Understanding the Impact of Transport Fuel Subsidy Reforms on Household welfare –A study based on Indian Household Survey Data

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Overview

Transport planning plays an important role in climate change mitigation policies and energy security as it accounts for roughly 63% of the share of global consumption of liquid fuels (WEC, 2016); and is expected to increase more than 80% by 2050 accounting for 70% of carbon emissions (IEA, 2012). The bulk of this growth is expected to come from developing non-OECD regions, in particular, fast-growing emerging economies of Asia, owing to their strong economic growth, a considerable increase in the middle class population, and rising standard of living; thus augmenting the demand for personal transportation. Transport fuel subsidy reform is seen to to be a move in enabling the government to curtail fuel consumption and internalise the external cost of the fuel consumption and vehicle usage; to promote sustainable development. However, the reduction in the fuel consumption and carbon emissions depends on the consumer's sensitivity to the fuel price changes, precisely price and income elasticities. Elasticity values are crucial for the impact evaluation or the distributional incidence of such energy pricing policies. Furthermore, it allows policy makers to forecast and manage energy demand and setting optimal investments and tax rates on fuels.

Rapid urbanisation and increasing population in emerging economies has accelerated residential transport energy use and vehicle ownership to satisfy their demand for mobility. This may raise serious concerns for energy security and climate, especially for emerging countries including India (Proost and Dender, 2012). In India, most of the existing research on transport fuel demand studies are primarily based on aggregate level data at state level or country level; household level energy demand studies are limited to cooking and lighting fuels (For example, Farsi et al.,2007; Gupta and Kohlin, 2006; Gundimeda and Kohlin, 2008). Our paper tries to fill this research gap by using the micro-data set to understand the residential demand for transport fuels in India using a demand system model.

Methodology & Data

The study uses the Linear Approximate Almost Ideal Demand System (LA-AIDS) using a two-stage budgeting technique proposed by Deaton and Muellbauer (1980) for modelling the fuel consumption behaviour of households. In the first stage, household decides on how much of the total income (consumption expenditure data has been used here as proxy) is to be allocated for fuel consumption, subject to consumption of non-fuel commodities.

Stage 1: Fuel expenditure function

$$Ln\,(X) = b+b_1 Ln\,(Y) + \Sigma\theta_i Z_r \tag{1}$$

Where X is the per capita fuel expenditure and Y is the per capita total expenditure (proxy for income). Household characteristics (Z_r) include household size, location dummy and primary employment status. Since it is a log-log function, the coefficient of the income (b_1) itself gives the Engel estimate with respect to the fuel expenditure. The result of the Breusch-Pagan test confirmed the presence of heteroscedasticity by rejecting the null hypothesis of a constant variance at 1% level. To get rid of the problem, we estimated the Engel curve for fuel expenditure using robust regression. Equation 1 is estimated by the OLS method.

Stage 2: Linear Approximate-AIDS (LA-AIDS) Model

In the second stage, total fuel expenditure is allocated among the various fuel sources (Firewood, LPG, Electricity, Kerosene and Transport fuels). The model was estimated using the Iterated Seemingly Unrelated Regressions (ISUR) with the properties of adding-up ($\Sigma_i\alpha_i= 1;\ \Sigma_i\gamma_{ij}= \Sigma_i\beta_i= 0$); homogeneity ($\Sigma_i\gamma_{ij}=0$); and symmetry ($\gamma_{ij}= \gamma_{ji}$) constraints imposed. In order to control for the household heterogeneities, sample was divided into three expenditure classes namely; low, middle and high for both urban and rural areas. The LA-Almost Ideal Demand System model can be expressed as follows:

$$W_i = \alpha_{i^*} + \Sigma_j \gamma_{ij} \log P_j + \beta_i \log (x/P^*) + \Sigma \theta_{ir} Z_r \qquad (2)$$

Where W_i, P, P* and Z_r are the budget share of fuels, price of the good, Stone price index and households characteristics respectively. According to Deaton and Muellbauer (1980), log P is approximated using Stone's price index:

$$\log P = \Sigma_j w_i \log p_i \qquad (3)$$

Thus, the AIDS specification is linearised by applying the Stone's Price Index. We compute price and income elasticities from the estimated parameters of the LA/AIDS.

Data is sourced from the Consumption Expenditure Survey conducted quinquennially by the National Sample Survey Office (NSSO) for the year 2011-12 in its 68th round. Apart from the consumer expenditure details, the survey is also designed to collect information on demographic attributes, household characteristics like household size, primary occupation of its members, and social group (scheduled caste, scheduled tribe, other backward castes, others) thus taking into account possible heterogeneity among the households. The survey is based on a two-stage stratified random sampling procedure through interviews from 59,695 rural households and 41,967 urban households.

Results

Our preliminary results indicate that transport fuel constitute a major part- around 14% to16%- of household's total fuel expenditure; necessitating an in-depth analysis into the residential consumption pattern of the fuel for inclusive and sustainable energy development strategy. Income is found to be the most important factor influencing the households decision to spend on transport fuel; indicating that household demand for the fuel is likely to increase rapidly in the long-run with economic growth. Consumption of transport fuel is also significantly related to the price of the fuel, household size and employment status of the household. We find that transport fuels are income inelastic while being price elastic. The elasticity values also reflect that Government's decision to remove transport fuel subsidy in India may reduce the residential energy use; however, lower income group remain vulnerable to price changes impacting the household welfare negatively. Transport fuel is also found to be a necessary good and a sizeable growth in its demand is expected to come from middle income group. This is an important observation in the context of India's expanding middle-class population.

Conclusion

Our study thus evinces on the urgent need to bridge the policy gap by introducing alternate carbon policies which can take into account growth; inclusion; and sustainability. Without major policy intervention, transportation sector will be heavily dependent on fossil-fuels. The results from this study can be used to estimate household demand projections for transport fuel; understand and mitigate the distributional incidence of the subsidy reform; and the implications for India's transformative policy decision to completely decarbonise transport sector by 2030.

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