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Impact of LPG Subsidy on Household Consumption Expenditure: Evidence from Assam and West Bengal

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Abstract

This study examines the association between government-subsidised liquefied petroleum gas (LPG) and household consumption expenditure in Assam and West Bengal using data from the Household Consumption Expenditure Survey (HCES) 2023–24. Using the number of subsidised LPG cylinders received per month as a proxy for LPG subsidy, the study estimates log-linear models using ordinary least squares (OLS), robust regression, and quantile regression. The results indicate a positive and statistically significant association between subsidised LPG and household consumption expenditure. The OLS and robust regression estimates suggest that an additional subsidised LPG cylinder is associated with approximately a 6% increase in household consumption expenditure, holding other factors constant. The quantile regression results further indicate a stronger association at the 30th percentile of the consumption-expenditure distribution, where an additional subsidised cylinder is associated with approximately a 7% increase in consumption expenditure. The findings suggest that LPG subsidies are associated with higher household consumption expenditure, particularly among households toward the lower end of the expenditure distribution.

1. Introduction

Energy is a crucial requirement for many aspects of human survival worldwide in the current era. Due to rapid urbanization and pressure for keeping the forest area intact, energy supply in terms of cooking fuel has become an essential ingredient for the households even in the rural areas. Indian government recently took many policies for ensuring access to LPG energy. The subsidized LPG not only enable millions of household's accesses to clean energy, but potentially reduces the economic burden of fuel to the households. The extra resources saved by the household due to the LPG subsidy might have been utilized for the

fulfilment of other economic requirement goods and services. The recent empirical studies on the impact of energy policies however reveal a contradictory picture. Heltberg, 2005 and Pachauri *et al.*, (2012) suggested that LPG subsidies increase household disposable income which will improve welfare by increasing expenditure on education, health and durable goods. However, Barnwal (2024) studied the impact of Direct Benefit Transfer (DBT) policy on household cooking fuel expenditure share and found no statistically or economically significant impact on the average share of household monthly expenditure. Gaikwad *et al.*, (2024) suggested that providing refills at subsidized costs rather than depositing the subsidy in bank accounts, to increase sustained LPG uses among the rural women. The contradictory picture regarding the welfare impact energy subsidy led many to study the heterogeneous impact on the household's welfare. Batdelger and Zagdbazar (2026) reveal that the complete removal of electricity subsidies will disproportionately affect poorer households in Mongolia. Choudhury *et al.* (2025) demonstrates that the PMUY significantly increased LPG adoption and reduced firewood use, with greater effects observed for marginalized households (Scheduled Castes, Scheduled Tribes, Other Backward Classes) and non-Hindu households compared to other groups. The recent studies however have received little attention on how LPG subsidy impact households' welfare and whether any heterogeneity exist in terms of its impact. Despite the growing literature on the adoption of LPG, clean cooking energy, and energy subsidies, little is known about the relationship between subsidised LPG consumption and household consumption expenditure. Most of the literature has paid attention to whether or not households get the LPG connection, whether they use it or not, cooking fuel costs, or whether they go off-grid from traditional biomass. These results are important but do not capture the overall household welfare effects of subsidised LPG. One important question is how much the LPG subsidy is helping to relieve the household's consumption expenditure and if this effect is different across the income distribution. In particular, lower-income households may respond differently to subsidies on energy compared to better-income households due to budget constraints, expenditure priorities, and the marginal value of added disposable resources. This question is particularly pressing in eastern India. Assam and West Bengal are prime geographical settings to study the relationship of subsidised LPG subsidies with household consumption expenditure since both states have large rural populations and are highly socio-economic and regionalized. At the same time, households in these states differ in their economic situation, consumption habits, access to modern energy, and use of traditional cooking fuels. Thus, a comparison of these states would be a good way to test whether the relationship between subsidised LPG and household consumption expenditure is consistent across different socioeconomic backgrounds rather than just between a single state and a nationally representative sample.

Hence, we consider data collected from the Household Consumption Expenditure Survey (HCES) 2023-24 for Assam and West Bengal in this paper. We consider the number of subsidised LPG cylinders received per month as an indicator of the exposure of households to subsidy and investigate its relationship to household consumption expenditure after controlling for household characteristics. A log-linear specification is determined using OLS, and robust regression is performed to see if the results remain stable when those data are not well known and the regression does not follow conventional errors. Quantile regression is

performed for different points of the household consumption-expenditure distribution to check if the relationship varies over time as an average regression coefficient would be too high, and thus the data would be less clear with relatively poor families and better-off families. We found a significant and statistically significant association between subsidised LPG and household consumption expenditure. The OLS and robust regression estimates show that an additional subsidised LPG cylinder is associated with about a 6 percent increase in household consumption expenditure, depending on the other factors included in our model. The quantile regression estimates also provide further evidence for heterogeneity: the association is stronger around the 30th percentile where an additional subsidised cylinder is associated with about a 7 percent increase in consumption expenditure. The stronger association with the lower part of the expenditure distribution suggests that subsidised LPG may be associated with the consumption capacity of economically poorer households.

The results of this study are threefold. First, it shifts the focus from LPG adoption and cooking-fuel expenditure to the overall household consumption expenditure and thus to a more general picture of household welfare. Second, to do so, we employ quantile regression and standard and robust estimation techniques and investigate the distributional heterogeneity of the relationship beyond average effect. Third, we study Assam and West Bengal based on recent HCES 2023-24 data and present current evidence in two of the most important eastern Indian states. We contribute to the debate on whether the benefits in these sectors of energy subsidies are distributed equally to all the households. As to the reason why this study does not necessarily show causal effects of LPG subsidies on household consumption expenditure, it has to be noted that the HCES data are observational and no quasi-experimental identification strategy is offered, and therefore the estimated coefficients could not be regarded as causal treatment effects. However, the stability of the positive relationship across OLS and robust regression and the distributional evidence from quantile regression provides some empirical evidence for the association between subsidised LPG access and household consumption behaviour. It can be helpful for the design and targeting of energy-support programmes in the current context in which policymakers are trying to reconcile clean-energy transition, affordability, and household welfare.

The purpose of this study is to investigate the nexus between household consumption expenditures and LPG subsidies provided by government. The result of this study show that household consumption expenditure is positively affected by government LPG subsidies. Moreover, we demonstrated that the effect of subsidized LPG cylinder on household consumption expenditure is more for the poor section of the society. Although, the differential effect implies that whereas subsidies generally boost welfare, their capacity to increase consumption may differ depending on the economic status of the household.

2. Literature Review

Kojima (2021) examined how policies have evolved and affected household LPG use, with most extensively along with 9 countries along India. Author found that that price subsidies, whether retail or conditional cash transfers, boosted household use of LPG, but many poor

households discontinued use without the subsidies. Kojima (2010) examines factors affecting household use of LPG using national household surveys in 10 developing countries including India alongside Guatemala, Indonesia, Kenya, Pakistan, Sri Lanka, Albania, Brazil, Mexico, and Peru. Authors discover that household income, fuel prices, were the two principal determinants of a household's decision to use LPG. Patel et al., (2016) examined the factors specially subsidies and improved distribution networks in determining rural household's cooking fuel preference. Employed Cost-Benefit Analysis (CBA) model, Analytic Hierarchy Process (AHP) authors found subsidies on LPG and electricity promotes their use. However, authors noted that in the absence of distribution networks and infrastructure biomass is more preferred. Jeuland et al., (2023) employing Randomized Control Trial (RCT) on 580 low-income Pradhan Mantri Ujjwala Yojana (PMUY) beneficiary households in India found that LPG subsidy increases LPG adoption. Dev (1998) employing household-level data on Public Distribution System (PDS) found a marginal increase in per capita income due of the poor from all consumer subsidies, including PDS, only 2.7 percent of their per capita expenditure in rural areas and 3.2 percent in urban areas. Cooke et al., (2016) found that fuel subsidies removal negatively impacts household welfare, particularly for the poorest group who experience a 2.1% reduction in total consumption in Ghana. Similarly, Siddig et. al., (2015) found that subsidy removal generally increases Nigeria's gross domestic product, but negatively impacts household income, especially for poor households in Nigeria.

While many studies have shown how LPG subsidies affect poor and richer households differently, however even within the same group, like "poor" households, some spend much more or less than others. This variation in spending is not fully captured by simple categories. Our paper fills this gap by using "quantile regression" of how subsidized LPG affects households at different spending levels in Assam and West Bengal.

3. Data and Methodology

This study uses the latest available Household Consumption Expenditure Survey (HCES), 2023-24, conducted by the National Statistical Office (NSO), Ministry of Statistics and Programme Implementation (MoSPI), Government of India. The HCES 2023-24 provides comprehensive information on household consumption expenditure, demographics and income of the household, household assets and amenities, land ownership, education, occupation, access to services and consumption of various commodities, for example cooking fuel. The survey therefore provides a micro-level dataset to investigate the relationship between subsidised LPG and household consumption expenditure. The analysis is based on households from Assam and West Bengal only. These two states are selected to provide evidence from eastern India and thus the analysis can be made in account of state-level differences in household characteristics and socioeconomic status. The unit of analysis is the household. The dependent variable is monthly household consumption expenditure (MPCE/household monthly consumption expenditure, depending on the exact HCES variable). Since household consumption expenditure is generally positively skewed, its natural logarithm is used in the regression analysis. The main explanatory variable is the

number of subsidised LPG cylinders received by the household per month and is used to measure the LPG subsidy exposure. Before estimation, we exclude observations which do not have values in the variables included in the regression model. Sample restrictions and data-cleaning procedures are applied to ensure consistency of the variables used in the empirical analysis.

3.1 Model Specification

To access the impact of government LPG subsidy on household consumption expenditure, the following model is considered.

$$\log(C_i) = \omega + \gamma_1 LPGsubsidy_i + \beta_1 land_i + \beta_2 land_i^2 + \beta_3 Worktype + \beta_4 Ration + \beta_5 Internet + \beta_6 size_i + \beta_7 Education_i + \beta_8 State \dots \dots \dots (1)$$

Where,

$\log(C_i)$ = log of household monthly consumption expenditure of i^{th} household,

$LPGsubsidy_i$ = Number of subsidized LPG cylinder received by the i^{th} household in a month,

$land_i$ = Area of land holding in acre by the i^{th} household,

Work type = Dummy for the type of work where the maximum income was derived by the household during last 365 days, the type of work are,

- (a) Self-employed in agriculture,
- (b) Self-employed in non-agriculture,
- (c) Regular-Wage/ Salary earner in agriculture ,
- (d) Regular-Wage/ Salary earner in non- agriculture,
- (e) Casual labour in agriculture and
- (f) Casual labour in non-agriculture.

Ration = dummy for the type of ration card that the households possess,

- (a) Antyodaya Anna Yojana (AAY),
- (b) Below Poverty Line (BPL),
- (c) Above Poverty Line (APL),
- (d) Priority House Holds (PHH),
- (e) State Food Security Scheme (SFSS),
- (f) Others,
- (g) No ration card

Internet = whether households have access to the internet,

$size_i$ = Family size of the i^{th} household,

$Education_i$ = Highest level of education attained by household in years.

For every level of education, we assign a number, which is the approximate years of schooling as follows. For not literate person (i.e. not able to read or write a simple message with understanding in any language) the assign value is 1 which is equivalent to one years.

Literate with non-formal education (like NFEC, AEC, TLC, literate without any schooling, etc.) the assign value is 2. Literate with formal education below primary is 3 years, primary years, upper primary/middle 5 years, secondary 6 years, higher secondary 7 years, diploma /certificate course (up to secondary) 8 years, diploma/certificate course (higher secondary) 9 years, diploma/certificate course (graduation & above) 11 years, graduate 12 years and post graduate and above 13 years. State is the state dummy, '1' for Assam and '0' West Bengal are taken under consideration.

Given violations in classical OLS assumptions in equation 1 (likely due to heteroscedasticity or outliers), robust regression was employed for more reliable estimation. Moreover, to investigate the impact of LPG subsidy on households' consumption expenditure at different expenditure levels, quantile regression is employed. To examine whether the effect of subsidised LPG varies across the distribution of household consumption expenditure, we employ quantile regression at the 30th percentile ($\tau = 0.30$). The study focuses on the 30th percentile because it allows us to examine the relationship among households located toward the lower end of the consumption-expenditure distribution, which is particularly relevant to our objective of assessing whether LPG subsidies have a differential association with consumption among relatively poorer households. The 30th percentile is therefore used to capture heterogeneity that may not be evident from mean regression estimates. The empirical analysis takes place in three steps. First, the baseline relationship is estimated with OLS. Second, robust regression is performed to assess the sensitivity of the estimates to potentially important observations. Finally, in quantile regression at the 30th percentile we estimate distributional heterogeneity of the relationship between subsidised LPG and household consumption expenditure. Together these complementary estimation approaches provide evidence from the conditional mean, a robust estimation framework and the lower part of the conditional expenditure distribution. The sign and statistical significance of the LPG coefficient across these parameters would help to support the evidence that subsidised LPG receipt is associated with household consumption expenditure. As the analysis is based on cross-sectional survey data, our estimated coefficients should be interpreted as conditional associations rather than causal effects. In particular, households receiving subsidised LPG may differ systematically from other households in unobserved ways and such differences may also affect consumption expenditure. The empirical results should therefore be interpreted within the confines of the identification strategy used.

4. Empirical Results

Table 1 presents the descriptive statistics of the main continuous variables we used in our empirical analysis. The average monthly consumption expenditure in the household is ₹12,607.42 and the median is ₹11,000. The difference between the mean and median indicates a slightly skewed distribution in consumption expenditure, as only a few households consume significantly more. The standard deviation of ₹7,263.93 also indicates a considerable spread in household expenditure around the sample mean.

The coefficient of variation (CV) for monthly consumption expenditure is 0.57 and indicates that there is significant but relatively moderate relative variation in household expenditure. The skewness coefficient of 2.45 also indicates a quite right-skewed distribution, and the kurtosis of 14.85 indicates a very leptokurtic distribution. The household consumption expenditure is therefore highly spread out by way of very low and medium consumption and relatively few households with very high expenditure. This distributional pattern is an important reason to use robust OLS estimates coupled with quantile regression for the mean.

Landholding has much more relative variation: the mean landholding is 0.35 acre whereas the median is only 0.08 acre. The much lower median than the mean indicates that most households have relatively small landholdings and that a relatively small number of households have much larger landholdings. This is also supported by the coefficient of variation of 1.73, the skewness of 4.35, and the kurtosis of 39.68. The extremely high kurtosis suggests that there are observations that have exceptionally large landholdings compared to the majority of the households. Such extreme heterogeneity makes the inclusion of landholding and proper treatment of influential observations particularly relevant in the regression analysis. The average household size is 4.03 members, with a median of 4 members and a standard deviation of 1.77. The close proximity of the mean and median suggests that the distribution is more concentrated than that for landholding and consumption expenditure, although the positive skewness of 1.16 indicates that some households may be much larger than the typical household.

The LPG variable is also quite heterogeneous. The average number of subsidised LPG cylinders received per month is 0.67 while the median is 0. The median value of zero means that more than half of the households in the sample did not receive a subsidised LPG cylinder in the reference period. At the same time, the standard deviation of 0.93 and coefficient of variation of 1.38 shows a large variation in the amount of subsidised LPG received by the households. The skewness coefficient of 1.18 suggests that the distribution is moderately right-skewed. The maximum value that we observe is four subsidised LPG cylinders per month received by one household.

We find that the descriptive statistics reveal considerable socioeconomic heterogeneity in the sample. Consumption expenditure and landholdings are particularly unevenly distributed and the subsidies of LPG to households are also highly different. This suggests that the single mean relationship may not be enough to explain the association between LPG subsidies and consumption expenditure in the household. The use of robust regression and quantile regression is therefore an appropriate adjunct to the conventional OLS analysis.

Only around 41.54 percent of households received a government-subsidised LPG cylinder, which suggests subsidised LPG access is substantial but not universal in the study sample. The relatively low median of the LPG variable with a positive mean also suggests that subsidy is transferred only to a small percentage of households. This point is especially important for assessing the distributional aspects of LPG policy.

Table 1: Descriptive statistics

Variable	Monthly Consumption Expenditure (Rs)	Land Holding (in acre)	Household size	LPG cylinder
Mean	12607.42	0.35	4.03	0.67
Median	11000	0.08	4.00	0
SD	7263.93	0.60	1.77	0.93
CV	0.57	1.73	0.44	1.38
Skewness	2.45	4.35	1.16	1.18
Kurtosis	14.85	39.68	6.77	3.26

Source: Authors' calculations

Table 2 shows the OLS and robust regression estimates of the relationship between subsidised LPG and household monthly consumption expenditure. The dependent variable is the logarithm of monthly household consumption expenditure. The results are largely similar for the two estimation approaches, suggesting that the main relationship is not driven solely by the traditional OLS estimation.

The coefficient of subsidised LPG cylinders is 0.06, and statistically significant at the 1% level in both cases. Since the dependent variable is in logarithmic form and the LPG is in the number of subsidised cylinders, the coefficient is a semi-elasticity. The OLS estimate suggests that each subsidised LPG cylinder per month is associated with about 6% more household consumption expenditure depending on the other ones in the model. Using the exact semi-log transformation, the estimated percentage association is approximately 6.18%.

This result indicates a positive association between subsidised LPG receipt and household consumption expenditure. One possible explanation is that subsidised LPG decreases the cost of cooking energy, thus allowing households to allocate resources to other consumption needs. However, the data is observational and not evidence that LPG subsidies cause household consumption expenditure to go up.

The coefficients on landholding are positive and statistically significant in both specifications. The positive coefficient on log landholding suggests that households with more land resources tend to have higher consumption expenditure (depending on other household characteristics). As the squared land term is added, the relationship between land resources and consumption expenditure is not linear. However, the economic interpretation of these two coefficients should be made jointly rather than separately, especially if the specification uses both log land and its squared term.

The ration card categories lead to systematic differences in consumption expenditure from the household without a ration card. The OLS specification shows that households with AAY, BPL, PHH, SFSS, and other ration card categories have negative and statistically significant coefficients compared to the omitted category of households without a ration card. The negative coefficients for AAY and BPL households are especially striking, because they are also households with higher exposure to targeted food security programs. The report can be interpreted as reflecting the fact that ration card status is a sign of poverty and that poverty is also reflected in household consumption expenditure, and therefore, the coefficients should

not be taken as a direct consequence of having a particular ration card. The coefficient for APL households is also negative in OLS and robust specifications, although the magnitude is smaller than those associated with several other ration-card categories. In the 30th quantile specification discussed below, the coefficient for APL becomes positive, which suggests that the relationship between ration card category and consumption expenditure may be different across the expenditure distribution.

Occupational status is strongly related to household consumption expenditure. Using casual labour in agriculture as the reference category, households that depend on casual non-agricultural labour, regular wage/salary employment, and self-employment have positive coefficients. The largest positive association is seen for regular wage/salary employment in non-agriculture, with a coefficient of about 0.18 in the OLS model. This is expected since relatively stable and higher-paying sources of household income are associated with higher consumption capacity. The coefficient for self-employment in non-agriculture is positive and statistically significant while self-employment in agriculture is less positive. The negative coefficient for the "other" occupational category indicates lower conditional consumption expenditure compared to the reference group. The occupational results indicate that the nature of the household's primary income-generating activity is an important determinant of consumption expenditure.

Internet access is positively and significantly related to household consumption expenditure. Households with internet access have a higher predicted level of consumption expenditure than those without internet access, depending on the other variables in the model. Internet access could partly account for differences in socioeconomic status, access to information, digital services, employment opportunities, and connectivity. However, this coefficient should also be viewed as conditional and not as a causal effect of internet access.

Household size is positively related to consumption expenditure in the OLS specification. This is intuitive since larger households have larger aggregate consumption needs. However, the household-size coefficient should be taken very carefully as the dependent variable is the total expenditure of the household rather than per capita consumption expenditure. A larger household can therefore have higher total expenditure even though the expenditure per member is lower.

Education is positively associated with household consumption expenditure in the baseline OLS model. Higher educational attainment might be associated with better employment opportunities, higher earnings, better access to formal sector employment, and differences in consumption preferences. The positive coefficient is therefore consistent with the wider socioeconomic relationship between human capital and household economic resources. The state dummy is positive and statistically significant. Using West Bengal as the reference state, Assam households have a higher conditional level of consumption expenditure after controlling for the other variables included in the model. This indicates that state-specific factors still matter after accounting for the observed household characteristics.

The residence variable has one of the largest coefficients in the model. Compared to rural households, urban households have much higher consumption expenditure. The positive

urban coefficient is indicative of income opportunities, labour-market structures, access to services, prices, and consumption habits between urban and rural households.

The OLS model explains approximately 41 percent of the variation in log household consumption expenditure, as indicated by the R-squared value of 0.41. This suggests a significant amount of explanatory power for a cross-sectional household-level model, though much of the variation is due to factors not captured by the explanatory variables. Importantly, the LPG coefficient also remains almost unchanged between OLS and robust regression. This consistency adds to the confidence that the main finding is not due to extreme observations alone. Still, we would like to make sure the difference in the control variables (household size and education) should be checked on the estimation output first.

Table 2: Regression results for OLS and Robust Regression.

Independent variable	OLS Estimation Coefficient (Robust standard error)	Robust Regression Coefficient
Subsidised LPG cylinder	0.06**(.0005)	0.06**(.0004)
log(land)	0.04**(.0008)	0.03**(.0008)
log(land ²)	0.008**(.0001)	0.008**(.0001)
Ration Card type Base (No ration card)		
<i>Antyodaya Anna Yojana (AAY)</i>	-0.18**(.002)	-0.17**(.002)
<i>Below Poverty Line (BPL)</i>	-0.20**(.002)	-0.20**(.002)
<i>Above Poverty Line (APL)</i>	-0.05**(.003)	-0.04**(.003)
<i>Priority House Holds (PHH)</i>	-0.17**(.001)	-0.18**(.001)
<i>State Food Security Scheme (SFSS)</i>	-0.12**(.002)	-0.13**(.001)
<i>Other</i>	-0.15**(.002)	-0.16**(.001)
Work Type base (CL_agriculture)		
<i>CL non-agriculture</i>	0.07**(.001)	0.07**(.001)
<i>RE_agriculture</i>	0.09**(.002)	0.08**(.003)
<i>RE_non-agriculture</i>	0.18 **(.001)	0.18**(.001)
<i>SE_agriculture</i>	0.02**(.001)	0.02**(.001)
<i>SE_non-agriculture</i>	0.12**(.001)	0.13**(.001)
<i>other</i>	-0.10 **(.003)	-0.08**(.002)
Internetuse Base(No internet)		
<i>Internet user</i>	0.08**(.0009)	0.07**(.0009)
Household size	0.13**(.0002)	0.03**(.0001)
Education level	0.03** (.0001)	0.17**(.0001)
State		

Base(West Bengal)		
Assam	0.19** (.001)	.1746225 **(.0011076)
Residence Base(Rural)		
Urban	0.42** (.003)	0.38**(.002)
Constant	8.42**(.002)	8.45**(.002)
R squared	0.41	

(Note: Significance level “**” at 1% and “*” at 5%, standard errors are in parenthesis, Source: Authors’ calculations)

Table 3 presents the quantile regression estimates at the 30th percentile of the conditional household consumption-expenditure distribution. Unlike OLS, which estimates the relationship at the conditional mean, quantile regression allows for analysis to examine whether the association between subsidised LPG and consumption expenditure differs among households situated toward the lower part of the expenditure distribution.

The most important result is the coefficient for subsidised LPG cylinders. At the 30th percentile, the coefficient is 0.07 and statistically significant at the 1 percent level, whereas 0.06 in the OLS specification. The coefficient implies that an additional subsidised LPG cylinder per month is associated with a 7 percent increase in household monthly consumption expenditure around the 30th percentile, while other characteristics are not changed. The exact semi-log interpretation is about 7.25 percent.

The bigger coefficient at the 30th percentile than the OLS estimate is suggestive of distributional heterogeneity: the association between subsidised LPG receipt and household consumption expenditure seems to be stronger among households that are in the lower part of the distribution of expenditure than at the conditional mean. This is particularly important from a policy perspective, since lower-expenditure households have a tighter budget and may therefore have a stronger link between energy expenditure reduction and their ability to allocate resources to other consumption needs. The quantile result is consistent with the possibility that subsidised LPG has greater relevance for households closer to the lower end of the expenditure distribution. For such households, even relatively modest reductions in the effective cost of cooking fuel might be a meaningful part of the household budget. So, resources associated with subsidised LPG may be linked to broader consumption expenditure more strongly than those associated with relatively affluent households. However, this interpretation is still associational because quantile regression does not in itself give a causal mechanism.

The coefficient on log landholding at the 30th percentile is positive but smaller than the corresponding OLS coefficient. The squared land term is also positive and statistically significant. This suggests that the relationship between land resources and consumption expenditure differs across the conditional expenditure distribution and that the relationship is weaker at the lower expenditure quantile than at the mean. The ration-card coefficients also show notable differences compared to the OLS estimates. AAY, BPL, PHH, SFSS, and other

types of ration cards are still negatively associated with consumption expenditure compared to families without ration cards, but their magnitude is generally smaller at the 30th percentile than in the OLS specification. The APL coefficient becomes positive at the 30th percentile. These differences suggest that ration-card status is not a uniform fact of household consumption expenditure from one to another.

Occupational coefficients are all in general consistent with the OLS findings. Compared with casual agricultural labour households, regular wage/salary employment in agriculture and non-agriculture is positively related to consumption expenditure. The coefficient for regular non-agricultural employment is particularly large at around 0.14. Self-employment in non-agriculture is also relatively strong positive. These results support the importance of employment structure in explaining household economic performance. The coefficient on internet access remains positive and statistically significant at the 30th percentile. This means that internet-connected households that fall in the lower part of the conditional expenditure distribution still spend more on consumption than other similar households without internet. Household size is positively associated with consumption expenditure at the 30th percentile, with a coefficient of approximately 0.12. Education is also positively associated with expenditure, but the estimated coefficient is smaller than that of some occupational and location-related variables.

The state coefficient for Assam is about 0.20 and statistically significant. Thus, even among households around the 30th percentile, Assam households have higher conditional consumption expenditure than comparable households in West Bengal after controlling for the other variables in the model. The urban-rural difference is especially pronounced. The coefficient on urban residence is approximately 0.44 at the 30th percentile, which indicates a strong positive association between urban residence and household consumption expenditure with rural residence. This is slightly larger than the corresponding OLS coefficient, implying that the difference between urban and rural expenditure is more pronounced at the lower part of the conditional expenditure distribution.

The pseudo-R-squared of 0.22 indicates that the explanatory variables account for a significant proportion of the variation around the 30th conditional quantile. However, the pseudo-R-squared values obtained via quantile regression are not directly comparable to the conventional OLS R-squared and should therefore not be interpreted as implying that the quantile model explains 22 percent of total expenditure variation in the same sense as the OLS R-squared.

Table 3: Quantile Regression Results.

Independent variable	Quantile regression 0.30 quantile
Subsidised LPG cylinder	0.07** (.0005)
log(land)	0.01** (.001)
log(land ²)	0.003** (.0002)

Ration Card type	
Base (No ration card)	
<i>Antyodaya Anna Yojana (AAY)</i>	-0.13** (.003)
<i>Below Poverty Line (BPL)</i>	-0.14** (.003)
<i>Above Poverty Line (APL)</i>	0.03** (.004)
<i>Priority House Holds (PHH)</i>	-0.09** (.002)
<i>State Food Security Scheme (SFSS)</i>	-0.09** (.002)
<i>Other</i>	-0.13** (.002)
Work Type	
base (CL_agriculture)	
<i>CL non-agriculture</i>	0.05** (.002)
<i>RE_agriculture</i>	0.07** (.004)
<i>RE_non-agriculture</i>	0.14** (.002)
<i>SE_agriculture</i>	0.01** (.002)
<i>SE_non-agriculture</i>	0.11** (.002)
<i>other</i>	-0.20** (.003)
Internet use	
Base(No internet)	
<i>Internet user</i>	0.07** (.001)
Household size	0.12** (.0003)
Education level	0.02** (.0002)
State	
Base(West Bengal)	
Assam	0.20** (.001)
Residence	
Base(Rural)	
Urban	0.44** (.003)
Constant	8.24 ** (.003)

(Note: Significance level “**” at 1% and “*” at 5%, standard errors are in parenthesis)

Number of obs– 889926, Pseudo R-squared - 0.22, Source: Authors’ calculations)

The results provide three broad conclusions. First, subsidised LPG is positively and significantly associated with household consumption expenditure after controlling for

landholding, occupational structure, ration card status, internet access, household size, education, state, and place of residence. Second, the similarity between OLS and robust regression estimates shows that the main LPG association is reasonably stable to the effect of unusual observations. Third, the quantile regression results show that the association is somewhat stronger among households towards the lower part of the consumption expenditure distribution.

These results are consistent with the economic argument that lowering the effective cost of a basic energy input can ease household budget constraints and allow resources to be deployed across a wider range of consumption needs. The result is especially relevant for the low-expenditure families since energy expenditure can be a large portion of their household budgets. However, the empirical estimates should not be interpreted as suggesting that LPG subsidies generate a corresponding increase in household consumption expenditure. The income of the household, preferences, LPG adoption decisions, access to markets, and other unobserved factors may influence both subsidy receipt and consumption expenditure at once.

The evidence should therefore be interpreted as showing a strong and statistically significant conditional association, with early evidence of a stronger relationship towards the lower end of the expenditure distribution. More causal studies, with longitudinal data and such instrumental variables and/or other credible identification strategies, would be useful to establish the causal welfare effects of LPG subsidies.

5. Discussion

The data shows that there is a consistent and statistically significant relationship between subsidised LPG receipt and household consumption expenditure. The coefficient on subsidised LPG cylinders is about 0.06 in both the OLS and robust regression specifications. Since the dependent variable is log-linear, it suggests that every subsidised LPG cylinder received as part of each month is associated with an increase in household monthly consumption expenditure by about 6.18 percent and all other household characteristics are unchanged. The stability of the coefficient in both OLS and robust regression indicates that the relationship is not dominated by the most important observations. Economically, the result is consistent with the possibility that subsidised LPG reduces the cost to the household of cooking and thus allows for much more for other consumption. However, since the analysis is based on cross-sectional observational data, one should consider the coefficient as a conditional association and not as a causal estimate of the welfare effect of LPG subsidies.

The results also show an overall positive and nonlinear relationship between landholding and household consumption expenditure. Both landholding and squared term are positive and statistically significant. If the nonlinear term is taken into account, we can see that the relationship between landholding and household consumption does not remain constant with different landholding levels. Land can give households productive assets, agricultural income, employment opportunities, and collateral or economic security. However, if net landholding is not lower than 50% and the marginality value is higher than 50%, the marginal relationship is stronger than when landholding is lower and the marginal factor is equal to

landholding is larger. In short, our earlier assumption that the marginal gain necessarily decreases at higher landholding levels should not be taken on unless the estimated specification actually yields a negative coefficient on the squared term or the marginal effect is diminishing. Thus, the coefficients should be interpreted jointly rather than describing the land and squared land coefficients separately.

Ration card status relates in a systematic way to household consumption expenditure. Compared to households without a ration card, households belonging to AAY, BPL, PHH, SFSS and other ration card categories have lower predicted consumption expenditure. The biggest negative relationships in the OLS specification are for BPL and AAY households. This data should not be taken as evidence that involvement in food security programmes reduces household welfare. Instead, as a whole, ration card status is very much related to socioeconomic vulnerability and is often used to identify households that might need more public support. The negative coefficients thus may at least partially reflect the economic disadvantage of households targeted by these schemes. In this context, the results are in agreement with the notion that welfare programmes are aimed at households with lower economic resources rather than the programmes themselves leading to lower consumption. The difference is that the regression does not identify the causal effect of ration-card participation.

The employment structure is a significant factor in household consumption expenditure. Compared to households that depend on casual agricultural labour, households with regular wage or salaried jobs and non-agricultural self-employment have higher consumption expenditure. The most positive association is for regular wage or salary work in non-agriculture and there is a coefficient of about 0.18, which is about 19.7 percent higher than in the reference category. This suggests that stable and diverse sources of income play an important role in household consumption capacity. Regular non-agricultural employment could provide more predictable earnings, better job security, and better access to formal economic opportunities than casual agricultural work. However, we would not expect that the transition into non-agricultural employment itself gives rise to the estimated increase in consumption because households that enter different jobs may differ in education, location, assets, and other things that are not observable.

Internet access is positively related to household consumption expenditure. The coefficient of about 0.08 indicates that households with internet access have an estimated consumption expenditure level about 8.3 percent higher than the comparable households without internet access. This may be linked to several complementary mechanisms. Internet access can enhance access to information, job opportunities, digital financial services, markets, government schemes, education, and other services. It may also increase participation in the formal and digital economy. At the same time, internet access is likely to be correlated with household income, education, urban residence, and other socioeconomic characteristics. For this reason, we should consider our results only as evidence of a strong relationship between digital connectivity and household economic status rather than as a single causal effect of internet access.

Household size is positively related to total household consumption expenditure. This is not surprising since larger households generally require more food, clothing, housing-related services, education, and other goods and services. The positive association could also be related to the fact that there are more income earners in larger households. However, since the dependent variable is the total household consumption expenditure, not consumption expenditure per household member, a higher household consumption expenditure is likely to be the main reason as to why such a large household can have a higher aggregate consumption expenditure than a smaller household. In future analysis in terms of per-capita expenditure or adult-equivalent expenditure, this level of household welfare could be further explored.

Education is positively related to household consumption expenditure. Higher educational attainment is associated with better employment opportunities and earning potential; higher occupational mobility; and access to economic and informational resources. The positive coefficient is therefore consistent with the larger human-capital perspective that education is a key determinant of household economic well-being. However, as with the other covariates, the coefficient should be considered to be conditional because education might also identify things that are unobserved such as ability, family background, occupational networks, and socioeconomic status. The state dummy shows a significant difference between Assam and West Bengal. With West Bengal as the reference category, the positive coefficient is 0.19 and Assam households have an estimated consumption expenditure of about 21% higher than West Bengal based on the exact semi-log transformation. This difference is not changed even after we take into account the household characteristics we included in our model. The state-level difference could potentially be related to the different prices and cost of living, domestic consumption structure, employment pattern, access to government programs, economic status of the region and the cultural background of the people living in Assam. Instead, it means there is a very large conditional difference for the two states that merits further investigation.

The coefficient associated with urban residence is particularly important. In comparison to rural households, urban households spend much more on consumption. The estimated coefficient of ≈ 0.42 in the OLS specification corresponds to an exact association of 52 percent. This could be because of the concentration of higher paying jobs, market integration, better access to services and the different price and preference of people in urban areas. At the same time urban families also pay higher prices for housing, transportation and other essential services. Indeed, the difference in nominal household expenditure should not be interpreted as the same difference in real welfare. A cost-of-living-adjusted or real expenditure analysis would be more precise in assessing the welfare effects of the urban-rural expenditure gap.

The constant term of approximately 8.42 is the predicted log monthly consumption expenditure for the reference household when the continuous explanatory variables are at zero and the categorical variables are at their omitted reference categories. In our case, that corresponds to a household in West Bengal which is rural, without internet, without a ration card and whose main employment category is casual agricultural labor, with the model taking continuous variables for consideration. The constant is only an intercept from which the other

estimated coefficients are interpreted and is not an economically meaningful estimate of a typical household.

The robust regression results largely support the central findings from OLS. In particular, the coefficient on subsidised LPG is still about 0.06 and statistically significant which indicates that the LPG consumption relationship is relatively stable when the influence of the most influential observations is reduced. The LPG coefficient remains the same in all estimation procedures, which is in part the reason why the findings are not necessarily endogenous or omitted variables.

Together, the findings suggest that household consumption expenditure is linked to energy access, productive assets, employment structure, social-protection status, digital connectivity, education, household composition and location. The positive relationship between subsidised LPG and consumption expenditure is particularly relevant for the welfare component of energy policy. The findings indicate that LPG subsidies may lead to greater household consumption capacity as opposed to just less expenditure on cooking fuel. The negative coefficients of targeted ration-card types as well as the lack of program participation are also important to ensure that the programme participation is linked to household vulnerability.

From a policy perspective, the findings favour an integrated approach to household welfare rather than treating energy subsidies as an individual intervention. Clean cooking fuel costs and affordability for economically vulnerable households can be especially important and sustainable for healthy cooking fuel consumption, and better employment, education, digital connections and access to productive assets may complement energy-support programs. The strong association for stable non-agricultural employment also demonstrates the importance of diversification of employment in rural areas where casual agricultural labour still dominates. The evidence is that the relationship between LPG subsidies and household consumption expenditure is positive, statistically significant and fairly robust across other estimation approaches. In our quantile regression results below, we further support this conclusion by examining whether the association is stronger among households at the lower end of the consumption expenditure distribution. This distributional analysis is important since an average association may miss the significant differences in the economic relevance of LPG subsidies between households with different consumption expenditure.

Quantile regression Results

Form the quantile regression results we observed that in case of bottom 30 percent of people (i.e. the household whose monthly consumption expenditure is below 30th quantile). A one unit extra subsidized cylinder increases their consumption expenditure by about 7 percent keeping other factors constant. The consumption expenditure of bottom 30 percent household in Assam is higher compared to West Bengal.

6. Conclusion

Using Household Consumption Expenditure Survey (HCES), 2023-24 data, we employed a log-linear model to assess the impact of government LPG subsidy on household welfare especially household consumption expenditure. The number of subsidised LPG cylinder

received by a household in a month is used as a proxy for LPG subsidy. We employed OLS with robust standard error to control for the heteroskedasticity and Robust Regression to account for outlier, and heteroskedasticity. Furthermore, to assess the differential impact of government LPG subsidy on household consumption expenditure at different income distribution of the households, we employed quantile regression. Since, the data on the level of income is not available in the particular dataset, rather a handful of proxies are available, and therefore we used those (i.e. land holding, work type, type of ration card held by household etc.) as a proxy for household income to reduce the possibility of omitted variable bias. We found that one unit increase in subsidized LPG cylinder correlates with a 6% increase in household consumption expenditure unanimously supported by OLS and Robust Regression results. However, this increase in household consumption expenditure is more (i.e., about 7%) in case of the household, whose consumption expenditure lies below 30th the quantile of the expenditure distribution. Overall, the empirical evidence suggest that LPG subsidy significantly increases household welfare by increasing household consumption expenditure. There finding are in line with (Timilsina et al., 2023; Bharati et al., 2021 and Guta et al., 2024). Moreover, in case of poor household, the impact of LPG subsidy on household consumption expenditure more, this finding is in line with (Coady et al., 2016 and Kojima et al., 2010; Tamanna, 2026). However, the main limitation of this paper lies in using the proxies for income which is a major determinant of consumption expenditure. Further research in this topic can be done by creating a new income index using income proxies. Nevertheless, this paper provides fresh evidence that, for the economic uplift of the poorer section of society, an energy subsidy could be an important policy strategy.

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