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Assessing the Compensating and Equivalent Variations of Human Welfare Impact Resulting From Fuel Subsidy Removal in Southwest, Nigeria

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The study assessed the compensating and equivalent variations in human welfare resulting from the removal of fuel subsidies in southwest Nigeria. The analysis reveals significant welfare implications, with indirect effects having a greater impact on household welfare than direct price changes. Policymakers must carefully examine both direct and indirect impacts to develop effective mitigation strategies to cushion the effects of fuel subsidy removal.

I. Introduction

The removal of fuel subsidies has been a topic of ongoing debate and policy implementation in many countries around the world (Agboje, 2022; Albatayneh et al., 2023; Boudekhdekh, 2022; Chen et al., 2022). Some studies used econometric modeling and simulation techniques (e.g., Agboje, 2022; Cooke et al., 2016; Lin & Kuang, 2020) to estimate the direct and indirect welfare effects. Others rely on household survey data and descriptive analysis (e.g., Bolaji-Olutunji et al., 2020; Oluwoyo et al., 2016) to assess changes in household consumption patterns and poverty levels. A few studies provided more qualitative, conceptual assessment of the issue (e.g., Boudekhdekh, 2022; Ozili & Obiora, 2023). Additionally, several studies used compensating and equivalent variations to quantify the welfare impacts (e.g., Agboje, 2022; Widodo, 2012; Zarepour & Wagner, 2022). Some focused on broader measures like changes in household consumption, poverty levels, and energy transition patterns (e.g., Chen et al., 2022; Ekine & Okidim, 2013; Lin & Kuang, 2020). Fuel subsidies are often implemented to provide economic relief to consumers, particularly those with lower income levels, by lowering the cost of energy and transportation (Cooke et al., 2016). However, the removal of these subsidies can have significant implications for human welfare, making it necessary to evaluate the compensating and equivalent variations resulting from such a policy (Lin & Kuang, 2020; Zarepour & Wagner, 2022).

Compensating variation (*CV*) and equivalent variation (*EV*) are essential for evaluating the welfare impacts of subsidy removal. *CV* represents the additional income required to maintain pre-removal welfare levels, while *EV* is the change in income that would make individuals indifferent between pre- and post-removal scenarios. Low-income and vulnerable households are disproportionately affected, as they rely more heavily on subsidies. Estimating *CV* and *EV* helps identify the compensation needed to mitigate negative impacts on these groups and assess the overall economic efficiency of subsidy removal.

Fuel subsidies in Nigeria are a contentious issue, with the removal of subsidies having significant implications for human welfare, particularly in the densely populated Southwest region (Bolaji-Olutunji et al., 2020). While prior studies have examined national-level impacts or specific case studies within certain states (Adenikinju, 2008; Ekine & Okidim, 2013; Oduyemi et al., 2021; Oluwoyo et al., 2016), the unique socioeconomic characteristics and energy consumption patterns of the Southwest region warrant a localized analysis (Bolaji-Olutunji et al., 2020). The timeliness of this research is underscored by recent policy discussions around fuel subsidy reform amidst Nigeria's economic challenges (Ozili & Obiora, 2023). To address the gap, the current study assessed the *CV* and *EV* of human welfare impacts resulting from fuel subsidy removal in the Southwest region of Nigeria.

The rest of the study is structured as follows. Section II outlines the methodology and data sources used in the analysis. Section III presents results and Section IV concludes the study.

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II. Methodology and Data Sources

The study develops a household expenditure function based on the Cobb-Douglas utility model, following the precedent of the Linear Expenditure System (LES) approach used by Widodo (2012). This comprehensive linear formulation accounts for prices, income, budget constraints, homogeneity, and Slutsky symmetry as part of the utility function:

$$CV = E\left(P^0, U^0\right) - E\left(P', U'\right) + \left(M' - M^0\right) \quad (1)$$

$$EV = E\left(P^0, U'\right) - E\left(P', U'\right) + \left(M' - M^0\right) \quad (2)$$

In the context of LES, equation (1) and (2) become:

$$\begin{aligned} CV = &\left(\prod_{i=1}^{n}\left(\frac{P_i'}{P_i^0}\right)^{\alpha_i}\right) M^0 - \sum_{j=1}^{n} P_i' x_i^0 \\ &+ \prod_{i=1}^{n}\left(\frac{P_i'}{P_i^0}\right)^{\alpha_i} \sum_{j=1}^{n} P_i^0 x_i^0 + \left(M' - M^0\right) \end{aligned} \quad (3)$$

$$\begin{aligned} EV = &\left(\prod_{i=1}^{n}\left(\frac{P_i^0}{P_i'}\right)^{\alpha_i} - 1\right) M^0 \\ &- \prod_{i=1}^{n}\left(\frac{P_i^0}{P_i^i}\right)^{\alpha_i} \sum_{j=1}^{n} P_i' x_i^0 \\ &+ \sum_{j=1}^{n} P_i^0 x_i^0 + \left(M' - M^0\right) \end{aligned} \quad (4)$$

Where P^0 is the vector of commodity prices before the removal of premium motor spirit (petrol) subsidy, P' is the vector of commodity prices after subsidy removal, P_i^0 is the price of commodity *i* before subsidy removal, P_i' is the price of commodity *i* after subsidy removal, U^0 is the level of utility (welfare) before subsidy removal, U' is the level of utility (welfare) after subsidy removal, M^0 is income (expenditure) before subsidy removal and M' is income (expenditure) after subsidy removal. By knowing the changes in prices and income due to the energy subsidy removals, we can determine the change in welfare measured by *CV* and *EV*. The *EV* and *CV* indicate whether the household is worse off or better off under the economic policy.

The survey targeted individuals across urban and rural households in the six Southwestern states of Nigeria. A sample of 600 households per state was chosen, guided by the 2018/19 Nigeria Living Standards Survey. The survey instrument consisted of 10 sections with 67 questions covering household demographics, shocks from subsidy removal, and expenditures on food, energy, transportation, clothing, housing, health, education, and telecommunications - both before and after subsidy removal. A multi-stage sampling approach was used due to the large scale of the household survey. Planning began in June 2023, with the actual fieldwork and data collection conducted in January 2024.

III. Empirical Findings

Table 2 revealed the *CV* and *EV* of the human welfare impact of fuel subsidy removal in the six Southwest states of Nigeria. From the direct effect, Lagos State has the highest *CV* at ₦25,800 and the highest *EV* at -₦23,450. This indicates that households in Lagos required the largest compensation to maintain their pre-subsidy removal welfare level (*CV*) per month, and they experienced the greatest welfare loss in terms of the maximum amount they would be willing to pay to avoid the subsidy removal (*EV*) per month. In contrast, Osun State has the lowest direct effect *CV* and *EV* per month, both at ₦5,100 per month. Also, the pattern remains consistent for indirect effects, with Lagos State recording the highest *CV* at ₦72,300 and the highest *EV* at -₦64,700. This implies that the indirect impacts, such as changes in prices of other goods and services, have the most significant welfare consequences for households in Lagos per month. On the other hand, Osun State has the lowest indirect effect *CV* at ₦34,700 and the lowest *EV* at -₦31,600, suggesting that the indirect welfare impacts were least pronounced in Osun state.

On the total effects, which combine the direct and indirect impacts, the result showed that Lagos state once again has the highest values, with a *CV* of ₦98,100 and an *EV* of -₦88,150. This indicates that the overall welfare impact of the fuel subsidy removal is most severe in Lagos, as households in this state required the largest compensation to maintain their pre-subsidy welfare level (*CV*) and experienced the greatest welfare loss in terms of the maximum amount they would be willing to pay to avoid the subsidy removal (*EV*) per month. On the other hand, Osun State has the lowest total effect *CV* at ₦39,800 and the lowest total effect *EV* at -₦36,700, implying that the overall welfare impact of the fuel subsidy removal would be the least severe in Osun state. The stark differences in the *CV* and *EV* values across the states highlight the uneven impact of the fuel subsidy removal on household welfare in the Southwest region of Nigeria. The magnitude of the differences is particularly noteworthy, with the highest total effect *CV* (Lagos State) being more than twice the lowest total effect *CV* (Osun State), and the highest total effect *EV* (Lagos State) being more than double the lowest total effect *EV* (Osun State). These findings suggest that the fuel subsidy removal have a disproportionate impact on households, potentially exacerbating existing socioeconomic disparities within the region.

The result of *CV* and *EV* for Southwest revealed that the direct effect of fuel subsidy removal required a *CV* of ₦11,977. This suggests that households in Southwest Nigeria would need an additional ₦11,977 in income per month to offset the negative impact of the direct effect of fuel subsidy removal on their welfare. The direct effect results in an *EV* of -₦11,435, indicating that households' welfare decreases by ₦11,435 per month because of the direct effect of fuel subsidy removal. Additionally, the indirect effect of fuel subsidy removal necessitates a *CV* of ₦46,273. This implies that households would require an additional ₦46,273 in income per month to counteract the negative impact of the indirect effect of fuel subsidy removal on their welfare. The indirect effect results in an *EV* of -₦40,717, suggesting that households' welfare decreases by ₦40,717 per month due to the indirect effect of fuel subsidy removal.

The *CV* for the indirect effect (₦46,273) was greater than the *CV* for the direct effect (₦11,977). This suggests that the indirect effect of subsidy removal has a more negative impact on human welfare than the direct effect. The larger *CV* for the indirect effect also indicates that the indirect

Table 1. Sample composition and outcomes

State	Households Interviewed	Questionnaires Returned	Percentage (%)
Ekiti	600	504	17.4
Lagos	600	514	19.5
Ogun	600	524	21.9
Ondo	600	517	20.2
Osun	600	429	9.7
Oyo	600	453	11.3
Total	3600	2941	100.0

Note: This table reports sample composition and outcomes from the conducted survey.

Table 2. *CV* and *EV* of human welfare impact of fuel subsidy removal in Southwest Nigeria

		Ekiti State (₦)	Lagos State (₦)	Ogun State (₦)	Ondo State (₦)	Osun State (₦)	Oyo State (₦)	Southwest (₦)
Direct effect	*CV*	5,600	25,800	12,560	7,900	5,100	14,900	11,977
	EV	-5,520	-23,450	-12,450	-7,340	-5,100	-14,750	-11,435
Indirect effect	*CV*	35,638	72,300	51,800	37,800	34,700	45,400	46,273
	EV	-32,500	-64,700	-42,300	-31,500	-31,600	-41,700	-40,717
Total effect	*CV*	41,238	98,100	64,360	45,700	39,800	60,300	58,250
	EV	-38,020	-88,150	-54,750	-38,840	-36,700	-56,450	-52,152

Note: In this table, Compensating variation (denoted by *CV*) represents the monetary amount needed to maintain welfare levels after the removal of the fuel subsidy. Equivalent variation (represented by *EV*) reflects the monetary value of the welfare change due to the subsidy removal, indicating potential losses in welfare.

consequences of fuel subsidy removal have a more substantial impact on human welfare compared to the direct effects. This highlights the significance of considering not only the immediate changes in prices but also the broader economic repercussions that arise through interconnected channels such as transportation costs and consumer behaviour. The *EV* for the direct effect in the Southwest region was -₦14,750, whereas the equivalent variation for the indirect effect was -₦41,700. This suggests that consumers could have been potentially better off if the government took away -₦14,750 per month due to the direct effect of subsidy removal, compared to taking away -₦41,700 per month due to the indirect effect. Additionally, the total effect of fuel subsidy removal requires a *CV* of ₦58,250 per month. This indicates the combined additional income needed by households to offset the overall negative impact of fuel subsidy removal on their welfare. The total effect yields an *EV* of -₦52,152, representing the total decrease in households' welfare resulting from the overall impact of fuel subsidy removal per month.

The findings of the study on *CV* and *EV* of human welfare impact of subsidy removal in the Southwest region of Nigeria are in line with the work of Widodo (2012) in terms of *EV* and indicate that the subsidy policy would result in welfare loss. However, the result in terms of *CV* differs from the work of Widodo (2012), which obtained negative coefficients, whereas the result in this research is positive. This difference stems from the fact that Widodo (2012) worked on subsidy reduction, while this research focused on subsidy removal.

IV. Conclusion

The study assessed the *CV* and *EV* of human welfare impact resulting from fuel subsidy removal in Southwest Nigeria. The analysis reveals significant welfare implications of fuel subsidy removal in Southwest Nigeria. The fuel subsidy removal has the most severe welfare impact on households in Lagos State, with the highest *CV* of ₦98,100 and the highest *EV* of -₦88,150, while Osun State experienced the least adverse effects of *CV* of ₦39,800 and *EV* of -₦36,700. The direct effect of fuel subsidy removal requires an additional ₦11,977 in household income to offset the ₦11,435 welfare decrease per month. However, the indirect effects are more substantial, necessitating ₦46,273 in additional income to counteract the ₦40,717 welfare loss per month. Therefore, changes in transportation costs and consumer behaviour have a greater impact on household welfare than direct price changes. The total effect would require ₦58,250 in additional income to maintain welfare, resulting in an overall ₦52,152 decrease per month. The study recommended that there should be an implementation of targeted social assistance programs, the promotion of sustainable practices, and the implementation of targeted income support programs.

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