Enhanced salience of nonlinear pricing and energy conservation

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- Nonlinear pricing systems, widely adopted by various utilities, particularly in low- and middle-income countries, are structured to promote energy conservation by imposing higher rates as consumption rises. However, many consumers are not fully informed about the timing and impact of these pricing tiers on their bills, leading to missed opportunities for energy savings and more efficient usage.
- This policy brief considers findings from a large-scale randomised controlled trial in Hanoi, Vietnam, which questions how a utility's redesigned mobile app interface – aimed at enhancing comprehension of nonlinear electricity pricing – affects consumer energy conservation.
- Findings suggest that leveraging digital data from smart meters and customer apps enables precise, high-frequency tracking of household energy consumption at a minimal cost.
- The app-based intervention is low-cost, scalable, and replicable, making it a practical tool for effective engagement in conservation efforts.

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Introduction

The energy efficiency paradox in low- and middle-income countries

In low- and middle-income countries (LMICs), the pressing energy dilemma revolves around the simultaneous need to meet escalating demands spurred by urbanisation and economic expansion while mitigating carbon emissions that originate from predominantly fossil fuel-dependent energy sources. This dual challenge necessitates not only the expansion of energy access to facilitate development but also demands that such expansion adheres to sustainability principles, minimising adverse environmental impacts. Deficient infrastructure and limited consumer comprehension regarding energy pricing structures further complicate matters, resulting in suboptimal energy utilisation and increased carbon emissions.

The ambiguous impacts of nonlinear pricing on energy consumption

Nonlinear pricing systems, widely adopted by various utilities, particularly in LMICs, are structured to promote energy conservation by imposing higher rates as consumption rises. The underlying concept aims to encourage lower-income households to maintain affordable access to basic electricity while imposing elevated rates on higher consumption levels to discourage excessive energy usage. This pricing strategy is envisioned to contribute to demand management and alleviate pressure on energy grids. However, the actual benefits of such a system remain unclear, primarily due to its intricate nature and a lack of consumer comprehension. Many consumers are not fully informed about the timing and impact of these pricing tiers on their bills, leading to missed opportunities for energy savings and more efficient usage (Ito, 2014; Shaffer, 2020).

Vietnam: A reflection of broader challenges

Hanoi – Vietnam’s capital and second-largest city – encapsulates the intricacies of managing urban energy demands. The city's swift economic expansion, growing household incomes, and escalating demand for electricity-intensive appliances parallel broader trends among low- and middle-income nations. The state-owned utility, EVN, employs a uniform six-tier nonlinear pricing system across Vietnam to address affordability and excessive usage concerns. However, persistent customer confusion regarding the intricate rate structure hampered its efficacy. A closer examination of Vietnam's initiatives to improve the understanding

of such nonlinear pricing and the ensuing consumer response provides valuable insights for LMICs striving to enhance energy sustainability.

Experiment design: utilising smart technology for consumer behaviour insights

This study, which commenced in October 2023, involves a large-scale randomised controlled trial in Hanoi, Vietnam. The primary focus is on evaluating the impact of an enhanced comprehension of nonlinear electricity pricing on consumer energy conservation.

In collaboration with EVN Hanoi, we utilise their recently introduced mobile app, integrated with the existing widespread smart meter infrastructure. From the pool of users of the utility mobile app, we randomly select 45,000 households. Subsequently, these households are assigned randomly to two treatment groups and a control group as follows:

- Treatment 1: Receives a graphical display of real-time marginal price tiers.
- Treatment 2: Receives a real-time display of the estimated cumulative bill to date.
- Control group: Has no access to detailed pricing information on their app.

The app's redesigned interfaces present personalised nonlinear pricing levels or cumulative costs corresponding to current consumption. The objective is to enhance users' understanding of how the pricing system influences costs, ultimately fostering energy conservation.

Noteworthy innovations of the project include the low-cost, scalable, and replicable nature of the app-based intervention and the use of digital data for accurate, high-frequency household-level tracking at minimal cost.

FIGURE 1: EVN Hanoi mobile app

Research Questions

This project specifically addresses three questions:

- Does frequent marginal price/cost data assist consumers in responding more effectively to nonlinear pricing for energy conservation?
- Is marginal price or total cost data more influential in inducing behavioural changes?
- How do responses evolve over time?

We investigate whether initial adjustments in energy usage persist and transform into more sustainable habits. By continuously monitoring changes in daily energy usage, the research explores how sustained access to electricity consumption information shapes long-term consumer behaviour.

Policy implications

The findings of this research offer several potential advantages for practical policymaking, particularly in the domain of energy efficiency and conservation. Leveraging digital data from smart meters and customer apps enables precise, high-frequency tracking of household energy consumption at a minimal cost. EVN Hanoi's recently introduced mobile app, coupled with the existing smart meter infrastructure, facilitates direct and cost-effective data sharing between the utility and customers, providing immediate consumption feedback crucial for accurate analysis of conservation behaviour.

Specifically, we assess the efficacy of apps as a cost-effective tool to promote environmentally friendly habits. The app allows customers easy access to personalised energy usage data and associated costs, fostering more informed and proactive planning for future consumption. This is particularly significant in a nonlinear pricing system with multiple tiers, where traditional monthly paper bills often fall short of indicating when prices shift to a higher tier. The role of technology in this context may be pivotal in understanding whether the limited comprehension of the nonlinear pricing system's benefits is attributed to its complexity or other factors. The app-based intervention is low-cost, scalable, and replicable, making it a practical tool for effective engagement in conservation efforts.

Lastly, the substantial sample size of our research enhances the reliability of our findings and broadens their applicability, especially in rapidly urbanising areas. We anticipate that the insights gained from our study in Hanoi can serve as a

model for other low- and middle-income countries or urban environments where digital tools are increasingly prevalent.

References

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