Market Structure and Subsidy Pass-through for Distributed Solar: Lessons from California

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June 17\(^{th}\), 2014

Special acknowledgement to multiple discussions with Kenneth Gillingham, Galen Barbose, Gregory Nemet and Naim Darghouth. This analysis was funded by the Solar Energy Technologies Office, Office of Energy Efficiency and Renewable Energy of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231
Motivations: CSI Rebate Distribution for <=10kW and Time Trends

Note that incentive amounts greater than $20,000 are omitted (113 observations)
Subsidy Pass-through: Definition

Subsidy pass-through rate is defined as how big proportion of the subsidy has been enjoyed by the consumers versus the suppliers, which depends on the supply and demand curvature and market competition.

\[
\text{Pass-through} = \frac{\Delta NP}{R} \times 100\%
\]
Literature Review

- Huge literature on pass-through (e.g. tax incidence, exchange rate and upstream cost shocks): both theoretical work (Delipalla and Keen, 1992; Fullerton and Metcalf, 2002; Sijm et al., 2012; Stern, 1987; VividEconomics, 2007) and empirical work (Bergin and Feenstra, 2009; Besley and Rosen, 1999; Bettendorf and Verboven, 2000; Karp and Perloff, 1989; Marion and Muehlegger, 2011).


- Related to subsidies to Solar, indirect research on installation price responding to factors including rebates (Wiser et al., 2007), an incomplete work by Peterman (2012), and another work on pass-through for Federal ITC (Podolefsky, 2013).
Methodology: Conduct Parameter and Regression Discontinuity Design

- **Conduct Parameter** (Genesove and Mullin, 1998; Wolfram, 1999)

\[
D = D(NP, X) \\
\text{Max } \pi_i = (NP + s)q_i - C(q_i, Z) \\
f.o.c. \quad NP + \theta^*P_QQ + s = C_Q \\
- \frac{dNP}{ds} = \frac{1}{1 + \theta^*(1 + A + E)} , \quad A = -\frac{C_{QQ}}{\theta^*NP_Q} \quad E = -P_{QQ} \frac{Q}{P_Q}
\]

- **Regression Discontinuity** (Imbens and Lemieux, 2008; Lee and Lemieux, 2010)

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### Graphical Representation

- **Pricepw** (left axis)
- **NetPricepw** (left axis)
- **Rebatepw** (right axis)

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Data Inputs

• Data Source: LBNL Deep Dive Project (TTS + Census + Hardware cost + Labor Cost, etc.)

• Conduct Parameter Approach
  - 49 biggest counties in California with longest history of PV installation since 2001, focusing on Emerging Renewables Program (ERP) and California Solar Initiative (CSI)
  - 97,735 PV systems <= 10 kW

• Regression Discontinuity Design
  - 70,281 CSI PV systems <= 10 kW, three IOUs

• Time range: systems installed by the end of 2012.
Results: Conduct Parameter Approach

Pass-through Rates by County
26/49 >= 95%, 34/49 >= 90%, 2/49 < 80%

Real Installation Price by County
Corr (PTR, Price) = -0.16, and statistically insignificant
Results: Regression Discontinuity Design

Parametric Results

\[ NP_i = \beta_1 \cdot s_i + f(x_i) \cdot D_i + \epsilon_i \]

Non-Parametric Results

\[ NP_i = \beta_1 \cdot s_i + \beta_2 \cdot x_i + \beta_3 \cdot (s_i x_i) + u_i \]

Net price jumped by the size of rebate rate change

Estimated pass-through coefficients insensitive to different bandwidths

Note: only results for PG&E are shown here
Conclusions

• Results consistently suggest a pass-through rate of around 100%, both from the structural modelling approach and the time regression discontinuity design.

• While multiple reasons could exist for such a high pass-through rate, this paper considers this phenomenon suggestive of a competitive market and a smoothly operating subsidy program.

• On the other hand, a pass-through rate of ~100% suggests limited cost reduction opportunities for installers.

• Moving forward, cost reductions could come from:
  - Market consolidation for productivity gains
  - Technological innovation—especially, balance of systems
References