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Low income households investment in energy efficient appliances

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Abstract

Introduction

- Does adopting energy efficient appliances reduce electricity consumption among low income households?
 - Low income households: households below 150% of the federal poverty level
 - Energy efficient appliances:
energy star refrigerators and energy star room air conditioners
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Literature Review

- Adoption of energy efficient appliances

Low adoption rates among renters (Davis, 2012)

- Low income households

- Energy efficiency

Energy efficiency upgrades (e.g., installing energy efficient appliances) can reduce energy expenses and improve thermal comfort among low income households (Hernandez and Phillips, 2015)

- Public policy

Participation in public assistance program (e.g., low-income home energy assistance program) improves low-income household energy security (Murray and Mills, 2014)

Empirical model

The reduced form approach is used for two appliances: refrigerators and room air conditioners

$$y_i = \alpha + \beta EEApliance_i + \mathbf{X}_i\boldsymbol{\gamma} + \varepsilon_i$$

Electricity consumption (y): kilowatt-hours of electricity consumption for an appliance

EEAppliance: 1 for energy efficient appliance

\mathbf{X} : Other variables include

price of electricity, household income, household size, age of head of household, owner, apartment, new house, house size, household income, electricity included in rent, electricity price, rural, cooling and heating degree days, and state dummies

Data

- 2009 Residential Energy Consumption Survey
 - Households electricity usage and their adoption of energy efficient appliances
 - low-income status: households below 150% of the federal poverty level
 - Electricity price (Miller and Alberini, 2016)
RECS 2009
 - total electricity expenditure / electricity usage for an appliance
 - a neighbor's electricity price within a state
(a given household's neighbors face a similar pricing structure but prices they face do not directly influence this household's consumption)
- Forms EIA-861
- average price of residential electricity in a state

Sample

Variable	Obs	Mean	Obs	Mean
	Full sample		Poverty	
Electricity usage for refrigerators in kwh (log)	7062	6.90	1728	6.77
Energy efficient refrigerator	7062	0.60	1728	0.48
Electricity usage for room A/C in kwh (log)	1845	5.99	574	6.14
Energy efficient room A/C	1845	0.63	574	0.56
Household income	7062	13.3 (\$50k~54.9k)	1728	5.34 (\$10k~14.9k)

Results – Refrigerators

Electricity usage for refrigerators in kwh (log)	Full sample	Poverty
Energy efficient refrigerator	-0.28***	-0.34***
Cooling degree days (log)	0.05***	0.06**
Electricity price (log)	-0.56***	-0.77***
House size (sq feet)	0.20***	0.21***
Electricity included in rent	0.23***	0.23***
Obs	7,603	1,729
R-squared	0.216	0.216

Other explanatory variables include heating degree days, household size, age of head of household, owner, apartment, new house, rural, state dummies.

Results – Room A/C

Electricity usage for room A/C in kwh (log)	Full sample	Poverty
Energy efficient room A/C	0.10**	0.13*
Cooling degree days (log)	1.29***	1.39***
Electricity price (log)	-0.92***	-0.79
House size (sq feet)	0.21***	0.21***
Electricity included in rent	0.22***	0.19*
Obs	1,845	574
R-squared	0.656	0.659

Other explanatory variables include heating degree days, household size, age of head of household, owner, apartment, new house, rural, state dummies.

Discussion

1) Refrigerators

adopting energy star refrigerators is negatively related to low-income households' electricity usage

2) Room air conditioners

adopting energy star room air conditioners is positively related to low-income household's electricity usage

→ Consistent results are obtained by using new energy efficient room A/C and including usage frequency of room A/C

→ Potential rebound effect exists

Future works

- Electricity bill burden among low-income households
 - the effect of adopting energy efficient appliances on energy insecurity of low-income households
- Other attributes of houses should be included to account for electricity usage on room a/c
- In the next version of paper, low income households' adoption of energy efficient appliances influence energy insecurity

Thank you!