

# Information Search and Peer Effects in Adopters of Residential Solar PV

Dr. Varun Rai

*Asst. Prof of Public Affairs*

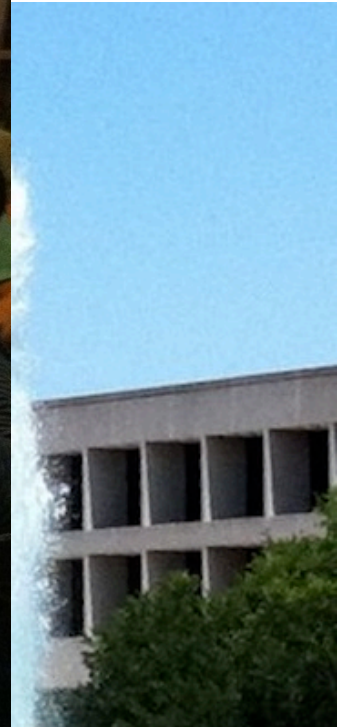
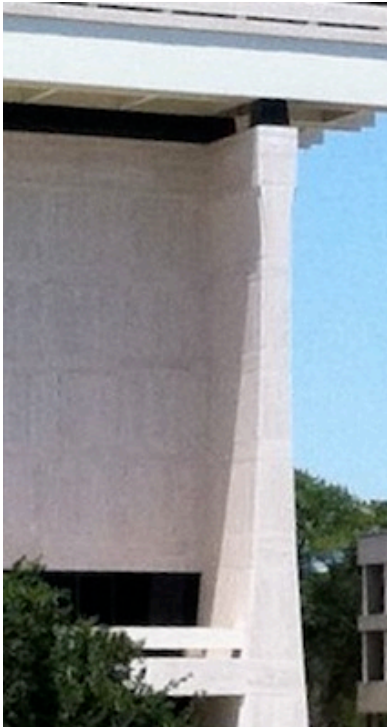
*Asst. Prof of Mechanical Engg.*

**University of Texas at Austin**

**Energy Systems Transformation Research Group (EST GROUP)**

BECC, Sacramento  
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[raivarun@gmail.com](mailto:raivarun@gmail.com)

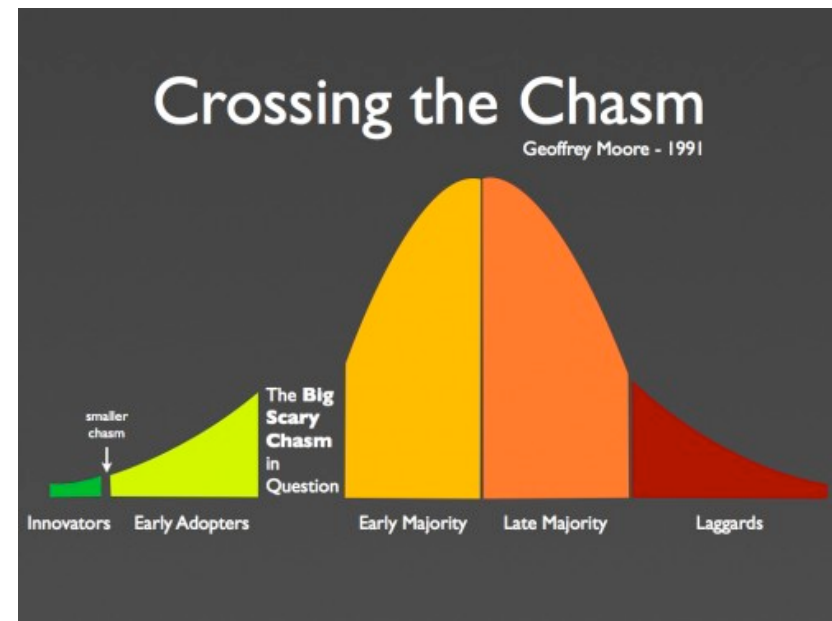




# The Project

## *Decision-Making and Behavior Change in PV Adopters*

- *Influence of contextual and attitudinal factors*
  - Impact of electricity rates, incentives, and socio-demographics (income, home value, environmental beliefs, etc.)
- *Uncertainties and non-monetary costs, and information networks*
  - Individual discount rates
  - Information networks
- *Post-installation experience*
  - Awareness of electricity use
  - Behavior change
    - Rebound or Ripple
    - Load-shifting





# Main Lines of Analysis

- Sources of information
- Financial aspects
- Post-installation experience
- Buy vs. lease
  - Cross-cutting evaluation of differences between buyers and leasers across the three dimensions above: finances; information; post-install experience



# Data

## 1. Program data collected by utilities in Texas

## 2. Survey of PV adopters

- Completed in Texas during Aug-Nov 2011
  - 365 completed responses, covering installations between 2004-2011
  - ~20% of the target population (existing rooftop PV owners). >30% response
- Data collected on
  - System details
  - Decision-making process
  - Financial aspects
  - Sources of information
  - Post-installation experience
  - Environmental attitude
  - Demographics



# Basic Demographics

Compared to the average population, PV adopters earn more, are more educated, and are older

- Median 2011 household income of sample is between \$85k-\$115k
  - Median 2009 household income in Texas was \$48,286 (Census 2010)
- Over 80% of the PV adopter sample has at least a bachelor's degree
  - 25.4% of Texas residents have a bachelor's or higher degree (Census 2010)
- Mean age of sample is 52 years (s.d. 11.4 years)
  - Median age of Texas residents in 2010 was 33.6 years (Census 2010)



# Motivation to Install PV

## All Responders

	General interest	Financial investment	Environmental impact	Influence of neighbors	Influence of acquaintance
Not important at all					
Somewhat important					
Moderately important					
Very important					
Extremely important					

## Total

- General interest: “Energy security”; “Off the grid”; “New technologies”





# Motivation to Install PV

## All Responders

	General interest	Financial investment	Environmental impact	Influence of neighbors	Influence of acquaintance
Not important at all	3.57%	4.35%	5.90%	72.05%	79.69%
Somewhat important	7.40%	6.91%	10.00%	11.79%	4.88%
Moderately important	17.35%	17.14%	14.62%	8.97%	8.23%
Very important	34.44%	33.25%	22.82%	5.90%	4.88%
Extremely important	37.24%	38.36%	46.67%	1.28%	2.31%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

- High level of interest in energy and environmental issues
- PV adopters pay close attention to financial/investment aspects of PV

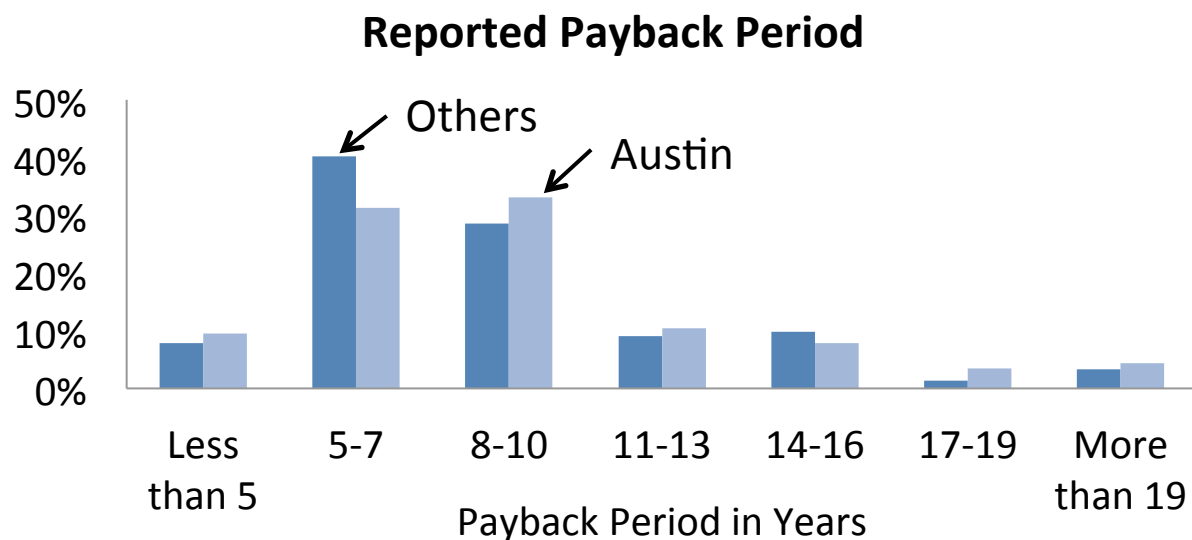




# Information Channels for Potential PV Adopters



# Potential PV Adopters Spend Most Time Understanding Financial Implications of PV



All Responders		
	Number	Percent
NPV	37	11.78%
IRR	113	35.99%
Payback Period	274	87.26%
None	23	7.32%
Number of Responders	314	

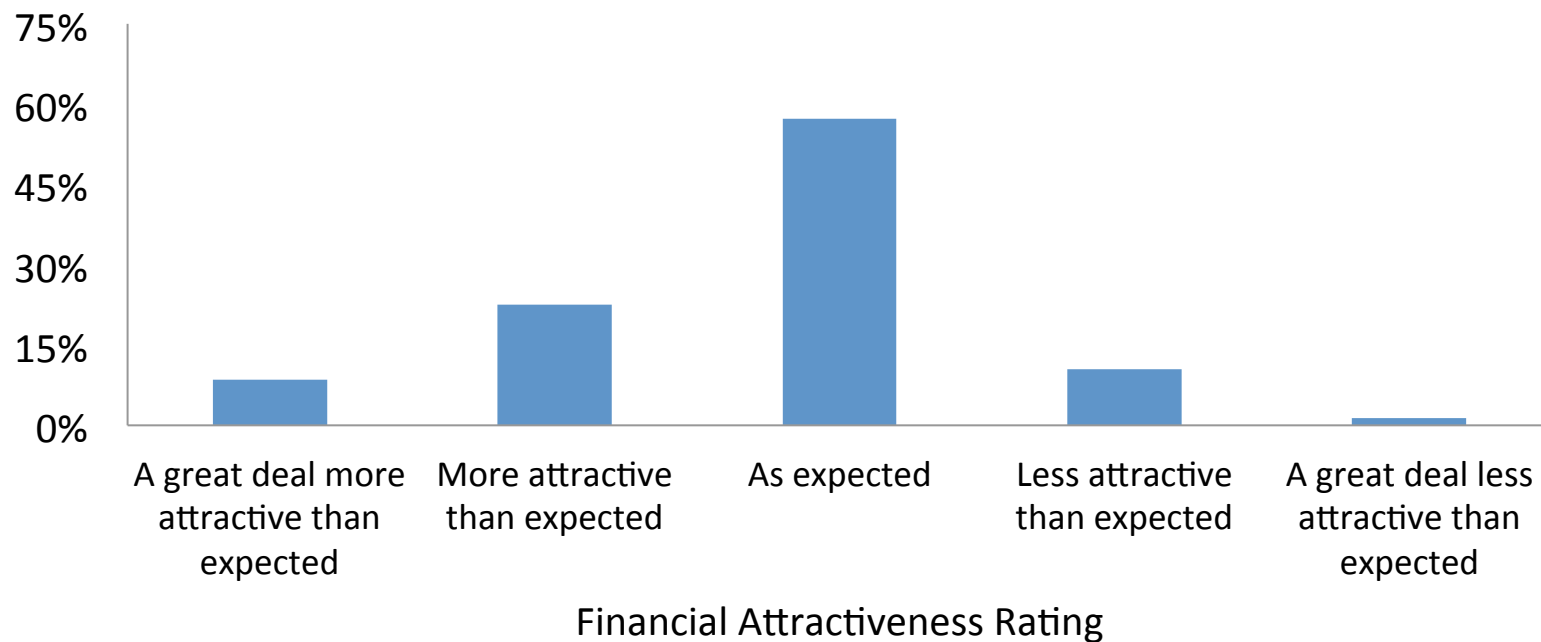
Help With Financial Calculations		
	All Responders	
	Number	Percent
Neighbor	10	2.72%
Family	10	2.72%
Contractor	164	44.69%
Online	26	7.08%
Utility	17	4.63%
Non-profit	7	1.91%
Myself	212	57.77%
No Calculations	27	7.36%
Number of Responders	367	



# Financial Attractiveness Post-Installation

- Typical investment scale: \$25-30 k
- **At the time of installation**
  - 68% report that they thought investment was financially attractive
  - 14% report they thought that the investment was not attractive

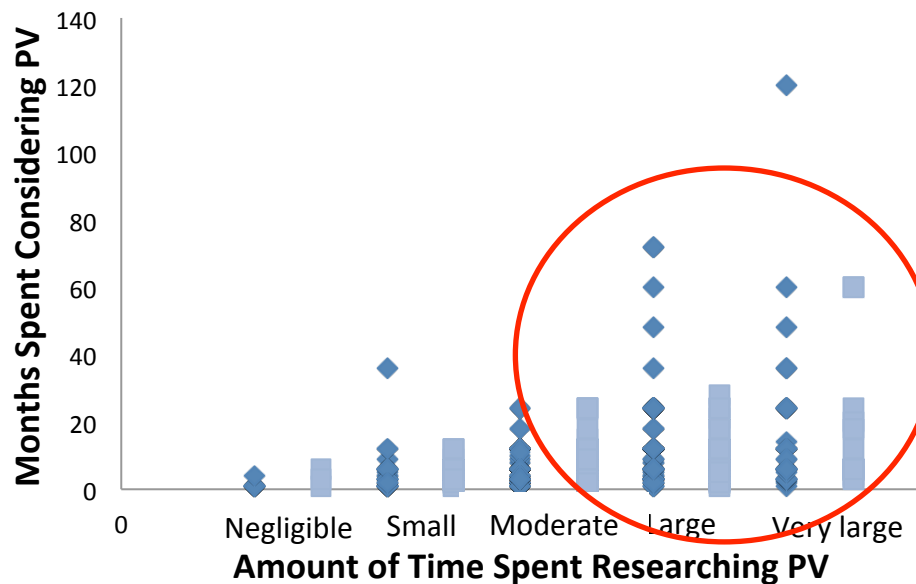
**All Responders: Post-installation Financial Attractiveness of PV**



# Information Overload

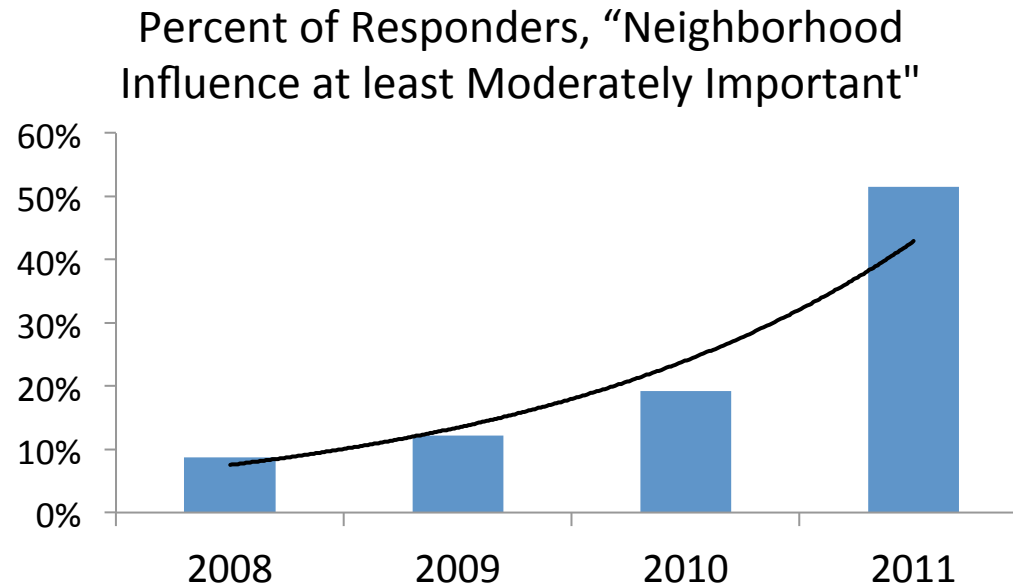
- Relatively easy to find information on solar PV
- But it takes considerable amount of time and effort
- Trustworthiness of information the main reason for extra time and effort
  - Centralized info by a **trusted “3<sup>rd</sup> party”** (Government; University; Utility)

## Research vs Consideration Time



# Peer Effects in Decision to Install PV

(Austin Data)



Level of Peer Effects = Number of PV systems in the neighborhood + Controls

Adj.  $R^2 = 0.15$

$P < 0.0001$

IV  $p < 0.001$



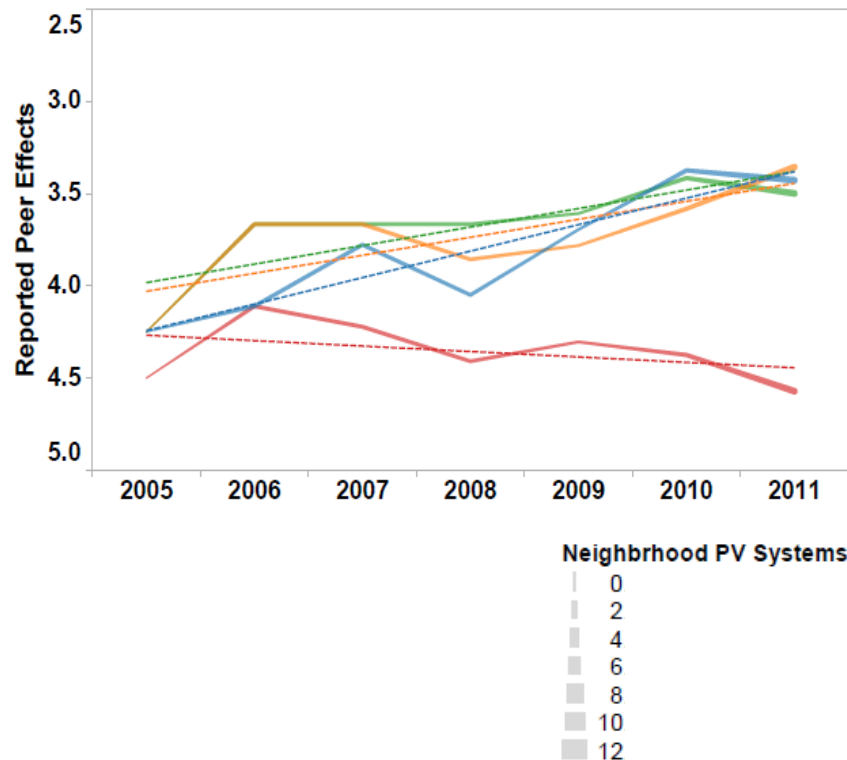
# Direct vs. Indirect Peer Effects

- **Neighborhood:** Defined as a radius of 5-10 blocks around the house
- **Indirect peer effects**
  - Attitudinal and behavioral stimulus that *seeing* PV systems in the neighborhood induces
- **Direct peer effects**
  - Includes the effect of *contact* with other PV owners

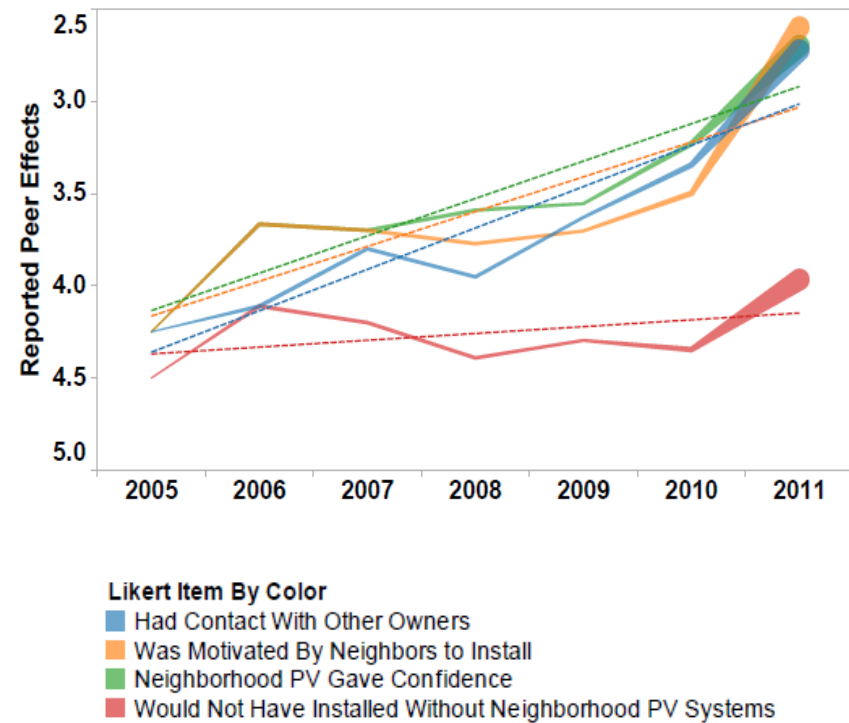


# Measuring Indirect Peer Effects

## No PV Dense Communities



## With PV Dense Communities



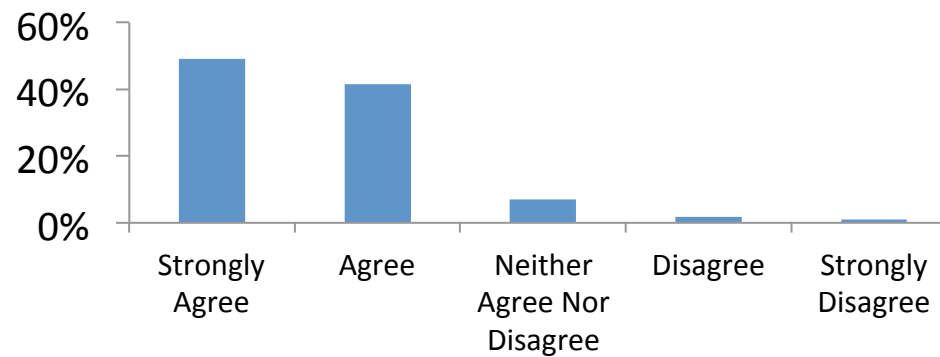
High density PV communities exhibit strong peer effects.



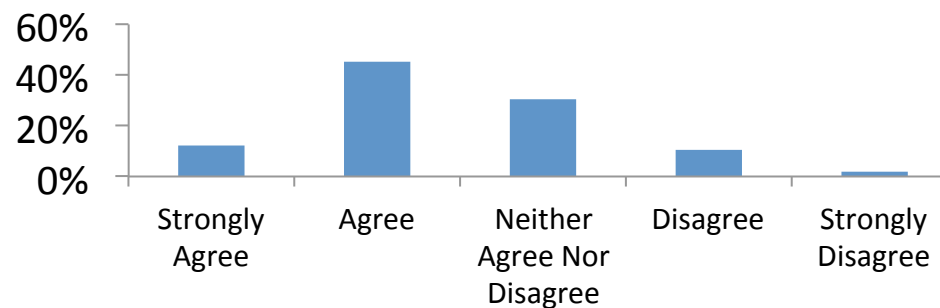


# Potential Adopters Who Contact Existing PV Adopters Report Receiving Valuable Information

**Respondents Who Talked to Other Owners, Talking Was Useful**



**Respondents Who Talked to At Least One Owner, Owners Profoundly Improved the Quality of Information**



# Value of Information and Contacts More Important for Buyers Than Leasers



Lease vs Buy in "Talking to Other Owners is Unnecessary"				
Talking to Other Owners is Unnecessary	Bought		Leased	
	Number	Percent	Number	Percent
Agree and Strongly Agree	98	50.78%	40	86.96%
Disagree and Strongly Disagree	95	49.22%	6	13.04%
Total	193	100.00%	46	100.00%

The leasing model makes information gathering redundant along several dimensions, especially on performance and O&M



# Modeling the Length of the **Decision Period**

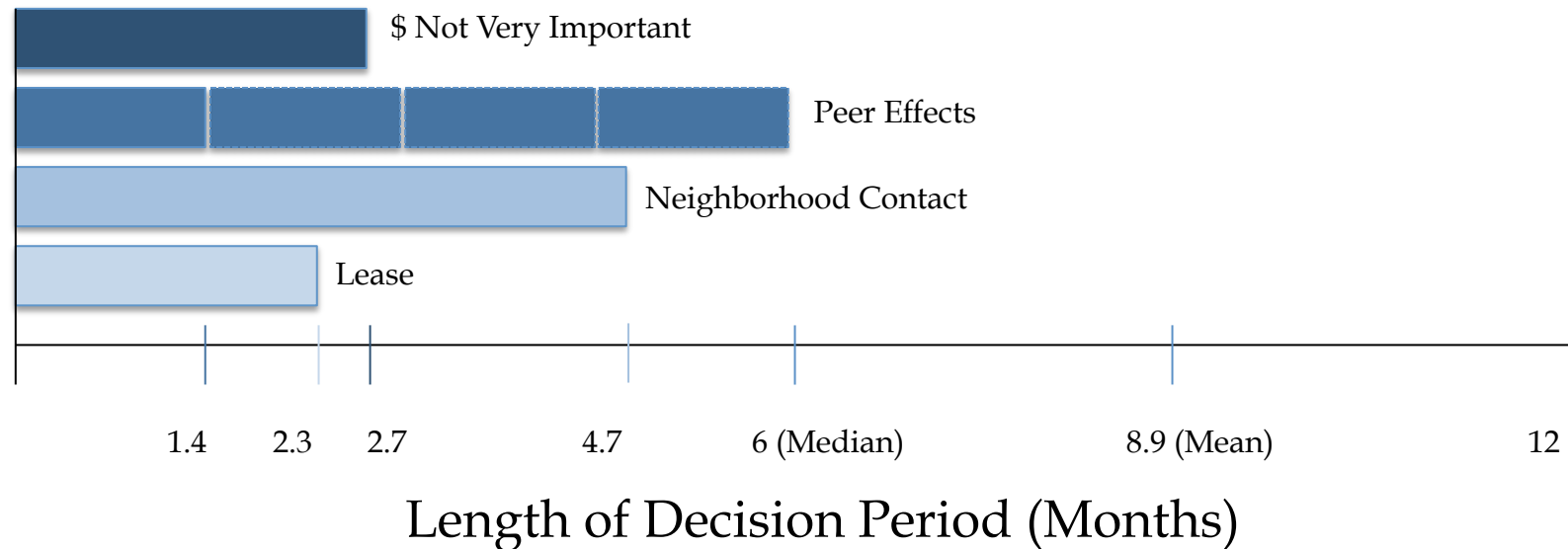
$ConsMo_i$

$$= \beta_0 + \beta_1 InvestVIEI_i + \beta_2 PeerEfSum_i + \beta_3 HCN_i + \beta_4 Lease_i + \beta_5 Own_{cont_i} + Controls + \varepsilon_i \quad (1)$$

Adj.  $R^2 = 0.24$

$P < 0.0001$

All IV  $p < 0.01$



- For example, **Contact in neighborhood** most effective in reducing decision time and effort: **4.7 months less in arriving at the decision** to install PV



# Key Takeaways

- **Profitability of PV adoption**

- Profitability critical in decision to adopt PV
- ~90% adopters use payback period as the key metric

- **Effective information channels**

- Centralized clearinghouse for information by a “trusted 3rd party”
- Peer effects and neighborhood contacts accelerate PV adoption

- **Buy vs. lease**

- Buyers more optimistic (lower discount rate) than leasers
- For the period of the study (2009-11) cost of leasing was significantly lower than that of buying
- Leasing option increases the pool of potential adopters



# Ongoing Work

- **Improve statistical power through second round of data collection: ~600 additional adopters**
- **Agent-based modeling of PV diffusion patterns**
- **Others: Innovations in BoS; Utility business models; Consumption patterns; Community-based efforts**
- Rai, V. and McAndrews, K., 2012. Decision-Making And Behavior Change In Residential Adopters Of Solar PV. *Proceedings of the World Renewable Energy Forum*, Denver, Colorado, May 2012.
- Rai, V. and Robinson, S. A. (2012). On information channels and peer effects in the adoption of residential solar PV. *Working Paper Draft*, Released on July 6, 2012.
- Rai, V. and Sigrin, B. (2012). Economics of decision-making in the adoption of residential solar PV. *Proceedings of the US Association of Energy Economists USAEE*, September, 2012 (final volume to appear in November 2012).