Liquidity Constraints and Healthcare Expenditure

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Motivation

- Healthcare expenditures are large and increasing
  - U.S. healthcare spending \$3.5 trillion, \$10,739 per person in 2017
  - \$365.5 billion for out-of-pocket expenditures
- Liquidity constraints may affect the wellbeing of poor households
  - strong relationship between family income and individuals' likelihood of receiving medical care
  - family income $<$ \$40,000, 36% forgo medical treatment
  - family income $>$ \$100,000, 8% skip
    (FRB Survey of Household Economics and Decisionmaking)

This paper

- **Question:** How do the liquidity constraints affect healthcare expenditures?
- How does the effect vary between wealthy and poor households?
- How is the effect different from non-health expenditures?

Literature

- Liquidity constraints
  - theory
    - Deaton (1991), Browning and Crossley (2009)
  - empirical
    - Zeldes (1989), Runkle (1991), Meghir and Weber (1996), Campbell and Hercowitz (2018)
- Health capital
  - Grossman (1972), Wagstaff (1986), Case and Deaton (2005), Galama (2015)

Preview of Findings

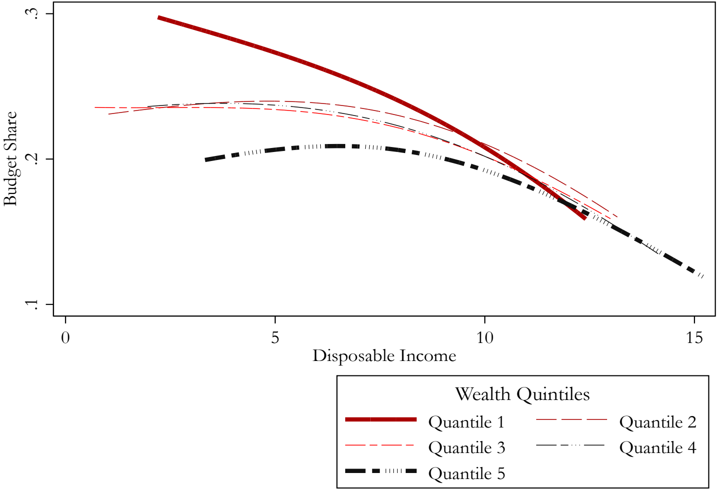
- Theoretical
  - higher marginal rate of substitution for health when constrained
  - healthcare choice involves multiple periods
  - one period ahead expectations in Euler relation for health capital
  - lag terms in linearized Euler relation for health investment

- Empirical
  - more dynamics in empirical test
  - liquidity constraints bind differentially across wealth
  - effects are larger than on non-health consumption
  - more variation in income elasticities, levels and growths

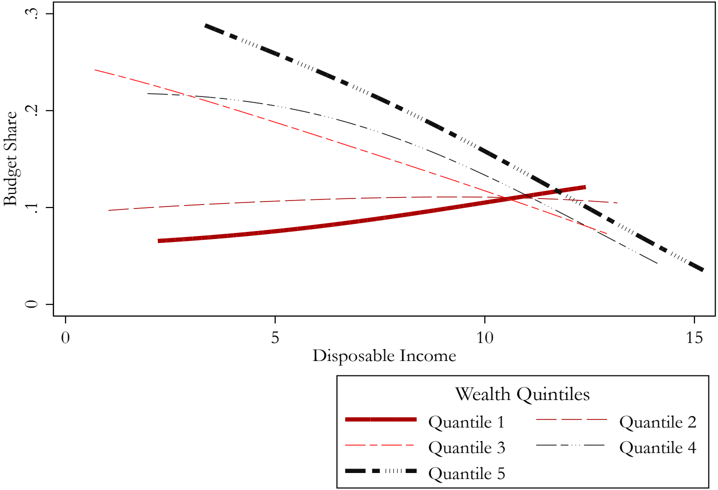
First Pass

- Health spending's interaction with income centers around macro-micro controversy in the literature
  - Macro data: income elasticity > 1
  - Micro data: income elasticity $\approx$ zero
- New angle on micro studies:
  - Heterogeneity in response is unknown

Engel Curve for food



Engel Curve for healthcare



MODEL

The Model

Preferences and Technology:

- utility over consumption good $C_{i,t}$ and service flows from health stock $H_{i,t}$
- choose how much to consume $C_{i,t}$, how much to invest for health $d_{i,t}$, and how much to save each period $A_{i,t+1}$
- depreciation of health stock δ^h
- health technology converts each dollar into a unit in stock of health $\Delta H_{i,t} = f(d_{i,t}) = d_{i,t}$
- imperfect credit markets with borrowing constraints

The Model

- Households maximize lifetime utility:

$$\mathbb{E}_t \sum_{\tau=0}^{T-t} \beta^{\tau} u(C_{i,t+\tau}, H_{i,t+\tau}) \tag{1}$$

- subject to:

$$C_{i,t} + d_{i,t} + A_{i,t+1} = (1 + r_{i,t})A_{i,t} + Y_{i,t} \qquad \text{(budget constraint)} \tag{2}$$

$$H_{i,t} = (1 - \delta^{h})H_{i,t-1} + d_{i,t} \qquad \text{(health capital accumulation)} \tag{3}$$

$$C_{i,t} \geqslant 0, \quad d_{i,t} \geqslant 0 \qquad \text{(non-negativity constraints)} \tag{4}$$

$$A_{i,t+1} \geqslant \underline{\mathrm{A}} \qquad \text{(liquidity constraint)} \tag{5}$$

$A_{i,0}, H_{i,0}$ is given

Optimality conditions:

- intertemporal condition for non-health consumption

$$u_c^{i,t} = \beta \mathbb{E}_t[(1+r_{i,t+1})u_c^{i,t+1}] + \mu_{i,t}.$$

- intertemporal condition for health stock

$$u_H^{i,t} = \beta \mathbb{E}_t[(1+r_{i,t+1})u_H^{i,t+1}] - \beta(1-\delta^h)\frac{\mathbb{E}_t[(1+r_{i,t+1})\mu_{i,t+1}]}{\mathbb{E}_t[1+r_{i,t+1}]} + \mu_{i,t}.$$

- $\mu_{i,t}$ is Lagrange multiplier for liquidity constraint

Intratemporal condition:

- marginal rate of substitution

$$MRS_{H,C}^{i,t} = \frac{u_H^{i,t}}{u_C^{i,t}} = \frac{\delta^h + r}{1+r} + \frac{(1-\delta^h)\mu_{i,t}}{V_A^{i,t}}$$

- assume $u(C_{i,t}, H_{i,t}) = \ln C_{i,t} + \ln H_{i,t}$, spending ratio

$$\frac{d_{i,t}}{C_{i,t}} = \frac{1+r}{\delta^h + r}\left[1-(1-\delta^h)\left(\frac{C_{i,t}}{C_{i,t-1}}\right)^{-1}\right]$$

EMPIRICAL MODEL

- felicity function

$$u(C_{i,t}, H_{i,t}; \Theta_{i,t}) = \left(\frac{C_{i,t}^{1-\phi}}{1-\phi} + \frac{H_{i,t}^{1-\xi}}{1-\xi} \right) exp(\Theta_{i,t})$$

- household specific taste-shifter

$$\Theta_{i,t} = g(age_{i,t}, edu_{i,t}, size_{i,t}, race_{i,t}, sex_{i,t}, marital_{i,t}, health\ indices, health\ shock) + \zeta_i + \chi_t + \nu_{i,t}$$

Linearized Euler Equations

- non-durable consumption

$$\Delta \ln C_{i,t+1} = \frac{1}{\phi}\{\ln(1+\mu'_{i,t}) + \ln\beta_i + \ln(1+r_{i,t+1}) - \ln(1+e'_{i,t+1}) + \Delta\Theta_{i,t+1}\}$$

- health expenditure

$$\Delta \ln d_{i,t+1} = \frac{\hat{m}}{\xi}\{\ln(1+\mu''_{i,t}+\mu'''_{i,t+1}) + \ln\beta_i + \ln(1+r_{i,t+1}) - \ln(1+e''_{i,t+1}) + \Delta\Theta_{i,t+1}\}$$
$$-\frac{\hat{m}-1}{\xi}\{\ln(1+\mu''_{i,t-1}+\mu'''_{i,t}) + \ln\beta_i + \ln(1+r_{i,t}) - \ln(1+e''_{i,t}) + \Delta\Theta_{i,t}\}$$

- $\hat{m} > 1$, stock-flow adjustment

Linearized Euler Equations

- non-durable consumption

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- health expenditure

$$\begin{aligned}\Delta \ln d_{i,t+1} = {} & \frac{\hat{m}}{\xi}\{\ln(1+\mu''_{i,t} + \mu'''_{i,t+1}) + \ln\beta_i + \ln(1+r_{i,t+1}) - \ln(1+e''_{i,t+1}) + \Delta\Theta_{i,t+1}\} \\ & - \frac{\hat{m}-1}{\xi}\{\ln(1+\mu''_{i,t-1} + \mu'''_{i,t}) + \ln\beta_i + \ln(1+r_{i,t}) - \ln(1+e''_{i,t}) + \Delta\Theta_{i,t}\}\end{aligned}$$

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Linearized Euler Equations

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- health expenditure

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- $\hat{m} > 1$, stock-flow adjustment

TESTS

Test for liquidity constraints

- $\mu_{i,t}$ is an omitted variable, enters into the error term
  - if not constrained $\mu_{i,t} = 0$
  - if constrained $\mu_{i,t} > 0$, correlated with consumption growth, endogeneity!
- income (current or lagged) as an extra regressor
  - under null hypothesis, PIH and no constraint, should have no effect
  - under alternative hypothesis, $\mu_{i,t} > 0$, negative coefficient
- split sample based on wealth, Zeldes (1989) and Runkle (1991)

Test for healthcare expenditure

- **Case 1:** $\mu_{i,t} > 0$ and $\mathbb{E}_t[\mu_{i,t+1}] = 0$
- **Case 2:** $\mu_{i,t} = 0$ and $\mathbb{E}_t[\mu_{i,t+1}] > 0$
- **Case 3:** $\mu_{i,t} > 0$ and $\mathbb{E}_t[\mu_{i,t+1}] > 0$
- **Case 4:** $\mu_{i,t} = 0$ and $\mathbb{E}_t[\mu_{i,t+1}] = 0$
- $\mu_{i,t} > 0 \rightarrow$ negative bias, $\mathbb{E}_t[\mu_{i,t+1}] > 0 \rightarrow$ positive bias

Direction of Bias

(+)

$$\Delta d_{i,t+1} = \beta_0 + \beta_1 X_{i,t} + \beta_2 r_{i,t+1} + \beta_3 y_{i,t} + \epsilon_{i,t}$$

(−)

$$\boxed{\beta_3 < 0} \qquad \mu_{i,t}$$

Direction of Bias

(−)

$$\Delta d_{i,t+1} = \beta_0 + \beta_1 X_{i,t} + \beta_2 r_{i,t+1} + \beta_3 y_{i,t} + \epsilon_{i,t}$$

(−)

$$\boxed{\beta_3 > 0}$$

$$\mathbb{E}_t[\mu_{i,t+1}]$$

EMPIRICAL ASSESSMENT

Data

- Panel Study of Income Dynamics (PSID) 1999-2015 waves
- consumption, income, demographics, wealth
- health spending = out-of-pocket expenditures + health insurance premiums
- net wealth with home equity, robustness without home equity
- Health indices for family
  - Acute: stroke, heart attack, cancer
  - Chronic: diabetes, lung disease, heart disease, psychological problems, arthritis, asthma, memory loss, learning disorder
- Health shock: hospitalization index (head or spouse or both)
- main sample, heads between 25-65 years old
- marginal tax rates, federal and state taxes in disposable income using NBER TAXSIM simulator

▸ Descriptive Statistics

Euler Equation Tests

- the presence of liquidity constraints tested by Lagrange multiplier $\mu_{i,t}$ in the error term
- specification in growth:

$$\Delta \ln C_{i,t+1} = \alpha_0^c + \alpha_{1i}^c + \alpha_{2t}^c + \alpha_3^c r_{i,t+1} + \alpha_4^c \ln y_{i,t} + X'_{i,t+1}\Gamma^c + u_{it+1}^c$$
$$\Delta \ln d_{i,t+1} = \alpha_0^d + \alpha_{1i}^d + \alpha_{2t}^d + \alpha_3^d r_{i,t+1} + \alpha_4^d r_{i,t} + \alpha_5^d \ln y_{i,t} + X'_{i,t+1}\Gamma_1^d + X'_{i,t}\Gamma_2^d + u_{it+1}^d$$

- liquidity constraints do not exist $\rightarrow$ α_4^c and α_5^d are zero
- liquidity constraints exist and binding $\rightarrow$ α_4^c and α_5^d are biased for constrained

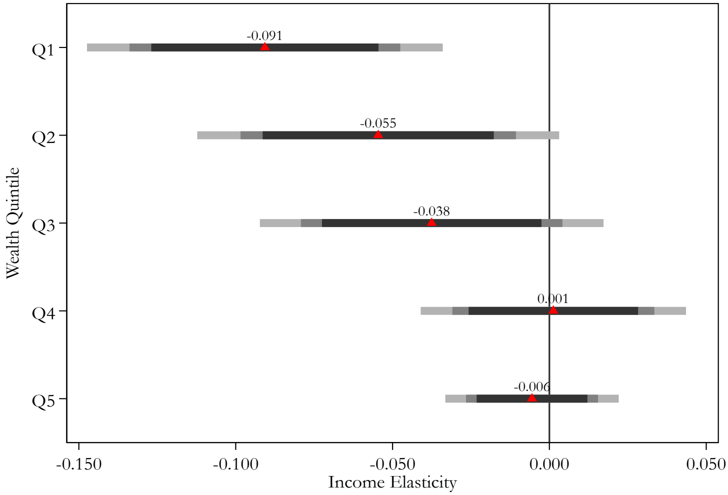
Identification

- $r_{i,t+1}$ is not known at t, correlated with expectation error $\rightarrow$ instrumental variable
  - any variable in the information set at time t is valid
- measurement error in consumption and forecast error for health spending $\rightarrow$ MA(1) errors
  - t-1 variables as instruments

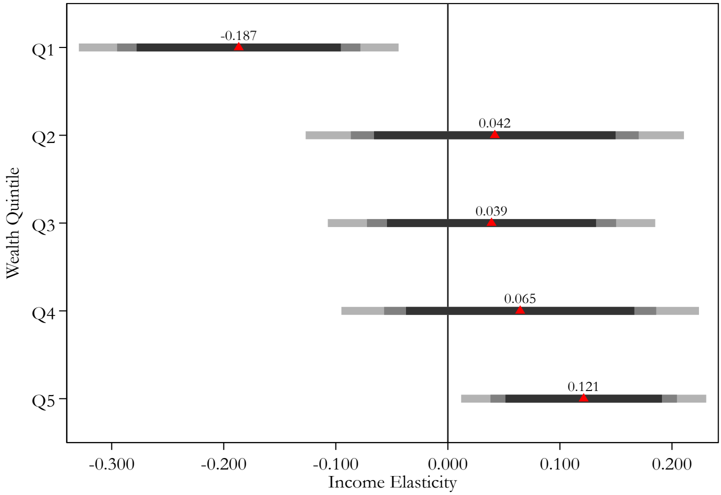
measurement error

- instrument set: head and spouse marginal tax rates at t-1, head hours worked at t-1
  - alternatively income at t-1 is common, control variable in health test
- higher order terms in Taylor expansion, approximation bias
  - comparative analysis
  - assume no differential bias for food vs healthcare

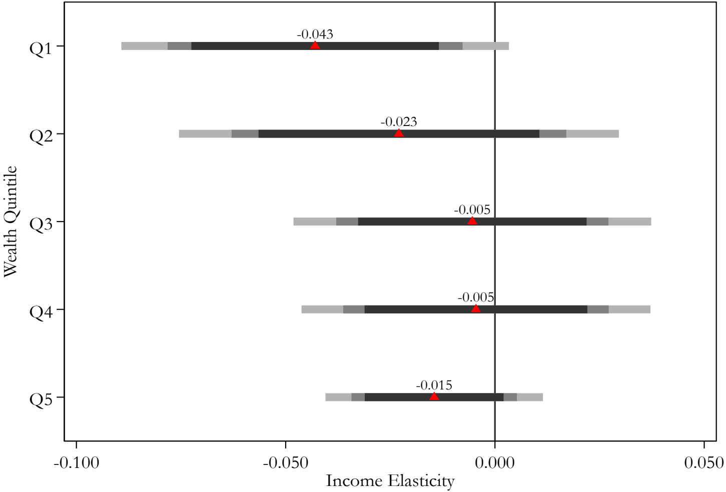
Test for Food Consumption



Test for Healthcare Expenditure



Test for All Expenditure



Robustness

- insurance choice
  - dummies for private, public, uninsured ▸ insurance
- misspecification: non-separable leisure
  - control hours worked ▸ hours
- alternative sample stratification
  - net wealth without home equity ▸ split

SUPPORTING EVIDENCE

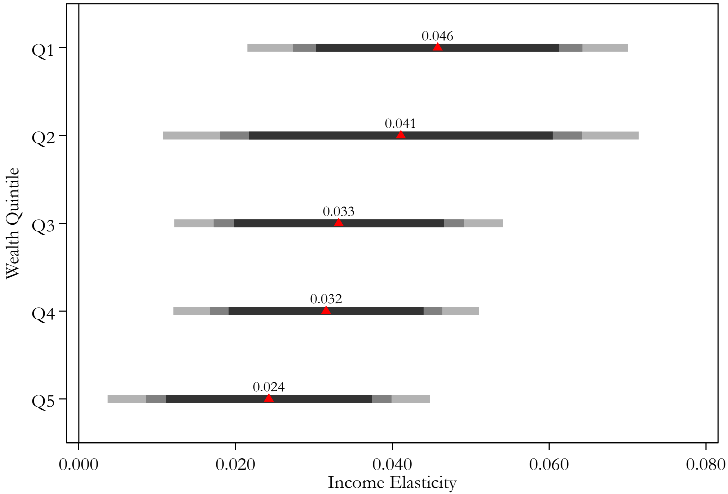
Income Elasticities

- specification in levels: income elasticity of consumption

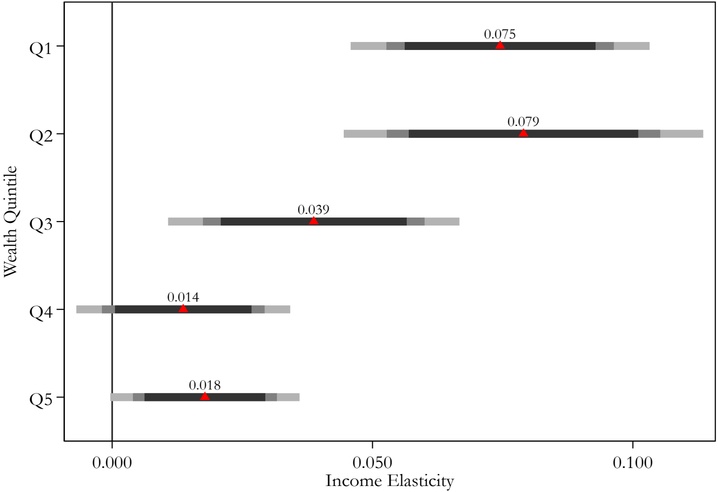
$$\ln c_{it} = \alpha_0^c + \alpha_1^c \ln y_{it} + \alpha_2^c HI_{i,t}^a + \alpha_3^c HI_{i,t}^c + \alpha_4^c H_{i,t}^s + X_{i,t}' \alpha_5^c + b_i^c + b_t^c + \iota_{i,t}^c$$
$$\ln d_{it} = \alpha_0^d + \alpha_1^d \ln y_{it} + \alpha_2^d HI_{i,t}^a + \alpha_3^d HI_{i,t}^c + \alpha_4^d H_{i,t}^s + X_{i,t}' \alpha_5^d + b_i^d + b_t^d + \iota_{i,t}^d$$

- $HI_{i,t}^a$ is acute health index,
  $HI_{i,t}^c$ is chronic health index,
  $H_{i,t}^s$ is hospitalization index,
  $X_{i,t}$ includes family size dummies, race, sex, marital status of head, education, a quadratic in age of head, type of health insurance and state dummies

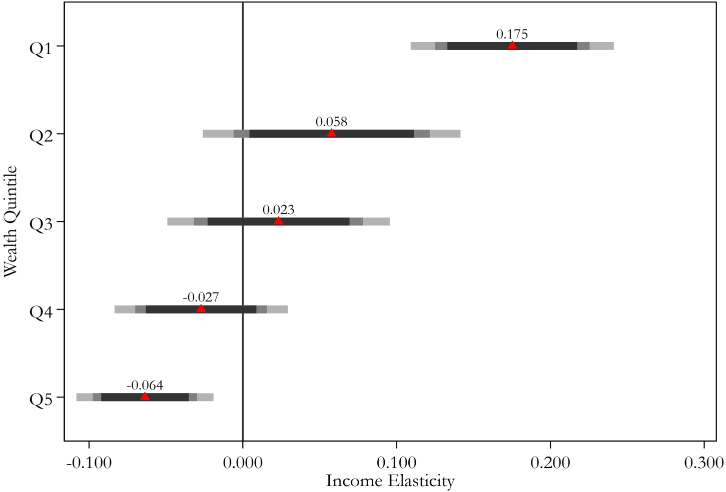
Income Elasticity of All Expenditures



Income Elasticity of Food Consumption



Income Elasticity of Healthcare Expenditure



Crowding-out

	Wealth Quintile				
	1st	2nd	3rd	4th	5th
	Food consumption				
Chronic index	-0.032**	0.004	-0.005	-0.020	0.014
	(0.015)	(0.015)	(0.012)	(0.013)	(0.011)
Hospitalization	-0.055*	-0.032	-0.023	-0.061***	-0.006
	(0.028)	(0.023)	(0.023)	(0.020)	(0.017)
	Non-health consumption				
Chronic index	-0.005	-0.001	-0.002	-0.020***	0.002
	(0.010)	(0.009)	(0.008)	(0.007)	(0.01)
Hospitalization	-0.048***	-0.009	-0.027*	0.003	-0.036**
	(0.017)	(0.015)	(0.014)	(0.015)	(0.017)
	Healthcare expenditures				
Chronic index	0.078**	0.072**	0.093***	0.027	0.026
	(0.032)	(0.033)	(0.027)	(0.024)	(0.021)
Hospitalization	0.087	0.234***	0.119**	0.204***	0.139***
	(0.067)	(0.061)	(0.048)	(0.050)	(0.042)

Conclusion

- Theoretical Implications:
  - higher marginal rate of substitution for health when constraint is binding
  - changes in healthcare spending are amplified when constraint is binding
  - health capital choice: deviation due to one period ahead expectation
  - health expenditure growth: multiple periods, stock-flow adjustment
- Empirical Findings:
  - liquidity constraints bind differentially for health-care expenditures
  - more variation in income elasticities, levels and growths
  - crowding out of health status

APPENDIX

Descriptive Statistics

	Wealth Quintiles					
	1st	2nd	3rd	4th	5th	Total
Net Wealth	-22.2	23.0	85.7	228.8	1,311.4	325.3
Disposable Income	27.0	31.6	41.9	53.4	96.8	50.2
Total Consumption	36.3	39.3	46.4	53.6	70.9	4.9
Food Consumption	6.9	7.6	8.4	9.3	10.9	8.6
Health Expenditure	3.7	4.2	4.8	5.9	8.3	5.4
Age	37.4	38.8	42.7	46.6	50.4	43.2
Education	13.4	13.1	13.5	14.1	15.0	13.8
Household Size	2.7	2.8	3.0	2.9	2.9	2.9
Observations	5930	5925	5927	5927	5927	29636

◂ data

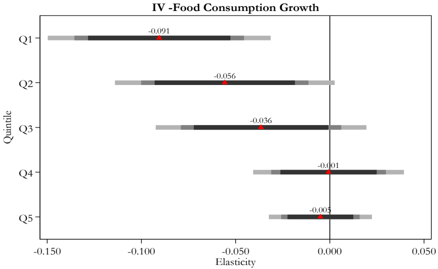
Measurement Error

- actual consumption $C^a_{i,t}$
- observed consumption $C_{i,t} = C^a_{i,t} * \kappa_{i,t}$
- $\kappa_{i,t}$ classical, multiplicative measurement error
- $\Delta \ln C^a_{i,t+1} = \ln C^a_{i,t+1} - \ln C^a_{i,t} = \ln(\frac{C_{i,t+1}}{\kappa_{i,t+1}}) - \ln(\frac{C_{i,t}}{\kappa_{i,t}}) = \Delta \ln C_{i,t+1} - \Delta \ln \kappa_{i,t+1}$
- linearized-Euler for observed consumption

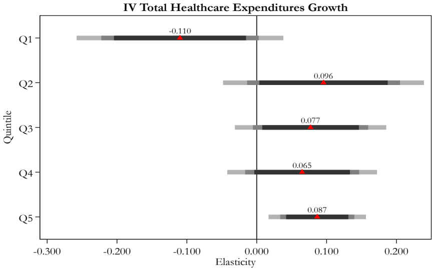
$$\Delta \ln C_{i,t+1} = \frac{1}{\phi}\{\ln(1+\mu'_{i,t}) + \ln \beta_i + \ln(1+r_{i,t+1}) - \ln(1+e'_{i,t+1}) + \Delta\Theta_{i,t+1}\} + \Delta \ln \kappa_{i,t+1}$$

◂ identification

Insurance Dummies



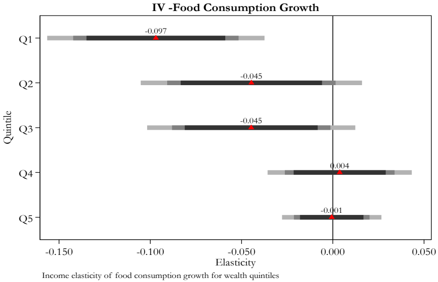
Income elasticity of food consumption growth for wealth quintiles

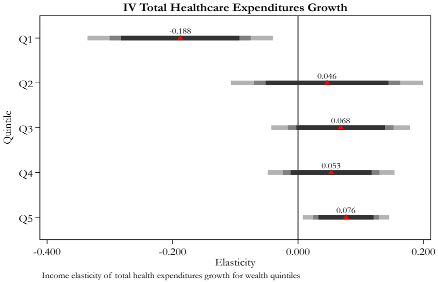


Income elasticity of total health expenditures growth for wealth quintiles

insurance

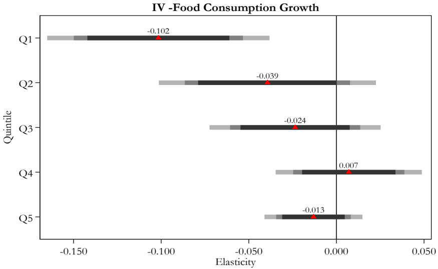
Non-separable leisure





hours

Alternative Splitting



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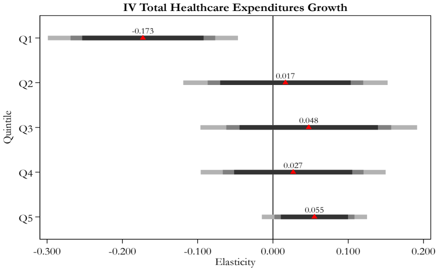

Income elasticity of total health expenditures growth for wealth quintiles

split