Fuel Subsidy Removal in Nigeria and Cross-Border Smuggling

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Energy RESEARCH LETTERS

We explore the impact of fuel subsidy removal on cross-border fuel smuggling in Nigeria. Using trucking data for premium motor spirit movement across the country and the linear mixed-effects model to test for mean differences, the results confirm a significant reduction in fuel consumption, especially by border States after subsidy removal, suggesting cross-border smuggling. The results imply that removing the fuel subsidy was the right policy decision.

I. Introduction

Fuel subsidy removal in June 2023 by the Nigerian government marked a pivotal moment in the country's economic landscape, triggering significant debates and concerns about its repercussions. This paper delves into the aftermath of this policy shift, particularly examining its impact on fuel movement across the nation, motivated by the hypothesis that the subsidy regime fostered illicit cross-border smuggling. Drawing upon theoretical insights from rent-seeking and public choice theories, we aim to shed light on the intricate dynamics between government intervention, economic distortions, and market efficiency. To our knowledge, no empirical literature exists that tests such a hypothesis in Nigeria.

A significant body of literature on fuel subsidy reform is available (see McCulloch et al., 2021; Rentschler & Bazilian, 2018; Siddig et al., 2014; Skovgaard & van Asselt, 2019). On the theoretical front, the works of Tullock (1967), Krueger (1974), and Posner (1975) analysed the idea of rent-seeking, where government intervention in the economy results in the development of fictitious or artificial rents. This is not the same with Ricardian rents or the temporary quasi-rents that result from private sector profit-seeking but rather a "contrived" rent.

According to Victor (2009), although consumer energy subsidies include a variety of declared reasons, such as temporary protection from international price shocks, environmental goals, and transfers to low-income households, in practice, these goals frequently conceal a political intention that creates allocation distortion. Victor's (2009) approach is firmly anchored in public choice theory, arguing that government actors such as politicians are motivated by individual goals that are at variance with the greater good (Mueller, 2003). This is why Olson (1965) asserts that political leaders, not the general populace, push for downstream consumer subsidies since the latter often need to be more organised to demand such rents. In addition, energy subsidies in developing nations have an ideological component or the firm belief that the populace is entitled to a portion of what is considered a national resource (Segal, 2012).

Our hypothesis is critical because it is essential to understand the need to eliminate fuel subsidies in Nigeria. While smuggling results from distortion of the market mechanism, it is a grievous form of waste for Nigeria, given that any smuggled fuel has already been subsidised using the state's resources, thereby stifling the economy of critical public investments. We can learn important things about fuel subsidy and smuggling dynamics using data-driven research, including whether the subsidy scheme has been driven by smuggling or domestic demand. By analysing the impact of this policy shift, we aim to add to the ongoing discussion surrounding the benefits of the recent Petroleum Industry Act (PIA, 2021), further informing policymakers about their choices. Future policy tweaks and initiatives that will strike an optimal balance between citizens' welfare and government efficiency can be shaped by this analysis.

We employ the linear mixed-effects model and find strong evidence of fuel smuggling across Nigeria's borders caused by the distortionary effect of the fuel subsidy regime. We followed with non-parametric permutation tests for robustness. These findings suggest that reintroducing subsidies may only perpetuate the waste associated with the previous subsidy regime and support the idea that consumption subsidies can contribute to inefficient resource allocation through an inefficient consumption pattern.

The paper is organised as follows: Aside from the introduction, section two presents the stylised facts and descrip-

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tive analysis. Data analysis and results are presented in section three, while section four concludes the study.

II. Stylised Facts and Descriptive Analysis

A. Variables and Descriptive Statistics

In Table 1, panel A, the first four variables denote time-based samples, while the last four denote spatial samples. Each sample is designed to address the respective hypothesis. The Anderson-Darling normality test rejects the null of normality.

The results indicate lower average values of fuel movements in the post-subsidy regime for all the groups except for states without international borders (NBS). The mean values for the full sample (FS) and states bordering countries without seaports (BWS) further dropped in the post-Niger coup regime. An inferential analysis is conducted in the subsequent section to validate these results.

B. Full Sample Analysis of Fuel Movement

The subsidy regime moved a daily average of 71.23 million litres of fuel to the 37 States. The daily average decreased by 32 per cent in the post-subsidy regime (Figure 1a and b). A further decline of 15 per cent was recorded after the Niger's coup. Although increased fuel price lowers its demand, it is also possible that the narrowed premium between the fuel price in countries bordering Nigeria, namely Cameroon, Chad, Niger, and Benin, may have curtailed part of the volume being smuggled from Nigeria.

The further decline after the Niger coup, as borders were closed, also suggests that smuggling was responsible for part of the total daily 'consumption' by Nigerians. To probe this claim, the data was further disaggregated into four groups of States: States with (BS) and without (NBS) international borders and States bordering countries with (BSS) and without (BWS) seaports (Table 1a).

C. Sub-sample Analysis of Fuel Movement (BS and NBS)

In the post-subsidy period, border states experienced a 37.8 per cent drop in fuel movement compared with 27.2 per cent recorded by the non-border states (figure 1). After the subsidy removal, fuel prices increased, narrowing the price premium and making it less attractive for cross-border smugglers. Consequently, the volume of smuggled fuel may have decreased, leading to a decline in fuel volume moved to border States. While these changes do not offer concrete proof, they nevertheless suggest the presence of cross-border smuggling.

D. Sub-sample Analysis of Fuel Movement (BSS and BWS)

An interesting result comes from the analysis of fuel movement between States bordering countries with seaports (Benin Republic and Cameroon) and those bordering countries without seaports (Chad and Niger). The results suggest that the former recorded a higher drop of 39.0 per

cent after the subsidy removal as against 27.3 per cent for the latter. Countries bordering BSS may have had the alternative of importing through their ports since fuel prices in Nigeria had become market-reflective. Conversely, BWS may have recorded a lower drop because they lacked a BSS-type alternative. In the next section, we employ the FME to probe our preliminary results further.

III. Data Analysis and Results

A. Hypotheses

To achieve the paper's objective, we hypothesise as follows:

Full Sample:

N_1 H_0: No difference in fuel moved to all States pre- and post-subsidy removal.

N_2 H_0: No difference in fuel moved to all States pre- and post-Niger coup after subsidy removal.

Sub-samples:

n_1 H_0: No difference in the fuel moved between border and non-border States, pre- and post-subsidy removal.

n_2 H_0: No difference in the fuel moved between border States with and without seaports, pre- and post-subsidy removal.

n_3 H_0: No difference in the fuel moved to border States without seaports, pre- and post-Niger coup.

where H_0 represents the null hypothesis, and the alternative hypothesis (not stated) is the converse of the H_0; and n_i (i = 1 to 6) represents the sub-samples of interest.

B. Model

We examine the impact of fuel subsidy removal in Nigeria by estimating the significant difference in the mean values of the sub-samples relevant to our hypotheses using the linear mixed-effects (LME) method and non-parametric permutation tests for robustness. The LME model first proposed by Henderson (1949) is used to analyse the relationship between fuel consumption (fuel) and time (date) and consists of both fixed and random effects.

The LME model can be expressed, following Yu et al. (2022), as follows:

$$fuel_{ij} = \beta_0 + \beta_1 \times date_{ij} + \mu_{0i} + e_{ij} \qquad (1)$$

Equation 1 captures the overall trend in fuel consumption over the period considered ($\beta_0 + \beta_1 \times date_{ij}$), while allowing for state-specific variations in baseline fuel consumption (μ_{0i}) and accounting for unobserved factors (e_{ij}). The parameters β_0 and β_1 are fixed effects, while μ_{0i} is a random effect.

C. Results

Table 2 shows that the average change in fuel consumption, denoted by $\Delta fuel_{ij}$, is negative and statistically significant at 1% for the five hypotheses stated. The negative signs indicate that average fuel movements in the post-subsidy regime were lower, and that of post-Niger in both FS and BWS were also lower. Hence, all five null hypotheses were rejected, suggesting that a statistically significant dif-

Table 1. Descriptive statistics

Panel A: Samples and Variables				
Description	**Acronym**	**Description**		**Acronym**
Full Sample (1/1/2023 – 20/8/2023)	FS	States with international border		BS
Subsidy regime (1/1/2023 – 31/5/2023)	SR	States without international border		NBS
Post-subsidy regime (1/6/2023 – 25/7/2023)	PSR	States bordering countries with a seaport		BSS
Post-Niger coup (26/7/2023 – 20/8/2023)	PNC	States bordering countries without a seaport		BWS

Panel B: Descriptive Statistics											
	Subsidy				**Post-Subsidy**				**Niger-Coup**		
	Mean	**SD**	**Skew**	**Kurt**	**Mean**	**SD**	**Skew**	**Kurt**	**Mean**	**SD**	**Skew**	**Kurt**
FS	1925441	2473499	3.4	18.1	1542780	1870199	4.2	22.8	1,184,910	1485890	3.6	20.1
BS	2377914	3364097	2.8	11.2	1478492	2340438	3.6	16.9				
NBS	1617072	1530579	1.5	5.5	1177623	1183349	1.7	6.7				
BSS	3197969	3796400	2.3	8.0	1949290	2724900	2.9	11.6				
BWS	1454446	1493184	1.5	5.8	1058970	1118474	1.9	7.7	961,481	966531	1.9	8.1
	Anderson-Darling normality test				Statistic	P-value						
					658.38	2.2e-16						

Note: This table reports selected descriptive statistics (mean, standard deviation (SD) and skewness) for the different regimes. The data are split into the subsidy, post-subsidy and post-Niger coup samples.
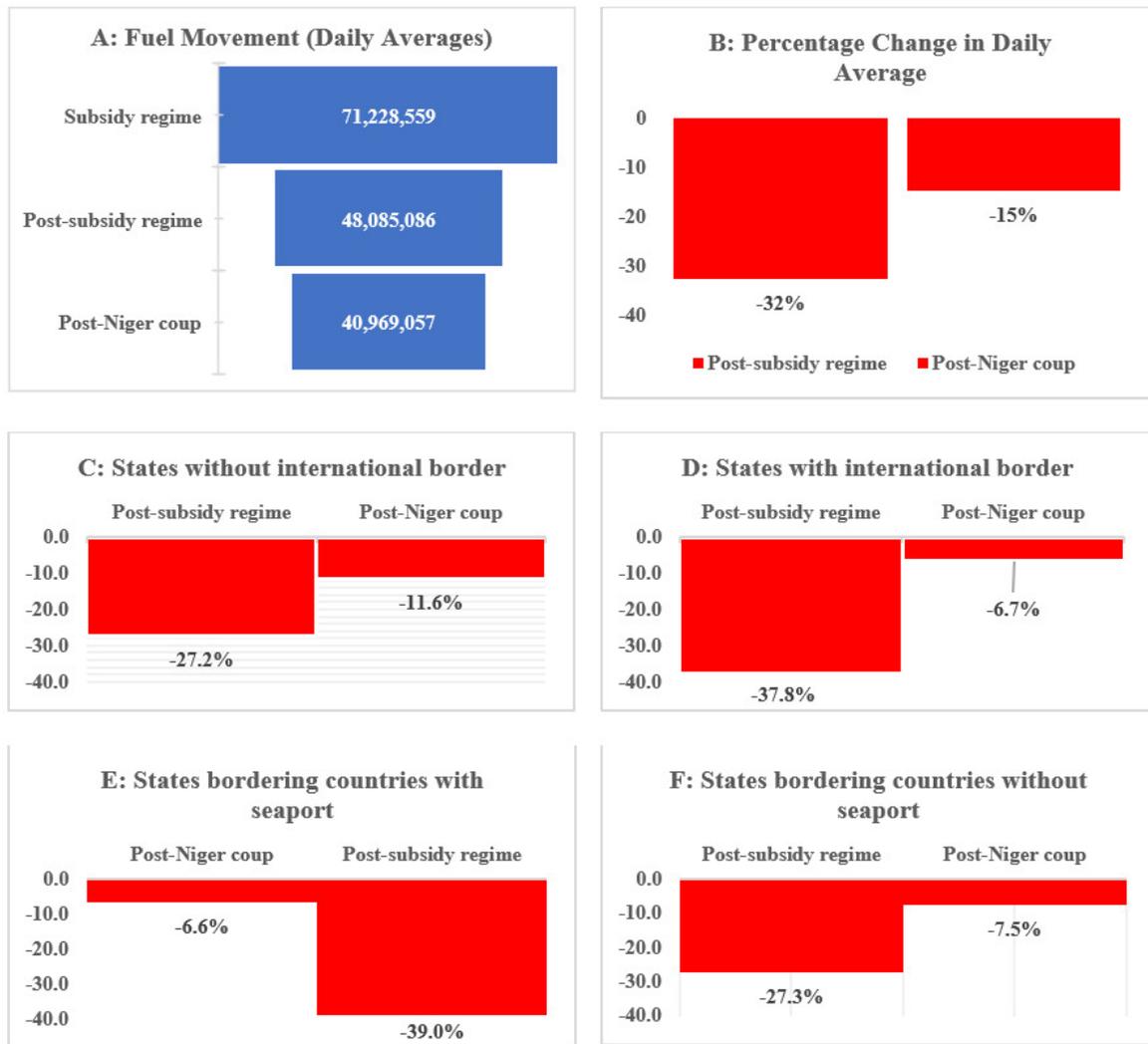
Figure 1. Fuel movements pre & post-subsidy removal and post-niger coup

Note: The plot contains six panels explaining fuel movement during the three regimes across the country. The data are the average daily amount sourced from the Nigerian Midstream and Downstream Petroleum Regulatory Authority (NMDPRA) and percentage changes.

ference exists between the group means in each of the hypotheses. Expressly, the LME results confirm the analysis in the descriptive analysis that statistical and significant differences exist between fuel moved to all States pre-and post-subsidy removal and pre-and post-Niger coup after. Also, there is a significant difference in the fuel moved between border and non-border States pre-and post-subsidy removal. Similarly, fuel moved to border States with and without seaport pre- and post-subsidy removal are statistically different. Finally, a statistically significant difference exists between fuel moved to border States without seaport pre- and post-Niger coup. The non-parametric tests conducted for robustness also confirm the results of the LME estimation. The results support the assertions by Hertog (2017), Moerenhout et al. (2017), Fattouh et al. (2016), Nwachukwu et al. (2013) and Akov (2015), who argued that interest groups have defended fuel subsidies for rent-seeking opportunities that smugglers of subsidised fuel have been the biggest beneficiaries of fuel subsidies.

IV. Conclusion

We examined the effect of subsidy removal on fuel movement across Nigeria. We hypothesised that the resulting narrowed fuel price premium between Nigeria and its neighbours curtailed smuggling. The LME results confirmed that fuel movement significantly declined post-subsidy. This change was partly due to lower demand as the price became market-based and partly due to reduced smuggling activities. The results confirmed that fuel movement to States bordering countries with seaports declined more than those without seaports, as the latter had fewer alternatives. Furthermore, after the Niger coup, when borders were closed, fuel movement to States bordering countries without seaports declined sharply, suggesting a significant level of smuggling was going on pre-subsidy removal and pre-Niger coup.

In conclusion, we recommend further research to ascertain the value chain in the downstream sector and how efficient structures can be established to exploit the citizens' full gains of subsidy removal.

Table 2. LME and NPP results

	LME Model (SR & PSR)		LME (PSR & PNC)		NPP Test (SR & PSR)	NPP Test (PSR & PNC)
	Δfuel_{ij}	t-value	Δfuel_{ij}	t-value	Observed Statistic	Observed Statistic
FS	-2,682.4	-11.2***	-2,914.2	-3.7***	625843.9***	476935.3*
BS	-4,221.0	-8.8***			899422.7***	
NBS	-1,633.9	-6.1***			439449.1***	
BSS	-5.9	-8.4***			1248679.0***	
BWS	-1,490.9	-7.4***	-2,404.1	-3.4***	201996.7***	76835.2*

Note: *** and * Denote significance at 1% and 10%, respectively. Δfuel_{ij} stands for the average change in fuel consumption. LME denotes Linear Mixed Effects, and NPP denotes Non-Parametric Permutation. Source: Authors Computation

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