# To Lease or to Own: A Behavioral Study on Solar Panels

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## Abstract

There has been an increase in residential solar photovoltaic (PV) systems in Massachusetts and nationwide from 2010 to 2018. Residents face a crucial decision: to rent or to own solar PV. There are many factors that determine household decisions to rent or own. This project examines whether household risk aversion and patience affect this choice. We found that risk averse households are likely to rent. Patience has little effect. In addition, the findings help make policy recommendations at the state level to help localize tax incentives.

## Motivation


Fig. 1: Solar Installation. Source: Getty Images

Among the households that have solar PV systems in Massachusetts, 68% are lessees and 32% are owners. The Massachusetts state government provides tax incentives to promote residential solar energy. When a resident chooses to own, the state incentives can be localized. The table below highlights the differences between the own versus lease options.

| | Own | Lease |
|---|---|---|
| Upfront cost for panels | ✓ | |
| Operation and maintenance cost | ✓ | |
| Eligible for rebates and tax incentives | ✓ | partial |
| Can sell SREC credits | ✓ | |
| Complete control over panel and roof | ✓ | |
| Energy Savings | high | high |
| Risk | | |
| Equipment Failure | ✓ | |
| Unforeseen sale of home | | ✓ |
| Lower than expected SREC price | ✓ | |

Table. 1: Own vs Lease

The choice between these two options naturally depends upon the level of risk aversion and patience (known as risk and time preferences, respectively).

## Sample

- Data on postal addresses of all solar residential installations in MA between 2010-2018 under the Massachusetts Renewable Portfolio Standard (RPS) Solar Carve-Out Program
- Sent recruitment letters to residential solar owners/lessees in Hampshire County, MA
  - 3,000 letters sent, approx. 8% response rate
- 248 participants across 13 lab sessions

## Methods

Each household participated in a three-part computerized session that lasted roughly 2.5 hours. The parts are as follows:

1. Incentivized Risk Tasks (40 decisions)
   - Choose between lottery options **A** and **B** (differing in prizes and winning probabilities)
2. Incentivized Time Preference Tasks (40 decisions)
   - Choose between time options **A** (lower sooner payment) and **B** (larger later payment)
3. Solar PV Survey (50+ questions)
   - Demographic characteristics (political affiliation, income, etc.)
   - Solar PV system information
   - Factors considered in solar adoption decision
   - Environmental preference indicators

## Decision Environment

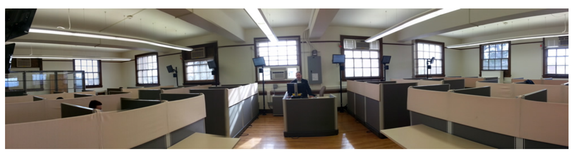

Fig. 2: Cleve E. Willis Experimental Lab

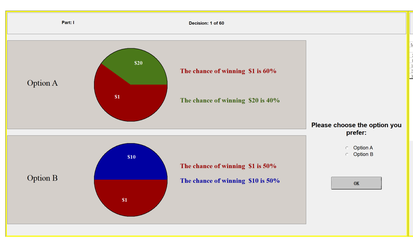


Fig. 3: Risk Aversion

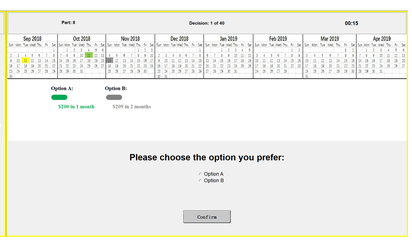


Fig. 4: Individual Discount Rate

## Results

We found that people who are more risk averse are more likely to lease. Patience, however, has no impact on the lease/own decision. These results are robust after controlling for time delay and PV system capacity.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| r | 0.788*** | 0.752*** | 0.802*** | 0.667*** |
| | (0.045) | (0.046) | (0.047) | (0.042) |
| r_lease | | 0.076*** | 0.076*** | 0.086*** |
| | | (0.022) | (0.023) | (0.031) |
| r_capacity | | | 0.357*** | 0.384*** |
| | | | (0.036) | (0.018) |
| r_delay | | | | 0.049*** |
| | | | | (0.008) |
| $\delta$ | 0.047*** | 0.048*** | 0.036*** | 0.094*** |
| | (0.010) | (0.009) | (0.011) | (0.019) |
| $\delta$_lease | | −0.001 | −0.001 | 0.002 |
| | | (0.008) | (0.005) | (0.012) |
| $\delta$_capacity | | | 0.102*** | 0.238*** |
| | | | (0.021) | (0.026) |
| $\delta$_delay | | | | −0.0207*** |
| | | | | (0.004) |
| $\mu$_r | 21.010*** | 20.870*** | 20.820*** | 21.060*** |
| | (0.867) | (0.866) | (0.869) | (0.895) |
| $\mu$_$\delta$ | 0.142*** | 0.141*** | 0.143*** | 0.112*** |
| | (0.034) | (0.034) | (0.034) | (0.024) |
| Log likelihood | −12198.539 | −12098.604 | −12088.618 | −12004.808 |

Robust standard errors clustered at household level in parentheses
N = 20160
*** $p < 0.01$

Survey results indicate the highest income bracket ($165,000+) is more likely to own and education has no impact. Additionally, strong previous pro-environmental decisions (like owning a hybrid vehicle) indicate increased likelihood to own.

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