Analyzing the effects of renewable energy and climate conditions on consumer welfare

NON TECHNICAL EXECUTIVE SUMMARY

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This paper measures the impact of the gradual adoption of renewable energy sources (RES) on consumer welfare. The cost of renewable energy generation is increasingly becoming an issue with relevance and impact for policymakers, as it may impact negatively on household budgets, creating potential substitution and welfare effects with other consumer goods. As such, a household would have to reallocate its limited budget in an optimal way, taking account of the higher price of the new energy source and the conditions for its deployment. This inevitable price rise is the reason for our work in this paper, which offers a theoretically based comprehensive analysis of the welfare effect of the associated costs.

We include in our analysis a new empirical quantification of the effect of weather conditions that studies, in a more comprehensive fashion, the impact on consumer welfare. To use a classic example from the consumer literature, consider the innovation in long life milk or in the quality of babies' diapers and the price increases that may result. These innovations can have different beneficial effects on households, or not, depending on whether they have children, or not, as presented by Pollak and Wales (1981). Similarly, we note that different weather conditions have different impacts on the optimal share of energy in the consumer's budget and therefore on the consumer's choice, including specifically RES choice.

We base our analysis on constructing an empirical measure of the true cost of living (TCL) and the equivalence scale (ES) for the residential sector for 64 countries, representing over two-thirds of the world population, according to World Bank indicators. The TCL is a measure of the cost of living changes -- and thus of welfare changes -- resulting from energy price movements, assuming that the reference welfare level remains constant over time. This allows for analysis of how consumers adjust their demand so as to maintain the same level of welfare after a price change. In parallel, the ES is a measure comparing welfare across consumers with differentiating characteristics, like climatic conditions. It shows the relative welfare differential due to these structural characteristics, all else being equal, and can be used to analyze how more severe climatic conditions may imply higher final household expenditure for some countries, even if prices for other goods remain similar.

In order to calculate ES and TCL we estimate the demand system for the representative household in each country using non-linear econometric techniques. We find that the ES of the temperature variables is positive and increasing, implying that an increase in degree days has a positive effect on energy demand, all else being equal. In other words, countries with extreme weather conditions need to spend more on energy than those that have milder temperatures. In addition, we find differences between the TCL and the consumer price index as a measure of household welfare, which varies according to a country's development level. We also quantify a differentiated welfare impact across countries, according to simulations of alternative scenarios for renewable energy implementation to 2035. We find an expected increase in energy cost due to higher fossil fuel prices, which rise according to Hotelling's rule, but this can be limited if a higher share of the energy composite is met using renewable energy. This is because for renewable energy sources, unlike fossil fuel prices, capital costs are expected to decline as a result of technological innovation. Our results suggest that countries with mild weather conditions, such as sub-tropical African and Asian countries, benefit more from the deployment of RES.

Our paper's conclusions have two general policy implications. First, a household's potential welfare improvement is conditional on the need for energy subsidies for the implementation of RES. This imposes a fiscal discipline on the policymaker to consider resource constraints when financing renewables subsidies. Second, it allows us to offer to policymakers some basis for designing appropriate scenarios for the deployment of renewables with the aim of fostering consumer welfare in a least-cost manner on a world scale. There is no one-size-fits-all policy recipe, so policymakers should consider the specificity of their geo-economic structure to achieve the intended results. This should alert policymakers that there is an empirical basis for undertaking more effective international negotiations on topics that have traditionally been contentious.