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
- Aging associated with more frequent and severe health problems

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

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

- Health shocks :
  - Change in **resources** (medical spending, earning capacity)
  - Change in **ability to derive utility** from consumption

  $\Rightarrow$ 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
   - Variance of transitory shocks **significant** and explains **more than half** of variance of income growth and health growth
2. Estimate **pass-through of transitory shocks to consumption**
   - Consumption **responds significantly** to both
   - Some heterogeneity across goods and across households
3. Determine the share of the response to health shocks **reflecting change in income and medical expenses** vs. **shift in utility**
   - Most of the response comes from a **shift in utility**
   - Modest effect of health shocks on available resources

Plan

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**
- Keep households with head **age 65-90**

Detailed sample selection

Income, health index, and consumption

- **Income**:
  - Net income
- **Health**:
  - Predicted value from regression of **self-reported health** (index on 1-5 scale) on **objective measures of health**
  - Avoids capturing fluctuations in self-reported health that are **not driven by objective fluctuations**
- **Consumption**:
  - Nondurables; Sum of necessities (food, utilities, and car-related expenses), plus expenses on leisure activities and on equipment

Health graphs | Detailed income | Detailed consumption and medical exp.

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Statistical model and parameters to estimate

- We assume (consistent with literature and moments):
  - log-income and the health index are the sum of a **permanent component** (RW subject to shocks η) and a **transitory shock** (ε)
  - little about consumption (shocks not anticipated)
- We want to measure:
  - **income and health risk**: $var(\varepsilon^y)$ and $var(\varepsilon^h)$
  - **pass-through of income and health shocks to consumption**

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

- We estimate them with Commault's robust **BPP estimator**

Graph of identification strategy | Identifying restrictions for risk | Identifying restrictions for pass-through

Income and health risk

Income risk		Health risk	
$var(\varepsilon_t^y)$	**.088*** **	$var(\varepsilon_{i,t}^h)$	**.020*** **
	(.005)		(.001)
Obs.	5105	Obs.	5105
$var(\eta_t^y)$	.029***	$var(\eta_{i,t}^h)$	.019***
	(.005)		(.002)
Obs.	3494	Obs.	3494
$cov(\varepsilon_{i,t}^h, \varepsilon_{i,t}^y)$		.004***	(.002)

$\Rightarrow$ Transitory risk **larger than or equal to** permanent risk

Still when assuming large measurement error

$\Rightarrow$ What are these shocks?

Income: mostly pensions and benefits (smaller but significant variance of shocks) Income risk excluding capital income

Health: s.d. of $\varepsilon_{i,t}^h = 0.141$

Pass-through to consumption

	Income shocks			Health shocks		
	All	Low wealth	Not low wealth	All	Low wealth	Not low wealth
Nondur.	**.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%

$\Rightarrow$ Significant pass-through of income shocks (no perfect insurance)
$\Rightarrow$ Significant pass-through of health shocks (but not proportional to pass-through of income)

Large measurement error | Excluding capital income | With wealthy HtM | Excluding institutionalized

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Model

Standard household maximization problem with:

- Consumption of medical goods, of which a part is paid out-of-pocket
- Utility that is additively separable in nondurable consumption and in medical consumption
- **Health-dependent weight** on the utility from nondurable consumption and from medical consumption

Decomposition: we use the implication that response of consumption is **additively separable in the effect of resources and in the effect of the change in value of the utility weight**, to measure the two separately

Decomposition results

	All	Low wealth	Not low 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
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%

Effect larger with measurement error Results
Effect of shift in utility is **not necessarily homogeneous** by wealth Graph
Effect of resources stronger for necessities By goods

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Conclusion

- **Substantial transitory** income and health **risk** in old age
- Transitory **income** shocks are not perfectly insured especially among low wealth and low liquid wealth people
- Transitory health shocks have **relatively modest resource consequences**, but **substantial effect on the utility** of consumption
- Policies that could **reduce ex-ante** the extent of transitory shocks would reduce this risk

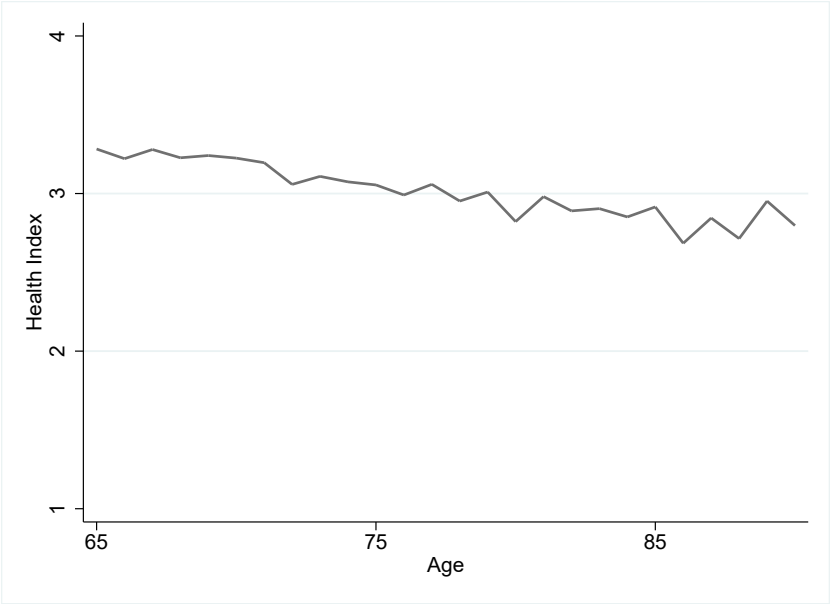
Sample selection

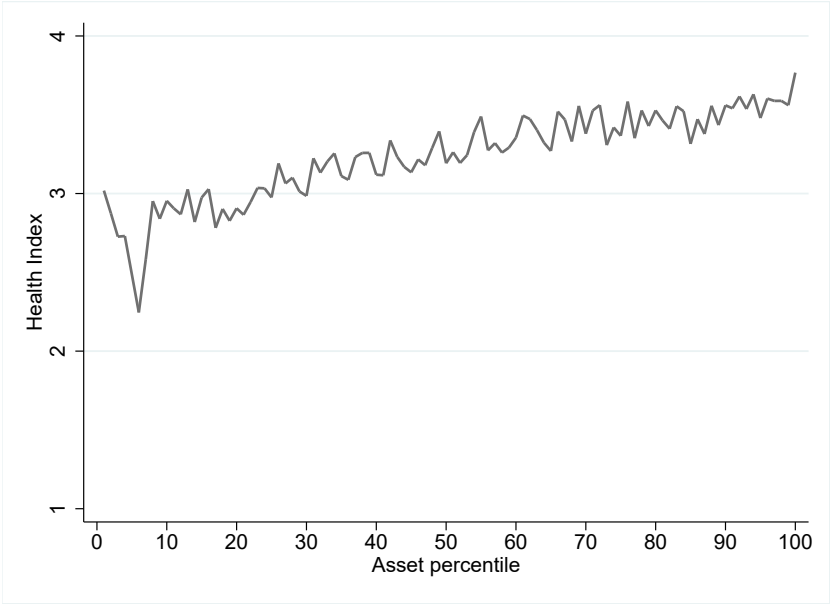
- All households with complete information, interviewed in regular interview year in the HRS
- Trim at top and bottom 1% in change of log consumption, income, and medical expenditures
- Demographic controls for: year of birth, year, education, race, region, number of household members, marital status,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

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

Back

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





Back

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

Back

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)

Back

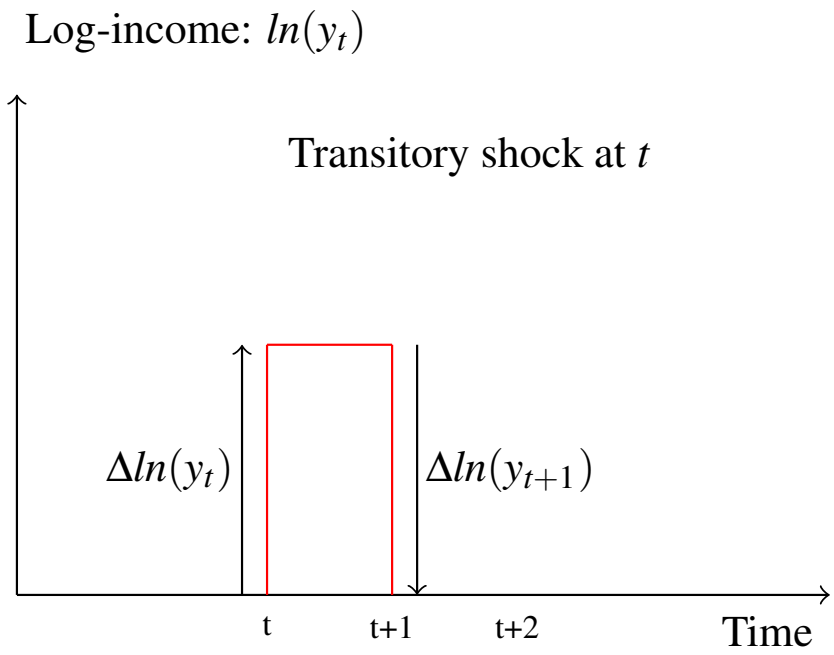
Moments

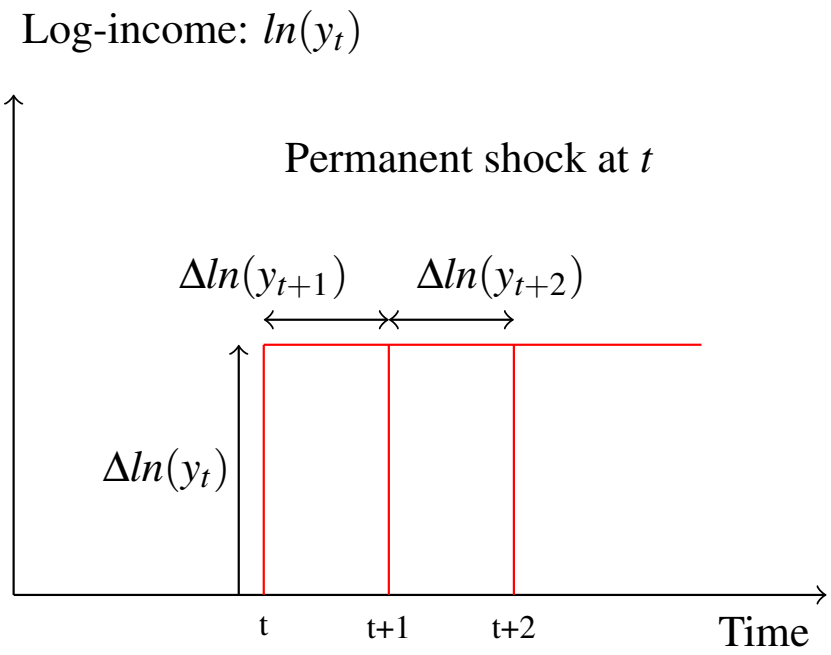
	$\Delta ln(y_t)$	$\Delta ln(y_{t+1})$	$\Delta ln(y_{t+2})$
$cov(\Delta ln(y_t),.)$	.215***	-.088***	-.008
	(.007)	(.005)	(.005)
$cov(\Delta ln(c_t),.)$	.016***	-.010***	-.001
	(.003)	(.003)	(.004)
Obs.	5,105	5,105	3,127
	Δh_t	Δh_{t+1}	Δh_{t+2}
$cov(\Delta h_t,.)$	.064***	-.02***	-.003
	(.002)	(.001)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

Back

Identification: instrumenting with future growth





Back

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:

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

Back

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

Back

Income risk assuming large measurement error

Income risk		Health risk	
$var(\varepsilon_t^y)$	**.044*****	$var(\varepsilon_{i,t}^h)$	**.01*****
	(.002)		(.001)
Obs.	5105	Obs.	5105
$var(\eta_t^y)$	.029***	$var(\eta_{i,t}^h)$	.019***
	(.005)		(.002)
Obs.	3494	Obs.	3494
$cov(\varepsilon_{i,t}^h, \varepsilon_{i,t}^y)$		.004***	(.002)

Back

Pass-through with measurement error

	Income shock			Health shock		
	Total	Low w.	High w.	Total	Low w.	High w.
Nondurables	.217***	.46**	.175**	.345**	.65***	.189
	(.073)	(.201)	(.077)	(.171)	(.241)	(.225)
Necessities	.177**	.664***	.092	.164	.642***	-.082
	(.079)	(.217)	(.085)	(.177)	(.261)	(.227)
Leis & eq.	.209*	-.421	.32***	.723***	.707*	.73*
	(.126)	(.35)	(.132)	(.293)	(.424)	(.381)
Obs.	5,105	1,000	4,105	5,105	1,000	4,105

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

Back

Decomposition results with measurement error

	All All	Low wealth	Not low wealth
$\phi_c^{\varepsilon^h}$	.392	.779	.202
	(.173)	(.243)	(.226)
Contribution of change in resources	**0.093*****	0.125	0.096**
	(0.042)	(0.040)	(0.040)
Av. change in resources (- 1 health)	$11,893	$5,118	$15,395
Contribution of shift in utility	.299*	.654***	.106
	(.177)	(.265)	(.23)
Obs.	4,975	956	4,019

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

Back

Income risk excluding capital income

	All	Low wealth	High wealth
$var(\varepsilon^y_{i,t})$	.097***	.075***	.103***
	(.006)	(.01)	(.006)
Obs.	5,052	998	4,054
$var(\eta^y_{i,t})$	.035***	.009	.041***
	(.007)	(.013)	(.008)
Obs.	3,447	654	,793

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

Back

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.	5,052	998	4,054	5101	1000	4101

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

Back

Pass-through with low and high liquid wealth

	Income shock		
	Not low w.	Low liq.	High liq.
Nondurables	.087**	.212***	.047
	(.039)	(.083)	(.042)
Necessities	.046	.146	.013
	(.042)	(.094)	(.047)
Luxuries	.16***	.312**	.11
	(.066)	(.151)	(.07)
Obs.	4174	1247	2927

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

Back

Pass-through to out-of-pocket medical expenses

	Income shock			Health shock		
	All	Low w.	High w.	All	Low w.	High w.
Med. exp.	.074	.026	.082	-.607***	-1.22***	-.291
	(.099)	(.295)	(.103)	(.231)	(.354)	(.29)
Drugs	.012	.117	-.006	-.607***	-.948***	-.431
	(.104)	(.285)	(.111)	(.242)	(.37)	(.308)
Serv. & sup.	-.108	-.215	-.089	-.048	-.292	.078
	(.145)	(.4)	(.155)	(.358)	(.537)	(.452)
Obs.	5105	1000	4105	5105	1000	4105

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

Back

Pass-through excluding long-term institutionalized

Excluding obs **if head or spouse spend more than 100 days in institution over two years** (drop 77 observations of first diff)

	Health shock		
	All	Low w.	High w.
Nondurables $\phi_c^{\varepsilon^h}$	.167*	.294***	.102
	(.086)	(.118)	(.113)
Necessities	.07	.272**	-.033
	(.089)	(.13)	(.114)
Luxuries	.382***	.389*	.378**
	(.147)	(.215)	(.191)
Obs.	5028	976	4052

Very similar results

Back

Expressions of the elasticities in this model

$$\frac{dln(c_t^k)}{d\varepsilon_t^y} = \underbrace{\overbrace{\frac{da_{t+1}/p_t}{d\varepsilon_t^y}}^{\substack{\text{effect of } \textbf{income} \\ \text{on assets passed on}}} \overbrace{A_t^k}^{\substack{\text{multiplier of} \\ \text{resources on} \\ \text{consumption}}}}_{\text{contribution of change in resources}} + \underbrace{\overbrace{\frac{dh_t}{d\varepsilon_t^y}}^{\substack{\text{effect of } \textbf{income} \\ \text{on current health}}} \overbrace{B_t^k}^{\substack{\text{multiplier of the} \\ \text{shift in utility caused} \\ \text{by a change in health} \\ \text{on consumption}}}}_{\text{contribution of shift in utility}},$$

$$\frac{dln(c_t^k)}{d\varepsilon_t^h} = \underbrace{\overbrace{\frac{da_{t+1}/p_t}{d\varepsilon_t^h}}^{\substack{\text{effect of } \textbf{health} \\ \text{on assets passed on}}} \overbrace{A_t^k}^{\substack{\text{multiplier of} \\ \text{resources on} \\ \text{consumption}}}}_{\text{contribution of change in resources}} + \underbrace{\overbrace{\frac{dh_t}{d\varepsilon_t^h}}^{\substack{\text{effect of } \textbf{health} \\ \text{on current health} = 1}} \overbrace{B_t^k}^{\substack{\text{multiplier of the} \\ \text{shift in utility caused} \\ \text{by a change in health} \\ \text{on consumption}}}}_{\text{contribution of shift in utility}}.$$

Back

Expressions of the pass-through coefficients in this model

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

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

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

contribution of shift in utility
= 0 if $\delta_1(.)$ is a constant

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

Back

Analytical expressions of the multipliers

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

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

Back

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

Back

Decomposition results by goods

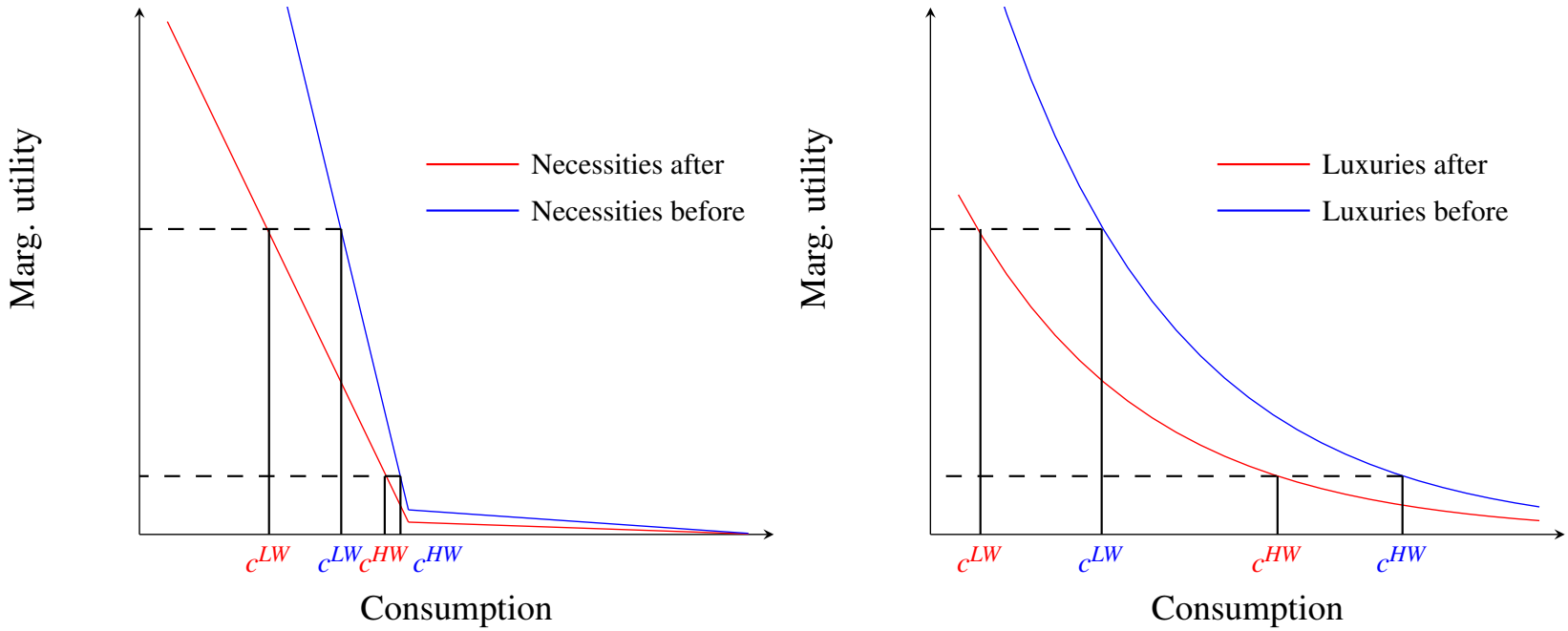


Figure: Effect of a shift in the weight put on utility for a linear and an exponential utility functions and for low-wealth and high-wealth households

Back

Decomposition results by goods

	All	Necessities	Leis. & eq.
$\phi_c^{\varepsilon^h}$	0.196**	0.1	0.379***
	(0.086)	(0.090)	(0.148)
Contribution of change in resources	0.023***	0.014**	0.021
	(0.012)	(0.001)	(0.015)
Av. change in resources (- 1)	$11,893	$7,000	$10,500
Resources multiplier ($1,000)	0.002***	0.002**	0.002
	(0.001)	(0.001)	(0.001)
Contribution of shift in utility	0.173**	0.086	0.358***
	(0.090)	(0.121)	(0.148)
Obs.	4,975	4,971	4,971

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

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

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:

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

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

- 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

Estimators

We make homogeneity assumptions to use two additional restrictions:

$$\phi_{c^k}^{\varepsilon^h} \approx \underbrace{\left(\phi_y^{\varepsilon^h}\frac{p_t y_t}{p_{t+1}} - \phi_m^{\varepsilon^h}\frac{p_t^m m_t}{p_{t+1}} - \sum_{l\neq k}\phi_{c^l}^{\varepsilon^h}\frac{p_t^l c_t^l}{p_{t+1}}\right)A^k}_{\substack{\text{contribution of change in resources}\\ =0 \text{ if the shock does not}\\ \text{affect income nor other spending}}} + \underbrace{B^k}_{\substack{\text{contribution of change}\\ \text{in marginal utility}\\ =0 \text{ if } \delta_1(.) \text{ is a constant}}} \tag{3}$$

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

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

Analytical expressions of the multipliers

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

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

Income and health 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)
$var(\varepsilon^h_{i,t})$	.02***	.035***	.017***
	(.001)	(.004)	(.001)
$var(\eta^h_{i,t})$	.019***	.032***	.016***
	(.002)	(.005)	(.002)
$cov(\varepsilon^h_{i,t}, \Delta ln(y_{i,t}))$	.004**	.003	.004**
	(.002)	(.004)	(.002)

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

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%