Consumer Demand Estimation for Heterogeneous U.S. Households

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Contribution

- We empirically estimate a full consumption demand system for the U.S.
  - Includes leisure
  - Uses flexible functional forms
  - Is heterogeneous across regions and income groups
  - Designed with EPA methods on characterizing baseline/policy forecasts for environmental regulations in mind

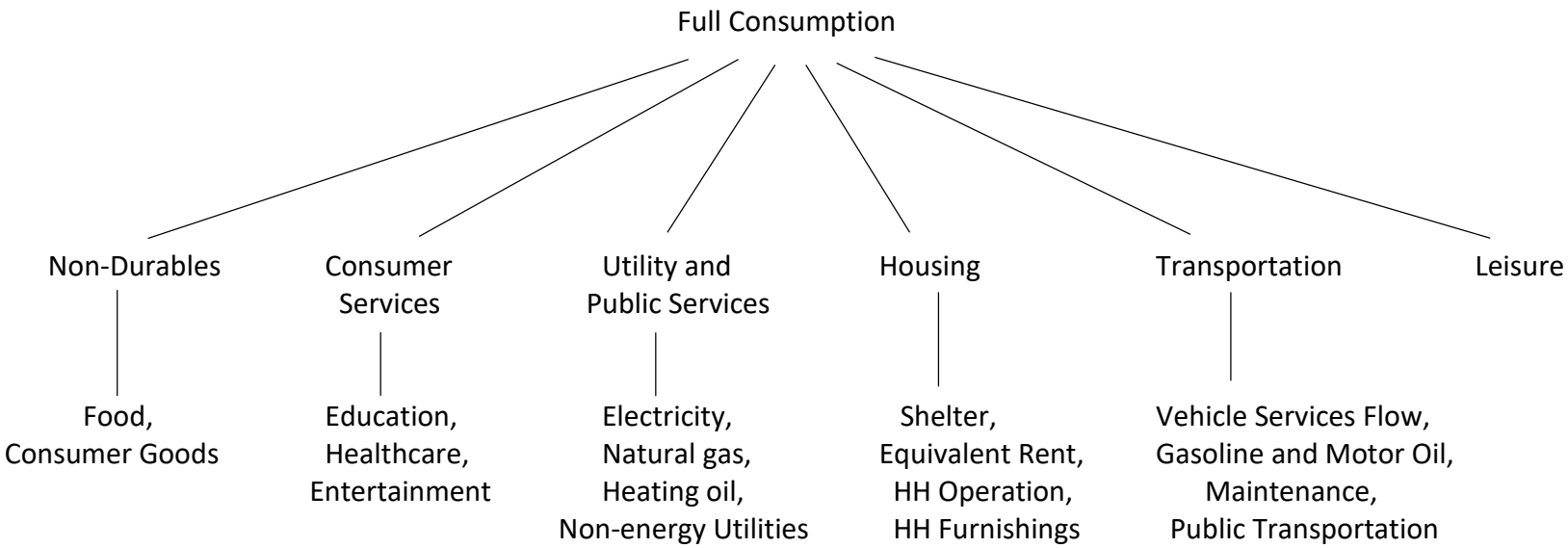
Data

- We need price, quantity (expenditure), and demographic controls

- Price data
  - MSA-level quarterly Cost of Living Index from CREC
  - State-level annual Regional Price Parity from BEA

- CEX Public-Use Microdata (Interview Survey)
  - Time range: 2013Q2-2017Q4
  - Data files: FMLY, MEMI, MTBI, NTAXI, OVB
  - Variables: CU expenditures and demographic characteristics

Consumer Demand Structure



- Categories are chosen based on:
  - Computational tractability
  - Connecting to categories important in EPA models

Demand System Expenditures

Category	CEX Expenditures Included	CEX Files
Non-Durables	1. Food (Food, Alcoholic Beverages, Tobacco Products and Smoking Supplies) 2. Consumer goods (Apparel, Personal Care, Reading)	FMLI
Consumer Services	Education, Healthcare, Entertainment (including cable)	FMLI, MTBI
Utilities and public services	Electricity, Natural Gas, Heating Oil, Non-Energy Utilities and Public Services (excluding cable)	FMLI
Housing	Shelter, Rental value of own property, Household Operations, Household Furnishings and Equipment	FMLI, MTBI
Transportation	Vehicle Services Flow (imputed), Gasoline and Motor Oil, Other Vehicle Expenses, Public Transportation	OVB, FMLI
Leisure	Imputed	MEMI, NTAXI

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Variables From MEMI Files

- # of adults: from CU members with age>=18
- Total hours worked (quarterly) from:
  - Number of hours worked per week
  - Number of weeks worked (last 12 months)

- Add up by CU id (newid)

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Variables From MTBI Files

- Negative health care expenditures (~470 obs)
  - Remove reimbursements and gifts
  - Add health care expenses using “cost” variable (excluding reimbursements and gifts)

- Equivalent rental value of own property from:
  - Estimated monthly rental value of owned home
  - Estimated annual rental value of timeshare
  - Estimated monthly rental value of vacation home available for rent

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Variables From NTAXI Files

- The available after-tax wage is negative for around 22,200 (~20%) CUs in CEX data.

$$\text{After} - \text{tax wage} = \frac{\text{CU wage}}{\text{total hours worked}} (1 - \text{federal tax marginal rate} - \text{state tax marginal rate})$$

  - Weighted federal/state marginal tax rate from:
    - Federal/State marginal tax rate
    - Wage and salary income of taxpayer
    - Wage and salary income of taxpayer's spouse
  - CU wage from:
    - Wage and salary income of taxpayer
    - Wage and salary income of taxpayer's spouse

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Leisure Imputation

- Want full consumption but leisure price and quantity not directly reported.
  - Leisure price= after-tax wage
  - Leisure value= after-tax wage * leisure time

$$\text{Leisure value} = \text{after} - \text{tax wage} * (\text{time endowment} - \text{total hours worked})$$

  - Time endowment = 10.96 hours/day (Fullerton and Rogers, 1993)
    - Leisure time: socializing & communicating, watching TV, participating in sport, exercise, and recreation
    - Leisure time: Assume 2.96 hours/day, on average, if working full time
    - Will explore sensitivity of our estimates to this assumption later

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Durable Good Purchases

- Durable good purchases are large and infrequent and need to be replaced with their services flow.

1. Housing purchases: use equivalent rent

2. Vehicle purchases:
   - Estimate vehicle purchasing price (Meyer and Sullivan, 2017)
   - Calculate vehicle services flow (Slesnick, 2000)

Vehicle services flow

1. Vehicle purchasing price is missing for some CUs
   - Estimate vehicle purchasing price (OVB & FMLI files)
     - RHS: vehicle age, fuel type, own use, new/used, family size, region, age, education, gender
     - Truck, make, and vehicle year fixed effects

2. Calculate vehicle services flow (S_t) in time, *t:*
   - $S_t = 0.25(r_t + \delta)(1 - \delta)^s P_0$
     - P_0: (predicted from/available in CEX) purchasing price
     - s (exponent): years since purchase
     - r_t: U.S. 20 Year Real Treasury Rate (assumed)
     - δ: depreciation from Bento, et al. (2018)
     - Depreciation rates are assigned to each vehicle based on vehicle age and year in OVB files

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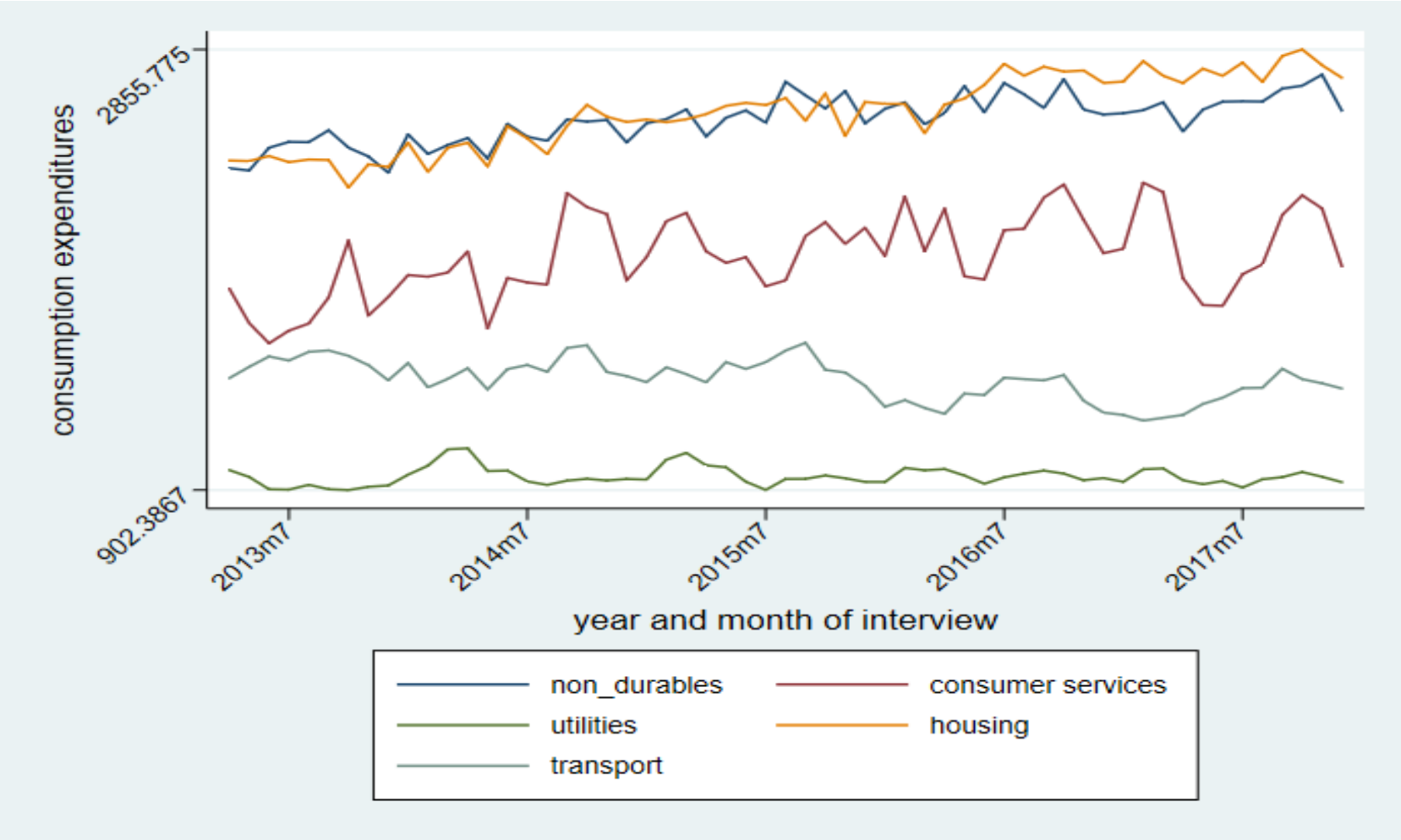
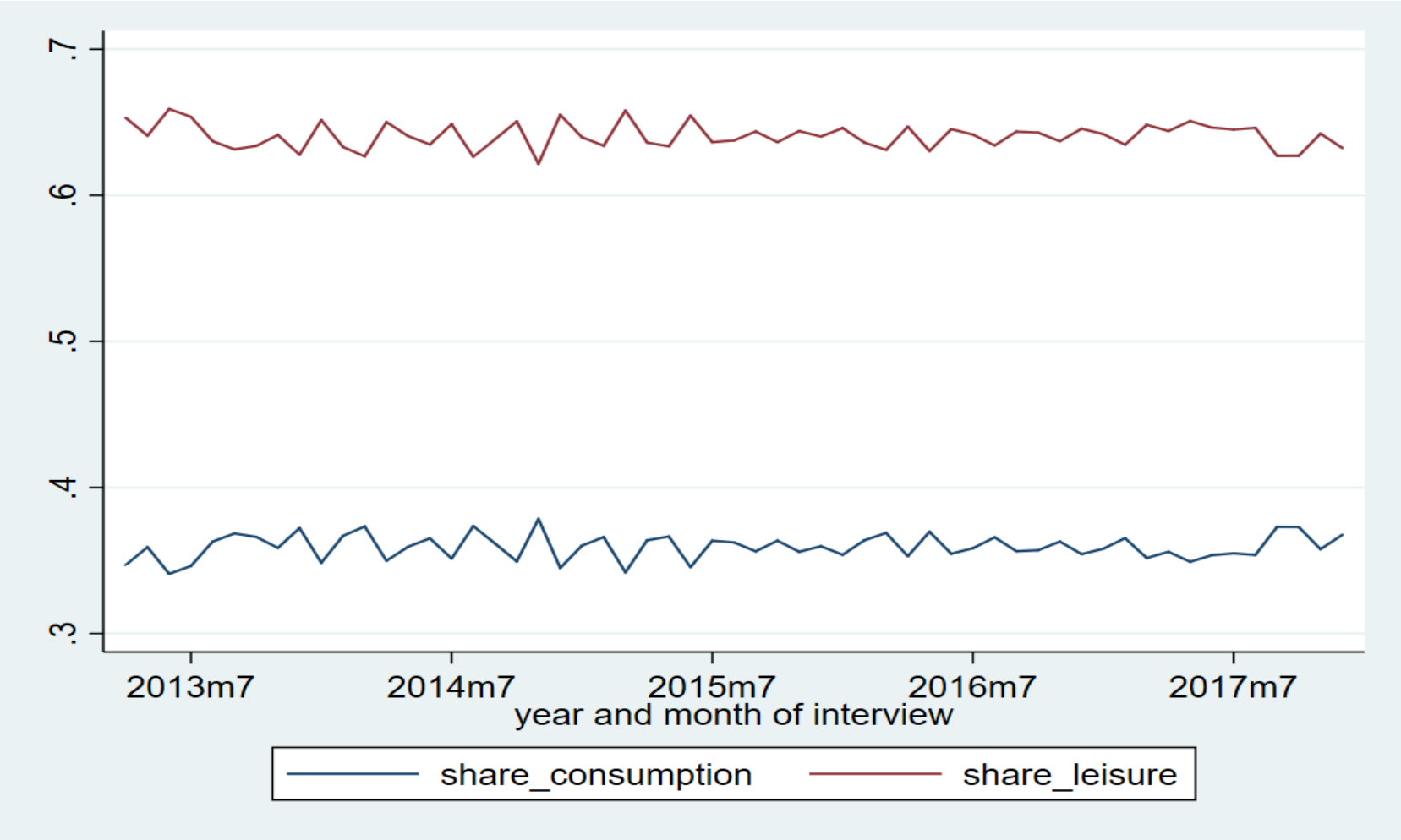
Consumption Expenditures



Full Consumption Expenditure Shares



Some CEX Data Concerns

- State variable is changed for ~11% of the CUs:
  - State-level price indices are matched to each CU based on the CU state (and time of interview).
  - State fixed effects are used in the estimation.
- The sample is a rotating panel survey: control for CUs who get interviewed multiple times?
- CEX tax data (NTAXI file) is available for ref. person & spouse.
  - Tax info for other CU members?
  - Could the tax data be used for economy-wide analyses (e.g. CGE modeling)?

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Thank you!

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