The power of routines in peak hour appliance prioritization
- Exploring Swedes stated preferences during hypothetical load restrictions

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Motivation

- Electricity/Energy on the (geo)political agenda

- Also for developed countries

- Electrification; Transition; Nuclear phase-out; Intermittent

- DSM and consumer flexibility

- Limited peak hour load – Prioritize chores, appliances

- Implications for household equality, justice, distribution, etc.

Literature

- Economics
  - Average household; VoLL; Soft load control; DSM – Hight WTP
  - Flexibility in appliance choice not important
- Social science
  - Electricity use linked to structure, social organization, etc. of hh members
  - Consequences and social costs of DSM and behavioral changes
  - Varying capacity to respond – energy justice and distr implications
  - Ability linked to work patterns, social practices, hh composition, culture, access to energy storage, etc.
  - Flexibility capital and justice – interact with the gendered organization of everyday life

Contribution

- Hypothetical scenarios with stepwise limited load

- Disclose routines, prioritization and potential substitution of appliances in peak hour

- Quantitative approach

- A (recursive) Bivariate Probit approach to analyze
  - Routines: use of appliances in a typical week during peak demand hours
  - Prioritization of appliances under limited load

Data and empirical approach

- Swedish households; ≈ 2,000 responses; Y 2017; Representative

- Questionnaire – three parts: Routines and habits; Hypothetical electricity contracts; VoLL (black-outs)

- High-power appliances during weekday afternoon, winter season

- Limited load scenarios -- 5 kW; 3.5 kW; 2 kW

Routines (habits)

Considering weekdays, 4.30-7.30pm, December through February. How often does your household use the following appliances?
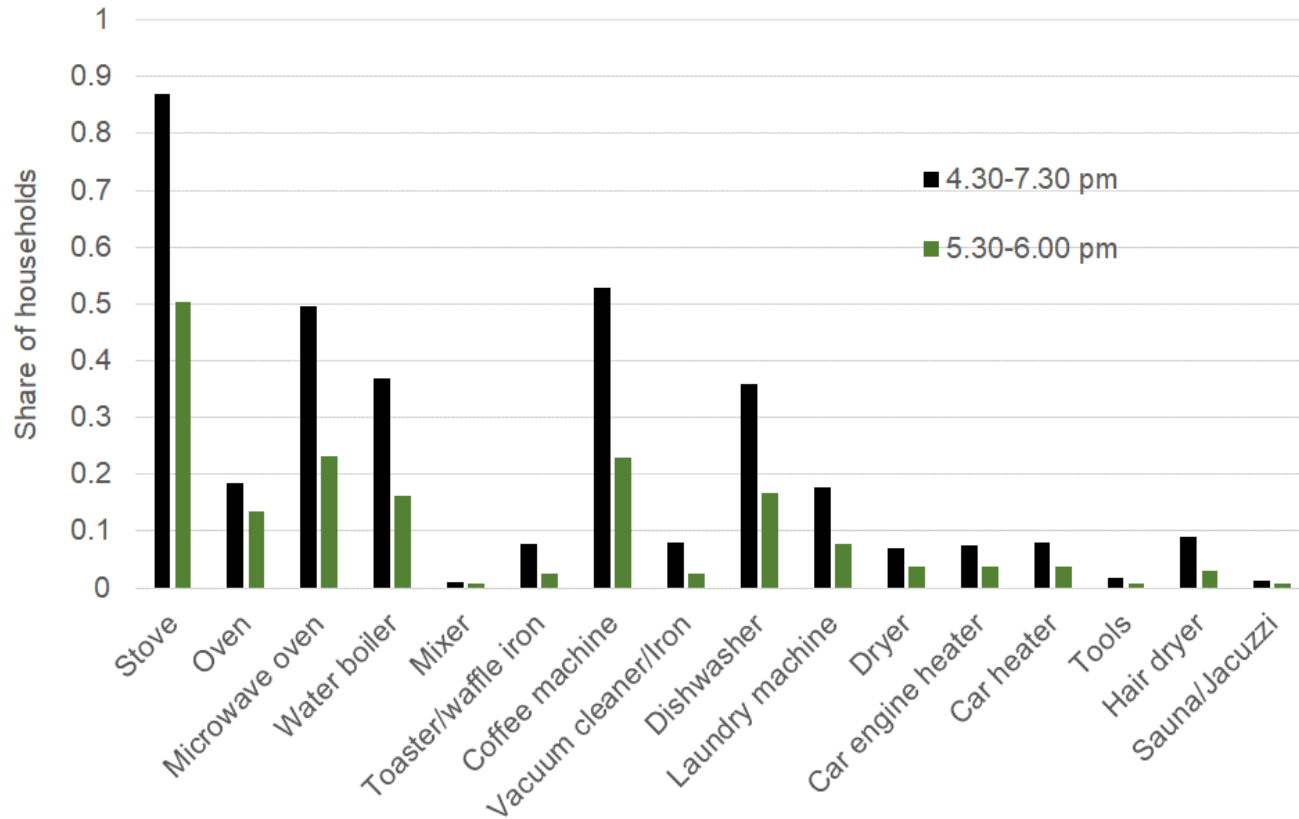
  4-5 days/week
  2-3 days/week
  0-1 days/week
  Never

[16 different appliances – high power]
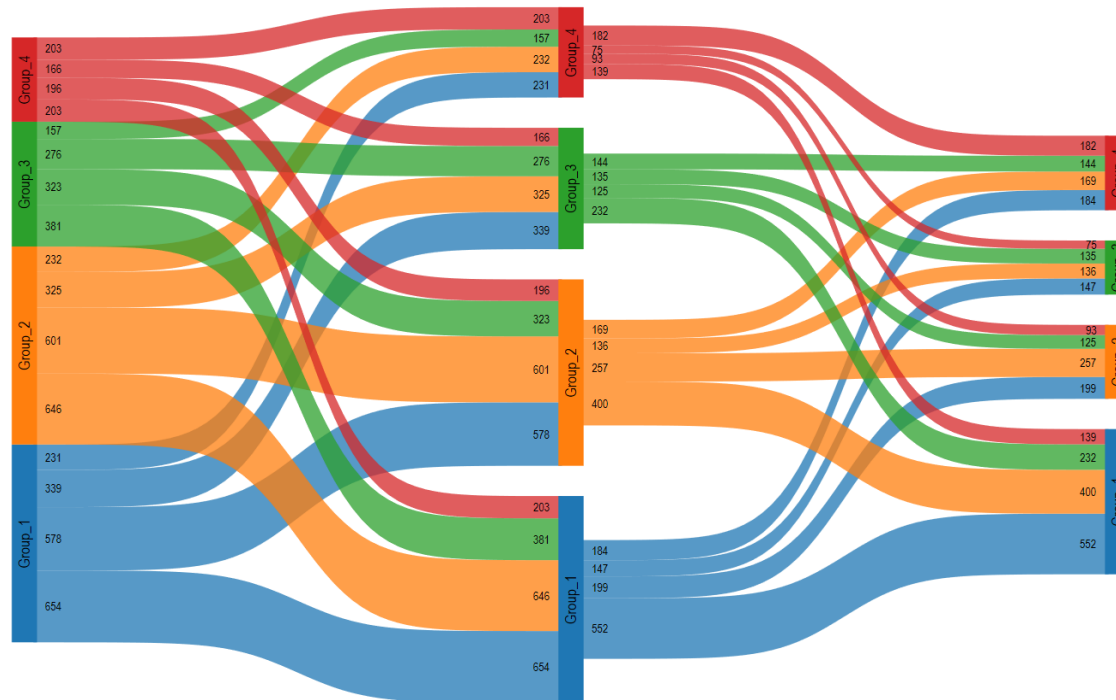
[Also asked about 5.30-6pm]

[4 to 5 workdays during a typical week]
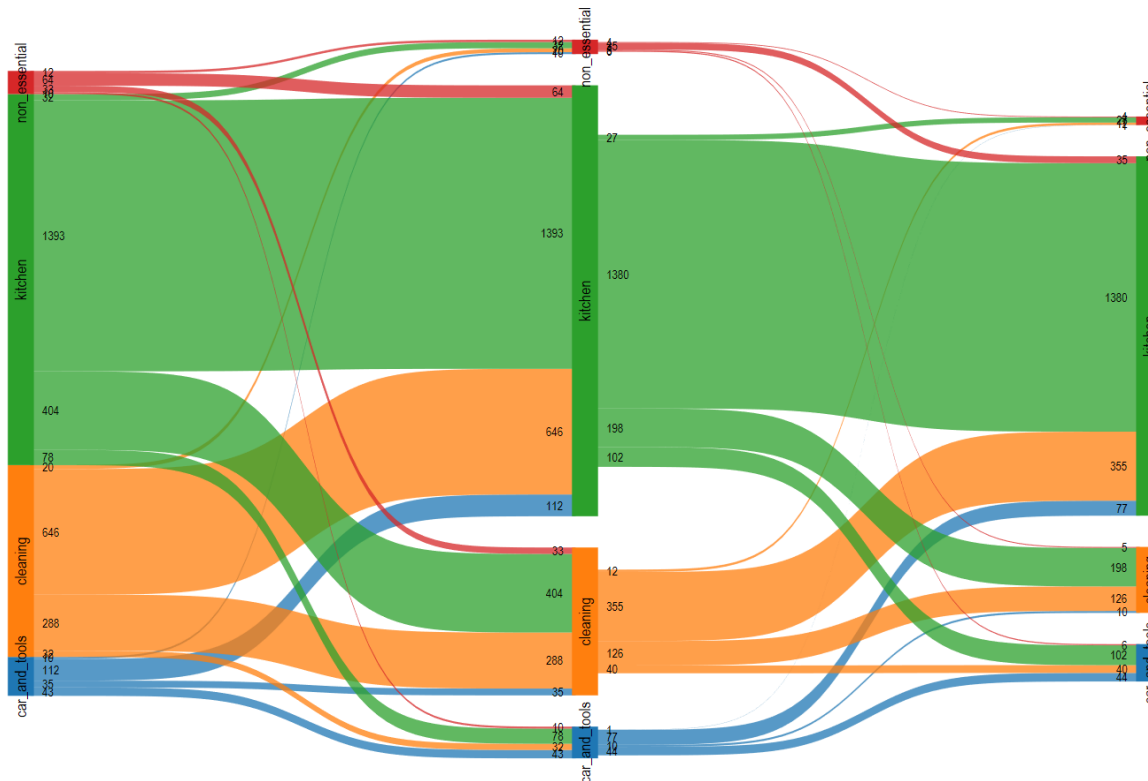
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- Design of load restrictions

  - 5kW max load → Select appliances

  - 3.5kW max load → Select appliances

  - 2kW max load → Select appliances

- Study substitution among appliances and across main chores (tasks)

Finding(s) 1: Flexible substitution among appliances

Finding(s) 2: Limited substitution across chores (cooking/cleaning)

# Exploring drivers for peak hour routines and prioritized appliances

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- **Routines:**
  - Dependent variables, during peak hour:
    - Stove >=2days/weekday – Yes/No
    - Washing machine >=2days/weekday – Yes/No
  - Explanatory variables:
    - Age, gender, income, education, one-adult hh, dependents at hh, city size

- **Appliance choice when limited load:**
  - Dependent variables, for 3.5kW limit:
    - Cooking appliances – Yes/No
    - Cleaning appliances (incl dishwasher) – Yes/No
  - Explanatory variables:
    - Routines as defined above + Explanatory variables listed above + Choice when 5kW limit

- Decision process – Simultaneous and/or endogenous

# Finding(s) 3: Routines are not endogenous, *only* simultaneously determined

	RBP-I	BP-I	RBP-II	BP-II
Correlation	0.658	0.572***	0.638	0.573***
	(0.600)	(0.0498)	(0.517)	(0.0498)
N	1850	1850	1850	1850
r2_a				
ll	-2028.7	-2028.8	-2027.1	-2027.1
aic	4097.5	4095.5	4102.1	4100.1
bic	4207.9	4200.4	4234.7	4227.2

Finding(s) 4: Differences in probability in engaging in the routines of using both stove and washing machine in a typical week
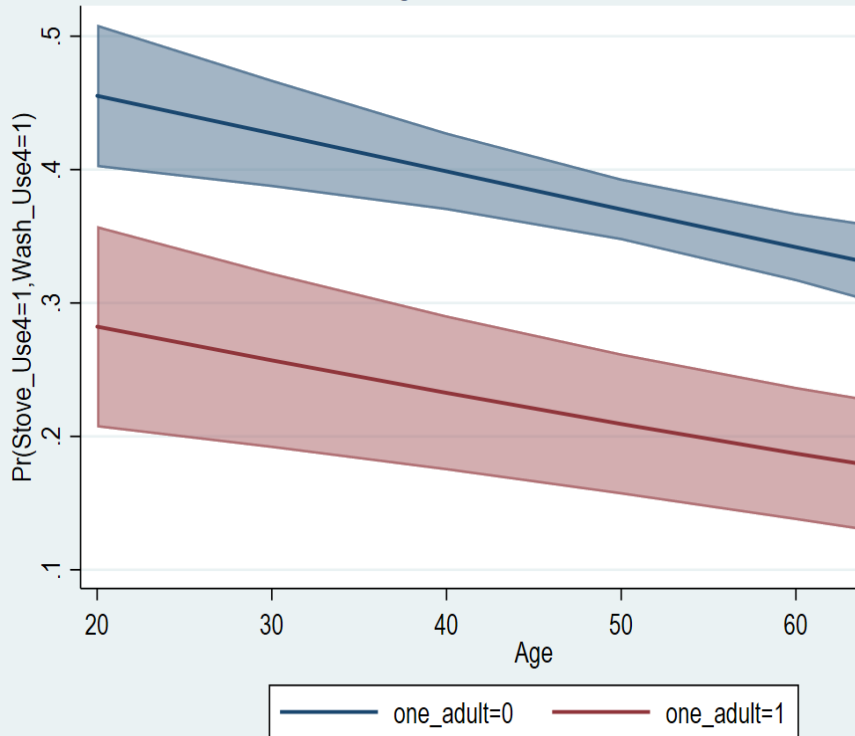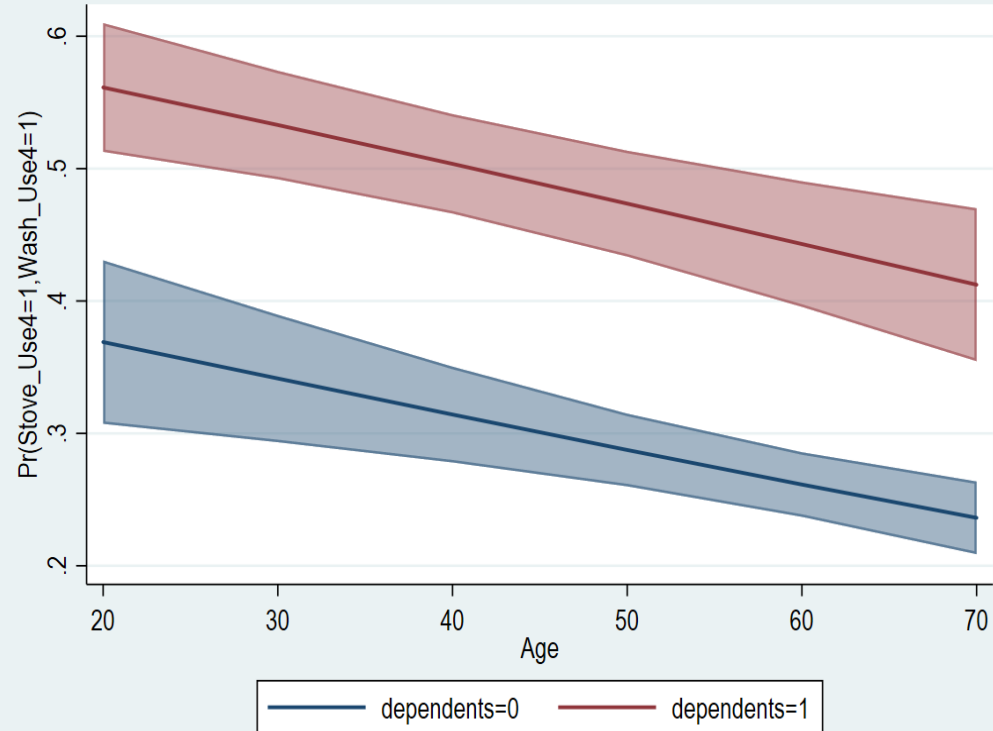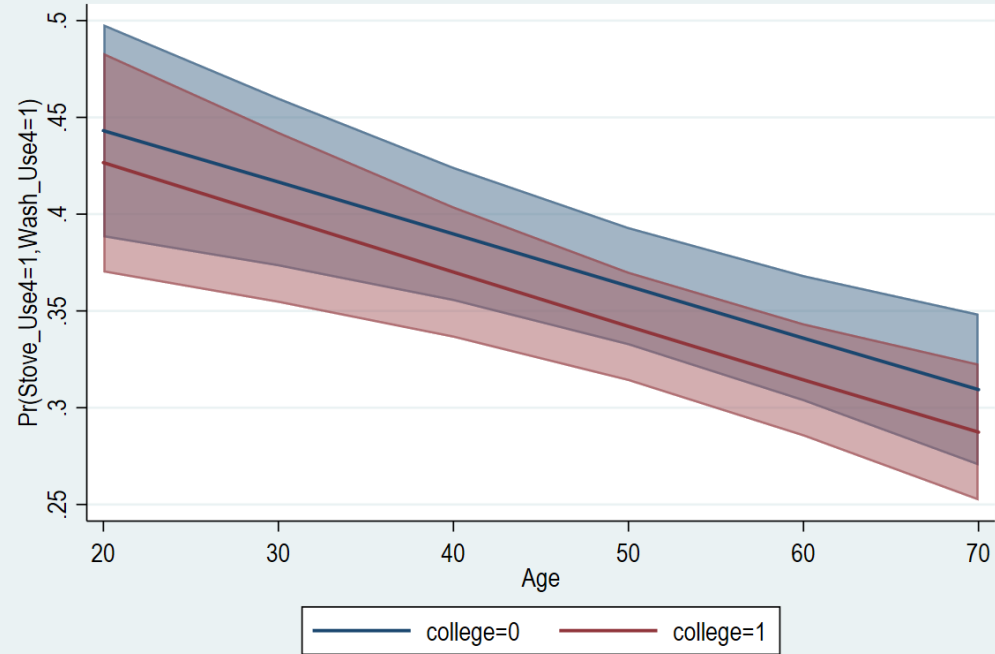
# Finding(s) 4: (Lack of) Differences in probability in engaging in the routines of using both stove and washing machine in a typical week
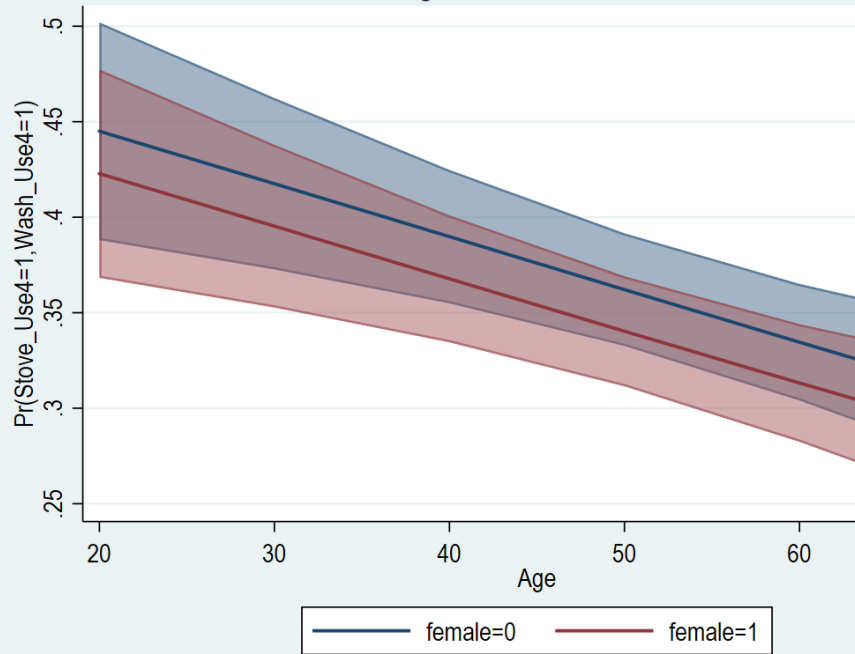
Finding(s) 5: Choices under limited load are determined by routines – *directly* and *indirectly* (like a sort of inertia)

|	RBP-I	BP-I	RBP-II	BP-II
Correlation	0.0418	-1.342***	0.191	-1.394***
	(0.766)	(0.0834)	(1.020)	(0.0823)
N	1850	1850	1850	1850
r2_a				
ll	-1450.7	-1455.5	-1433.2	-1437.1
aic	2929.4	2937.1	2926.5	2932.3
bic	3006.7	3008.9	3092.1	3092.4

Finding(s) 6: Effect on probability choosing both cooking and cleaning appliances
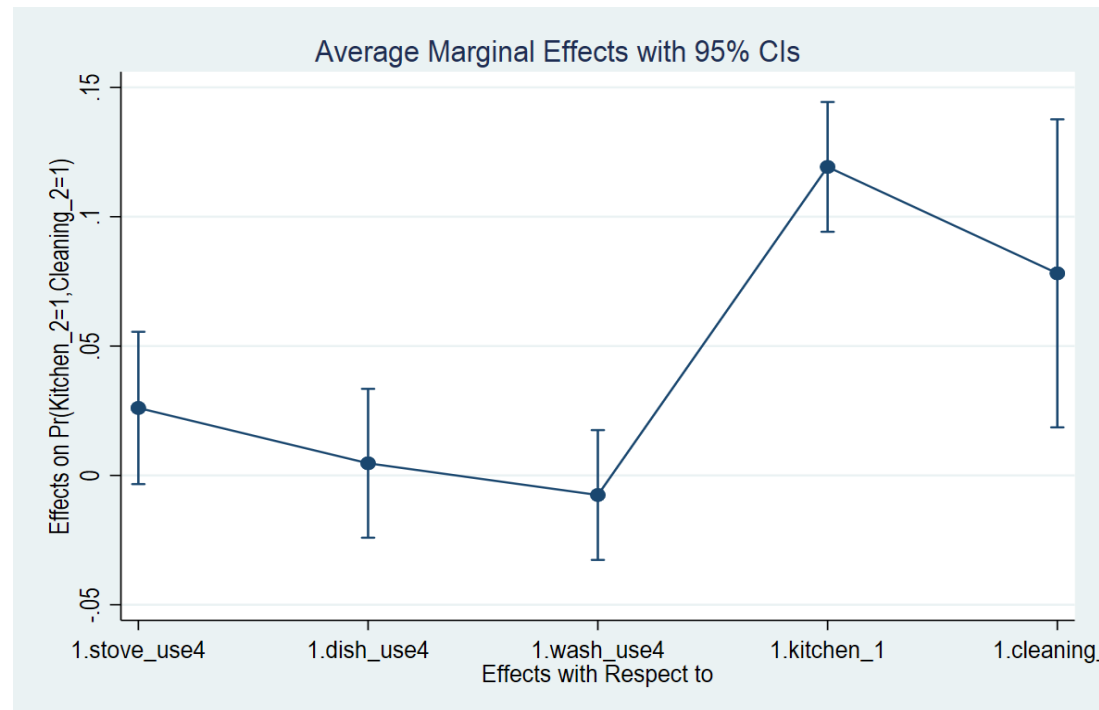
Finding(s) 6: Effects on probability choosing (left) cooking appliances only, and (right) cleaning appliances only
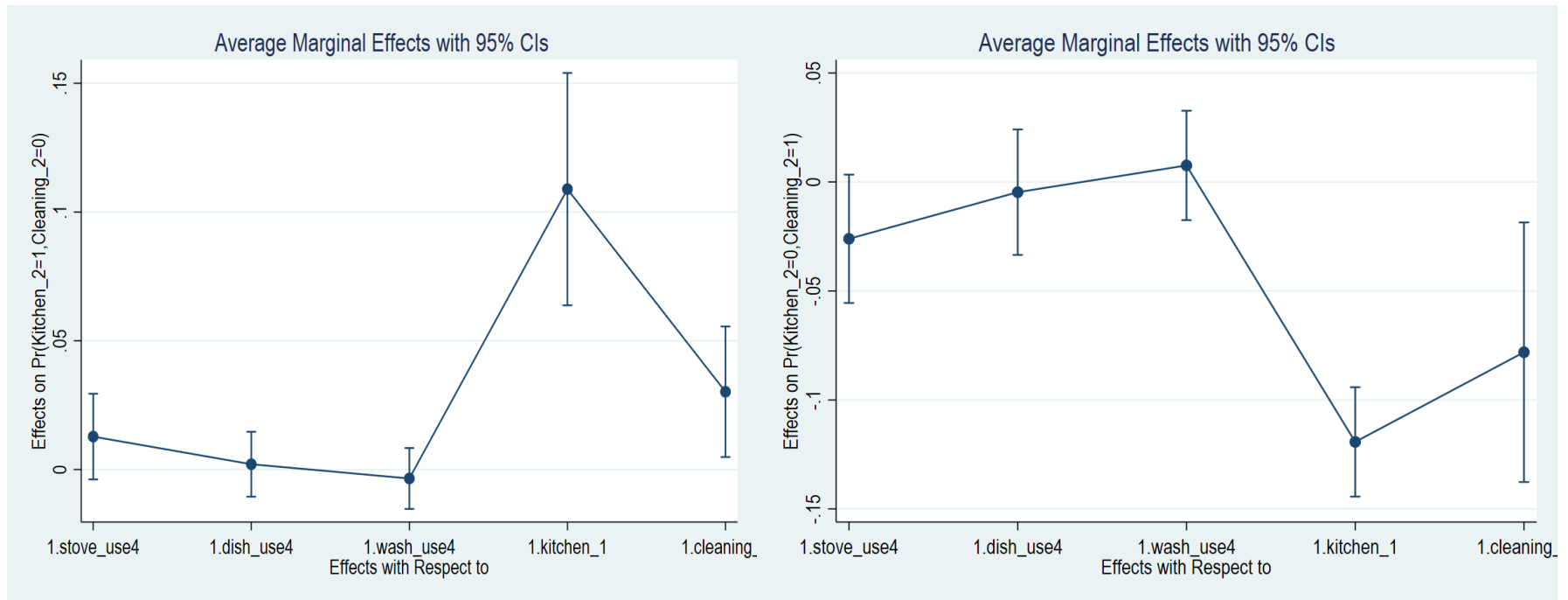
Concluding remarks

- Household characteristics predict routines

- Routines trumps household characteristics when limited load

- Flexibility across appliances, but within chores

- Household implications from prioritized appliances - but not within the scope of this study

- The 2kW restriction?

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Thank you!

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Note(s)

Categorization of appliances

- Cooking: oven, hot air oven, stove, microwave, kettle, food processor, baking, electric heater, toaster, waffle iron, coffee maker, coffee machine

- Cleaning: vacuum cleaner, iron, dishwasher, washing machine, tumble dryer