ABSTRACT

One in every five people in the world does not have access to electricity. This population lives on less than 2 USD daily income and mainly relies on harmful kerosene for their lighting needs. Solar based solutions such as solar home systems and portable solar bulbs require high upfront investment and are often unaffordable for this market due to their tight liquidity constraints. In contrast, there are business models relying on rechargeable light bulbs that are sold at a subsidized price (which makes them affordable) and require regular micropayments for recharges (which helps with liquidity constraints). These bulbs provide a cheaper and healthier light source than kerosene, yet their adoption is lower than expected and some consumers continue to use kerosene. In this paper, we propose a stylized consumer behaviour model to explain this technology preference. In addition to monetary costs incurred while using a light source, our model accounts for the inconvenience cost (due to repeated purchases) and blackout cost (due to liquidity constraints) associated with that source. We find that, although using kerosene costs more money than bulbs, consumers who face high inconvenience (blackout) cost relative to blackout (inconvenience) cost prefer kerosene to bulbs because the quantity flexibility offered by kerosene allows them to purchase in large (small) quantities which helps them save on their long run inconvenience (blackout) cost. At the firm level, increasing bulb capacity increases market level demand for bulbs but reduces revenue-per-consumer due to lower recharge frequency. This trade-off leads to an optimal bulb capacity. We also show that the firm operating rechargeable bulbs could gain consumers from the segments which normally prefer kerosene by offering a more flexible product design, such as allowing partial recharges. Strategies which alleviate liquidity constraints (such as price discounts, mobile micropayments) may not always lead to better adoption because they result in higher consumption rate in the long run which in turn leads to higher inconvenience. However, when they are combined with inconvenience reducing strategies, together they are likely to improve the usage of bulbs.
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