Why does consumption fluctuate in old age and how should the government insure it?

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Motivation

- Population is aging in many countries
  - Old-age dependency ratio: 21 in 1990 vs. 30 in 2019
  - Projected to increase to 49 in 2050
- Aging associated with more frequent and severe health problems

$\Rightarrow$ Older households can face **both income and health shocks**

$\Rightarrow$ **How important are these shocks and to what extent are people able to insure against their economic consequences?**

$\Rightarrow$ **Implications**: value of additional health insurance

Measuring insurance

- Insurance: extent to which an initial change in current resources is passed on to current consumption

- Income shocks :
  - Change in **resources**

- Health shocks :
  - Change in **resources** (medical spending, earning capacity)
  - Change in **utility**

  $\Rightarrow$ Changes in utility **should be passed on to consumption**
  $\Rightarrow$ Whether the response of consumption reflects lack of insurance depends on **why consumption responds**

Contributions

1. Measure transitory **income and health risk** in old age
   - Focus on transitory shocks
   - Large variance of both income and health transitory shocks
2. Estimate **pass-through of shocks to consumption**
   - Consumption responds significantly to both
   - Substantial heterogeneity across goods and households
3. Determine the share of the response to health shocks **reflecting change in resources** vs. **shift in utility**
   - Shift in utility explains most of the response
   - Modest effect of health shocks on available resources

Literature Review

1. **Impact of health shocks on economic outcomes**: Dobkin, Finkelstein, Kluender, and Notowidigdo (2018), Morrison, Gupta, Olson, Mstat, and Keenan (2013); Meyer and Mok (2016), Poterba, Venti, and Wise (2017)
2. **Dependence between utility of consumption and health**: Viscusi and Evans (1990), Evans and Viscusi (1991), Finkelstein, Luttmer, and Notowidigdo (2009), Finkelstein, Luttmer, and Notowidigdo (2013)
3. **Consumption insurance**: Cochrane (1991), Attanasio and Davis (1996); Krueger and Perri (2005, 2006), Blundell and Preston (1998), Blundell, Low, and Preston (2013), Blundell, Pistaferri, and Preston (2008)
4. **Savings and risk during retirement**: Love, Palumbo, and Smith (2009), De Nardi, French, and Jones (2010), Blundell, Crawford, French, and Tetlow (2016), Poterba, Venti, and Wise (2018); Kopecky and Koreshkova (2014); Braun, Kopecky, and Koreshkova (2016)

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Data: HRS and CAMS

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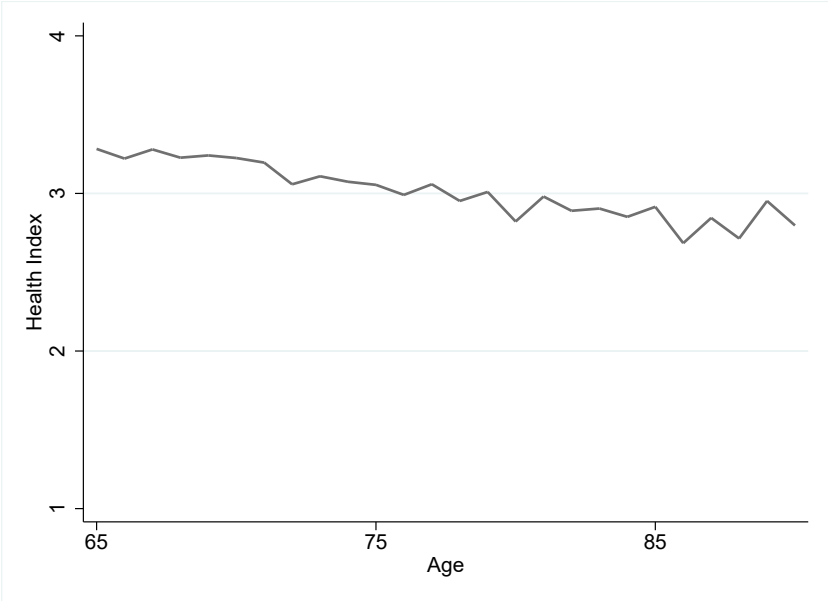
Data

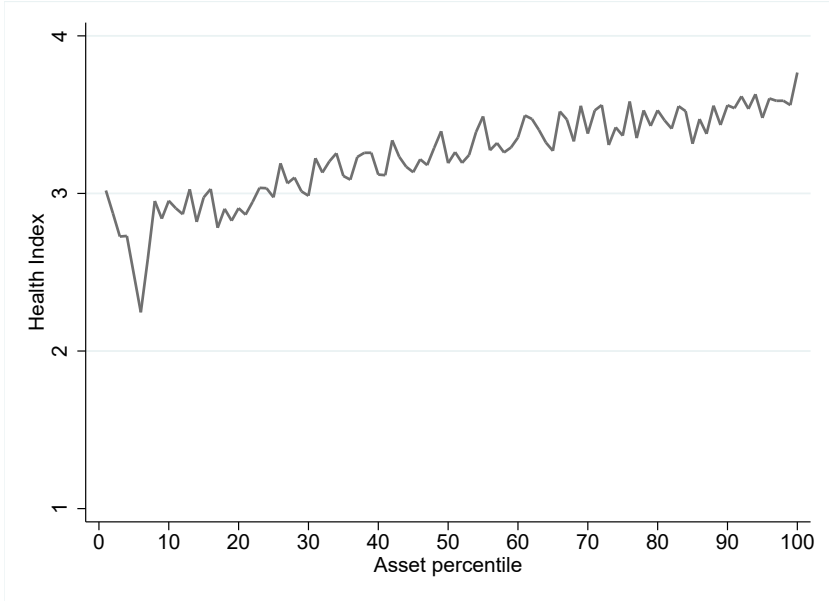
- **Health and Retirement Survey** (HRS) - Rand version of data
  $\Rightarrow$ Income and health data
- **Consumption and Activities Mail Survey** (CAMS)
  $\Rightarrow$ Consumption and medical expenditures data
- Both collected biannually: a period is **two years**
- Observation period is **2001-2013**

Health index

- Predicted value from regression **self-reported health** (1-5 scale) on **objective measures of health** (health conditions and ability to perform physical activities + initial health status + age + year)
- Avoids capturing fluctuations in self-reported health that are **not driven by objective fluctuations**
- Similar to Blundell, Britton, Costa-Diaz and French (2017)
- For households with two spouses, we use the average of the two
- The lower the health index, the worse is health

Health index by age (left panel) and by wealth (right panel) without attrition





Income, wealth and consumption

- **Income**:
  - Net income (earnings, pensions, capital income, benefits, other income); sum of incomes of head and spouse (if any)
- **Wealth**:
  - Net wealth per adult equivalent; deflated using 2015 CPI
  - Low-wealth: below $ 75,000 per adult equivalent
  - High-wealth: above $ 75,000 per adult equivalent
- **Nondurable consumption**:
  - Sum of necessities (food, utilities, and car-related expenses), plus expenses on leisure activities and on equipment; deflated using category specific 2015 CPI
- **Medical expenses**:
  - Out-of-pocket expenditures on drugs, on medical services and medical supplies; deflated using category specific 2015 CPI

Income categories

Includes:

- earnings
- capital income
- pensions
- income from Social Security disability and Supplemental Security income
- income from Social Security retirement and widow benefits
- unemployment benefits and worker's compensation
- veterans benefits, welfare, and food stamps
- alimony, other income, and lump sums from insurance, pension, and inheritance

NB: 73.79% have a head fully retired, 13.09% partly retired, 8% work part time or full time, remainder are not in the labour force

Consumption categories

Consumption		
Necessities	Food	Food at home, food away from home
	Utilities	Electricity, water, heat, phone and internet
	Car-related	Car insurance, car repairs, gasoline
Luxuries	Leisure	Trips and vacations, tickets, sport equipment, hobbies equipment, contributions to charities, gifts
	Equipment	House supplies, house services, yard/garden supplies, yard/garden services, clothing, personal care equipment and services
Medical exp.		
	Drugs	Drugs
	Serv. and sup.	Medical services, medical supplies

Sample selection

- All households with complete information, age 65-90, interviewed in regular interview year in the HRS
- Trim at top and bottom 1% in change of log consumption, income, and medical expenditures
- Demographic controls for: year of birth, year, education, race, region, number of household members, marital status, labor force status (both husband and wife, if present), year interactions.

$\Rightarrow$ **5,105 observations**

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Statistical model

$$ln(\tilde{y}_{i,t}) = p^y_{i,t} + \varepsilon^y_{i,t}, \quad with \quad p^y_{i,t} = p^y_{i,t-1} + \eta^y_{i,t}.$$

$$\tilde{h}_{i,t} = p^h_{i,t} + \varepsilon^h_{i,t}, \quad with \quad p^h_{i,t} = p^h_{i,t-1} + \eta^h_{i,t},$$

Assumptions:

i $\varepsilon^h, \eta^h, \varepsilon^y, \eta^y$, are **drawn independently over time and across households** (but not necessarily drawn from same distributions at each period and for each household)

ii $\varepsilon_{i,t}$ and $\eta_{i,t}$ are independent of one another, but the $\varepsilon^y_{i,t}$ and $\varepsilon^h_{i,t}$ **can be correlated**, and $\eta^y_{i,t}$ and $\eta^h_{i,t}$ **can be correlated**

Consumption (net of demographics) simply a flexible function of current and past shocks

Moments

	$\Delta ln(y_t)$	$\Delta ln(y_{t+1})$	$\Delta ln(y_{t+2})$
$cov(\Delta ln(y_t),.)$	.215***	-.088***	-.008
	(.007)	(.005)	(.005)
$cov(\Delta ln(c_t),.)$	.016***	-.010***	-.001
	(.003)	(.003)	(.004)
Obs.	5,105	5,105	3,127
	Δh_t	Δh_{t+1}	Δh_{t+2}
$cov(\Delta h_t,.)$	.064***	-.02***	-.003
	(.002)	(.001)	(.002)
$cov(\Delta ln(c_t),.)$	.006***	-.004**	.005**
	(.002)	(.002)	(.002)
Obs.	5,105	5,105	3,127

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

Discussion of statistical model

Income shocks after age 65:

- transitory-permanent process standard for modeling earnings
- **no evidence of different dynamics** when including pensions, capital, other income
- similar overall results when **excluding capital income**

Health shocks after age 65:

- **No significant effect of health insurance**: Black, Espin-Sanchez, French, and Litvak (2017)
- **No significant effect of past medical expenses**: Brook et al. (1983), Fisher et al. (2003), Finkelstein and McKnight (2008)

Parameters to estimate

Transitory risk:

$$var(\varepsilon^y_{i,t}) \quad \text{and} \quad var(\varepsilon^h_{i,t})$$

Pass-through coefficients:

$$\phi^{\varepsilon^y} = \frac{cov(\Delta ln(\tilde{c}_{i,t}), \varepsilon^y_{i,t})}{var(\varepsilon^y_{i,t})} \quad \text{and} \quad \phi^{\varepsilon^h} = \frac{cov(\Delta ln(\tilde{c}_{i,t}), \varepsilon^h_{i,t})}{var(\varepsilon^h_{i,t})}$$

- Share of transitory income fluctuations in the sample that translates into consumption fluctuations (idem for health)
- Can be interpreted as an elasticity under additional assumptions

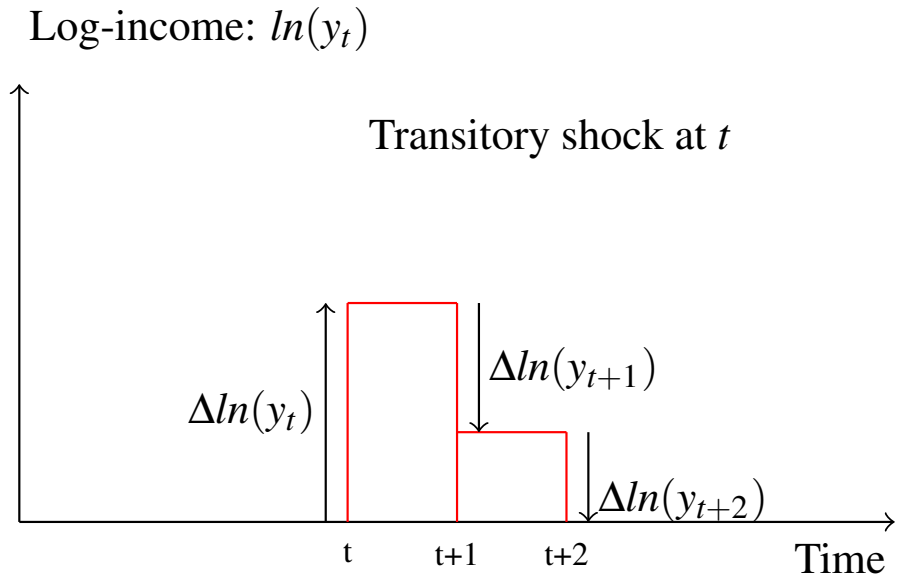
Identification strategy

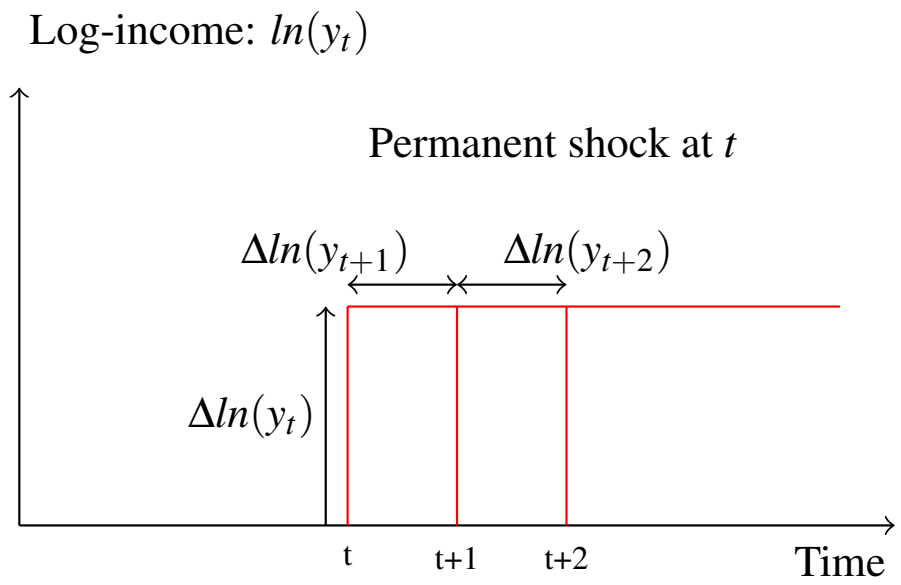
Problem: ε_t^y and ε_t^h not observed in the data, only $\Delta ln(y_t)$ and Δh_t are

Solution:

- Use future growth $\Delta ln(y_{t+1})$ and Δh_{t+1} as instrument
- Capture the mean reversion of the transitory shock at t
- Independent of the permanent shock at t

Identification: instrumenting with future growth





Estimating restrictions for income and health risk

- Variance of temporary health shocks:

$$var(\varepsilon_{i,t}^{h}) = cov(\Delta h_{i,t}, -\Delta h_{i,t+1})$$

- Variance of temporary income shocks:

$$var(\varepsilon_{i,t}^{y}) = cov(\Delta ln(y_{i,t}), -\Delta ln(y_{i,t+1}))$$

- Other parameters:
  - Variance of permanent income shocks:

$$var(\eta_{t}^{y}) = cov(\Delta\tilde{y}_{t}, \Delta\tilde{y}_{t-1} + \Delta\tilde{y}_{t} + \Delta\tilde{y}_{t+1}).$$

  - Variance of permanent health shocks:

$$var(\eta_{t}^{h}) = cov(\Delta\tilde{h}_{t}, \Delta\tilde{h}_{t-1} + \Delta\tilde{h}_{t} + \Delta\tilde{h}_{t+1}),$$

  - Covariance:

$$cov(\varepsilon_{t}^{h}, \varepsilon_{t}^{y}) = cov(\Delta\tilde{y}_{t}, -\Delta\tilde{h}_{t+1}),$$

$$cov(\varepsilon_{t}^{h}, \varepsilon_{t}^{y}) = cov(\Delta\tilde{h}_{t}, -\Delta\tilde{y}_{t+1}).$$

Estimating restrictions for covariance with consumption and pass-through

- Again, use future growth as an instrument:

$$cov(\Delta ln(\tilde{c}_{i,t}), \varepsilon^h_{i,t}) = cov(\Delta ln(\tilde{c}_{i,t}), -\Delta \tilde{h}_{i,t+1})$$

$$cov(\Delta ln(\tilde{c}_{i,t}), \varepsilon^y_{i,t}) = cov(\Delta ln(\tilde{c}_{i,t}), -\Delta ln(\tilde{y}_{i,t+1}))$$

- Pass-through coefficients are identified from:

$$\widehat{\phi}_c^{\varepsilon^h} = \frac{cov(\Delta ln(\tilde{c}_{i,t}), -\Delta \tilde{h}_{i,t+1})}{cov(\Delta \tilde{h}_{i,t}, -\Delta \tilde{h}_{i,t+1})} = \phi_c^{\varepsilon^h}$$

$$\widehat{\phi}_c^{\varepsilon^y} = \frac{cov(\Delta ln(\tilde{c}_{i,t}), -\Delta ln(\tilde{y}_{i,t+1}))}{cov(\Delta ln(\tilde{y}_{i,t}), -\Delta ln(\tilde{y}_{i,t+1}))} = \phi_c^{\varepsilon^y}$$

- Not possible to estimate the pass-through to permanent shocks without more stringent restrictions

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Income risk

	All	Low wealth	High wealth
$var(\varepsilon_t^y)$	.088***	.067***	.093***
	(.005)	(.009)	(.005)
Obs.	5105	1000	4105
$var(\eta_t^y)$	.029***	.018*	.031***
	(.005)	(.01)	(.006)
Obs.	3494	655	2839

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

$\Rightarrow$ Transitory risk is 3 times larger than permanent risk

$\Rightarrow$ Larger for high wealth households

Income risk excluding capital income

	All	Low wealth	High wealth
$var(\varepsilon^y_{i,t})$	.097***	.075***	.103***
	(.006)	(.01)	(.006)
$var(\eta^y_{i,t})$	.035***	.009	.041***
	(.007)	(.013)	(.008)

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

Health risk

	All	Low wealth	High wealth
$var(\varepsilon^h_{i,t})$	.020***	.035***	.017***
	(.001)	(.004)	(.001)
Obs.	5105	1000	4105
$var(\eta^h_{i,t})$	.019***	.032***	.017***
	(.002)	(.005)	(.002)
Obs.	3494	655	2839
$cov(\varepsilon^h_{i,t}, \varepsilon^y_{i,t})$	.003**	.003	.003**
	(.001)	(.003)	(.001)
Obs.	5105	1000	4105

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

$\Rightarrow$ Transitory risk is as large as permanent risk

$\Rightarrow$ Substantially larger for low wealth households

$\Rightarrow$ S.d. = 0.141 (change in ability to carry 10 lb = 0.152; change in score for depression 0.045)

Pass-through to consumption

	Income shocks			Health shocks		
	All	Low w.	High w.	All	Low w.	High w.
Nondurables	.109***	.23**	.087**	.173**	.325***	.094
	(.036)	(.101)	(.039)	(.085)	(.12)	(.112)
Necessities	.089**	.332***	.046	.082	.321***	-.041
	(.04)	(.109)	(.042)	(.089)	(.131)	(.114)
Leis. & eq.	.105*	-.21	.16***	.361***	.354*	.365*
	(.063)	(.175)	(.066)	(.147)	(.212)	(.191)
Obs.	5105	1000	4105	5105	1000	4105

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

$\Rightarrow$ No perfect insurance against transitory income shocks

$\Rightarrow$ Significant response of consumption to transitory health shocks

Pass-through excluding capital income

	Income shock			Health shock		
	Total	Low w.	High w.	Total	Low w.	High w.
Nondurables	.095***	.186*	.078**	.172**	.325***	.093
	(.036)	(.101)	(.038)	(.085)	(.12)	(.112)
Necessities	.066*	.283***	.027	.082	.321***	-.041
	(.039)	(.105)	(.041)	(.089)	(.131)	(.114)
Leis & eq.	.12**	-.182	.174***	.358***	.354*	.36*
	(.06)	(.173)	(.062)	(.147)	(.212)	(.191)
Obs.	5139	1017	4122	5101	1000	4101

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

Pass-through with low and high liquid wealth

	Income shock			Health shock		
	High w.	Low liq.	High liq.	High w.	Low liq.	High liq.
Nondurables	.087**	.212***	.047	.094	.01	.149
	(.039)	(.083)	(.042)	(.112)	(.187)	(.141)
Necessities	.046	.146	.013	-.041	-.174	.046
	(.042)	(.094)	(.047)	(.114)	(.193)	(.139)
Luxuries	.16***	.312**	.11	.365*	.494	.281
	(.066)	(.151)	(.07)	(.191)	(.311)	(.238)
Obs.	4174	1247	2927	4105	1221	2884

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

$\Rightarrow$ the Wealthy Hand-to-Mouth are driving the response of high wealth households to a transitory income shock

Pass-through to out-of-pocket medical expenses

- No response to an income shock
- Significant response to a health shock but modest level change ($ 1,571 for a 1 unit change in health)
- Driven by low-wealth households ($ 2,517 for a 1 unit change in health among low-wealth households)

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Household maximization problem

$$\max_{\{c_t\}_{t=0}^{T}} \quad \sum_{t=0}^{T} \beta^t E_0 \left[s_t(\pi_t^h) \left(\sum_{k=1}^{K} \delta_k(h_t) u(c_t^k) + \kappa(h_t) v(\tilde{m}_t) - \alpha(h_t) \right) \right]$$

subject to:

$$p_{t+1} a_{t+1} = (1 + r_t) p_t a_t + p_t y_t - p_t^m m_t(\tilde{m}_t) - \sum_{k=1}^{K} p_t^k c_t^k \qquad \forall t,$$

$$c_t^k \geq 0 \quad \forall t, \ \forall k,$$

$$a_T \geq 0,$$

- Survival probabilities $s_t(\pi_t^h)$ allowed to depend on the permanent component of health
- Utility additively separable in each good k and in medical expenses
- Health-dependent weight $\delta_k(h_t)$ on the utility derived from each good k

Expressions of the pass-through coefficients in this model

- Obtain **expressions of the elasticities** of consumption to transitory income and health shocks
- They write as the sum of the contributions of the effect of the shock on **resources** and its effect on **utility**
- **Two coefficients**:
  - The effect on consumption of an additional change in resources caused by the shock
  - The effect on consumption of the shift in utility caused by an additional change in current health caused by the shock

Expressions of the pass-through coefficients in this model

$$\frac{dln(c_t^k)}{d\varepsilon_t^h} = \overbrace{\underbrace{\left(\frac{dln(y_t)}{d\varepsilon_t^h}\frac{p_t y_t}{p_t} - \frac{dln(m_t)}{d\varepsilon_t^h}\frac{p_t^m m_t}{p_t} - \sum_{l\neq k}\frac{dln(c_t^l)}{d\varepsilon_t^h}\frac{p_t^l c_t^l}{p_t} \right)}^{\text{effect of the shock on real future assets (resources) } \frac{da_{t+1}/p_t}{d\varepsilon_t^h}} A_t^k}^{\text{multiplier of resources on consumption}}$$

contribution of change in resources
= 0 if the shock does not affect income nor other spending

$$+ \underbrace{\overbrace{\frac{dh_t}{d\varepsilon_t^h}}^{\text{effect of the shock on current health} = 1} \overbrace{B_t^k}^{\substack{\text{multiplier of the shift in utility caused by a change in health on consumption}}}}_{\substack{\text{contribution of shift in utility} \\ = 0 \text{ if } \delta_1(.) \text{ is a constant}}},$$

Expression of income elasticity $dln(c_t^k)/d\varepsilon_t^y$ with similar A_t^k and B_t^k.

Expressions of the pass-through coefficients in this model

$$\frac{dln(c_t^k)}{d\varepsilon_t^h} = \overbrace{\underbrace{\left(\frac{dln(y_t)}{d\varepsilon_t^h}\frac{p_t y_t}{p_t} - \frac{dln(m_t)}{d\varepsilon_t^h}\frac{p_t^m m_t}{p_t} - \sum_{l\neq k}\frac{dln(c_t^l)}{d\varepsilon_t^h}\frac{p_t^l c_t^l}{p_t} \right)}^{\text{effect of the shock on real future assets (resources) } \frac{da_{t+1}/p_t}{d\varepsilon_t^h}} A_t^k}^{\text{multiplier of resources on consumption}}$$

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Expression of income elasticity $dln(c_t^k)/d\varepsilon_t^y$ with similar A_t^k and B_t^k.

Analytical expressions of the multipliers

$$A_t^k = \frac{E_t\left[\frac{dc_{t+1}^k}{da_{t+1}} \frac{-u''(c_{t+1}^k)}{-u''(c_t^k)} \frac{\delta_k(h_{t+1})}{\delta_k(h_t)} \frac{s_{t+1}(\pi_{t+1}^h)}{s_t(\pi_t^h)} \frac{p_t^k}{p_{t+1}^k/p_{t+1}}\right]\beta(1+r)}{c_t^k + \frac{c_t^k p_t^k}{p_t} E_t\left[\frac{dc_{t+1}^k}{da_{t+1}} \frac{-u''(c_{t+1}^k)}{-u''(c_t^k)} \frac{\delta_k(h_{t+1})}{\delta_k(h_t)} \frac{s_{t+1}(\pi_{t+1}^h)}{s_t(\pi_t^h)} \frac{p_t^k}{p_{t+1}^k/p_{t+1}}\right]\beta(1+r)}$$

$$B_t^k = \frac{\frac{\delta_k'(h_t)}{\delta_k(h_t)} \frac{u'(c_t^k)}{-u''(c_t^k)}}{c_t^k + \frac{c_t^k p_t^k}{p_t} E_t\left[\frac{dc_{t+1}^k}{da_{t+1}} \frac{-u''(c_{t+1}^k)}{-u''(c_t^k)} \frac{\delta_k(h_{t+1})}{\delta_k(h_t)} \frac{s_{t+1}(\pi_{t+1}^h)}{s_t(\pi_t^h)} \frac{p_t^k}{p_{t+1}^k/p_{t+1}}\right]\beta(1+r)}$$

Note that A_t^k and B_t^k capture the effect of the multiplier on the borrowing constraint.

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Decomposition results

	All	Low wealth	High wealth
$\phi_c^{\varepsilon^h}$	0.196**	0.381***	0.083**
	(0.086)	(0.121)	(0.115)
Contribution of change in resources	0.023***	0.034*	0.023**
	(0.012)	(0.020)	(0.015)
Av. change in resources - 1 health	$11,893	$5,118	$15,395
Resources multiplier ($1,000)	0.002***	0.007*	0.002**
	(0.001)	(0.004)	(0.001)
Contribution of shift in utility	0.173**	0.346***	0.081
	(0.086)	(0.121)	(0.112)
Obs.	4,975	956	4,019

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

NB: Effect of shift in utility is **not necessarily homogeneous** by wealth

Decomposition results - Necessities and utilities

	All	Low wealth	High wealth
Necessities			
$\phi_c^{\varepsilon^h}$	.1	.38***	-.037
	(.09)	(.13)	(.115)
Contribution of change in resources	0.014**	0.034***	0.023
	(0.007)	(0.001)	(0.023)
Contribution of shift in utility	.086	.339***	-.047
	(.09)	(.13)	(.115)
Luxuries			
$\phi_c^{\varepsilon^h}$	.379***	.389*	.374**
	(.148)	(.223)	(.189)
Contribution of change in resources	0.021	-0.011	0.044**
	(0.011)	(0.008)	(0.015)
Contribution of shift in utility	.358***	.4*	.33*
	(.148)	(.226)	(.189)
Obs.	4971	954	4017

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

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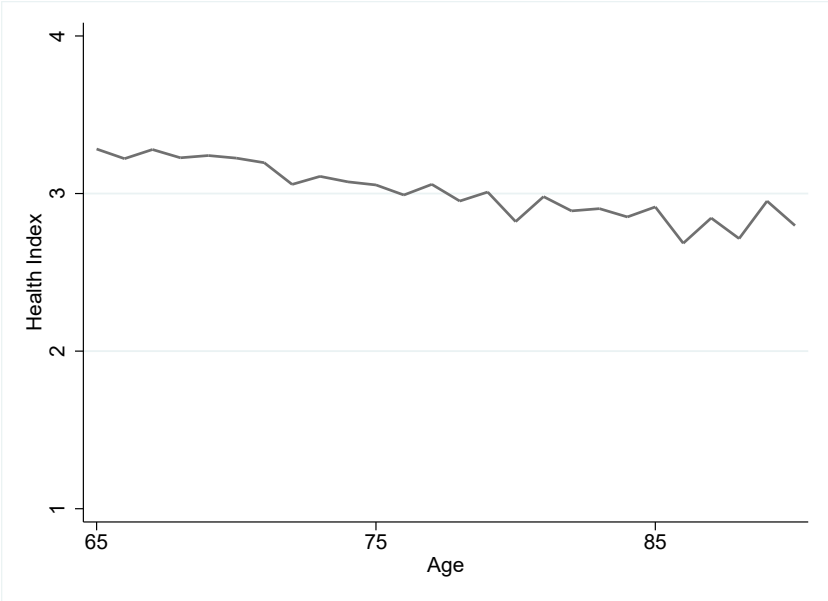
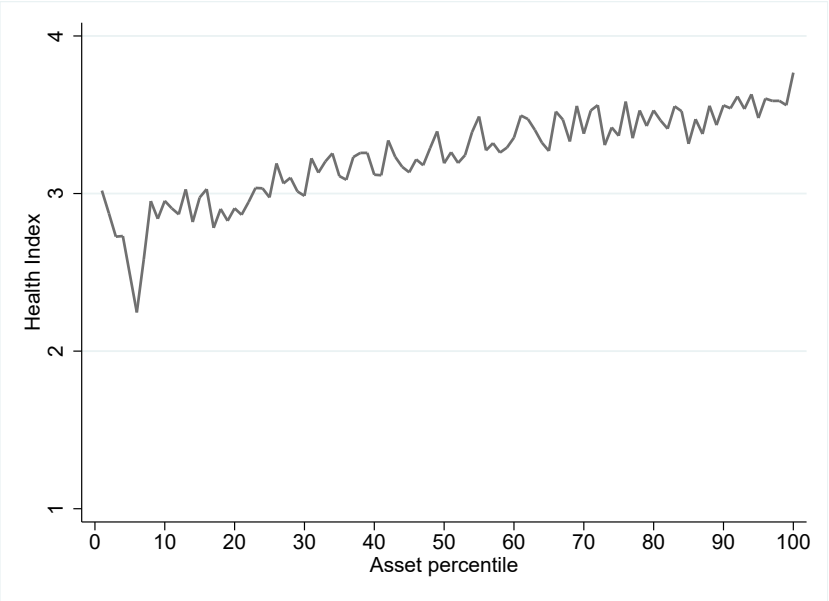
- Households in old age are subject to **substantial transitory income and health risks**
- They are **not perfectly insured against transitory income shocks** (except for high total wealth and high liquid wealth households)
- They are **relatively well insured against transitory health shocks**, because these shocks have **modest economic consequences**, in particular for low-wealth households

Health index by age (left panel) and by wealth (right panel) without attrition





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Income categories

Income includes:

- earnings (wage/salary income, bonuses/overtime pay/commissions/tips, 2nd job or military reserve earnings, professional practice or trade income)
- capital income (business or farm income, self-employment earnings, business income, gross rent, dividend and interest income, trust funds or royalties, and other asset income)
- pensions (income from all pensions and annuities)
- income from Social Security disability and Supplemental Security income
- income from Social Security retirement and widow benefits
- unemployment benefits and worker's compensation
- veterans benefits, welfare, and food stamps
- alimony, other income, and lump sums from insurance, pension, and inheritance

Back

Consumption categories

Consumption		
Necessities	Food	Food at home, food away from home
	Utilities	Electricity, water, heat, phone and internet
	Car-related	Car insurance, car repairs, gasoline
Luxuries	Leisure	Trips and vacations, tickets, sport equipment, hobbies equipment, contributions to charities, gifts
	Equipment	House supplies, house services, yard/garden supplies, yard/garden services, clothing, personal care equipment and services
Medical exp.		
	Drugs	Drugs
	Serv. and sup.	Medical services, medical supplies

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Sample selection

- All households with complete information, age 65-90, interviewed in regular interview year in the HRS
- Trim at top and bottom 1% in change of log consumption, income, and medical expenditures
- Demographic controls for: year of birth, year, education, race, region, number of household members, marital status, labor force status (both husband and wife, if present), year interactions.

$\Rightarrow$ **5,105 observations**

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Discussion of statistical model

Income shocks after age 65:

- transitory-permanent process standard for modeling earnings
- **no evidence of different dynamics** when including pensions, capital, other income
- similar overall results when **excluding capital income**

Health shocks after age 65:

- **No significant effect of health insurance**: Black, Espin-Sanchez, French, and Litvak (2017)
- **No significant effect of past medical expenses**: Brook et al. (1983), Fisher et al. (2003), Finkelstein and McKnight (2008)

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Moments

	$\Delta ln(y_t)$	$\Delta ln(y_{t+1})$	$\Delta ln(y_{t+2})$
$cov(\Delta ln(y_t),.)$	.215***	-.088***	-.008
	(.007)	(.005)	(.005)
$cov(\Delta ln(c_t),.)$	.016***	-.010***	-.001
	(.003)	(.003)	(.004)
Obs.	5,105	5,105	3,127
	Δh_t	Δh_{t+1}	Δh_{t+2}
$cov(\Delta h_t,.)$	.064***	-.02***	-.003
	(.002)	(.001)	(.002)
$cov(\Delta ln(c_t),.)$	.006***	-.004**	.005**
	(.002)	(.002)	(.002)
Obs.	5,105	5,105	3,127

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

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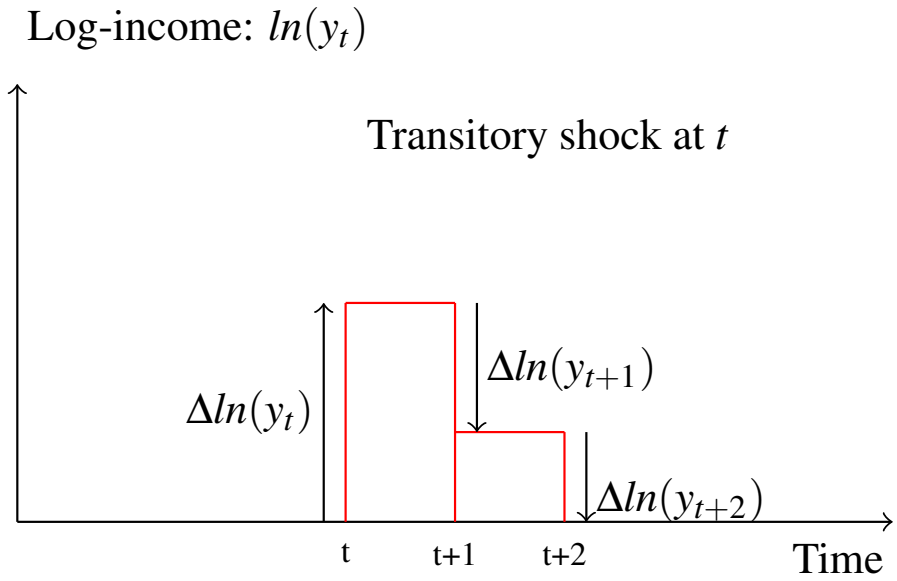
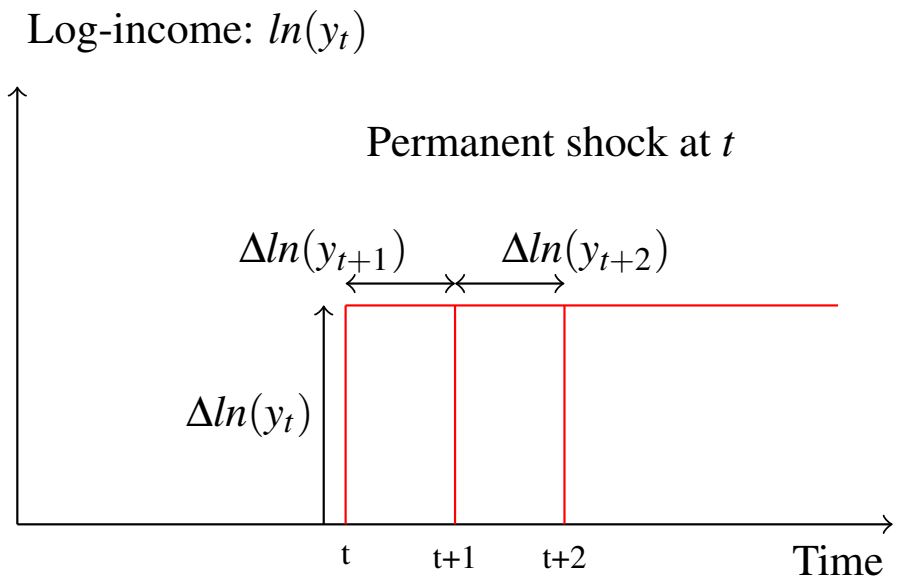
Identification: instrumenting with future growth





Estimating restrictions for income and health risk

- Variance of temporary health shocks:

$$var(\varepsilon^h_{i,t}) = cov(\Delta h_{i,t}, -\Delta h_{i,t+1})$$

- Variance of temporary income shocks:

$$var(\varepsilon^y_{i,t}) = cov(\Delta ln(y_{i,t}), -\Delta ln(y_{i,t+1}))$$

- Other parameters:
  - Variance of permanent income shocks:

$$var(\eta^y_t) = cov(\Delta\tilde{y}_t, \Delta\tilde{y}_{t-1} + \Delta\tilde{y}_t + \Delta\tilde{y}_{t+1}).$$

  - Variance of permanent health shocks:

$$var(\eta^h_t) = cov(\Delta\tilde{h}_t, \Delta\tilde{h}_{t-1} + \Delta\tilde{h}_t + \Delta\tilde{h}_{t+1}),$$

  - Covariance:

$$cov(\varepsilon^h_t, \varepsilon^y_t) = cov(\Delta\tilde{y}_t, -\Delta\tilde{h}_{t+1}),$$
$$cov(\varepsilon^h_t, \varepsilon^y_t) = cov(\Delta\tilde{h}_t, -\Delta\tilde{y}_{t+1}).$$

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Estimating restrictions for covariance with consumption and pass-through

- Again, use future growth as an instrument:

$$cov(\Delta ln(\tilde{c}_{i,t}), \varepsilon^h_{i,t}) = cov(\Delta ln(\tilde{c}_{i,t}), -\Delta \tilde{h}_{i,t+1})$$

$$cov(\Delta ln(\tilde{c}_{i,t}), \varepsilon^y_{i,t}) = cov(\Delta ln(\tilde{c}_{i,t}), -\Delta ln(\tilde{y}_{i,t+1}))$$

- Pass-through coefficients are identified from:

$$\widehat{\phi}_c^{\varepsilon^h} = \frac{cov(\Delta ln(\tilde{c}_{i,t}), -\Delta \tilde{h}_{i,t+1})}{cov(\Delta \tilde{h}_{i,t}, -\Delta \tilde{h}_{i,t+1})} = \phi_c^{\varepsilon^h}$$

$$\widehat{\phi}_c^{\varepsilon^y} = \frac{cov(\Delta ln(\tilde{c}_{i,t}), -\Delta ln(\tilde{y}_{i,t+1}))}{cov(\Delta ln(\tilde{y}_{i,t}), -\Delta ln(\tilde{y}_{i,t+1}))} = \phi_c^{\varepsilon^y}$$

- Not possible to estimate the pass-through to permanent shocks without more stringent restrictions

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Income risk excluding capital income

	All	Low wealth	High wealth
$var(\varepsilon^y_{i,t})$	.097***	.075***	.103***
	(.006)	(.01)	(.006)
$var(\eta^y_{i,t})$	.035***	.009	.041***
	(.007)	(.013)	(.008)

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

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Pass-through excluding capital income

	Income shock			Health shock		
	Total	Low w.	High w.	Total	Low w.	High w.
Nondurables	.095***	.186*	.078**	.172**	.325***	.093
	(.036)	(.101)	(.038)	(.085)	(.12)	(.112)
Necessities	.066*	.283***	.027	.082	.321***	-.041
	(.039)	(.105)	(.041)	(.089)	(.131)	(.114)
Leis & eq.	.12**	-.182	.174***	.358***	.354*	.36*
	(.06)	(.173)	(.062)	(.147)	(.212)	(.191)
Obs.	5139	1017	4122	5101	1000	4101

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

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Pass-through with low and high liquid wealth

	Income shock			Health shock		
	High w.	Low liq.	High liq.	High w.	Low liq.	High liq.
Nondurables	.087**	.212***	.047	.094	.01	.149
	(.039)	(.083)	(.042)	(.112)	(.187)	(.141)
Necessities	.046	.146	.013	-.041	-.174	.046
	(.042)	(.094)	(.047)	(.114)	(.193)	(.139)
Luxuries	.16***	.312**	.11	.365*	.494	.281
	(.066)	(.151)	(.07)	(.191)	(.311)	(.238)
Obs.	4174	1247	2927	4105	1221	2884

Standard errors in parentheses. * at 10%, ** at 5%, *** at 1%

$\Rightarrow$ the Wealthy Hand-to-Mouth are driving the response of high wealth households to a transitory income shock

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Expressions of the pass-through coefficients in this model

$$\frac{dln(c_t^k)}{d\varepsilon_t^h} = \underbrace{\overbrace{\left(\frac{dln(y_t)}{d\varepsilon_t^h}\frac{p_t y_t}{p_t} - \frac{dln(m_t)}{d\varepsilon_t^h}\frac{p_t^m m_t}{p_t} - \sum_{l\neq k}\frac{dln(c_t^l)}{d\varepsilon_t^h}\frac{p_t^l c_t^l}{p_t} \right)}^{\text{effect of the shock on real future assets (resources) } \frac{da_{t+1}/p_t}{d\varepsilon_t^h}} \overbrace{A_t^k}^{\substack{\text{multiplier of} \\ \text{resources on} \\ \text{consumption}}}}_{\substack{\text{contribution of change in resources} \\ = 0 \text{ if the shock does not affect income nor other spending}}}$$

$$+ \underbrace{\overbrace{\frac{dh_t}{d\varepsilon_t^h}}^{\substack{\text{effect of the shock} \\ \text{on current health} = 1}} \overbrace{B_t^k}^{\substack{\text{multiplier of the} \\ \text{shift in utility caused} \\ \text{by a change in health} \\ \text{on consumption}}}}_{\substack{\text{contribution of shift in utility} \\ = 0 \text{ if } \delta_1(.) \text{ is a constant}}},$$

Expression of income elasticity $dln(c_t^k)/d\varepsilon_t^y$ with similar A_t^k and B_t^k. Note that A_t^k and B_t^k capture the effect of the multiplier on the borrowing constraint.

Analytical expressions of the multipliers

$$A_t^k = \frac{E_t\left[\frac{dc_{t+1}^k}{da_{t+1}} \frac{-u''(c_{t+1}^k)}{-u''(c_t^k)} \frac{\delta_k(h_{t+1})}{\delta_k(h_t)} \frac{s_{t+1}(\pi_{t+1}^h)}{s_t(\pi_t^h)} \frac{p_t^k}{p_{t+1}^k/p_{t+1}}\right]\beta(1+r)}{c_t^k + \frac{c_t^k p_t^k}{p_t} E_t\left[\frac{dc_{t+1}^k}{da_{t+1}} \frac{-u''(c_{t+1}^k)}{-u''(c_t^k)} \frac{\delta_k(h_{t+1})}{\delta_k(h_t)} \frac{s_{t+1}(\pi_{t+1}^h)}{s_t(\pi_t^h)} \frac{p_t^k}{p_{t+1}^k/p_{t+1}}\right]\beta(1+r)}$$

$$B_t^k = \frac{\frac{\delta_k'(h_t)}{\delta_k(h_t)} \frac{u'(c_t^k)}{-u''(c_t^k)}}{c_t^k + \frac{c_t^k p_t^k}{p_t} E_t\left[\frac{dc_{t+1}^k}{da_{t+1}} \frac{-u''(c_{t+1}^k)}{-u''(c_t^k)} \frac{\delta_k(h_{t+1})}{\delta_k(h_t)} \frac{s_{t+1}(\pi_{t+1}^h)}{s_t(\pi_t^h)} \frac{p_t^k}{p_{t+1}^k/p_{t+1}}\right]\beta(1+r)}$$

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Estimators

We make homogeneity assumptions to use two additional restrictions:

$$\phi_{c^k}^{\varepsilon^h} \approx \underbrace{\left(\phi_y^{\varepsilon^h}\frac{p_t y_t}{p_{t+1}} - \phi_m^{\varepsilon^h}\frac{p_t^m m_t}{p_{t+1}} - \sum_{l\neq k}\phi_{c^l}^{\varepsilon^h}\frac{p_t^l c_t^l}{p_{t+1}}\right)A^k}_{\substack{\text{contribution of change in resources}\\ =0 \text{ if the shock does not}\\ \text{affect income nor other spending}}} + \underbrace{B^k}_{\substack{\text{contribution of change}\\ \text{in marginal utility}\\ =0 \text{ if } \delta_1(.) \text{ is a constant}}} \tag{1}$$

$$\phi_{c^k}^{\varepsilon^y} \approx \underbrace{\left(\frac{p_t y_t}{p_{t+1}} - \phi_m^{\varepsilon^y}\frac{p_t^m m_t}{p_{t+1}} - \sum_{l\neq k}\phi_{c^l}^{\varepsilon^y}\frac{p_t^l c_t^l}{p_{t+1}}\right)A^k}_{\substack{\text{contribution of change in resources}\\ =0 \text{ if the shock does not}\\ \text{affect income nor other spending}}} + \underbrace{\phi_h^{\varepsilon^y} B^k}_{\substack{\text{contribution of change}\\ \text{in marginal utility}\\ =0 \text{ if } \delta_1(.) \text{ is a constant}}} . \tag{2}$$

- These restrictions can identify A^k and B^k

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Consumption categories

Consumption		
Necessities	Food	Food at home, food away from home
	Utilities	Electricity, water, heat, phone and internet
	Car-related	Car insurance, car repairs, gasoline
Luxuries	Leisure	Trips and vacations, tickets, sport equipment, hobbies equipment, contributions to charities, gifts
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Medical exp.		
	Drugs	Drugs
	Serv. and sup.	Medical services, medical supplies

Estimators

- Variance of temporary income shocks:

$$var(\varepsilon^{y}_{i,t}) = cov(\Delta ln(y_{i,t}), -\Delta ln(y_{i,t+1}))$$

- Variance of temporary health shocks:

$$var(\varepsilon^{h}_{i,t}) = cov(\Delta h_{i,t}, -\Delta h_{i,t+1})$$

- Variance of permanent shocks and covariances between shocks estimated with different instruments

Identification strategy and estimators

- Again, use future growth as an instrument:

$$cov(\Delta ln(\tilde{c}_{i,t}), \varepsilon^h_{i,t}) = cov(\Delta ln(\tilde{c}_{i,t}), -\Delta \tilde{h}_{i,t+1})$$

$$cov(\Delta ln(\tilde{c}_{i,t}), \varepsilon^y_{i,t}) = cov(\Delta ln(\tilde{c}_{i,t}), -\Delta ln(\tilde{y}_{i,t+1}))$$

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$$\widehat{\phi}_c^{\varepsilon^h} = \frac{cov(\Delta ln(\tilde{c}_{i,t}), -\Delta \tilde{h}_{i,t+1})}{cov(\Delta \tilde{h}_{i,t}, -\Delta \tilde{h}_{i,t+1})} = \phi_c^{\varepsilon^h}$$

$$\widehat{\phi}_c^{\varepsilon^y} = \frac{cov(\Delta ln(\tilde{c}_{i,t}), -\Delta ln(\tilde{y}_{i,t+1}))}{cov(\Delta ln(\tilde{y}_{i,t}), -\Delta ln(\tilde{y}_{i,t+1}))} = \phi_c^{\varepsilon^y}$$

- Not possible to estimate the pass-through to permanent shocks without more stringent restrictions

Estimators

We make homogeneity assumptions to use two additional restrictions:

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$$\phi_{c^k}^{\varepsilon^y} \approx \underbrace{\left(\frac{p_t y_t}{p_{t+1}} - \phi_m^{\varepsilon^y}\frac{p_t^m m_t}{p_{t+1}} - \sum_{l\neq k}\phi_{c^l}^{\varepsilon^y}\frac{p_t^l c_t^l}{p_{t+1}}\right)A^k}_{\substack{\text{contribution of change in resources}\\ =0 \text{ if the shock does not}\\ \text{affect income nor other spending}}} + \underbrace{\phi_h^{\varepsilon^y} B^k}_{\substack{\text{contribution of change}\\ \text{in marginal utility}\\ =0 \text{ if } \delta_1(.) \text{ is a constant}}} . \tag{4}$$

- These restrictions can identify A^k and B^k

Analytical expressions of the multipliers

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Income and health risk excluding capital income

	All	Low wealth	High wealth
$var(\varepsilon^y_{i,t})$	.097***	.075***	.103***
	(.006)	(.01)	(.006)
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	(.002)	(.005)	(.002)
$cov(\varepsilon^h_{i,t}, \Delta ln(y_{i,t}))$	.004**	.003	.004**
	(.002)	(.004)	(.002)

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Pass-through excluding capital income

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