Prepaid electricity: Evidence from South Africa

Kelsey Jack (Tufts)
Grant Smith (University of Cape Town)

November 2015

Monthly electricity bills

Standard model for electricity cost recovery: bill for past consumption

- Customers: Liquidity constrained households struggle to pay lumpy, unpredictable bills
- Utilities: Disconnection is costly
  - Political economy barrier to disconnection (McRae 2014)

Result: Customers pay late or not at all (Szabo and Ujhelyi 2014)
$\rightarrow$ Utilities lower service quality, ration connections to poor customers

Prepaid meters: A cheap enforcement technology

Prepaid meters align consumption and payments

- Same payment innovation behind the rise of mobile technologies (Aker and Mbiti 2009)

South Africa: an early adopter of prepaid metering

- 75% of residential customers in Cape Town

Rapidly expanding in other low- and middle-income countries

Prepaid electricity meter

Electricity in Cape Town

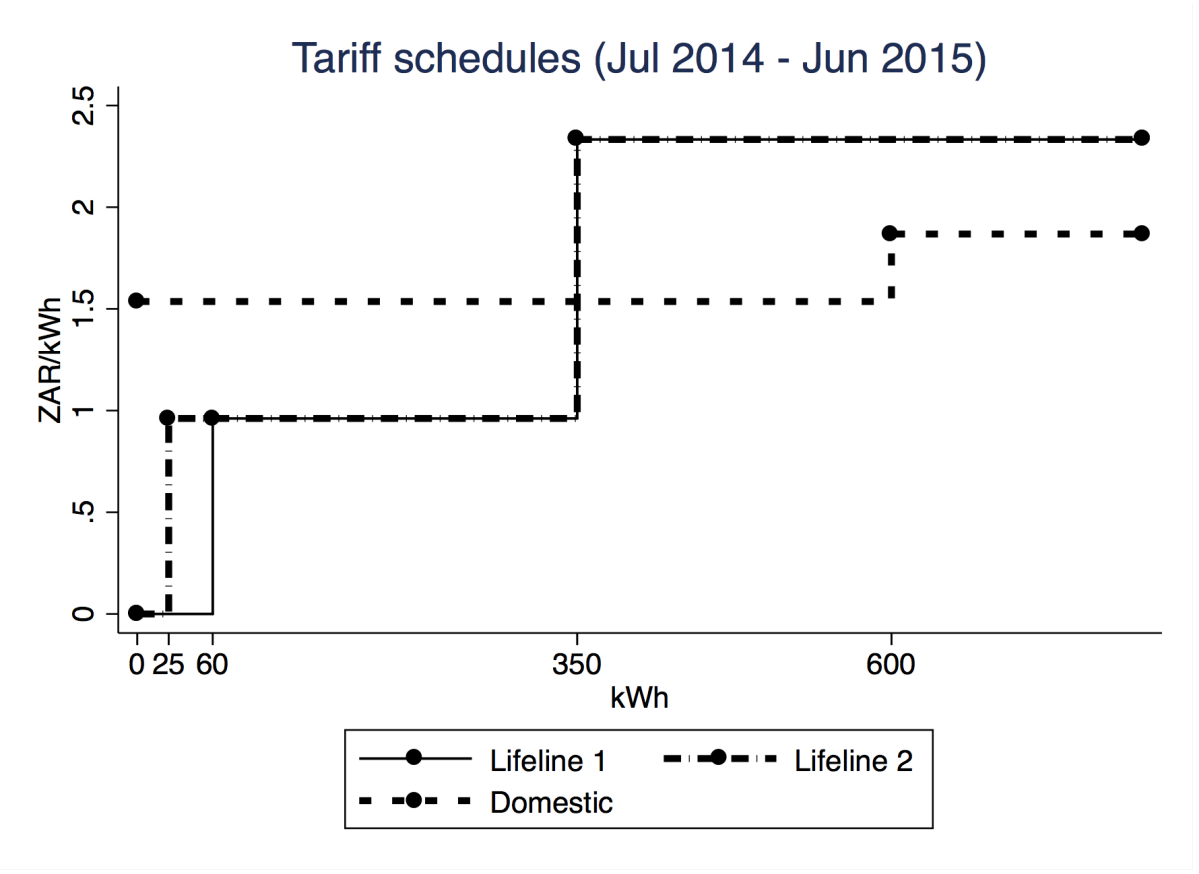
Municipal utility provides electricity to ~75% of residents

- Purchases electricity from the national grid (Eskom)
- Supply shortages in winter – rolling blackouts

Tariffs

- Increasing block tariffs, adjusted in July each year
- Subsidized tariff provides "free basic electricity" (FBE)
- Tariff resets on the first of each month

Tariffs in Cape Town



Case study: Prepaid meter phase-in

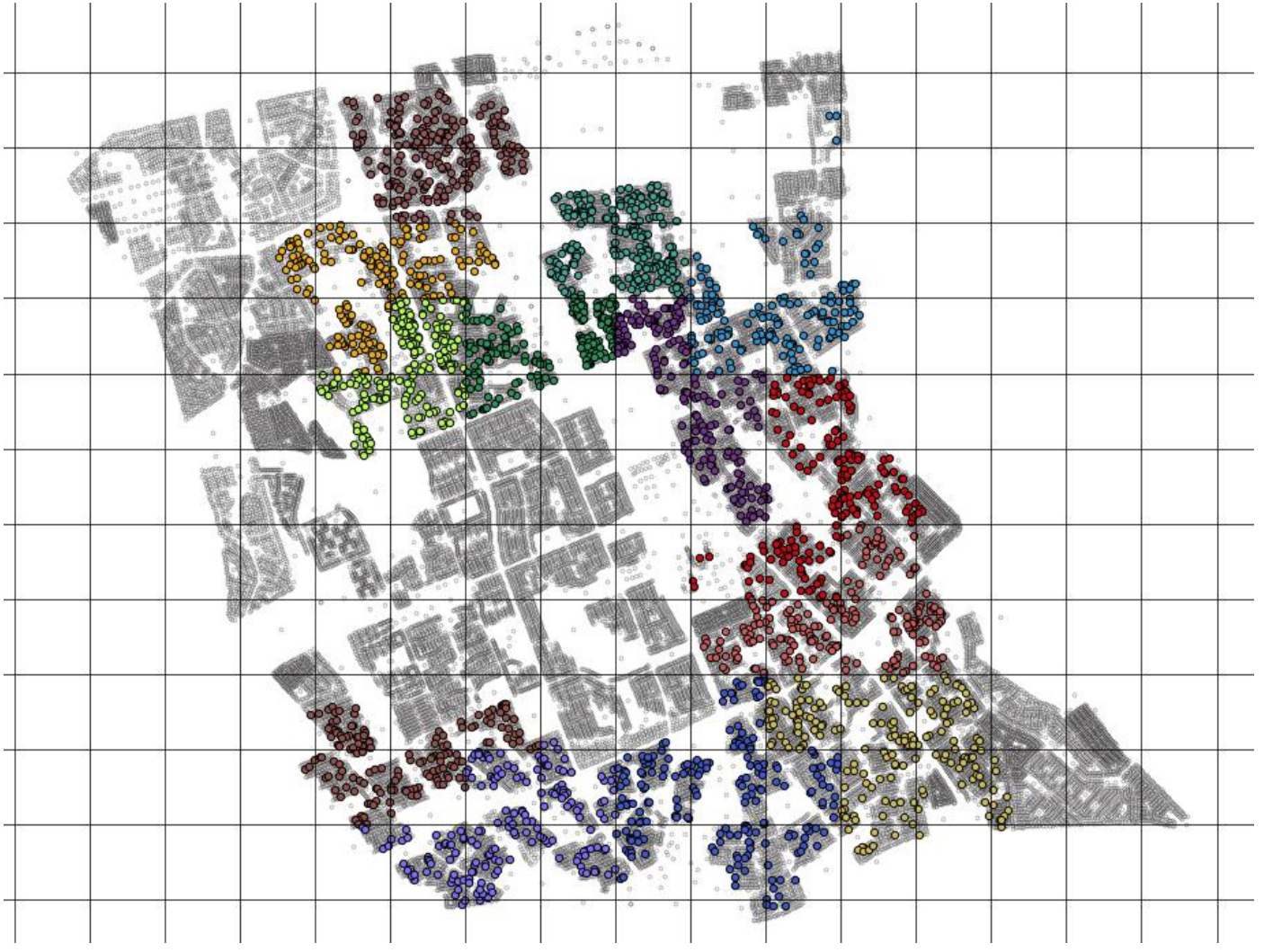
Collaboration with City of Cape Town (CoCT) to phase in 2,272 prepaid meters in the suburb of Mitchells Plain

- Postpaid households involuntarily switched to prepaid between November 2014 and February 2015

CoCT agreed to randomize phase-in order, with some constraints:

- No fewer than 150 contiguous households in a "block"
- Finish project 4 months after start $\rightarrow$ short run effects
- Contractor worked with multiple teams, imperfect compliance

Assignment



Data

- All customers: Tariffs, property value, location
- Postpaid: Monthly bills (kWh consumed), payments received
- Prepaid: Transactions (kWh purchased), date and time of purchase

- Outcome measure: Average daily kWh
  - Assumption: within a month, consumption = expenditure
  - Evidence: purchase >2x/week, low observed balance
  - Upward bias in prepaid outcome if customers save

Analysis

The effect of switching to prepaid on average daily kWh

- Within customer: before vs. after switch
- Within month (month-year): switched vs. not-switched customers

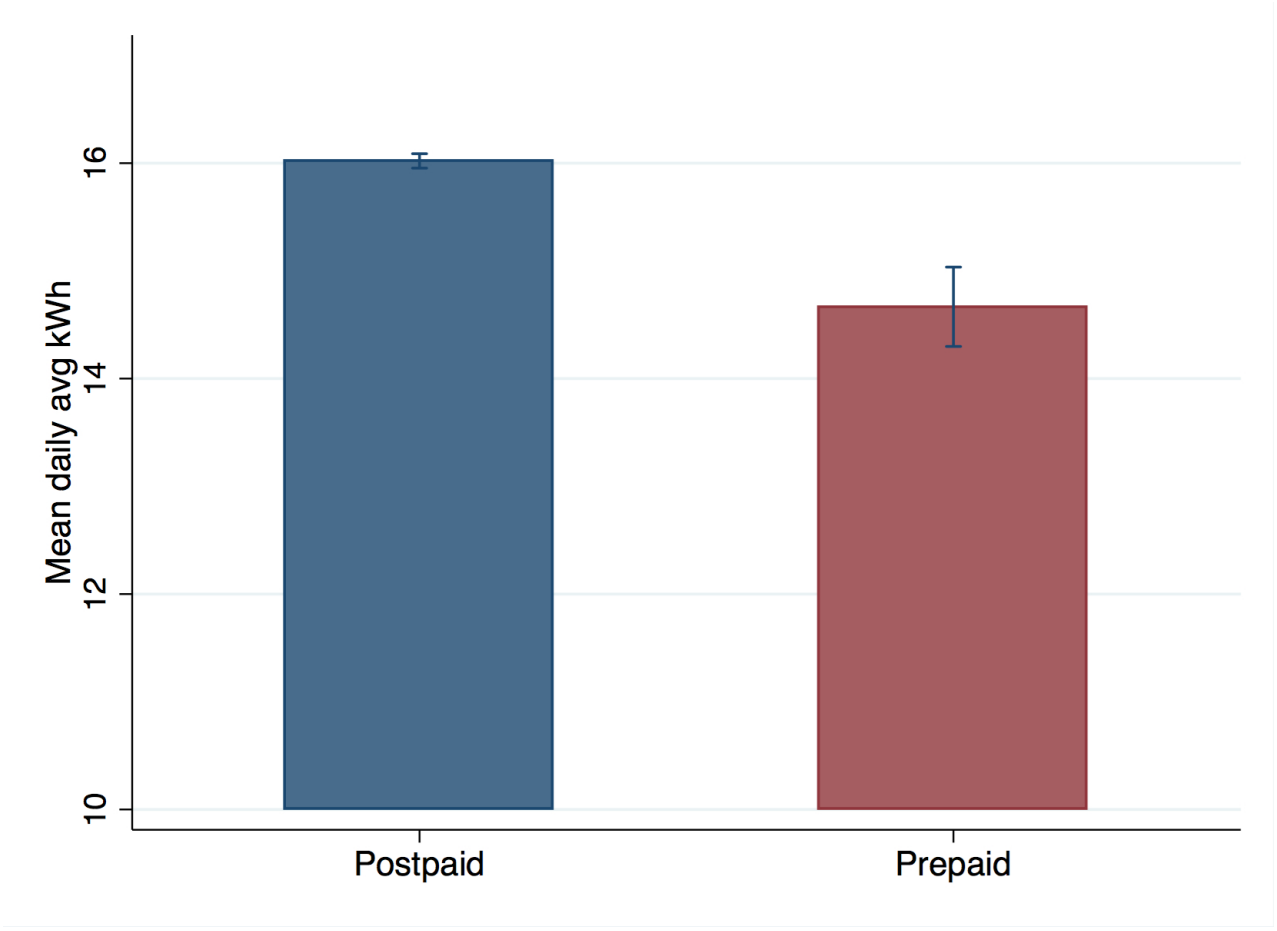
Address non-compliance by using the midpoint of the assigned switch window rather than the actual switch date

Summary statistics and balance

	Mean [SD]
Property value	291K
	70K
Avg daily kWh	16.00
	[7.67]
Lifeline tariff	0.41
	[0.49]
In debt to city	0.55
	[0.50]
Never pay on time	0.48
	[0.50]

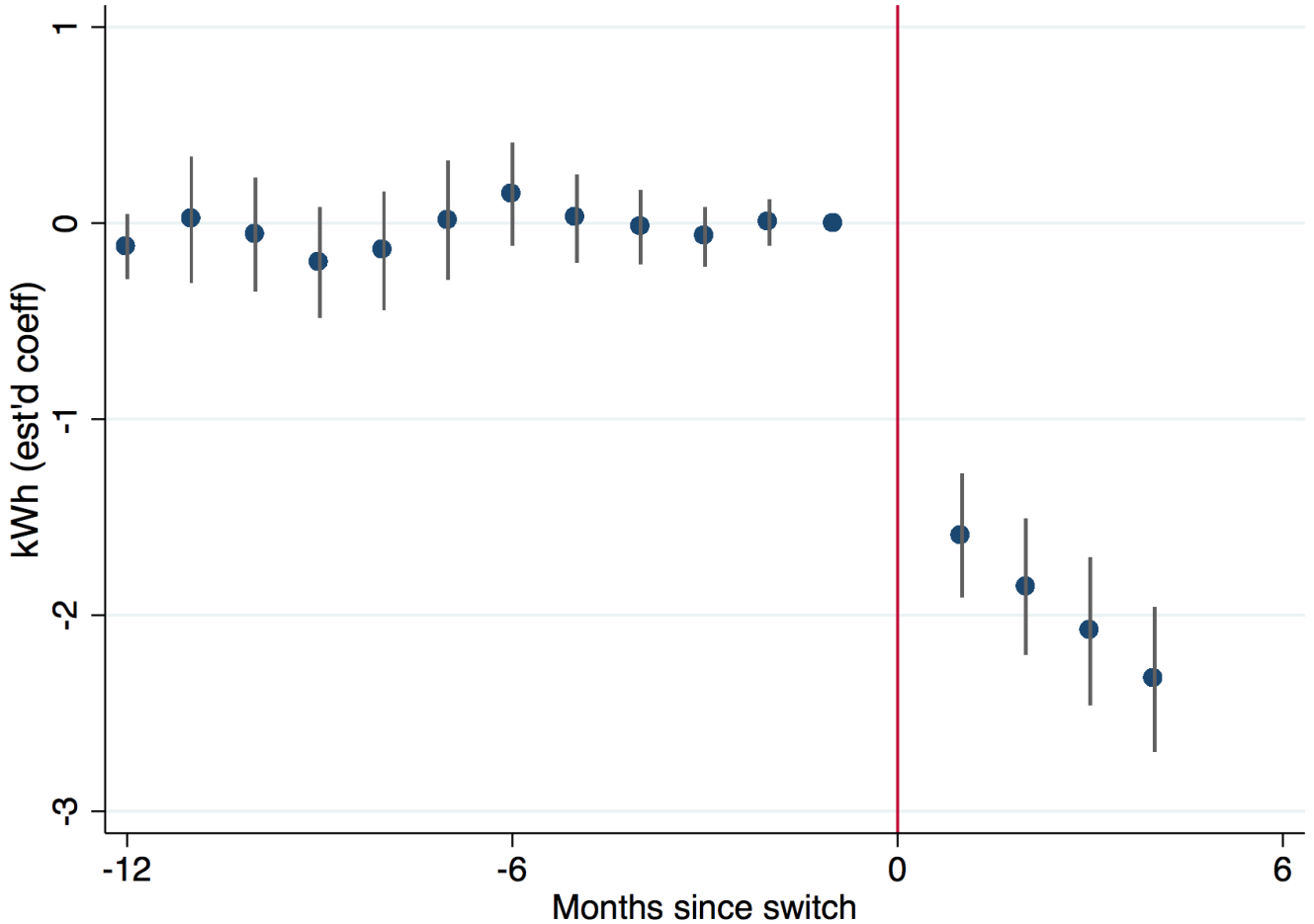
- Avg daily usage balanced on assigned switch window
- Non-random non-compliance
- Rely on within-customer comparisons

Usage (kWh)

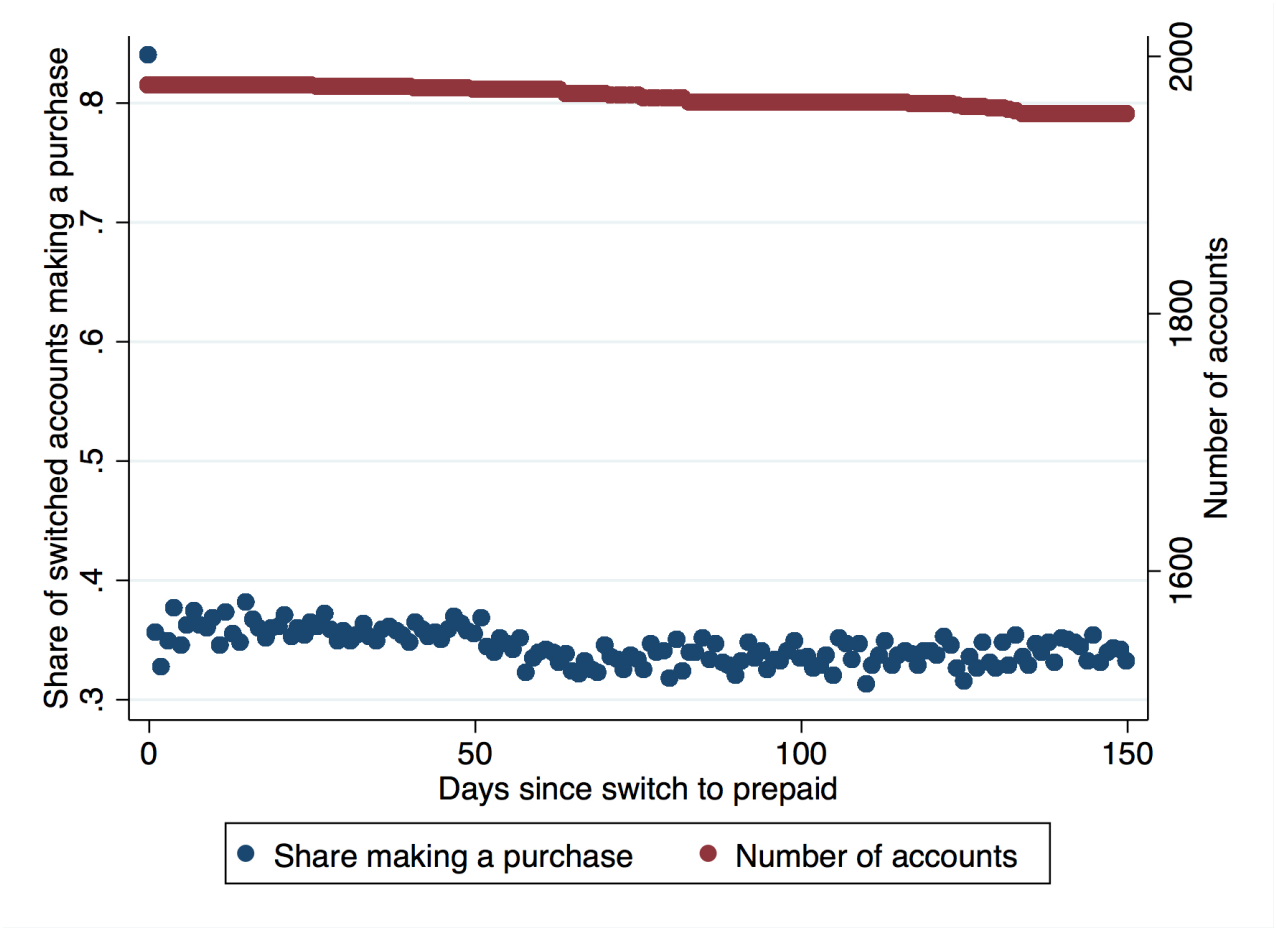


Average daily kWh falls by 0.6 - 2.0 from a mean of 16 kWh/day

Usage over time

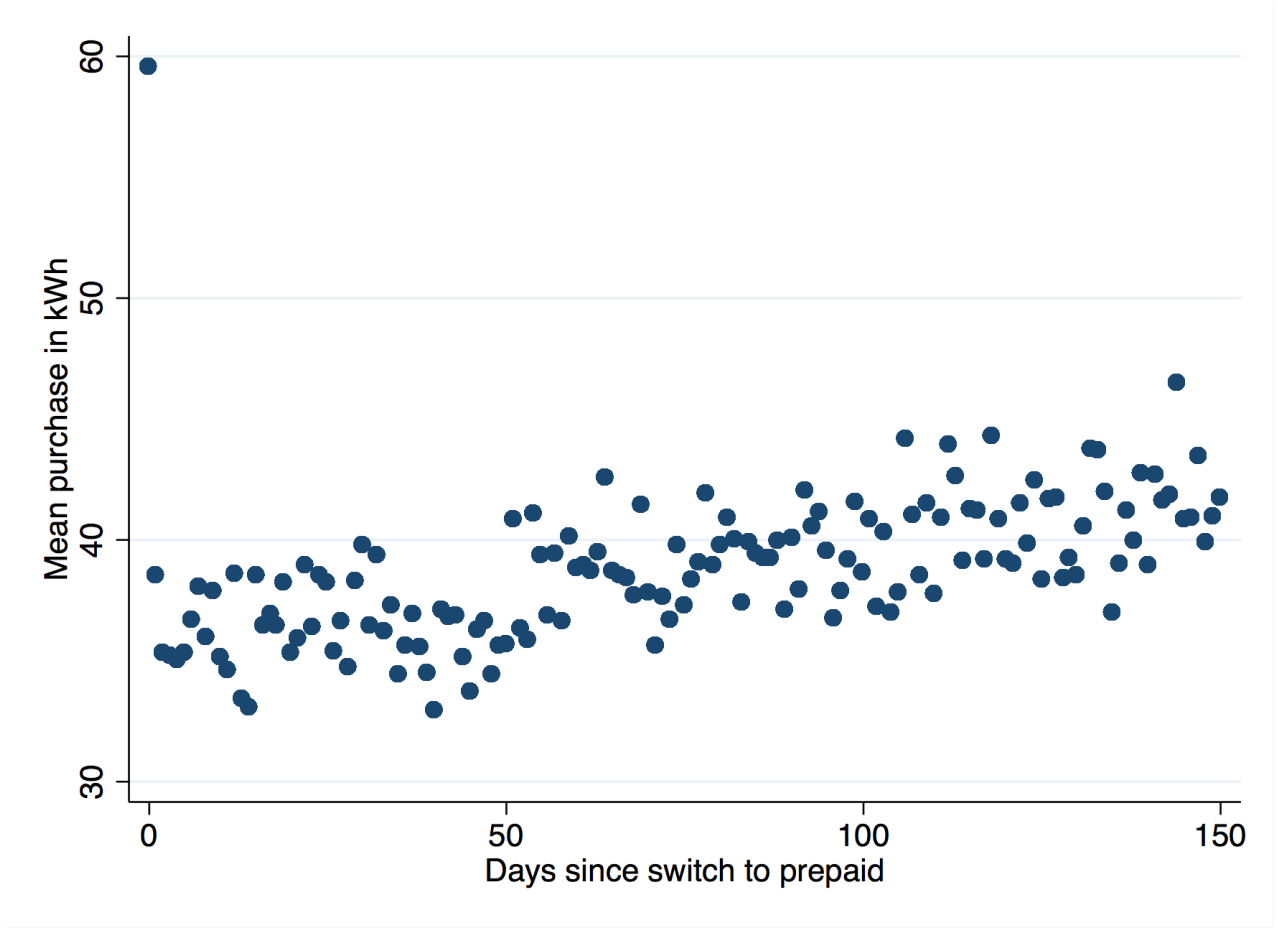


Prepaid transaction patterns



Customers purchase 2-3 times per week, on average

Prepaid transaction patterns



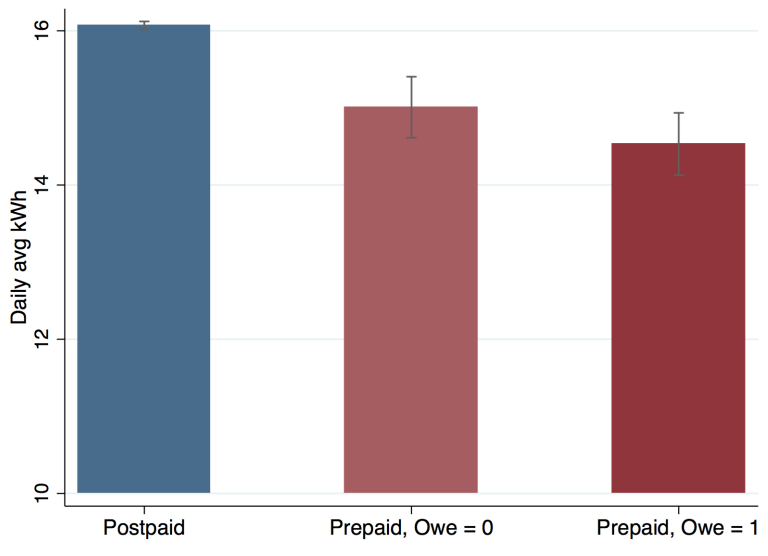
Mean purchase size gradually increases

How and why does consumption respond to prepaid meters?

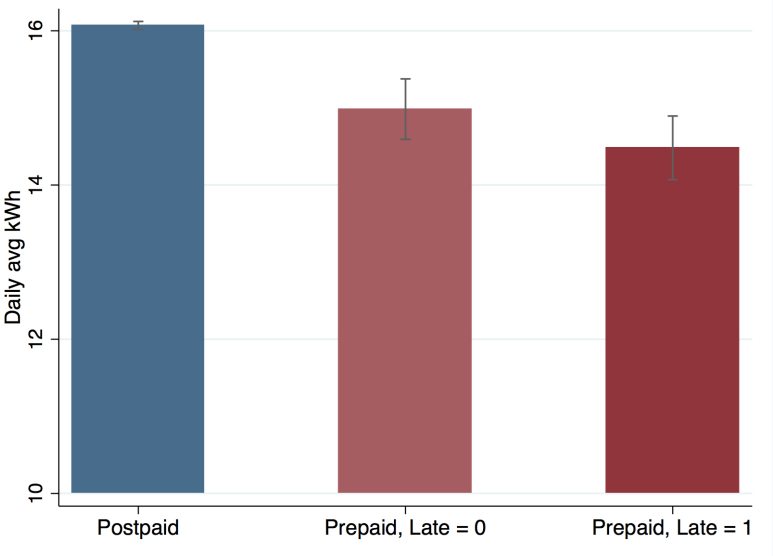
When switched to a prepaid meter, daily kWh falls by ~10%

- Who responds to prepaid metering?
- Why?
  1. Prepaid meters align consumption and expenditures
  2. Price feedback is more immediate, consumption more salient
  3. Transaction costs are higher

Who responds to prepaid metering?

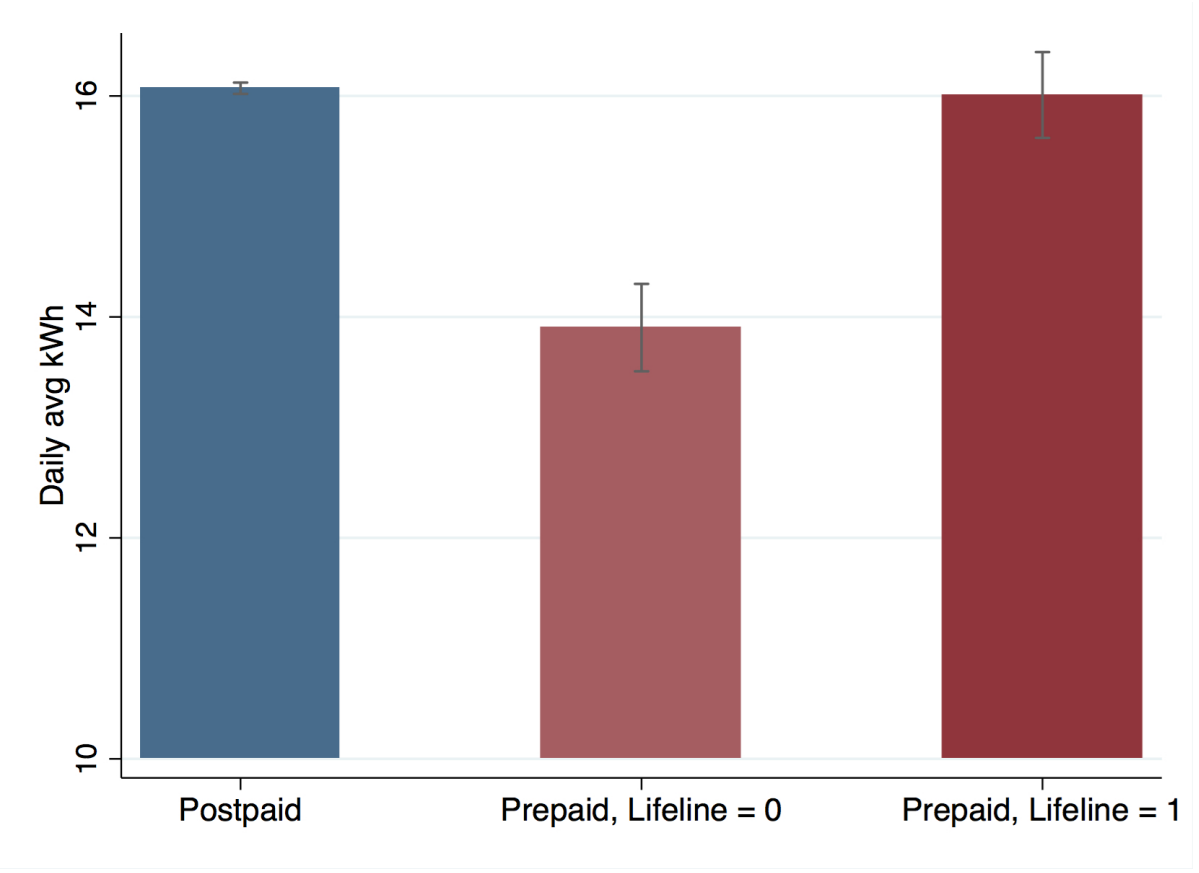


(a) Owe money



(b) Pay late

Who responds to prepaid metering?



(c) Lifeline

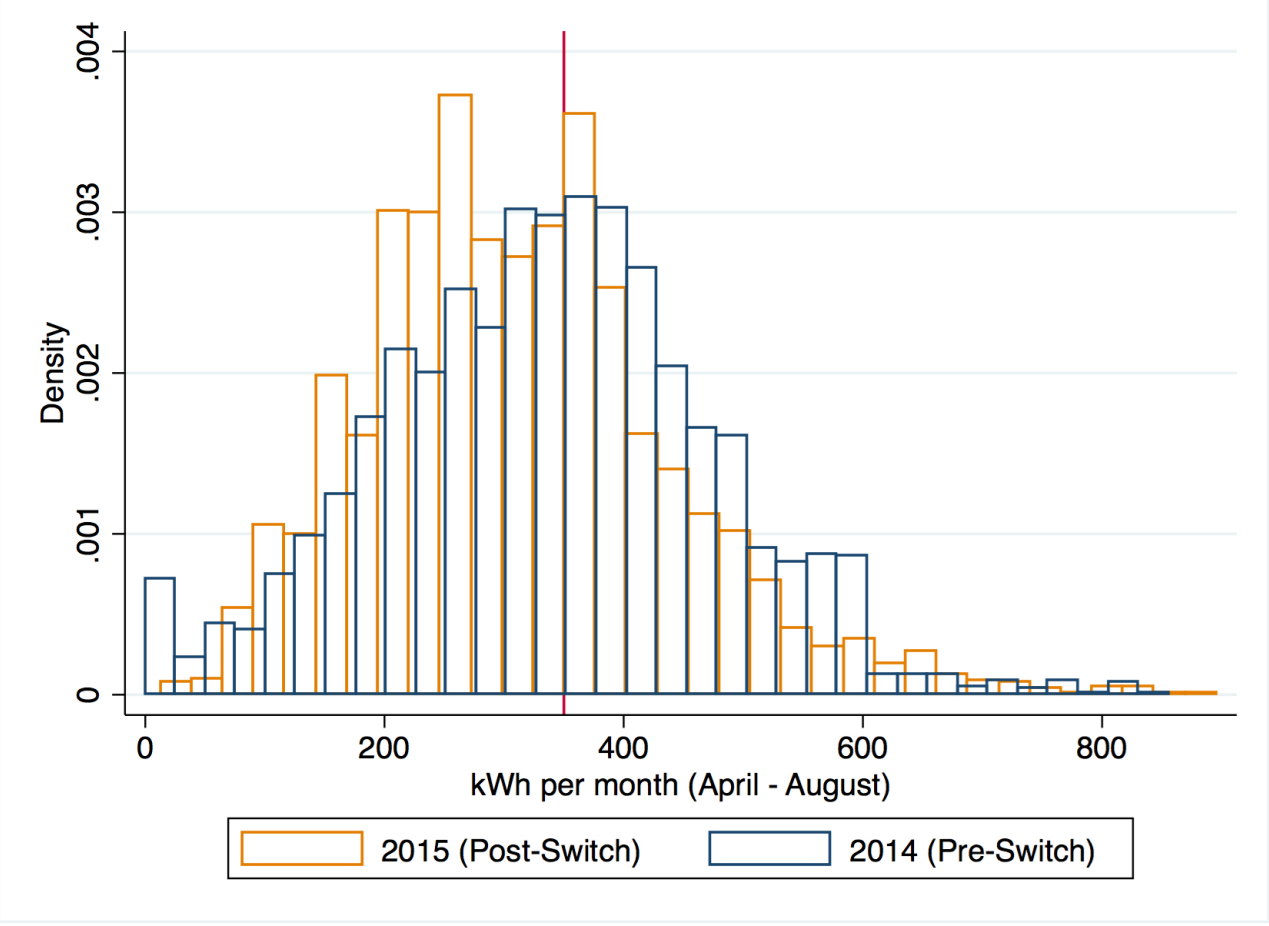
Why? Align consumption and expenditures

Analysis shows bigger response from customers least able to pay monthly bills

Survey responses suggest liquidity constrains consumption

- Most common stated benefit of prepaid meter: greater control over electricity expenditures
- 25% have gone without electricity because they had no money
- 60% say that liquidity determines transaction size

Why? Salience/Information



More bunching at relevant tariff discontinuities on prepaid

Why? Salience/Information

Price:

- Only 15% of hh say that prices are the same for postpaid and prepaid meters
- Twice as likely (30%) to name a correct price on prepaid

Quantity:

- 85% of households refuse to guess how much they consumed in the last 30 days
- 5pp more likely to offer some number on prepaid

Overall:

- Improvements in information are modest at best
- Bunching appears reactive

Survey responses: Transaction cost

- Most common stated drawback prepaid meter: hassle of buying electricity
- 95% say they choose where to purchase based on convenience
- 18% have ever bought online/phone

Why not buy larger amounts less frequently? Liquidity constraints

Summary

Case study: decrease in total electricity consumption

- Reduction of ~1.5 kWh/day is meaningful:
  - equivalent to 6 fewer hours of light from 4 incandescent bulbs – behavior change or zero balance?

Policy implications:

- Customers: Trade off greater control with higher transaction costs
  - Online/phone payments lower TCs
  - Leverage prepaid transactions to provide price information
- Utility: Decrease in consumption
  - Biggest reductions from customers with debts and late payments, but also those paying "full fare"

Future work

Revenue implications

- Drop in revenue made up for by more timely and complete payments?
- Impact on other bill payment (water, property taxes)
- Extend post-switch window

Expand to the rest of the city

- Switchers since 2004
- Tradeoff: less clean research design vs. more representative sample

Thank you

Collaboration and data sharing: City of Cape Town

- Electricity Department
- ERP
- Utilities Division

Funding support: IGC, J-PAL
Research assistance: Kathryn McDermott, Guthrie Gray-Lobe