

Q-complementarity in household adoption of photovoltaics and electricity-intensive goods: The case of electric vehicles

Jed Cohen¹⁽¹⁾, Valeria Azarova⁽¹⁾, Andrea Kollmann⁽¹⁾, Johannes Reichl⁽¹⁾

⁽¹⁾Energieinstitut an der Johannes Kepler Universität Linz

Motivation und zentrale Fragestellung

Many past studies have investigated the driving factors and attitudes behind household adoption of low-carbon, pro-environmental energy items, especially PV (photovoltaic) units and EVs (electric vehicles). This paper takes a step past the study of factors driving adoption of PV and EV, to look into the potential relationship between these two decisions. Specifically, we posit that PV and EV technologies may be q-complements in household utility, such that the welfare gain (benefits) from adopting one of these technologies is increased if the other technology is also owned/adopted. Joint ownership of an EV and a PV unit can allow for greater loadshifting potential, where the household shifts the times of electricity use to deploy more 'home-made' solar power in the home. Utility of the PV unit could increase through the following two avenues:

1. Increasing the households' perception of their environmental efficacy, and their interest in energy topics.
2. Saving money and increasing ROI from the investment in a PV unit.

Methodische Vorgangsweise

A theoretical model is developed whereby households may make EV and PV adoption decisions as a joint decision process, where the goods are compliments in utility, or "q-compliments". The theoretical exposition shows that if EVs and PV units are q-compliments then we should see correlated adoption of these goods. Obviously, many other factors affecting household consumption decisions will also result in correlated adoption decisions, most notably income and environmental awareness. Thus, we employ multiple statistical models and a suite of explanatory variables to control for possibly confounding effects. This includes the use of a recursive bivariate probit model, which accounts for potential endogeneity between EV and PV decisions, which will exist if the theoretical model of a joint decision process holds true.

Data for the statistical analysis come from the LEAFS project survey of Austrian residential electricity customers from the states of Salzburg and Upper Austria. The survey obtained socio-demographic information from respondents, including their living situation, appliance ownership, and various questions about their future energy behavior. In total, 2,541 responses were collected, with 25% of respondents owning a PV unit, 4.2% owning an EV, and 25% stating that they plan to purchase an EV in the next 5 years.

Ergebnisse und Schlussfolgerungen

As a first novel output we find that PV ownership is in fact correlated with the ownership of big ticket, electricity-intensive household goods including electric central heaters, dryers, saunas, pools, and EVs, after controlling for income and environmental-attitude effects. This finding suggests that PV units may be q-complements to the listed goods due to the increased perception of environmental efficacy and potential for loadshifting/offsetting electricity consumption in households who own these big ticket items. Our findings with respect to PV adoption also confirm past literature in showing that environmentalist attitudes, home ownership, and household size positively influence adoption probability [1, 3].

As a second novel output, we show a positive relationship between household PV ownership with EV ownership, and with the intention to purchase EV in the next five years. Notice that while PV ownership has an effect on current EV ownership, with an estimated 7% increase in EV ownership probability, it has a relatively strong effect on the intention for future EV adoption, with an estimated 18% increase in EV adoption intention probability. This difference could signify an increased interest in

¹ Altenbergerstraße 69, 4040 Linz, Österreich, Telefon- +43 732 2468 5662, Email – cohen@energieinstitut-linz.at

energy issues and sustainable energy practices following household PV adoption, as discussed by prior research [2, 4]. Nevertheless, the findings support our hypothesis of q-complementarity, namely that having a PV unit may increase the marginal utility gained from purchasing an EV.

Literatur

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