Does Asymmetric Information in Residential Rental Markets Lead to an Energy Efficiency Gap?

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Camp Resources

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Motivation

- There are two potential market failures in energy use associated with the landlord-tenant relationship
  1. Overuse when landlords pay for the utilities
  2. Energy cost information asymmetries when tenants pay for the utilities
     - If tenants are not informed, landlords cannot capitalize on efficiency investments with higher rents
- **I focus on the latter and look for evidence of energy cost information asymmetries between landlords and tenants in residential housing**
- Policy Implications:
  - Effectiveness of carbon policies such as cap-and-trade
  - Effectiveness of individual metering of energy use

My Approach

- Perfect Experiment: Random shift in the energy costs of apartment units where one group has full information and the other does not and see how market outcomes differ (e.g. turnover, investment, incidence of the price change)
- Energy Cost=Price*Q(efficiency, quantity of energy services)
  - A shift in price, efficiency or quantity consumed would affect energy costs
  - Use a random shift, in the price of energy, to test whether energy cost information is incorporated in the rental housing market

My Approach

- Exogenous variation comes from the difference between residential heating oil and natural gas prices over time
  - Compare outcomes, such as rent, for oil units relative to natural gas units as these prices change
- I assume landlords are informed about unit energy costs and look for evidence that tenants are also informed
  - Use whether landlords or tenants pay for heating fuel (payment regime)
- Look at the incidence of the price change, turnover rates, efficiency investments

Search Model

- In a search model equilibrium rents are affected by search frictions
  - Monopolistically competitive landlords have rent-setting power as a consequence of tenants' search
  - Positive profits are erroded by free entry
  - This set up results in rent dispersion and vacancy (aspects of rental markets not explained by the competitive model)

Search Model Cont'd

- Matching technology: flow of potential contracts representing frictions or time it takes for landlords and tenants to get together
- Tenants have a distribution of idiosynctratic preferences that determine match quality and an outside option of temporary housing. They optimize the tradeoff between reduced search cost and lower rent
- Based on the tenants' optimization, landlords maximize revenue trading off higher rent vs. vacancy

The Role of Information

Case 1 Landlords Pay Utilities	Case 2 Tenants Pay Utilities Full Information	Case 3 Tenants Pay Utilities No Information
$\underset{r}{\text{Max}} : \theta(r) * (r - \mu)$	$\underset{r}{\text{Max}} : \theta(r + \mu) * r$	$\underset{r}{\text{Max}} : \theta(r + \bar{\mu}) * r$
$\frac{\partial r^*}{\partial \mu} > 0$	$\frac{\partial r^*}{\partial \mu} < 0$	$\frac{\partial r^*}{\partial \mu} = 0$

where θ is the probability that landlords will find a matching tenant as a function of rent, r, and μ stands for the utility payment. $E[\mu] = \bar{\mu}$. Assume no moral hazard

Testable Predictions

- Full information (Cases 1&2): utility payment burden for otherwise identical units will be the same for both landlords and tenants in Case 1 as in Case 2 (Tax Incidence Result)
- Turnover and investment should be the same as well no matter which party pays the utilities

Testable Predictions: Cont'd

- When tenants pay and are not informed (Case 3), the relative rents of oil and gas units won't be correlated with the relative price changes
- Tenants match with units based on $E[\mu] = \bar{\mu}$
  - If oil is expensive, in oil units where tenants pay utilities $\mu > \bar{\mu}$
    - the match lower quality than expected $\Longrightarrow$ oil units will be ***more*** likely to turnover
  - If oil is expensive, in gas units where tenants pay utilities $0 < \bar{\mu}$
    - the match will be better than expected $\Longrightarrow$ gas units will be ***less*** likely to turnover
- Landlord's incentive to invest in efficiency (e.g. switching from oil to gas) is reduced when tenants pay the utilities (landlord-tenant problem)

Preview of Results

- I find evidence that energy prices are not capitalized into rents when tenants pay the utilities
- There is some capitalization of energy prices into rents when landlords pay the utilities
- Turnover is consistent with tenants lacking information about fuel prices
    - the more expensive heating fuel units turnover faster relative to the less expensive heating fuel units when tenants pay the utilities as compared to when landlords pay the utilities
- Landlords with heating oil are more likely to switch to gas as oil prices get high if they pay the utilities themselves

Previous Work

- Most studies of the landlord-tenant problem use residential energy use surveys to compare the penetration of energy efficient appliances between homeowners and renters that pay their own utilities (Davis 2010, Murtishaw and Sathaye 2006, Gillingham et al. 2011)
- Identifying assumption: renters and homeowners do not systematically differ in their preferences for energy
- Population that rents different than the population of homeowners, perhaps in unobservable ways
- Renters preferences could be divergent to explain the difference in energy efficiency investments absent market failures

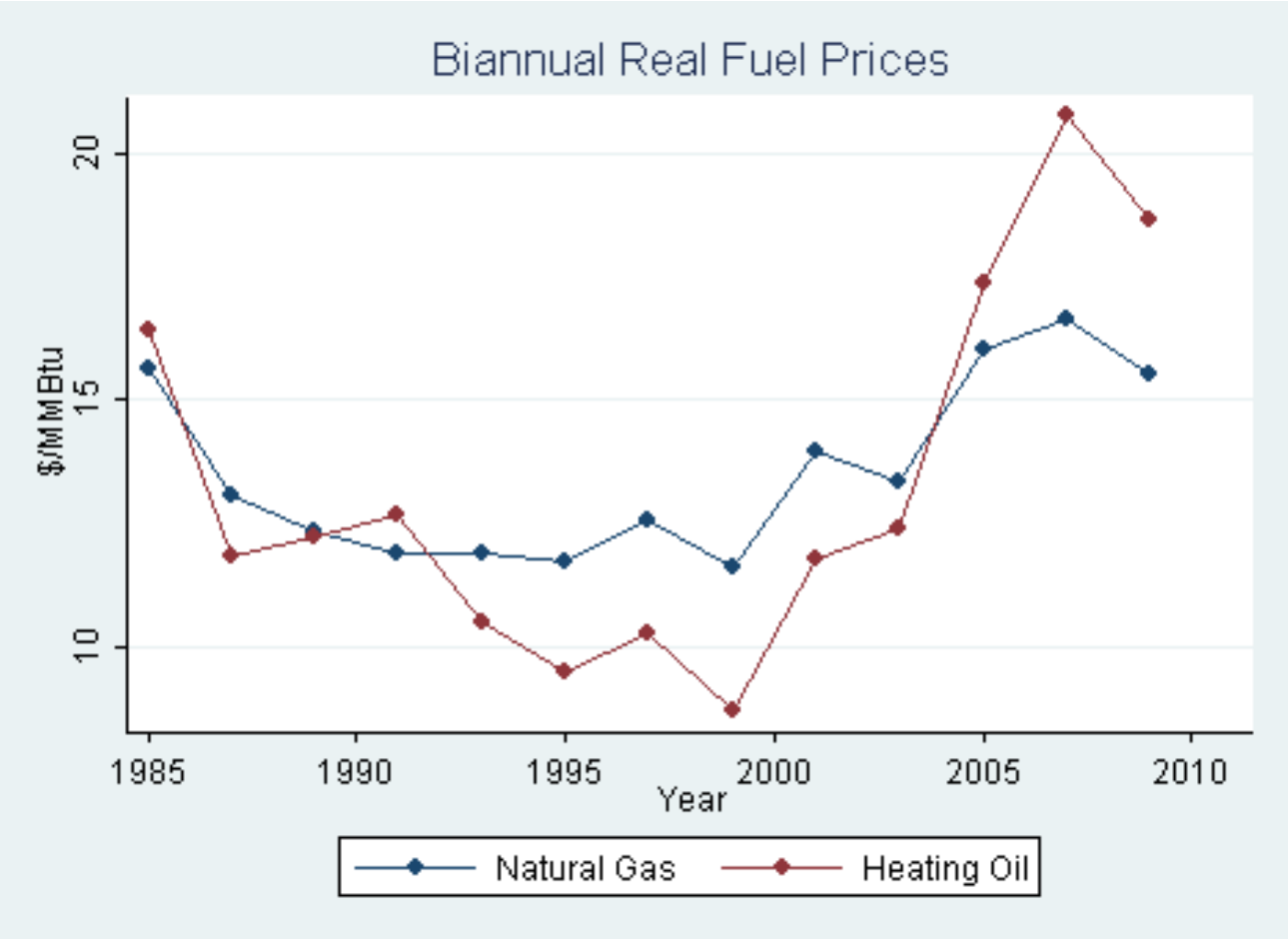
This Paper's Contribution

- First to look at the causal effect of energy cost changes on market outcomess
- Using two different payment regimes and two different fuel types I can test several predictions of the effects of asymmetric information
- Compare investment behavior in the rental market alone
  - preferences of renters between payment regimes more alike than renters vs. homeowners
- Compare not just stock of energy fuel type in the 2 payment regimes, but how landlords respond differently to energy price changes
  - can control for time invariant unobservables

Data

- I use data from the American Housing Survey (1985-2009)
  - 50,000 + households surveyed every two years
  - same housing units are surveyed with additions to reflect new construction
- Covariates: bedrooms, rooms, half bath, bath, units in building, degree day scale, clothes dryer, dishwasher, decade built, room air, central air, indicator for living conditions, income
- Focus on the Northeast Census region, where around 40% of households heat with heating fuel
  - landlords pay utilities: 1097 gas units, 1766 oil units
  - tenants pay utilities: 2538 gas units, 717 oil units
- Consumption weighted average of state-level annual residential retail heating fuel prices reported by the EIA for NE Census Region

Data: Price Variation



Capitalization Estimation

Is the difference in the price of heating oil relative to natural gas capitalized into rents?

$$Rent_{it} = \beta_1 oil_{it} + \beta_2 oil_{it} x diff_t + \alpha_t + \Sigma\beta X_{it} + \varepsilon_{it}$$

oil_{it} = indicator for fuel oil (unit 'i' period 't')
$diff$ = price of oil-price of gas
X_{it} = covariates

Rent Difference Variation with Price Difference Variation

Results

Table 1: Split Sample Estimation

	LL (rent)	TEN (rent)	LL (rent)	TEN (rent)	LL (rent)	TEN (rent)
oil	48.89***	17.85	74.49***	41.85***	-3.517	-28.75*
	(9.932)	(12.37)	(8.816)	(11.52)	(9.511)	(12.53)
oil x $(p^{oil} - p^{gas})$	9.082**	4.824	8.810**	2.833	6.205*	2.259
	(3.442)	(4.620)	(3.178)	(4.220)	(2.810)	(3.269)
Covariates	No	No	Yes	Yes	Yes	Yes
Unit FE	No	No	No	No	Yes	Yes
Observations	13444	12764	13444	12764	13444	12764
F-test interact. equal&opp.	Fstat=5.43 pval=.0198		Fstat=1.53 pval=.2157		Fstat=3.20 pval=.0738	

Standard errors in parentheses

All specifications include year FE, SE clustered at unit level

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results Summary

- Consistent estimates among specifications
- When landlords pay the utilities:
  - relative rent of oil units increase \$9-\$18 for a \$1/MMBTU rise in the price of oil relative to natural gas
  - average home uses 92-125 MMBTU/year $\Longrightarrow$ \$7-10 per month
  - within the confidence interval of the estimates
- When tenants pay the utilities:
  - Cannot reject zero capitalization

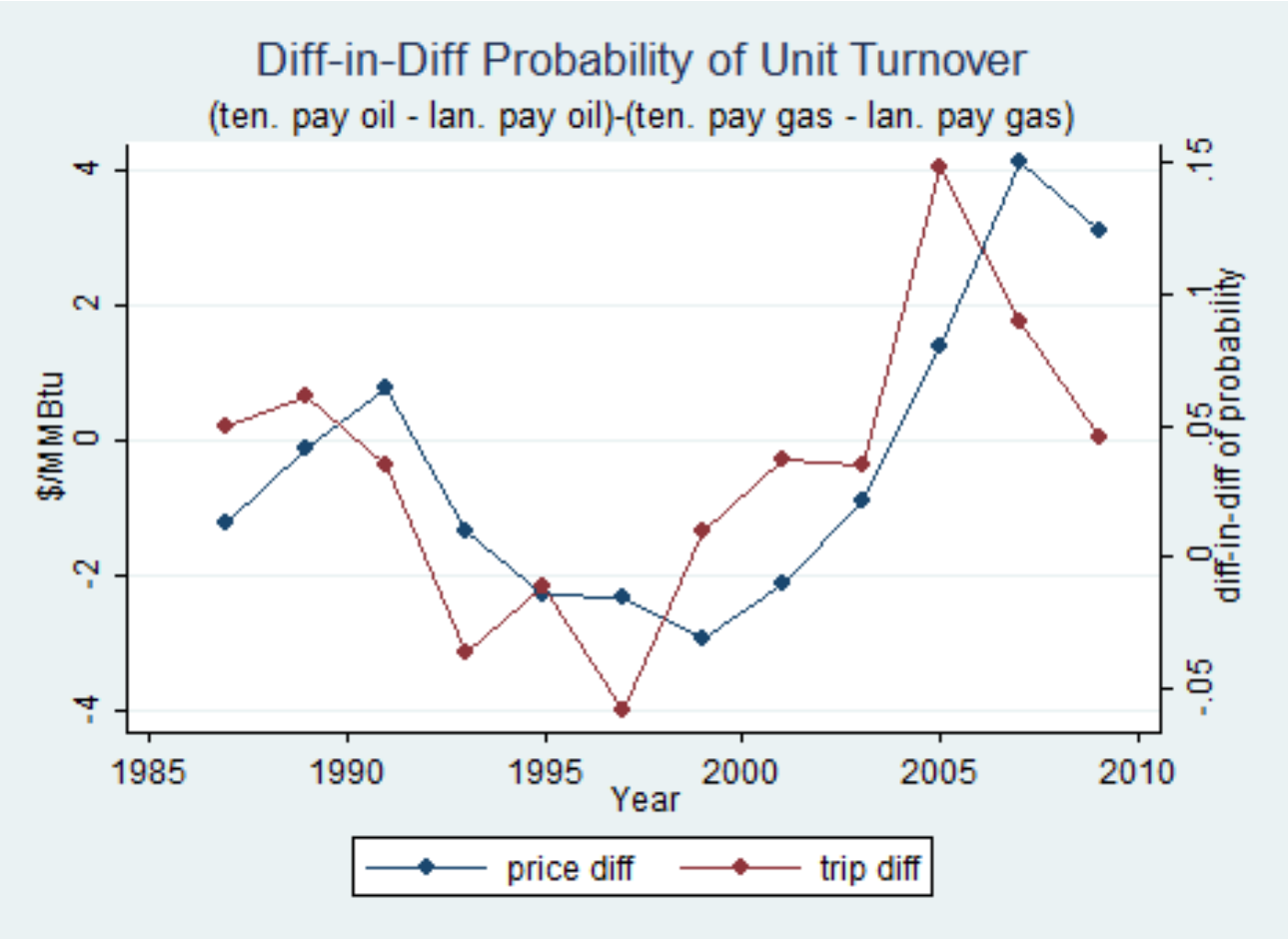
Estimation of Turnover

$$Turnover_{it} = \beta_1 + \beta_2 oil_{it} + \beta_3 tpu_{it} + \beta_4 oil_{it} x tpu_{it} + \beta_5 oil_{it} x diff_t + \beta_6 tpu_{it} x diff_t + \beta_7 oil_{it} x tpu_{it} x diff_t + \alpha_t + \Sigma \beta X_{it} + \varepsilon_{it}$$

oil_{it} = indicator for fuel oil (unit 'i' period 't')
tpu = indicator for tenant pays utilities
$diff$ = price of oil-price of gas
X_{it} = covariates

Coefficient of interest=β_7. Interpretation: diff-in-diff (tpuxoil - lpuxoil)-(tpuxgas-lpuxgas) in probability of turnover per \$1/MMBtu increase in the price of oil relative to gas

Diff-in-Diff Variation with Price Difference Variation



Results

Table 1: Triple Difference: Turnover and Length of Tenancy

	turnover	turnover	turnover
oil	-0.0707***	-0.0485***	
	(0.0145)	(0.0143)	
tpu	0.00176	0.0218	
	(0.0143)	(0.0147)	
tpuxoil	0.0538**	0.0435*	
	(0.0220)	(0.0224)	
oilx($p^{oil} - p^{gas}$)	-0.00673	-0.00530	-0.0136*
	(0.00570)	(0.00566)	(0.00701)
tpux($p^{oil} - p^{gas}$)	-0.00704	-0.00783	-0.0135*
	(0.00556)	(0.00550)	(0.00715)
tpux($p^{oil} - p^{gas}$)xoil	0.0246**	0.0230**	0.0338***
	(0.00955)	(0.00948)	(0.0121)
Covariates	No	Yes	Yes
Unit FE	No	No	Yes
Observations	25215	25215	23583

Standard errors in parentheses

All specifications include year FE. SE clustered at unit level

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

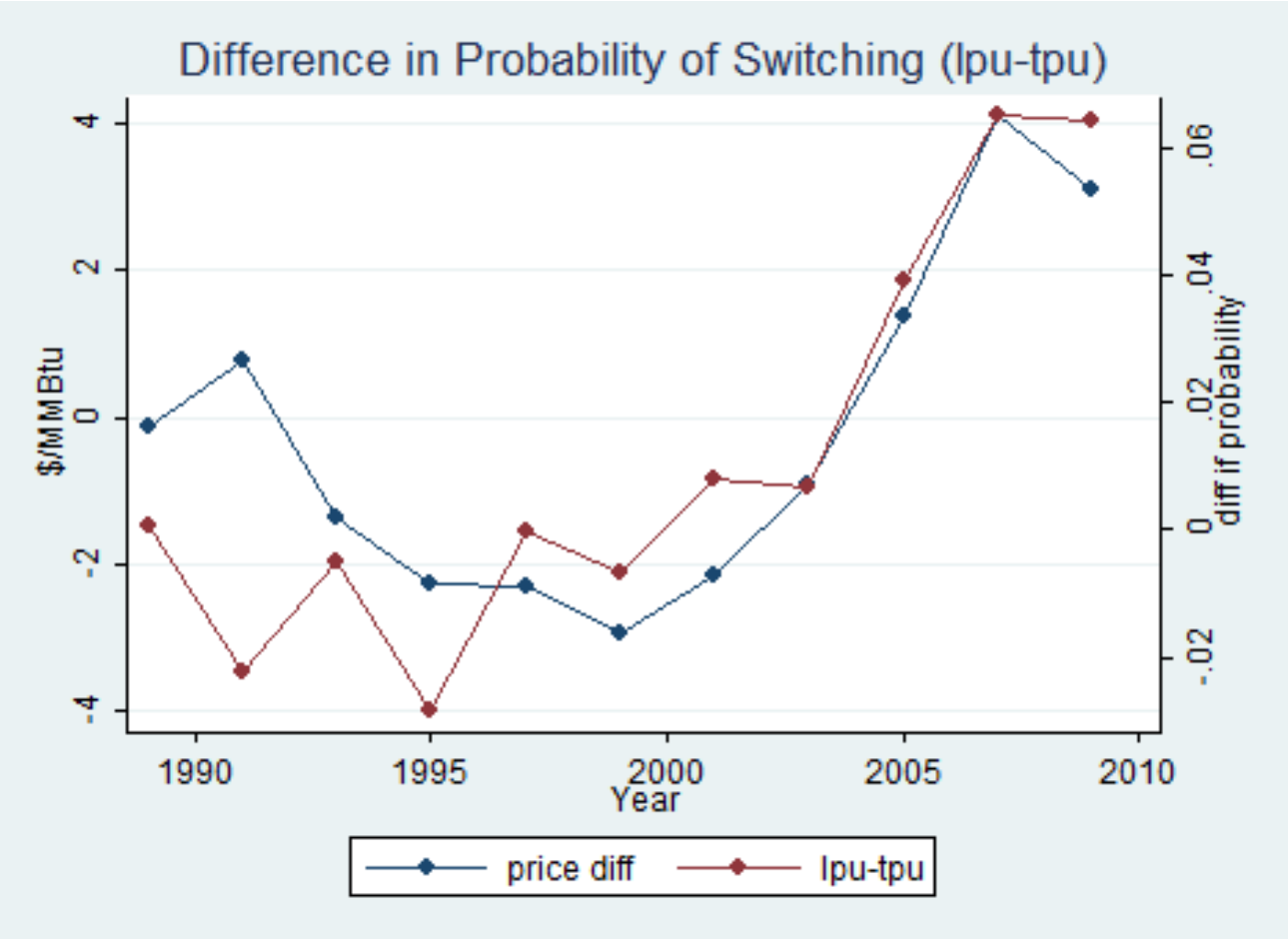
Switching Estimation

Question: Are landlords more likely to switch from oil to natural gas when they pay for the utilities themselves than when they do not?

$$switch_{it} = \beta_0 + \beta_1 lpu_{it-1} + \beta_2 lpu_{it-1} \times (p_t^{oil} - p_t^{gas}) + \gamma_t + \Sigma\beta X_{it} + \varepsilon_{it}$$

$switch_{it}$ = indicator for switch to gas
lpu_{it-1} = indicator for landlord pays (unit 'i' period 't-1')
p_{oil} = price of oil
p_{gas} = price of gas
X_{it} = covariates
γ_t = year FE
ε_{it} = error term

Graph of Switching Analysis



Switching Results

Table 7: Switching to Gas Regressions

	switch2gas	switch2gas	switch2gas	switch2gas
lpu	0.0113	-0.00438	0.0482***	-0.00723
	(0.00620)	(0.00746)	(0.0110)	(0.00803)
lpu x $(p^{oil} - p^{gas})$	0.0103***	0.00951**	0.0155***	0.00866*
	(0.00307)	(0.00305)	(0.00325)	(0.00415)
lpu trend			-0.0137***	
			(0.00190)	
Covariates	No	Yes	Yes	Yes
ll pay trend	No	No	Yes	No
covxyear interact.	No	No	No	Yes
Observations	4142	4142	4142	4142

All models include year FE, standard errors in parentheses

SE clustered at unit level

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Conclusions:

- I cannot reject zero capitalization when tenants pay the utilities
- There is capitalization of energy prices into rents when landlords pay the utilities
- Turnover is consistent with tenants lacking information about fuel prices
    - the more expensive heating fuel units turnover faster relative to the less expensive heating fuel units when tenants pay the utilities as compared to when landlords pay the utilities
- Landlords with heating oil are more likely to switch to gas as oil prices get high if they pay the utilities themselves

Thank You!