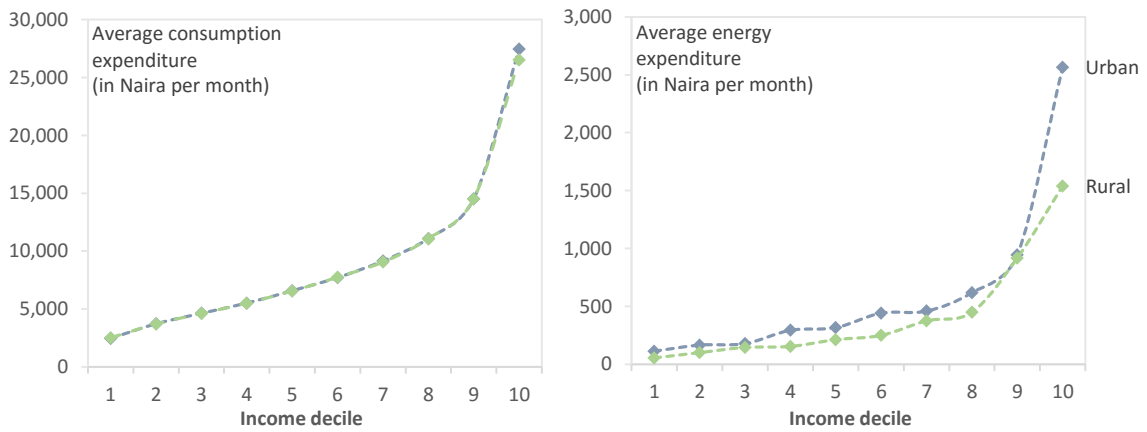
Figure 2: With wealth comes mobility



Note: Average household expenditure for all consumption goods (upper panel), and petrol (lower panel), according to ownership of motorised vehicles. All numbers are in Naira per month.

The level of inequality in Nigeria is reflected in Figure 3. Consumption expenditure (which includes food, rent, education, energy, among others) is a common proxy for income levels, and indeed varies substantially across income deciles. In per capita terms, the data suggests that consumption expenditure by the richest 10% of the population exceeds that of the poorest 10% by a factor 10. The 2nd and 9th deciles still differ by a factor 4 – and there is little difference to this pattern between urban and rural areas.

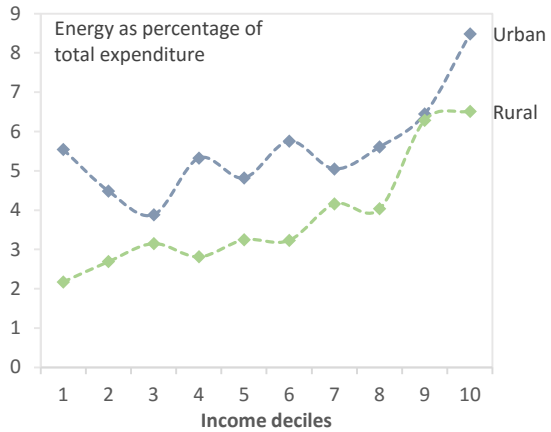
Figure 3: The inequality of consumption



Note: Left panel: Average per capita expenditure on all consumption goods, according to income deciles. Right panel: Average per capita expenditure on energy goods, according to income deciles. All numbers are in Naira per month.

Considering energy consumption separately, inequality is significantly more pronounced than for aggregate consumption (Figure 3, right panel). In urban areas, the richest 10% spend 28 times more on energy consumption than the poorest 10%. In rural areas this difference falls to a factor 23 – this is primarily due to a large discrepancy between urban and rural households within the top income decile. Notably, across the entire income distribution, average energy expenditure by urban households is consistently higher than by rural households (despite having the same level of total expenditure). This may reflect a variety of issues, including access to and availability of energy, and differing economic activities. It comes as no surprise that subsidies – which yield financial benefits to energy users – primarily benefit the rich, and thus directly reinforce existing patterns of inequality and poverty.

Figure 4: Energy spending in proportion



Note: Expenditure on energy goods as a share of total consumption expenditure, according to income deciles.

The stark difference between urban and rural areas is also evident when considering the share of energy in overall consumption expenditure. Regardless of income levels, urban households spend a larger share of their income on energy than their rural counterparts. Roughly speaking, most of the urban population spends around 5% of their income on energy, while rural households spend around 3%; and in both cases the energy share is significantly larger for the highest income households.

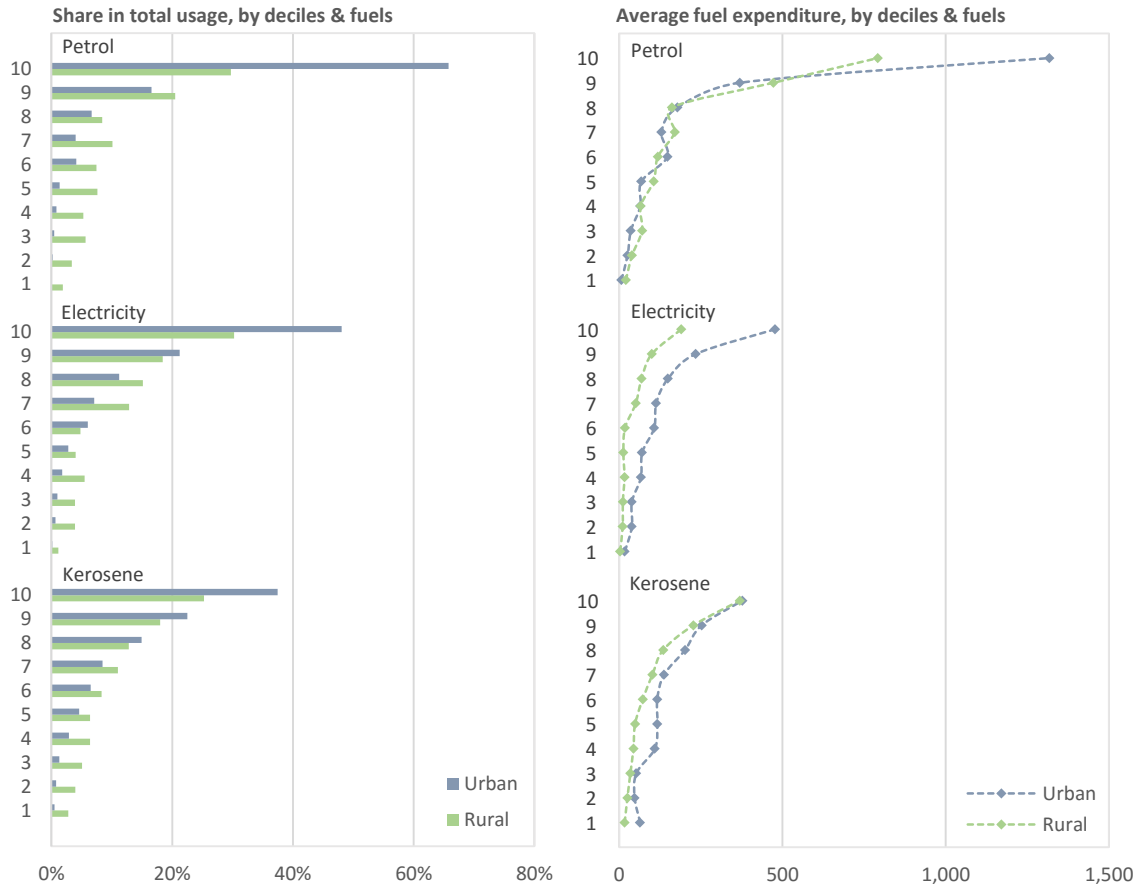
However, it should be recognised that these figures only reflect direct spending on energy goods (e.g. fuels and electricity) and they do not take into account the energy cost of other consumption goods. In the medium to long run, changes in energy prices will indirectly affect the costs of public transport, manufacturing, distribution of goods, and other parts of the economy. This means that a larger share of overall consumption is affected by energy prices than the above numbers suggest. Moreover, even if overall spending on energy is small, this figure does not fully reflect the importance of energy for maintaining livelihoods – particularly for low-income households. Even small amounts of energy can be crucial for income-generating activities (incl. agriculture), and for ensuring access to services and markets. For high-income households, energy consumption is more likely to be “compressible” – i.e. relatively more energy (such as transport fuels) is used for non-essential purposes.

To understand this, it is useful to disaggregate consumption patterns for different forms of energy, which typically serve very different purposes (Figure 5). Kerosene, for instance, is a fuel most commonly used for lighting and cooking – richer households typically substitute kerosene for cleaner energy, such as electric light. Moreover, natural constraints (e.g. on the number of meals prepared per day) mean that kerosene has a lower income elasticity than, for example, petrol which displays the characteristics of a luxury good.

In fact, petrol consumption can be seen to be very “unequal”: The richest 10% consume 65.8% of all petrol used in urban areas (29.7% in rural areas), while the poorest 10% consume a mere 0.03% (1.9% in rural areas). In contrast, kerosene consumption is more evenly distributed. These differences can be

summed up by consumption Gini coefficients, which in urban areas are 0.65 for petrol, 0.48 for electricity, and 0.35 for kerosene (in rural areas 0.53, 0.56, and 0.49 respectively).

Figure 5: Different fuels, different usage patterns



Note: Left: Share in total expenditure, according to income deciles and different fuels. Right: Average monthly per capita spending on different fuels, according to income deciles.

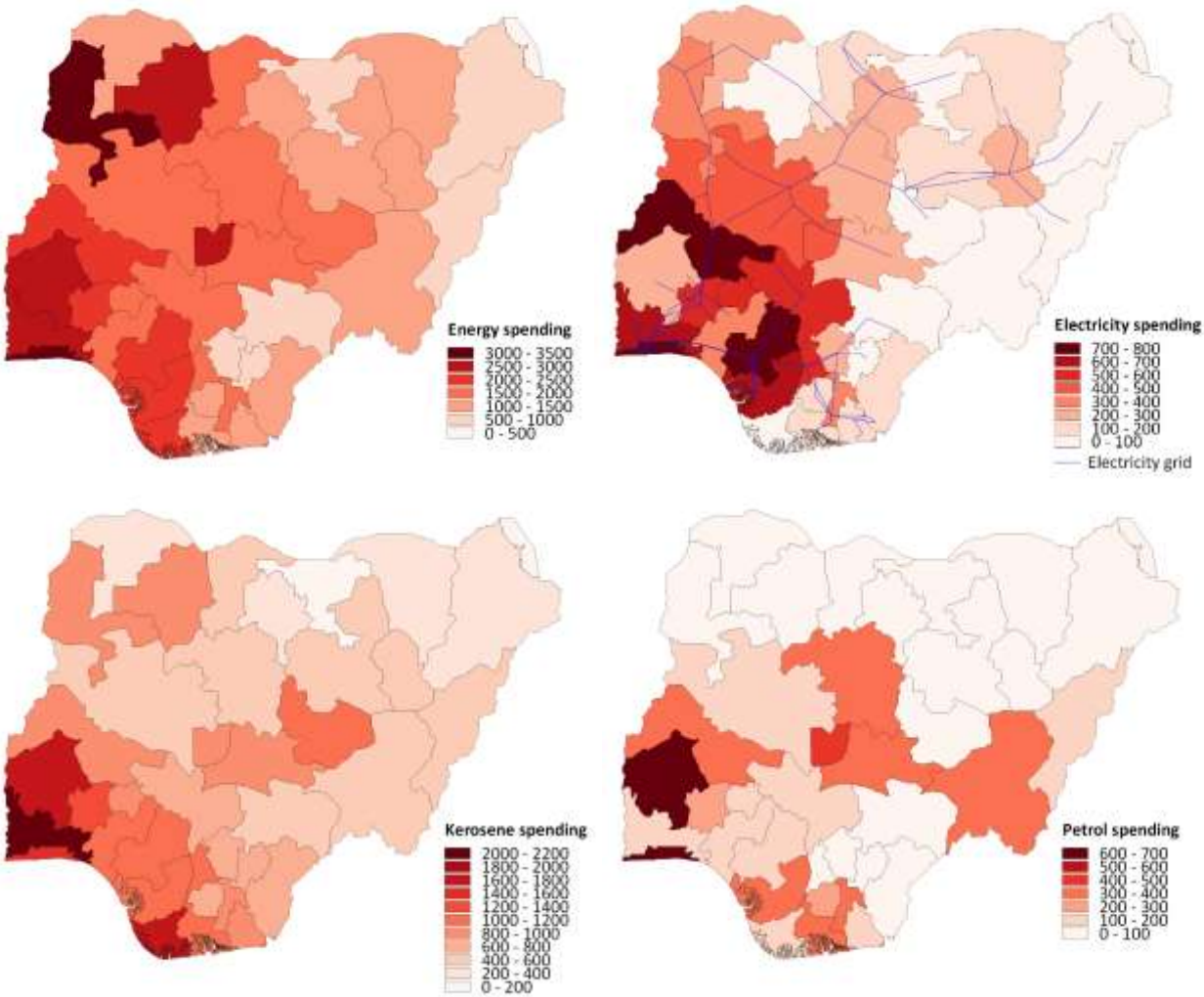
Across all fuels types, it is striking that consumption inequality is less pronounced in rural than in urban areas (Figure 5, left panel); i.e. rural poor consume more energy than their urban counterparts, while rural rich consume less than urban rich. In terms of average expenditure, rural households spend less than urban households, particularly on electricity and kerosene. As noted above, the fact that total energy consumed in rural areas is considerably less than in urban areas may reflect issues around access and availability.

This difference hints at a more complex underlying pattern, which the binary *rural–urban* distinction may not fully capture. Even at the same income level, regional differences may have a substantial influence on energy consumption. For policy makers designing a fuel subsidy reform, it is critical to understand not only which households are particularly vulnerable to energy price shocks, and how vulnerability varies across regions.

Figure 6 illustrates how the sharp regional differences: For each state, it maps the average monthly expenditure by poor people (here defined as total consumption expenditure being under N55,000 per year) for energy overall, petrol, kerosene, and electricity. It is evident that expenditure levels differ significantly across states, and across different energy goods. In general, energy spending is higher in states in the more developed and industrialised South and South-West. This suggests that poor people

in these states rely more significantly on energy. Since these low-income households make up the majority of the population, taking into account their needs and vulnerability is critical for designing politically viable subsidy reforms.

Figure 6: Different fuels matter in different places



Note: These maps display the average monthly per capita spending on energy by all Nigerians living below the absolute poverty line (here defined as total consumption expenditure below 55,000 Naira per year, which roughly corresponds to $1 per day in 2010). All numbers are in Naira per month.

Taken together, the data presented in this section allow for several observations on energy consumption in Nigeria: (i) Absolute spending on energy goods is more unequally distributed than overall consumption and income. Households of the highest income decile make up between 37.5% and 66% of total expenditure (depending on which energy good is considered). (ii) Energy expenditure relative to income is increasing with income. Top income households spend the highest income share on energy. (iii) Roughly speaking, poor people in the more industrialised Southern states spend significantly more on energy than poor people in Northern states.

It appears reasonable to infer that poor households, which are particularly reliant on energy for their livelihoods (e.g. for income generating activities), will be especially vulnerable to energy price shocks.

By definition subsidy removal results in such price shocks, so identifying vulnerable households and assessing the level of their exposure and vulnerability is necessary for designing adequate compensation and social protection measures.

4. Simulating reform

This section provides the results from a subsidy reform simulation for the case of Nigeria. The focus of this simulation is to get an indication of the magnitude of the short- to medium-term welfare effects of a subsidy removal, and understand how these effects may vary across regions.

This simulation only considers the direct welfare effects that occur when a removal of fuel subsidies increases households' cost of maintaining energy consumption. It does not account for further indirect welfare effects which are bound to occur as rising energy prices also increase the cost of other consumption goods, such as food and public transport; accounting for such indirect price effects requires the analysis of input-output tables, or use of general equilibrium models. A study by Arze del Granado et al. (2012) suggests that on average indirect effects make up about 60% of the total impacts of a subsidy removal.[7]

However, the omission of indirect price effects is reasonable if the focus is on understanding regional differences and the short- to medium-term effects (e.g. up to 2 months) of a subsidy removal. The first few months after a reform are arguably the most critical with respect to managing the political economy risks. In the past, mismanagement and underestimation of the political challenges have been at the core of several failed subsidy reform attempts. Thus, understanding where and who the most vulnerable households are, and providing timely and adequate compensation and social protection measures is critical for ensuring public acceptability of subsidy removal.

As Araar and Verme (2012) point out, focusing on direct, short- to medium-term effects has several advantages in practice: The analysis is less complex and more easily reproduced than general equilibrium approaches. It only has relatively small data requirements, as a single household expenditure survey is sufficient. This allows quick policy advice with a transparent methodology, and improves consistency as the analysis is applied to further case studies.[8] Moreover, the results require few ex-ante modelling assumptions, and no social accounting or input-output matrices which are the basis for CGE analyses (Siddig et al., 2014).

The following sub-section describes the theoretical underpinnings for estimating the short- to medium-term effects of subsidy reform, and is based on Araar and Verme (2012) who offer a more detailed exposition. This methodology corresponds to the partial equilibrium approach in Coady (2006).

4.1 Methodology

The underlying methodology for assessing direct welfare effects of standard fossil fuel subsidy removals is simple: Expenditure on aggregate consumption is used as a proxy for a household's income and thus its level of welfare.[9] As subsidies for certain energy goods are removed, their prices increase. Given the developing country setting, it is assumed that the majority of households cannot simply draw on savings to compensate for higher energy prices. This implies that – at least in the short- to medium- run – it is reasonable to assume that households' budget constraints are fixed; thus, households can only respond to higher prices by reducing the consumption of the (formerly) subsidised good, or by

[7] Total impacts are direct plus indirect impacts.
[8] See for instance Araar et al. (2015) and Verme & El-Massnaoui (2015) who consider fuel subsidy reforms in Libya and Morocco respectively.
[9] For the purpose of household survey analyses consumption based welfare measures are the most common approach; see Deaton (2003).

substituting it (e.g. for a cheaper type of fuel). Aggregated at the national level, these effects mean that overall consumption expenditure (i.e. welfare) would fall, and poverty increase.

Formally, the overall change in welfare ($\Delta\, W$) due to subsidy removal can be expressed as

$$\begin{aligned} \Delta\, W = \Delta\, C &= -\sum_{i=1}^{N} c_{g,i}^{0} dp_g \\ &= -\sum_{i=1}^{N} c_{g,i}^{0} \frac{\Delta\, p_g}{p_g^0} \end{aligned} \tag{1}$$

where $c_{g,i}^0$ denotes consumption expenditure for subsidised good g by the household i before the reform (i.e. $t = 0$). N denotes the overall number of households in a country or state, and $\Delta\, p_g$ the absolute price change (i.e. $\Delta\, p_g = p_g^0 - p_g^1$). This implies that irrespective of whether and how households substitute away from the subsidised good, the real decrease in welfare is equivalent to the relative change of the cost of pre-reform consumption of the subsidised good.

In other words, the countrywide welfare effect of a subsidy reform depends on two main factors: the pre-reform level of consumption of the subsidised good, and the relative price change induced by subsidy removal. One of the main motivations of this analysis is that these factors can differ across regions, thus leading to different welfare effects, and necessitating different compensation measures.

Consumption of the subsidised good (c_g^0): In absolute terms, the more a household consumes of the subsidised good before, the higher the absolute welfare effects of reform. Likewise, relative welfare effects depend on the share of the subsidised good in total consumption expenditure (c_g^0/c^0); i.e. the more a household spends on the subsidised good relative to income, the more it is "exposed" to the welfare effects due to the removal of subsidies. The analysis in this section will focus on the consumption of subsidised fuels, as the data required for this purpose are readily available from household expenditure surveys (see the discussion in Section 4).

Relative price change due to subsidy removal (dp_g): The extent to which a subsidy reform affects household consumption and welfare depends on the extent to which prices increase. In principle, if the level of subsidy is known (e.g. in terms of $/litre of petrol), the price change due to subsidy removal is straightforward to establish. In practice, as in the Nigerian example, official government-set prices may vary substantially from actual prices in the market place, due to issues such as misappropriation of subsidy funds, corruption, ineffective distribution, multiple intermediaries. This issue is difficult to quantify, and remains an uncertainty throughout the analysis.

In line with equation (2), which shows the post-reform decrease in overall spending or welfare, the absolute change in consumption of the subsidised good can be expressed as

$$\Delta\, C_g = \sum_{i=1}^{N} \varepsilon_{g,i} c_{g,i}^{0} dp_g. \tag{2}$$

Incorporating the own-price elasticity of demand $\varepsilon_{g,i}$ reflects that households may adjust their consumption of the subsidised good in response to changing prices. Note that the elasticity is given by the ratio of the relative changes in consumed quantity and price:

$$\varepsilon_{g,i} = \frac{\Delta\, q_{g,i}/q_{g,i}^0}{\Delta\, p_g/p_g^0} \tag{3}$$

Note that inelastic demand ($\varepsilon_g = 0$) would imply that subsidy removal does not cause households to adjust the consumed quantity of the subsidised good (yet, a fixed budget constraint means that consumption of other goods is reduced). In practice this could, for instance, be the case if the subsidised

fuel is critical for income generating activities, and no alternative fuels are available. On the other hand, fully price elastic demand ($\varepsilon_g = -1$) would imply that households reduce consumption of the subsidised good at the same rate with which prices were increased.

In addition to investigating aggregate consumption and welfare, it is possible to make a simple approximation of a government's reform revenue. In the formal setting introduced above, the additional revenue for a government that results from the removal of fuel subsidies can be expressed as

$$\Delta R_s = \sum_{i=1}^{N} c_{g,i}^{0} dp_g \left(1 + \varepsilon_{g,i}(1 + dp_g)\right). \quad (4)$$

This expression implies that reform revenue is equivalent to the nominal aggregate change in households' consumption expenditure on the subsidised good; or in other words, the households' loss (in terms of reduced consumption) is the governments gain (i.e. avoided payment of subsidies). Note that for the purpose of this paper, overall reform revenue is the sum of revenues from subnational states s, such that $\Delta R = \sum_{s=1}^{S} \Delta R_s$.

4.2 A hypothetical fuel subsidy reform: *Two scenarios*

This section briefly sets out the main features of a hypothetical fossil fuel subsidy reform. It should be emphasised that the chosen numbers are based on known circumstances and existing estimates, and yet are somewhat arbitrary in the sense that they may not reflect actual policy ambitions. The hypothetical fuel subsidy reform considered here serves the purpose of illustrating the importance of a disaggregated analysis and well-designed social protection and compensation scheme. The analysis could easily be repeated, e.g. for different levels of subsidy reduction.

Elasticities: There are few robust estimates for price elasticities of different fossil fuels in Nigeria. The analysis is complicated by highly distorted and manipulated markets, significant supply shortages and access barriers (Iwayemi, Adenikinju, & Babatunde, 2010). Omisakin et al. (2012) find that energy demand in Nigeria is relatively inelastic: long-run price elasticities are estimated to be -0.016 for petrol and -0.205 for kerosene. Iwayemi et al. (2010) use cointegration regressions to estimate statistically significant long-run price elasticities of –0.115 for kerosene, and –0.106 for aggregate energy products (i.e. petrol, diesel and kerosene). In the short-run, they estimate price elasticities to be –0.415 for diesel, and –0.249 for petrol.

In a survey of 18 developing countries Dahl (1994) suggests that short- run price elasticities for oil demand tend to be clustered between –0.05 and –0.09, while long-run elasticities are as low as –0.3. These figures are in line with a more recent study: Arzaghi & Squalli (2015) estimate elasticities for petrol demand in 32 fuel-subsidizing economies. They find short- and long-run price elasticities to be around –0.05 and –0.25 respectively.

For the purpose of this paper a price elasticity of –0.3 is used for all energy products. For comparison, Verme & El-Massnaoui (2015) conduct a subsidy reform analysis for Morocco, and use a price elasticity of –0.2 for all energy products. Araar et al. (2015) conduct a similar study for Libya, and apply a price elasticity of –0.5 for all energy products. It should be noted that the choice of elasticity plays an important role in estimating the post-reform level of energy consumption. However, estimates of overall welfare impacts do not depend on elasticities, as illustrated by equation (1).

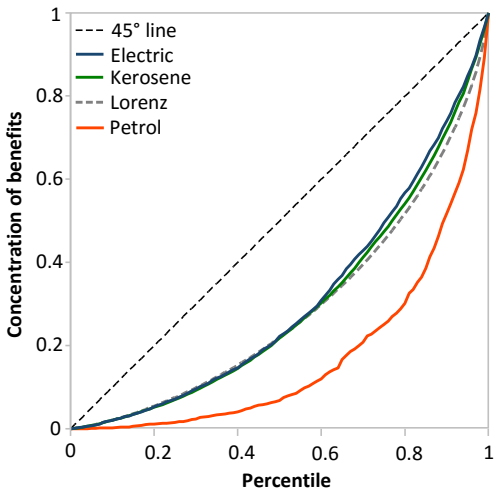
Energy goods and subsidies: In this paper, subsidies on petrol, kerosene, and electricity are considered. These three energy types represent over 80% of total energy consumption. In the case of Nigeria, obtaining reliable figures on consumer subsidies for these energy goods is remarkably difficult. While retail prices are officially fixed by the government (e.g. kerosene at N50 per litre), it is uncertain what price end-users actually pay. Large-scale smuggling, black market activities, and complex intermediary retail structures mean that market prices can be significantly higher than those prescribed (and paid for) by the government.

Besides the difficulty of determining actual retail prices, it is also unclear how large overall subsidy payments have been (both in terms of subsidy per litre, and at the national level). For instance, while the government officially suspended kerosene subsidies in 2009, the Nigeria National Petroleum Corporation (NNPC), which administers kerosene subsidies, claims arrears of N310 bn. But it remains unclear whether or to what extent this sum was actually disbursed as subsidies. Overall, frequently changing policies, contradicting information and data, and opaque institutions increase the margin of error. The GSI (2012) and IMF (2013) provide detailed accounts of energy subsidies in Nigeria, and provide the basis for the numbers used in this study.

- Petrol: The subsidised retail price is assumed to be N65 per litre for 2010 (corresponding to the year of the household survey). Subsidies are assumed to be N90 per litre.
- Kerosene: While the government prescribes a price of N50 per litre, the actual retail price is often significantly higher. Middlemen siphon off around N108 per litre. For this study an average retail price of N100 per litre is assumed. Given well-established structures of intermediary retailers, subsidy removal is assumed to be uniformly passed on to end-users.
- Electricity usage varies distinctly across different regions. The pre-reform effective electricity tariff of N7/kWh is used as a baseline. As production costs are estimated to be around N23/kWh, this implies an electricity subsidy of N16/kWh.

Figure 7 illustrates the regressivity of the above defined subsidy levels for petrol, kerosene and electricity. In absolute terms, the monetary benefits from subsidies are concentrated on high-income households. Benefits from electricity and kerosene subsidies can be seen to be concentrated disproportionately on the rich, following a similar distribution as overall income (see Lorenz curve for consumption as reference). Benefits from petrol subsidies are significantly more concentrated on the rich than benefits from electricity and kerosene. Note that this pattern results directly from the starkly unequal distribution in the consumption of energy goods (Figure 5).

Figure 7: Regressivity of subsidy benefits



Note: Subsidies predominantly benefit higher income households. Subsidies on petrol are the most regressive.

Compensation and social protection: For the purpose of this study, a compensation scheme is considered which aims to mitigate adverse effects on households by directly compensating them for income shocks. The considered compensation mechanism takes the form of a universal, untargeted cash transfer scheme. Under this compensation scheme, households receive a uniform cash payment. 'Uniform' cash payments imply that regardless of location or income bracket, the same lump sum payment is made per person.

In practice, uniform and universal cash transfer schemes do not require costly and administratively complicated targeting of beneficiaries; this makes them particularly relevant in policy environments with low administrative capacity and limited pre-existing social safety net infrastructure. By assuming that compensation payments are made universally, this study estimates an upper bound for the cost of compensation. Targeting compensation payments to only the most vulnerable, rather than the entire population is likely to be cheaper, especially when existing social protection infrastructure can be used to keep targeting costs low. Existing administrative channels, and 'poverty registers' can play a crucial role in facilitating more effective targeting, administration and disbursement of payments to vulnerable households. In Nigeria, no strong social protection system exists with country-wide coverage.

Two reform scenarios are chosen for this study. In both scenarios it is assumed that a subsidy reduction implemented by the national government will indeed cause a universal and uniform increase in energy prices across the country. (i) **R50:** The first scenario represents a case in which subsidies are reduced by 50% on all three considered energy goods. Note that this implies price increases of 69% for petrol, 108% for kerosene, and 114% for electricity. (ii) **R100:** The second case represents complete subsidy removal, i.e. a reduction by 100%. Again, this implies price increases of 138% (petrol), 216% (kerosene), and 228% (electricity). While a 100% reduction may seem a radical step – especially considering the high subsidisation rate – yet this is precisely what the Nigerian government attempted to implement in both 2009 (kerosene) and 2012 (petrol).

Moreover, total consumption expenditure of N55,000 per year or less is used for defining absolute poverty (this roughly corresponds to $1 per day in 2010).

4.3 Estimation results: The impacts of reform

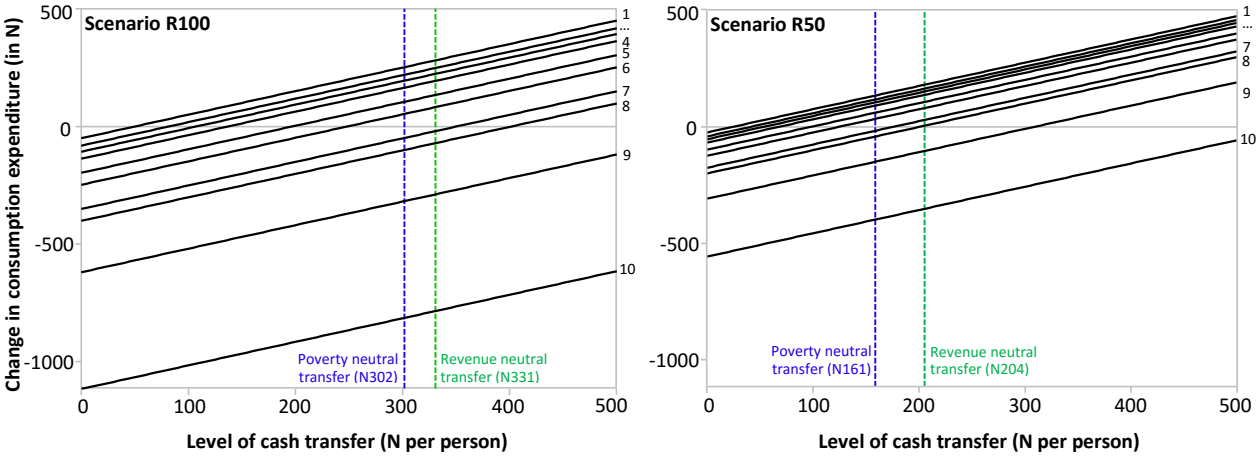
This section presents the estimated effects of implementing a subsidy reform for petrol, kerosene, and electricity. The analysis was conducted using the empirical subsidy simulation program by Araar & Verme (2012; Subsim), for which the basic underlying methodology was presented in section 4.1. As stated above, this study only covers the direct price effects that occur as a result of subsidy removal; indirect effects are not reflected. Hence all results must be interpreted as the short- to medium-term effects of a subsidy reform (e.g. up to 2-3 months). Conclusions from this analysis cannot be directly extrapolated to the medium- to long-term, as this would require an analysis of general equilibrium effects (see the introduction to section 4 for details).

Moreover, it should be noted that uncertainties around estimated elasticities and actual subsidy levels mean that results should be interpreted first and foremost with respect to relative effects and associated policy implications; rather than for concrete numerical values. Note that any potential weakness of the applied elasticity estimates does not affect the estimated welfare impacts, as these do not depend on elasticities (see equation 1).

4.3.1. Impacts at the national level

Arguably the most important question from a household perspective is how the proposed subsidy reform impacts on welfare. This impact is determined by several factors, including (i) the pre-reform level of income and energy expenditure, (ii) the extent to which subsidies are reduced, and (iii) the level of cash compensation received. Figure 8 shows that across income groups, the reduction in welfare can be mitigated or offset by adequate cash transfers. In both reform scenarios, a threshold for cash compensation is determined that ensures *net* poverty neutrality of the reform (blue dashed line); i.e. the national poverty rate does not increase due to the reform, if this lump sum compensation is transferred uniformly to each person. Note that these cash transfer levels mean that roughly the poorest 60% of the population are better off after the reform.

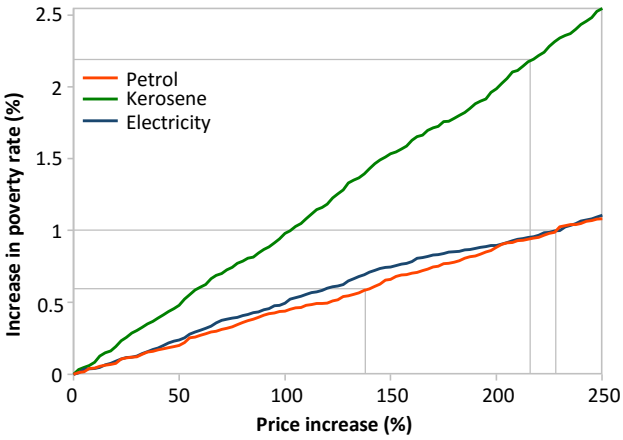
Figure 8: Compensation makes the difference



Note: The solid lines reflect the ten income deciles; the blue dashed line indicates the minimum cash transfer required to prevent an increase of the national poverty rate. *Left:* Scenario with 100% reduction of electricity, petrol and kerosene subsidies. *Right:* Scenario with 50% reduction in subsidies.

At the lower end of the income distribution the welfare losses due to a subsidy reform can mean that already poor households are pushed deeper into poverty. Households that were previously just above the poverty line may be pushed into poverty, as energy prices increase and purchasing power is reduced. The extent to which subsidy removal increases poverty rates depends on which energy good is considered (Figure 9). Section 3 has illustrated how the relative importance of certain energy goods varies across income groups. The price increases due to subsidy removal are thus bound to have different impacts on poor or near-poor households. In particular, increases in the price of kerosene can be seen to have strong impacts on the overall poverty rate, while rising petrol and electricity prices increase poverty at a lower rate.

Figure 9: Uncompensated price increases push up poverty levels

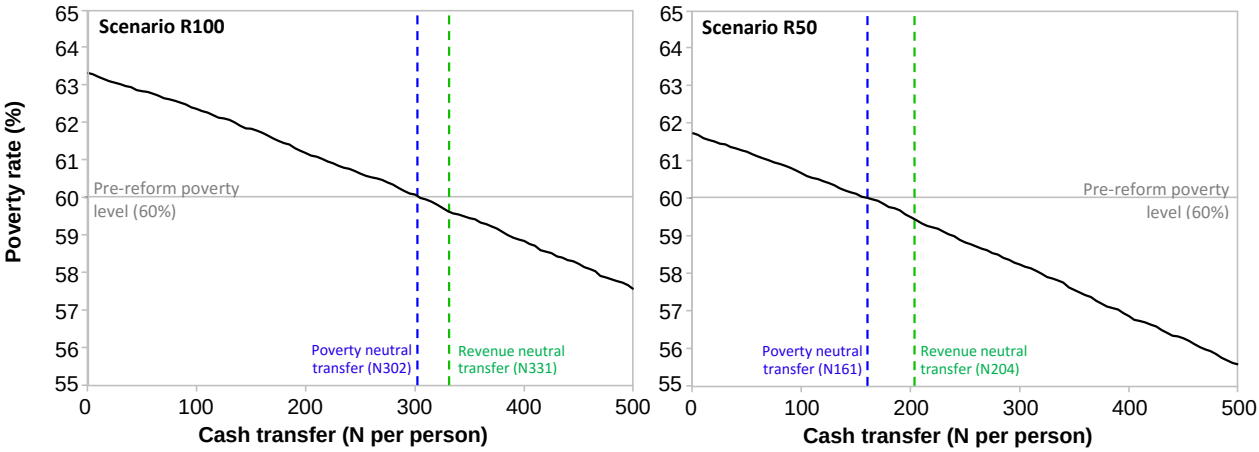


Note: Reducing subsidies, and thus increasing the price of energy goods means that overall poverty levels rise. These lines represent the impact on poverty for each energy good separately (i.e. they are not stacked); and a 100% subsidy removal is not equivalent to a 100% price increase (Section 4.2)

The importance of compensation is illustrated in Figure 10: In the absence of any compensation a 100% (or 50%) reduction of subsidies will instantly increase the poverty headcount rate from pre-reform 60%

to 63.3% (or 61.8%); at the same time, the poverty gap increases from 25.7% to 27.8%. It comes as no surprise that any uncompensated subsidy reform tends to be met by strong public opposition. The figure illustrates further that by providing a universal (i.e. untargeted) and uniform cash transfer, the government can mitigate the increase of poverty—and above a certain level even offset and reverse it. In comparison – using the same methodology – Araar et al. (2015) estimate that full removal of energy subsidies in Libya would increase energy prices by 670% and more than double the pre-reform poverty rate of 8.5%.

Figure 10: Cash transfers can mitigate a rise in poverty

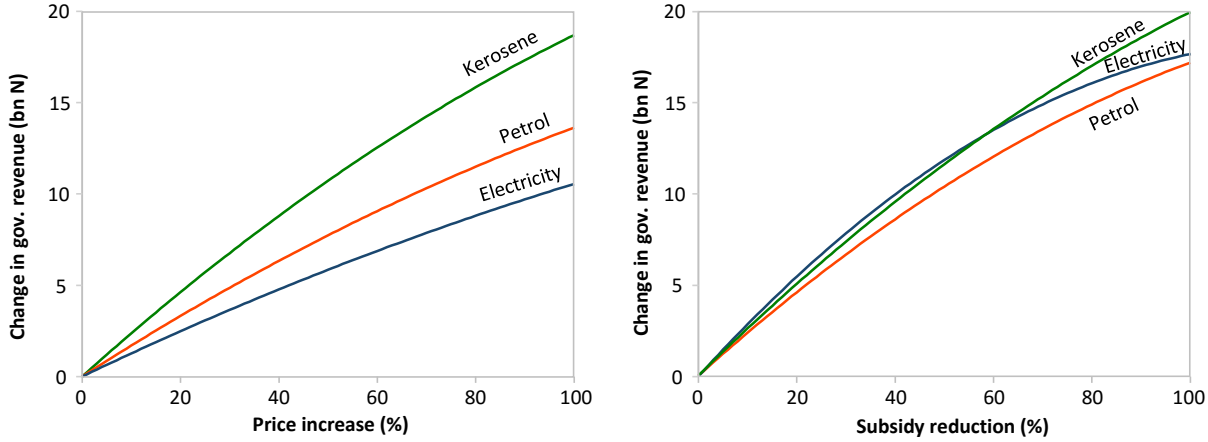


Note: *Left:* In the case of a complete removal of fuel subsidies (scenario R100) a monthly cash transfer of at least N302 is necessary to avoid a post-reform increase in poverty (relative to the pre-reform poverty level of 60%). *Right:* For a 50% reduction in subsidies (scenario R50) a monthly cash transfer of about N161 is needed to prevent a rise in post-reform poverty.

In the case of a 100% removal of existing subsidies on petrol, kerosene and electricity, a total of N54 bn can be raised. With a population of approximately 163 million, this implies that a uniform and universal cash transfer of N331 can be provided. This redistribution of reform revenues would instantly reduce the national poverty rate by about 1%. These figures illustrate how subsidy removals can not only be poverty neutral, but directly benefit the poor. Moreover, if compensation is directly targeted to poor households (rather than provided universally as in this example), and if additional funds are used, cash transfers may deliver more significant poverty reductions than in Figure 10. It is the government's responsibility to clearly communicate – and deliver – these benefits along with a subsidy reform. Note that these figures ignore potential transaction costs of cash transfers, but these tend to be lower than those of subsidies which are highly vulnerable to corruption and graft.

While Figure 10 is based on the two pre-defined scenarios (50% or 100% reduction of subsidies on petrol, electricity and kerosene), it is worth considering the implications for government revenues if subsidies on different energy goods are reduced at different rates. The potential revenues from subsidy removal depend on the overall demand for an energy good, and the associated pre-reform total subsidy payments. This is illustrated by Figure 11 (left panel), which reflects that the average Nigerian household spends more on kerosene than on petrol, and more on petrol than on electricity. Increasing the price of kerosene will thus yield the highest reform revenues in absolute terms – but it should be noted that reducing kerosene subsidies is also associated with the highest rate of poverty increase (Figure 9), thus requiring larger cash transfers to compensate vulnerable households.

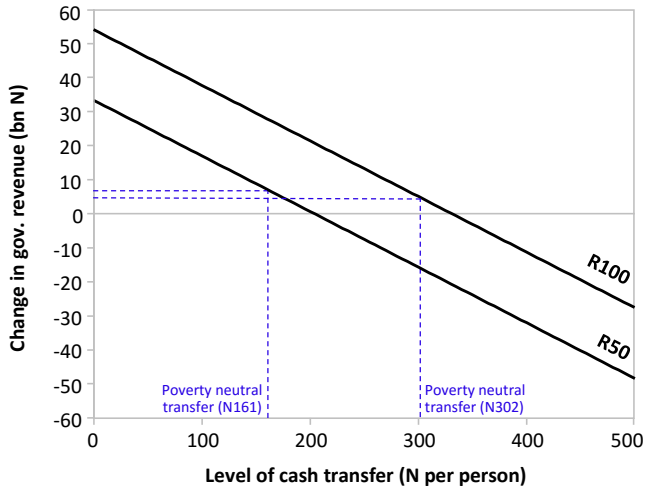
Figure 11: Reform revenues



Note: Government revenues from reducing fossil fuel subsidies depend on the specific energy good. Note that these lines are not stacked; they do not account for the cost of compensatory cash transfers.

In practice, particularly in developing countries, subsidy removals without compensation are politically unviable, as price shocks have significant impacts on the welfare of a majority of the population. Thus, ultimately, any statement on reform revenues must account for the cost of compensation. Figure 12 shows the estimated *net* government revenues for both reform scenarios, with respect to the level of the per capita compensatory cash transfer. When subsidy removal is made poverty neutral through cash transfers, *net* revenues are N4.7 bn in the case of a 100% subsidy reduction (R100), and N7 bn for R50. In the absence of any compensation, revenues are N54 bn (R100) and N33.3 bn (R50).

Figure 12: Reform revenues and compensatory cash transfers



Note: The two lines refer to the scenarios of 100% and 50% fuel subsidy removal. For each case, the dotted lines indicate the minimum universal cash transfer necessary to avoid an increase in poverty, and the associated government revenue.

These government revenue figures refer to "avoided" monthly subsidy payments. This means they represent direct immediate savings that the government can realise in the short-term. In practice, case studies of past subsidy reforms show that compensatory cash transfers do not tend to be provided indefinitely, but are complemented with (potentially revenue generating) public investments, e.g. in infrastructure. While poverty neutral reforms (both R50 and R100) yield similar net revenues in the short

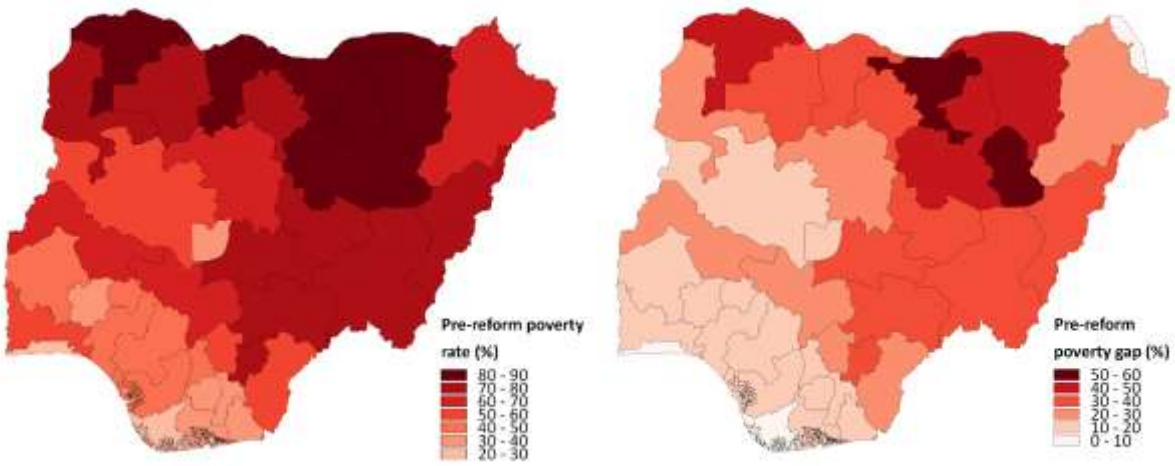
term, full subsidy removal unlocks larger revenue streams in the long run. Thus, measuring reform revenues in the long term is more complex than for the short-term, and depends greatly on redistribution and reinvestment decisions.

In countries such as Nigeria, where fossil fuel subsidies are financed through resource rents, the redistribution and reinvestment of reform revenues is closely linked to the management of natural resource revenues. A large literature exists which discusses different approaches to sustainable resource management, which in many cases calls for capital and infrastructure investments which help to diversify income streams (Gill et al., 2014). Notably, a series of studies have also explored and advocated the implementation of a resource dividend, in the form of a permanent uniform cash transfer (Devarajan et al., 2011; Moss & Young, 2009; Segal, 2011; Standing, 2014). This would essentially institutionalise the short-term cash compensation suggested in this section, as a direct and long-term measure for reducing poverty and increasing welfare.

4.3.2. Disaggregating impacts to the state level

Like most previous studies on the impacts of subsidy removal, the analysis in section 4.3.1 has focused on national averages. However, vulnerability to price shocks is highly context specific and a compensation policy based on national averages is likely to be inadequate for certain population groups. The maps in Figure 13 illustrate one dimension of state-level differences by displaying two measures of poverty, as measured by the household expenditure survey. As headcount rates of absolute poverty vary between 25% and 88%, the consequences of subsidy removal and energy price shocks are bound to differ.

Figure 13: Pre-reform poverty



Note: Left: Headcount rates of people living in absolute poverty in each state, as observed in the household expenditure survey. Right: Poverty gap measure for each state, indicating the severity of poverty of people living below the absolute poverty line.

To complement studies at the national level, this section disaggregates the estimates to each of Nigeria's 36 federal states. While impacts on poverty can still differ substantially *within* states, it becomes apparent that disaggregation to the state level can illustrate these differences – thus calling for a tailored reform design.

This section considers different compensation strategies, and analyses how they may affect poverty levels across states. In particular, the purpose of this section is to show that the effects of subsidy removal differ significantly across states, and illustrate to what extent a nationally uniform compensation policies may overcompensate some, while undercompensating others.

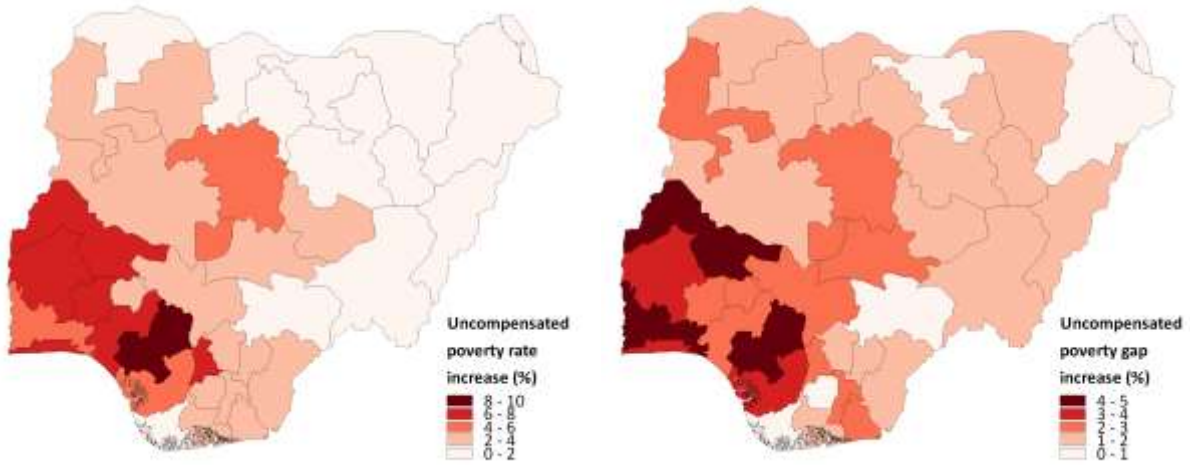
The compensation strategies considered in this section are chosen for illustrative purposes, and are uniform at the state-level (i.e. within states, cash transfers are assumed to be of equal size, and provided to everyone). In practice, if large-scale social safety nets and poverty registers are available, these are likely to allow more efficient targeting of vulnerable households. Existing social protection channels can be used to identify and support those who are worst hit. If safety nets lack coverage or simply do not exist – as in the case of Nigeria – identifying and targeting vulnerable households may prove to be expensive and slow. For simplicity, only the scenario of 100% subsidy removal (R100) is considered in this section.

Uncompensated subsidy removal

Relative to pre-reform levels of poverty, full removal of fossil fuel subsidies is estimated to increase poverty rates most in the more developed states of Southern Nigeria. Low pre-reform poverty rates are indicative of a large group of near-poor households, who are pushed into poverty through the reform induced energy price shock. This effect is exacerbated as poor and near-poor households in these states tend to rely on energy subsidies more heavily than households of similar income levels in the North.

Poverty rates in northern states are estimated to increase less drastically. However, this must not be interpreted in the sense that subsidy removal has little impact in these states. With pre-reform poverty rates of 70% to 90%, there is less scope for the *number* of people in absolute poverty to increase. But the *severity* of poverty of those who are already poor is likely to be aggravated. The maps in Figure 14 show the estimated increase in poverty (both in terms of headcount rate and poverty gap) if subsidies are fully removed without any form of compensation.

Figure 14: Poverty increases in the absence of compensation or social protection

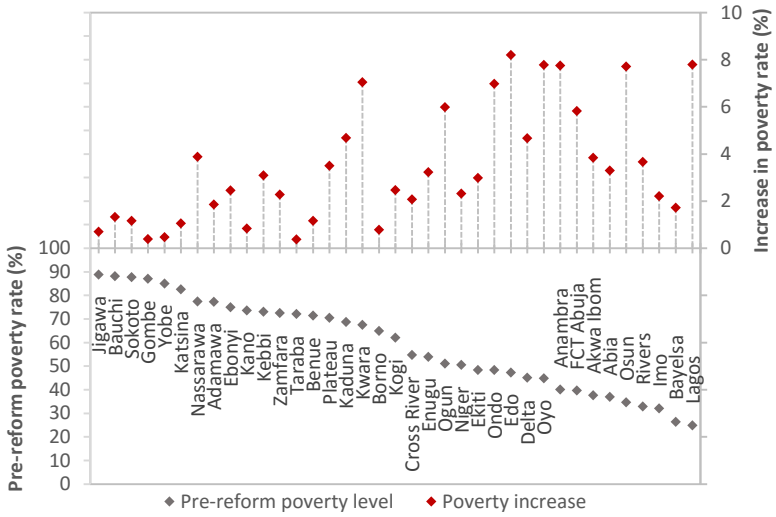


Note: Left: Estimated increases in poverty headcount rates. Right: Estimated increases in the poverty gap of respective states.

The attempted removal of fossil fuel subsidies in Nigeria in 2012 was accompanied by the *Subsidy Reinvestment and Empowerment Program*, which was to feature a range of infrastructure investments (especially in the power, transportation, water and downstream petroleum sectors), as well as social safety nets (IMF, 2013). However, the announcement of these vague plans for compensation and reinvestment came late, and their implementation even more so. Large parts of the population expected reform revenues to flow into wasteful government spending or feed corruption. Thus the reality, or the public's perception of it, resembled the uncompensated subsidy removal scenario outlined above.

Violent protests followed the removal of subsidies, with particularly severe unrest occurring in metropolitan regions in the South (dark red in Figure 14).

Figure 15: Post-reform poverty rates without compensation



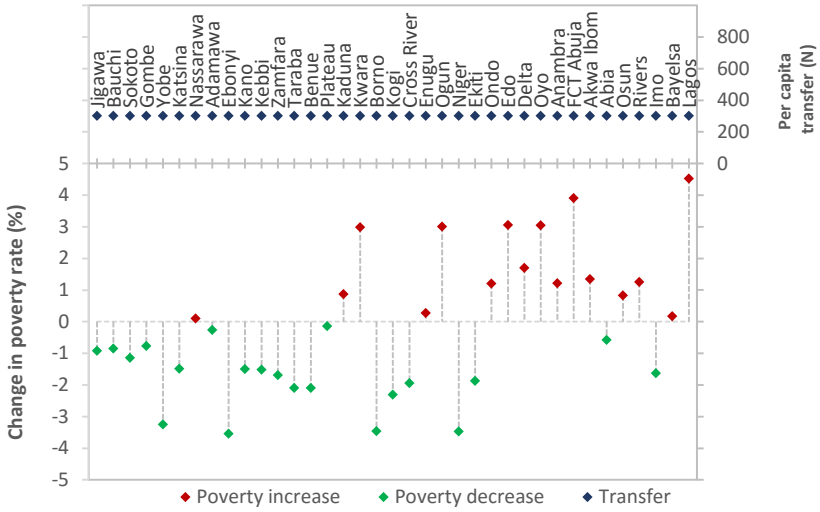
Note: A 100% reduction of subsidies increases poverty headcount rates in all states. States with lower pre-reform poverty rates tend to have larger increases in poverty.

Figure 15 highlights that the largest increases in poverty rates are estimated to occur in some of the urbanised and most populous states, including Oyo, Anambra and Lagos. While these are among the more developed states, with lower poverty rates, they are of high political importance. This illustrates the two – possibly competing – needs of a successful subsidy reform: Managing political economy challenges by ensuring adequate compensation in richer states; as well as social protection, equitable redistribution of funds, and poverty alleviation in poorer states.

Poverty neutral compensation

By providing per capita cash compensation, governments can offset the increase in poverty that may result from removing energy subsidies. In the previous section, it was estimated that providing nationwide universal cash compensation of N302 could neutralise the increase in poverty that an uncompensated reform would cause. According to the estimates, this would indeed hold at the national average; however, the state level analysis suggests that the N302 cash transfer is likely to undercompensate in some states while overcompensating in others. In other words, the level of cash compensation that maintains poverty neutrality at the national level, does not actually achieve this objective in any specific state (Figure 16). While some states benefit from poverty reductions of up to 4%, cash transfers of N302 still leave poverty rates spiking by up to 5% in Southern states; thus failing to address the political economy risks highlighted in the *uncompensated reform* section (Figure 17, left).

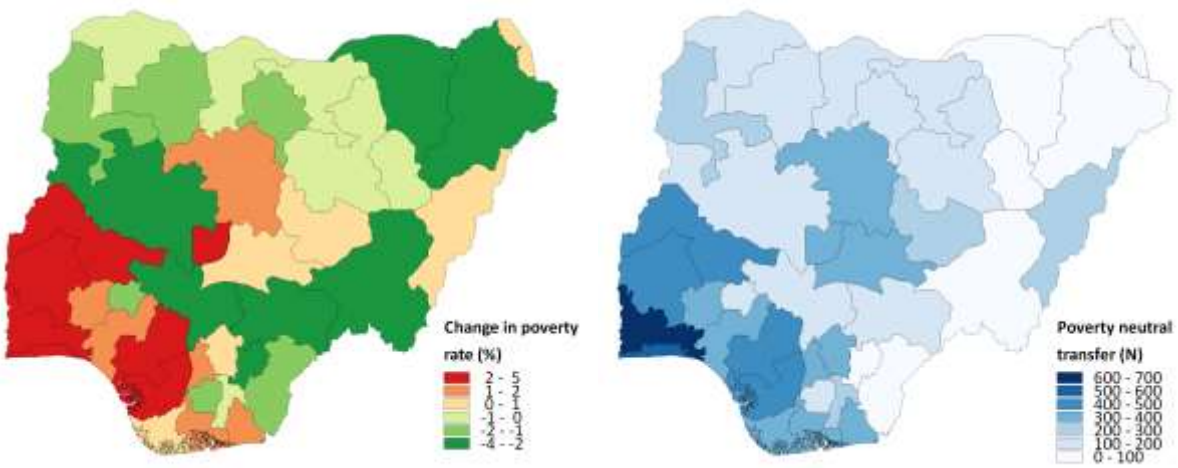
Figure 16: Poverty neutral compensation?



Note: Uniformly providing a cash compensation of N302 to every person in Nigeria is estimated to neutralise any change in the national poverty headcount rate. At the state level however, this cash transfer level causes poverty reductions in some states, while failing to mitigate poverty increases in others. Notably this includes states such Lagos and Abuja, which experienced intense public opposition to subsidy reforms in 2012.

As energy consumption patterns differ across states, so does the level of cash compensation that is needed to maintain poverty neutrality of a given subsidy removal. Figure 16 (right) shows the minimum cash compensation transfer that is required in each state. Note that, as shown in Figure 8, this estimated cash transfer threshold will prevent an increase in the state's average poverty rate; low income households are still likely to benefit overall from the reform, while high-income households are likely to lose from the reform. This emphasises that fossil fuel subsidy reform, paired with uniform cash transfers, can be a pro-poor progressive fiscal reform.

Figure 17: Poverty neutral compensation

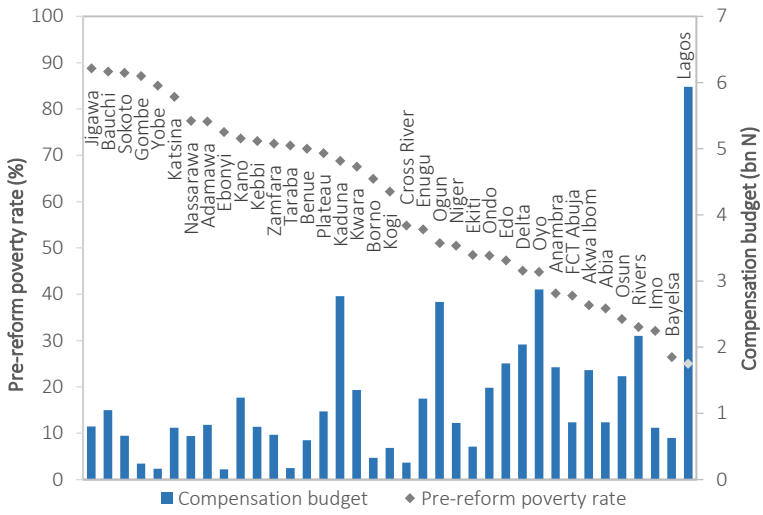


Note: Left: Change in poverty rates after a universal "poverty neutral" compensation payment of N302 per person. While keeping the national poverty level constant, changes in poverty rates can be significant at the state level. Right: Estimated cash transfer levels that neutralise post-reform poverty increases in each state.

Overall, ensuring poverty neutrality should be the minimum ambition of a government removing fuel subsidies – i.e. mitigating adverse effects by compensating for income shocks. This is critical not only for protecting the livelihoods of the poorest, but also for ensuring broad public support for subsidy reforms. As Nigeria's 2012 experience illustrates, failing to communicate and deliver direct compensation can lead to the downfall of the entire reform endeavour.

However, if the government's goal is to maximise the development potential of a subsidy reform, gathering political support by using poverty neutral cash compensation is not sufficient. Poverty neutral cash transfers that are only provided in the short term can mitigate adverse effects for poor households, but further complementary policies are critical to ensure that subsidy reforms actively benefit the poor and are invested in the foundations for future development.

Figure 18: Locating the compensation budget



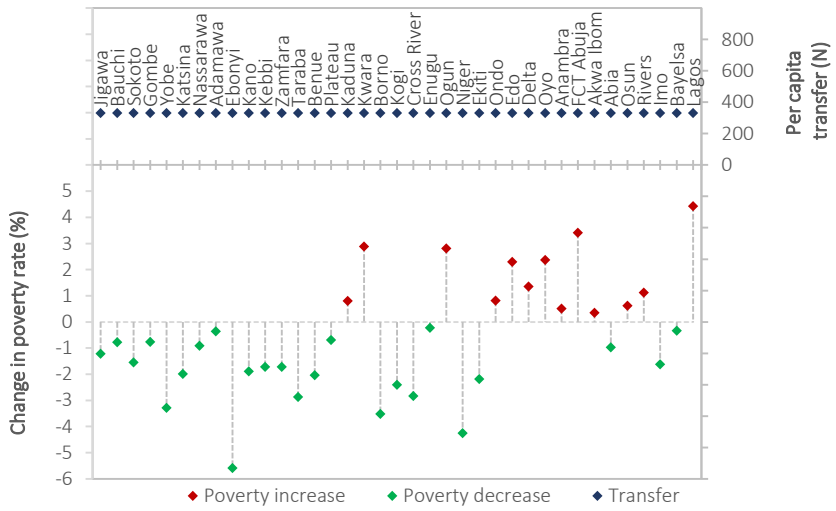
Note: This figure shows the overall budget requirement in each state for implementing a state-level uniform cash transfers scheme that maintains existing poverty rates. The budget distribution favours richer states.

One of the main concerns raised by poverty neutral cash transfers is the unequal distribution of compensation (and thus reform) benefits. States with lower pre-reform poverty rates and higher energy consumption require higher compensation payments. Consequently, states with lower pre-reform poverty rates receive a larger share of the overall compensation budget. Figure 18 shows how the overall compensation budget – which depends on per capita transfer levels and a state's population size – is distributed. The required compensation budget tends to be significantly larger for states with lower pre-reform poverty rates.

Revenue neutral compensation

Besides poverty neutral compensation, it is also worth considering the effect of a revenue neutral compensation scheme. In this scenario, reform revenues are distributed entirely in the form of universal cash transfers. This can be a particularly interesting strategy in resource rich countries with large political economy challenges. As fossil fuel subsidies are typically funded through resource rents in these countries, subsidy removal is a "gift that keeps giving" – rather than simply reducing government expenditure or yielding a one-off windfall, it unlocks a long-term revenue stream. By fully dedicating this revenue stream to compensation in the short-term, governments can not only mitigate adverse effects, but also deliver immediate and tangible benefits to the population and secure broad public support. In the medium- to long-term, governments can then shift their priority from compensation to reinvestment and more targeted social safety nets.

Figure 19: Revenue neutral compensation

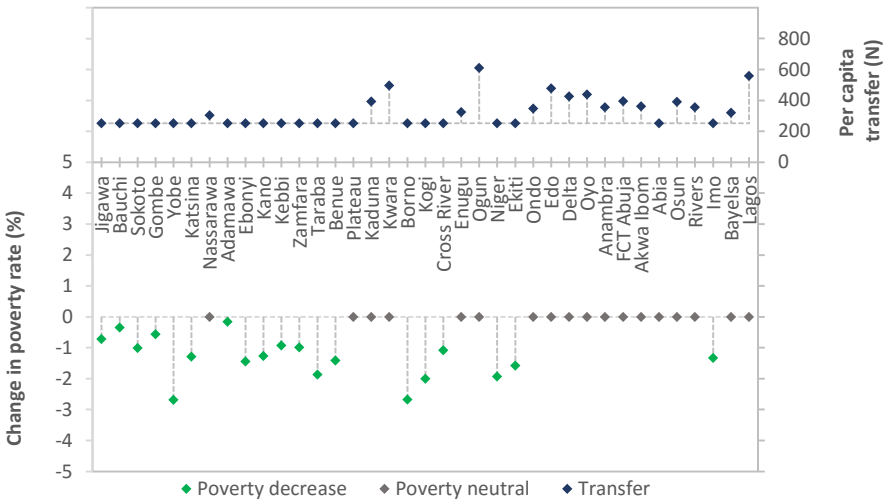


Note: Post-reform poverty rates after a uniform revenue neutral transfer (which is N331).

The revenue neutral – and nationally uniform – cash transfer level of N331 estimated through the national level analysis displays the same variation at the state level as the uniform poverty neutral compensation scheme. Figure 19 presents the effect of a uniform revenue neutral cash compensation scheme on poverty rates in all states. As estimated in the national level analysis, revenue neutral compensation could reduce the national poverty rate by about 1%. This average however conceals that certain regions, most notably the capital Abuja and Lagos, would still experience significant income shocks and thus increases in their respective poverty rates. As these regions have been hotspots of social unrest and public opposition to past subsidy reforms, this calls for dedicated attention to the needs and vulnerabilities of the local population.

Thus, lastly, another hypothetical and revenue neutral compensation scheme is considered in this section: Poverty neutral compensation is provided in states where revenue neutral compensation alone would not prevent increasing poverty rates. The remaining reform revenue (N31.2 bn) is redistributed at N253 per person in all other states. This compensation scheme maintains revenue neutrality and is preferable to poverty neutral compensation alone. Increases in poverty rates are avoided in all states, while a series of poorer states benefit from poverty rate reductions of up to 3%.

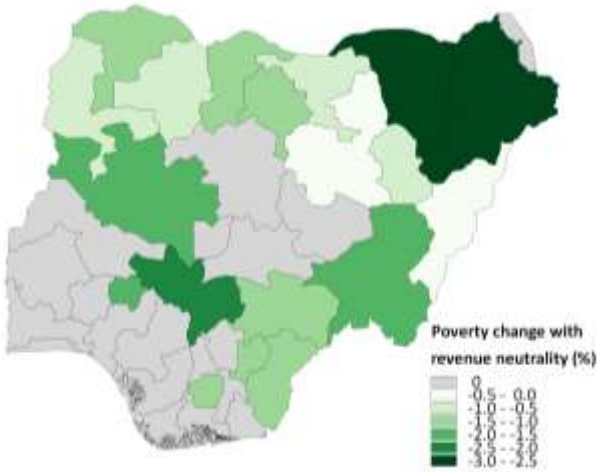
Figure 20: Revenue and poverty neutral compensation



Note: The poverty impacts of an adjusted compensation scheme. Poverty neutral compensation is provided in states where revenue neutral compensation alone would not prevent increasing poverty rates. The remaining reform revenue is redistributed at N253 per person in other states.

Figure 21 shows that this combined compensation scheme can prevent poverty increases in richer states in the south, thus helping to secure public support for reforms in this region. At the same time, Northern states benefit from reduced poverty rates, and higher transfers of wealth than in the purely poverty neutral case.

Figure 21: Combined poverty and revenue neutral compensation



Note: This map depicts impact of a combined compensation programme on state level poverty rates.

It should be emphasised that the compensation strategies considered in this section are hypothetical and stylised. They mainly serve the purpose of highlighting the important differences at the subnational level. Taking these into account may help to design more effective and equitable subsidy reforms.

5. Designing fossil fuel subsidy reforms

This paper focuses on Nigeria, and uses the statistical simulation model by Araar & Verme (2012) to estimate the direct welfare effects of reducing or removing fuel subsidies. It considers different compensation strategies and investigates their effect on poverty rates. Besides considering reform impacts on national welfare and poverty figures, this paper also provides estimates for impacts at the state-level.

In practice, designing an adequate subsidy reform strategy requires policy makers to complement the act of subsidy removal with a series of additional measures, including public communication, compensation, social protection, and sustainable and equitable long-term reinvestment. The analysis in this paper alone cannot determine the exact features and needs of such a comprehensive policy package; and uncertainties surrounding some of the data mean that estimates should not be interpreted as being precise, but instead are indicators of magnitudes and relationships. However, the analysis in this paper highlights several issues:

- **Inequality:** Energy consumption is highly unequal; rich households account for a disproportionately high share of total energy expenditure. The level of consumption inequality varies for different fuel types, with petrol being most and kerosene least unequal.
- **Regressivity:** Consumption inequality is the reason for the high level of regressivity of fuel subsidies; i.e. subsidies predominantly benefit the rich. Nevertheless, removing fossil fuel subsidies can have severe effects on the livelihoods of poor people. These results are in line with findings from similar studies e.g. for Morocco, Libya, and Jordan, and also reflect the insights from cross-country studies (Arze del Granado et al., 2012; Verme & El-Massnaoui, 2015).
- **Compensation is key:** The analysis shows that compensation measures play a central role in mitigating energy price shocks and thus ensuring affordability and protecting livelihoods. For instance, a countrywide universal (i.e. untargeted) cash compensation program can prevent increases in poverty rates, while still unlocking significant net reform revenues. Redistributing all reform revenues in the form of cash transfers can significantly increase welfare levels throughout the country.
- **Seeing beyond national averages:** The analysis also shows that due to varying energy consumption patterns, poverty impacts and vulnerabilities can vary substantially across geographic regions. Income levels alone may be incomplete indicators of vulnerability to energy price shocks. By considering national averages alone, policy makers may fail to recognise certain high vulnerability groups. For instance, certain compensation measures (e.g. uniform cash compensation) that appear effective when considering national averages can still fail to adequately mitigate price shocks in certain states, risking strong public opposition and shocks to livelihoods.
- **The need for tailored strategies:** This paper shows that in the case of Nigeria a combined compensation strategy can help to offset the largest poverty increases in high income states, while contributing to active poverty reduction in low-income states. This highlights that there can be a trade-off between mitigating public opposition to reform, and pro-poor wealth transfers. Balancing these requirements and priorities calls for careful analysis and tailored reform design.

The challenges of designing an effective reform program appear particularly complex in large and economically diverse countries such as Nigeria, with its expansive urbanised and industrialised areas, as well as large rural regions with high poverty rates. The insights from this analysis can help overcome political economy obstacles by identifying regions and population groups that are particularly vulnerable to price shocks. This can help policy makers to design adequately tailored mitigation and compensation policies, which can reduce public opposition – often one of the key barriers to reform.

However, generalisations based on the results in this paper should be made with caution: The extent to which the analysis can be disaggregated depends on the availability of data. State-by-state disaggregation requires a household expenditure survey with complete coverage and a large number

of observations. However, other disaggregation criteria may be chosen (e.g. urban vs. rural; or broader subnational regions) which can reduce data requirements, and yield useful insights nevertheless.

Similarly, the practicality and effectiveness of compensation and social protection programs will depend greatly on country-specific characteristics: The availability of pre-existing social safety nets, poverty registers, and access to reliable infrastructure (incl. mobile phones, and bank accounts) as well as alternative energy forms are critical factors which need to be taken into account when designing reforms. The analysis in this paper aims to contribute to developing a more refined understanding of the impacts of subsidy reforms and show the need for a thorough, disaggregated analysis of subsidy reforms, and tailored reform strategies.

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