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Social acceptance of new energy technology in developing countries: A framing experiment in rural India

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ABSTRACT

While the literature on the social acceptance of new technologies focuses on industrialized societies, concerns about new technologies are often deeper and more widespread in developing countries. In a survey experiment with 3208 villagers from six major states of northern India, we examine the social acceptance of off-grid solar power as an alternative to grid extension. By randomly assigning different frames about this energy technology to the villagers, we study how concerns about the cost of sustainable energy, inequality of energy access, and the role of private business and the state shape individuals' acceptance of off-grid solar power. We find that concerns about the role of private business and possible increases in rural-urban inequality are salient among the rural population. The rural population is concerned about (i) exploitative businesses practices and (ii) the inequality that solar power in villages is more expensive than conventional grid power in urban areas. These findings show that the social acceptance of new, sustainable energy technologies cannot be taken for granted in rural development and offer insights into the salience of different varieties of concerns.

1. Introduction

How can we understand the social acceptance of new technology in developing societies? The literature on the social acceptance of energy technology is enormous but largely focuses on industrialized societies. The few studies that focus on the developing world – such as Yuan et al. (2011) on solar power, Amigun et al. (2011) on biofuels in Africa, and Mallett (2007) on renewable energy technology in general – are mostly descriptive and do not try explain patterns of social acceptance and opposition. And yet, if anything, new technologies have larger social effects in developing than in industrialized countries. On the one hand, new technologies hold greater potential to improve productivity and improve the quality of life in conditions of poverty and scarcity. On the other hand, new technologies also present a more significant change to societies that are less used to continuous technological change.

Our research focuses on the introduction of off-grid solar power as a complement or substitute to traditional grid extension in rural India, where one-third of the population lives without a household electricity connection (Government of India, 2011). Some see solar energy as a promising solution to improve rural electrification in the country, but off-grid solar power is not without detractors. Compared to conventional grid electricity, the unit cost of off-grid solar power is much higher, especially when one considers the subsidized grid electricity prices in rural India (Gambhir et al., 2012). Meanwhile, the Government of India does not have a consistent long-term program for the development of off-grid solar power, bringing uncertainty to the prospects of solar energy in the country. Although private entrepreneurs have begun to install solar technology on a commercial basis, studies show that India's rural population holds negative perceptions of the private sector (Urpelainen, 2016). With rural poverty being a lasting concern in Indian political debates (Drèze and Amartya, 2002) and, by some estimates, Indian households spending about 13.2% of their monthly expenditure on energy (Alkon et al., 2015, 3), theories of "relative deprivation" (Smith et al., 2012; Fontaine and Yamada, 2014) suggest that rural households react negatively to the possibility that they have to pay more for their electricity than their wealthier urban counterparts.

We look at how different ways of framing a new technology influence public opinion toward it. In this context, to frame is "to select some aspects of a perceived reality and make them more salient" (Entman, 1993, 52). In a survey experiment, we randomly assign different descriptions of off-grid solar power to respondents to test how framing influences popular support for this technology as an alternative to traditional grid extension (Gaines et al., 2007). Because we focus on

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a new technology to reduce energy poverty with potential to improve the quality of life, we concentrate on assessing the effects of *negative* frames. In other words, we consider the new technology a potentially valuable innovation and examine whether negative frames undermine its legitimacy among the general population in a developing society.

Specifically, we test two sets of hypotheses on the origins of negative perceptions of new technology. The first pertains to the role of the *identity* of the actors that provide the technology. We examine how survey respondents react to frames that emphasize the role of the state or the private sector in promoting the use of off-grid solar power, expecting both frames to reduce popular support for solar power. The literature on Indian public opinion, both generally and in the context of energy technology, has found that the rural population distrusts both the state (Lal, 2006) and private business (Santhakumar, 2008; Aklin et al., 2014). The second pertains to the cost of off-grid solar power relative to subsidized grid electricity. We frame the issue first in terms of the cost implication, and then in terms of the rural-urban inequalities surrounding the introduction of off-grid solar power, again expecting both frames to reduce support for solar power.

The results show that framing solar technology in light of private business involvement or rural-urban inequality provokes opposition against it among the study population. Both frames have a statistically significant negative effect on support for solar power, whereas frames emphasizing government intervention or higher prices have smaller and less significant effects. Specifically, putting the emphasis on privatization decreases support for solar power by 0.07 standard deviations, while highlighting rural-urban inequality reduces such support by 0.081 standard deviations.[1] These effects, then, are substantively large. Additional subgroup analysis suggests that the results are mainly driven by households with established grid connection, households living in electrified habitations, households who have heard of solar power, and households who prefer micro-grids over regular grids.

2. Solar energy in rural India

Large swaths of rural India remain without access to reliable electricity. According to the 2011 Census of India, 400 million people lived in a household that did not use electricity as its primary source of lighting (Government of India, 2011). This amounts to 67% of the Indian population; in rural areas, 45% of households were without basic electricity access. Although the numbers have improved somewhat over the past years, as the government has invested in a major electrification drive called the Rajiv Gandhi Rural Electrification Scheme (Palit et al., 2014), hundreds of millions remain without basic electricity access. Even among households with a household electricity connection to the main grid, fluctuating voltage and frequent power outages reduce the value of such access (Chakravorty et al., 2014; Harish and Tongia, 2014).

Distributed solar power offers a possible solution to this problem. While reforms of the Indian power sector remain mired in political difficulties (Kale, 2004; Joseph, 2010; Aklin et al., 2014), village-level solar power can be provided at the local level. Technology options range from solar home systems to micro-grids that distribute electricity to multiple households (Chaurey and Kandpal, 2010). A typical solar power system contains a solar panel, a battery for storage, and the wiring required to distribute the power. In the 2011 Census of India, fewer than 1% of all households reported using solar power as their primary source of lighting (Government of India, 2011), but the number is rapidly increasing. Rural India now has a large number of entrepreneurs who sell solar home systems, operate micro-grids for a monthly service fee, or lease out equipment to interested rural communities.

While distributed solar power can contribute to basic energy access in rural India, it is not without its weaknesses. Typically, the cost of purchasing one unit of electricity generated with off-grid solar technology is very high compared to the cost of grid electricity, especially after one considers the heavily subsidized electricity prices in India. The high unit price of solar electricity has two consequences. First, it means that distributed solar power is not ideally suited to generating large loads of power. Ultra-efficient technologies allow households to gain affordable access to basic services, especially lighting and mobile charging (Alstone et al., 2015), because the number of units of electricity generated is low, but the cost of solar electricity would be much higher if the households were to have a fridge or an air-conditioner. Even the cost of operating a fan would be relatively high.

Second, the high unit cost of solar electricity inevitably prompts the question of equity. When poor rural households pay more per unit of electricity than their much wealthier urban counterparts, economic inequality increases. Some Indian non-governmental organizations, such as Prayas, are indeed calling for regulatory approaches to reduce inequality in electricity prices for the poor when decentralized options are used. As the Prayas Energy Group, an Indian non-governmental organization advocating for equitable electricity supply, puts it, “new policy-regulatory instruments for more equitable tariffs and innovative sustainable business models be put in place going forward” (Gambhir et al., 2012, 14).

3. Poverty, inequality, and new technology

We expect an energy-poor rural population to see new energy technology both as an opportunity and a potentially disruptive force. Given that the argument for new technology as an opportunity is straightforward, the theory building focuses on the disruptive effects of technology. We analyze the “social acceptance” of new technology with an emphasis on the negative consequences of fears about disruptive effects, defining the term according to whether “broad majorities of people tend to agree with the idea of public support” (Wüstenhagen et al., 2007, 2685).[2] In practice, our empirical approach examines people's support for government subsidies for new technology – in this case, off-grid solar power. Importantly, we do not examine people's individual willingness to pay for new technology, as such decisions are only partially related to the broader issue of social acceptance.

We borrow from Assefa and Frostell (2007, 69), who consider “fear” or “concern” to be central elements of the social acceptance of new technologies. Defined as an “unpleasant feeling of perceived risk or danger, real or not,” the notion of fear captures the general public's concerns about the negative consequences of new technology. In the context of rural India, for example, fear could originate from the general public's concerns about the affordability of electric power. Hypotheses that frame solar off-grid power in terms of possible negative consequences increase the salience of the fearful reaction, and could thus turn the population against off-grid solar power.

Our first set of hypotheses focuses on the possible negative effects of new technology. Drawing on a large body of literature on the social acceptance of new technologies, we hypothesize about the effects of high cost and inequalities. Although the role of these factors in shaping public opinion has not been studied in the context of widespread rural poverty, the theoretical expectations are clear: concerns with cost and inequality should reduce popular support for new technology. In economic sociology, this approach falls under the category of those that emphasize the characteristics of a technology in explaining the diffusion of innovations (Wejnert, 2002).

The second set of hypotheses focuses on the role of the state and private actors in the introduction of new technology. New technologies

[1] These estimates are based on models with village fixed effects. Results are virtually the same if state fixed effects are used instead.

[2] Wüstenhagen et al. (2007) also offer more restrictive definitions focusing on “community acceptance” and “market acceptance.”