Measuring health and its consequences

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Health and its consequences

- Paper 1. The lifetime costs of bad health (with Pashchenko and Porapakkarm)
  - Men with a high school degree, from age 21
  - Bad health is very costly
  - Health very unequally distributed even within this group
- Paper 2. Health inequality by race, ethnicity, and gender (with Nicolo' Russo, Margherita Borella, and Ross Abram)
  - People age 51+, regardless of education level
  - Enormous health inequality by race, ethnicity, and gender

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Among **men with high-school degree**, on average ...

A. Large difference in economic outcomes by health

i. The healthy earn 37% more (conditional on working)...
ii. ...and have 65% more wealth at the time of retirement

▸ Wealth gradient (HRS)

B. Two important questions

i. What generates this large difference?
ii. How costly it is to be unhealthy from the entire life cycle perspective?

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Linking health and economic outcomes

Channel 1: Health affects economic outcomes

Channel 2: Economic outcomes affect health

Channel 3: Healthy and unhealthy people are ex-ante different

$\Rightarrow$ *Channel 3* well-recognized but overlooked in existing structural studies

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What about *Channel 3*?

- People differ in genetic endowments, personality traits, early life experiences...
- Empirical literature on importance of these factors for outcomes later in life (Anda et al., 2006; Barth et al., 2020; Case et al., 2005; Conti et al., 2005 ...)
- We introduce rich unobserved heterogeneity in a structural life-cycle model
- People differ in fixed characteristics that are multi-dimensional and possibly correlated among each other

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1^{st} **Part**, Estimate health shock process

- Document new facts about *health duration dependence*
- Estimate process for health consistent with these facts
- Key Finding
  - *Health types* are key drivers of health dynamics, even controlling for long history-dependence

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- Estimate a life cycle model with health shocks and correlated ex-ante heterogeneity in

  $$\{\textit{health types},\ \ \textit{fixed labor productivity},\ \ \textit{patience}\ \}$$

- Show that this heterogeneity and its correlation structure is important to explain disparity in economic outcomes by health

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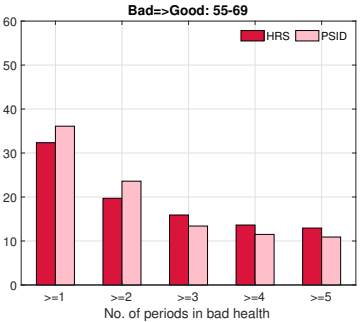
Health status transitions by previous health duration

Panel C1: % Transition from bad to good health



Age group: 55-69. The difference between waves is 2 years

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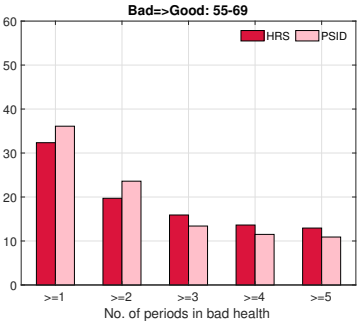
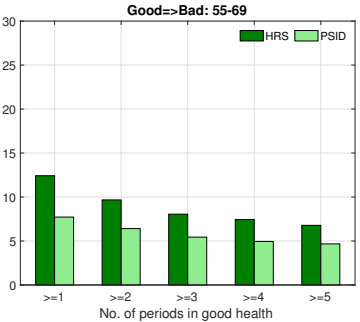


Panel C2: % Transition from good to bad health



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Health shock process

How can we account for these facts?

- Duration dependence
- Fixed health types

Formulate ordered logit model of health shocks that allows for

- History-dependence (τ_B, τ_G) and discrete health types (η)

Results: Key findings

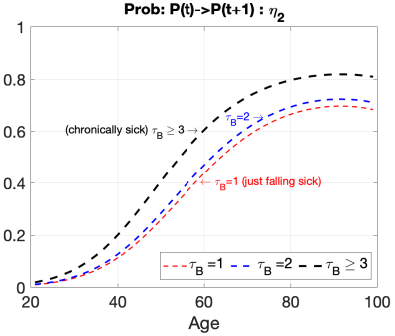
- Health types are always significant even when controlling for long lagged health history (up to 8 years)
- Health types (η) are correlated with fixed labor productivity (γ)

	η_1	η_2	η_3
$Pr(\eta)$	0.08	0.35	0.57
$Pr(\eta \mid \gamma_L)$	0.13	0.44	0.43
$Pr(\eta \mid \gamma_M)$	0.08	0.36	0.56
$Pr(\eta \mid \gamma_H)$	0.04	0.24	0.72

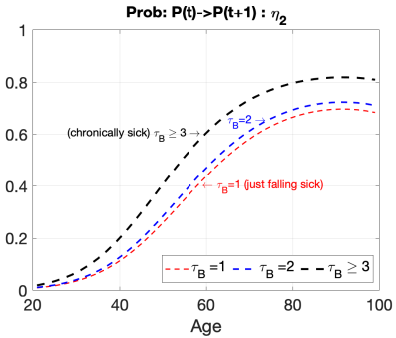
Measure of η at age 21 (T=3)

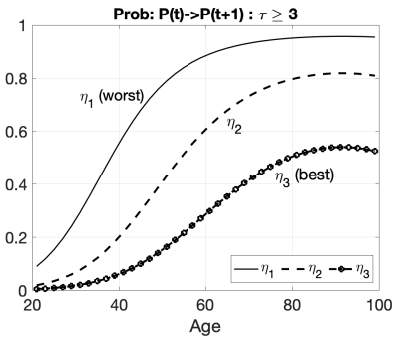
Results : Estimated health transition probabilities (T=3)

History dependence : fix health type to η_2



History dependence *vs.* Fixed health types





- Variation in health transition prob. by health types larger than by health histories

- 21-64→work, 65-99→retired ...(model period = 2 yrs)
- Health types $\eta \in \{\eta_1, \eta_2, \eta_3\}$ and discount factor: $\beta \in \{\beta_{low}, \beta_{high}\}$

$$0 \leq Pr(\beta_j|\eta_m) \leq 1; j \in \{low, high\}, m \in \{1, 2, 3\}$$

- People face productivity, health, medical expenses, and survival uncertainty
- Retired people receive Social Security benefits and are covered by Medicare

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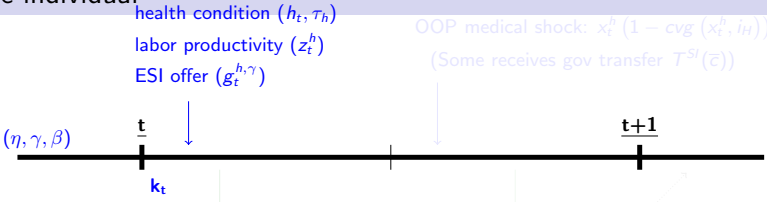
A working-age individual



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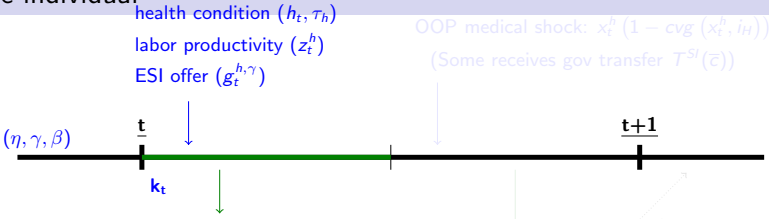

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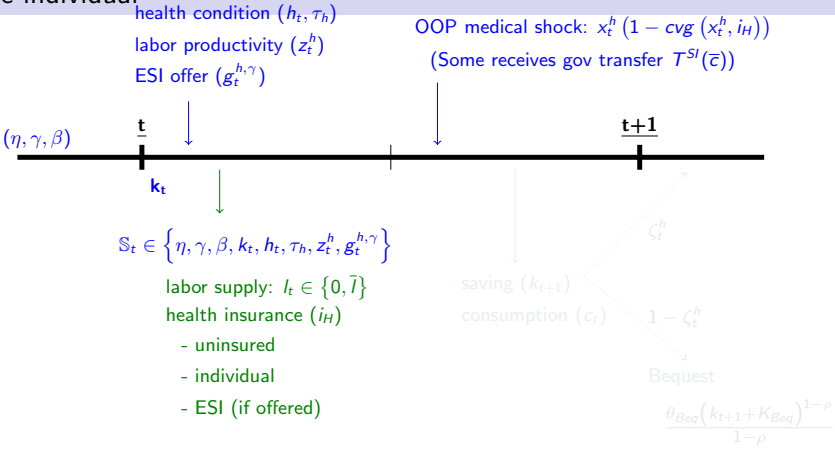

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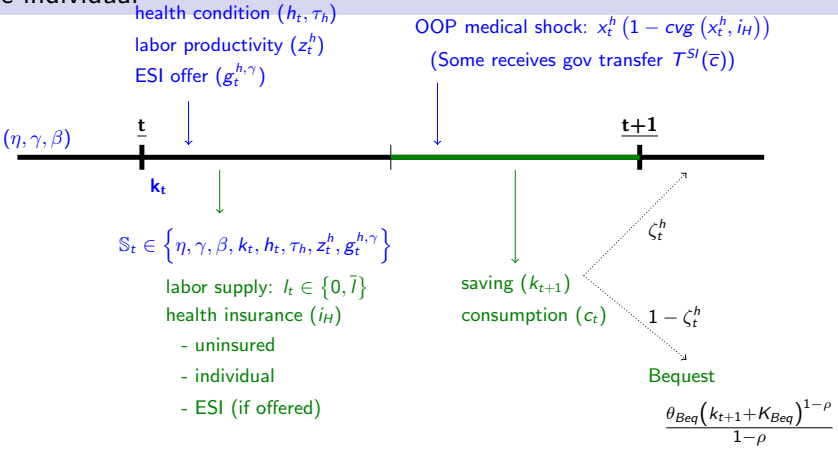

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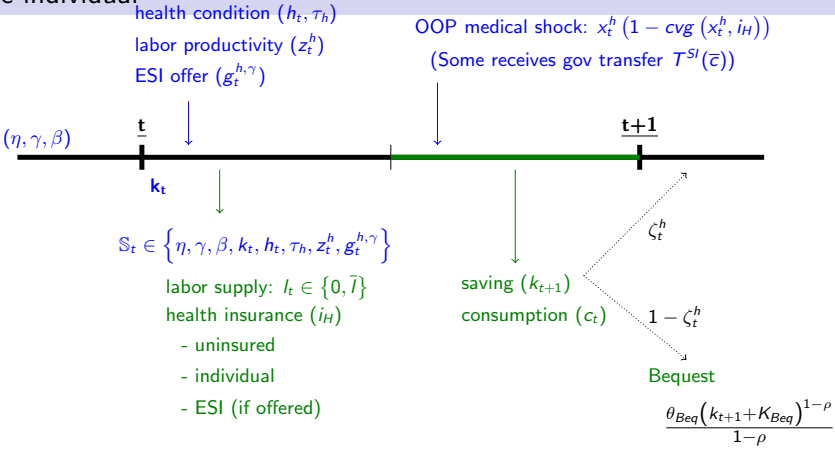

$$u(c_t, l_t, h_t) = \frac{c_t^{1-\rho}}{1-\rho} - \phi_W \mathbf{1}_{\{l_t>0\}} - \phi_F \mathbf{1}_{\{h_t=F, l_t>0\}} - \phi_P \mathbf{1}_{\{h_t=P, l_t>0\}} + \overline{\mathbf{b}}$$

Parameters estimated inside model

parameters	value	targets
$\{\beta_{low}, \beta_{high}\}$	$\{0.877, 0.992\}$	"
$Pr(\beta_{low}\|\eta_i)$	η_1: 0.78; η_2: 0.79; η_3: 0.38	wealth profiles by health (PSID)

* η_1: *worst health type*

- Substantial preference heterogeneity
- Less patient people are more likely to be of the bad health types

Key mechanisms

- Observed correlation between health and life-cycle outcomes generated by

1. Causal effects of bad health:
   a. Decreases productivity and increases disutility from work
   b. Increases OOP medical spending
   c. Lowers life expectancy

2. Composition effect:
   - Heterogeneity in health types (η), fixed productivity (γ), and patience (β)
   - $\{\eta, \gamma, \beta\}$ are correlated

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Results

R1. Importance of composition difference between healthy and unhealthy

R2. Lifetime monetary losses due to bad health

R3. Lifetime welfare losses due to bad health

No correlation between types and patience, but still preference heterogeneity

Wealth difference by health	PSID	Baseline	No (β, η) correlation
25^{th} pct	\$56	\$67	**\$38**
50^{th} pct	\$142	\$146	**\$38**
75^{th} pct	\$210	\$260	**\$91**

in 1000USD

- Miss health-wealth gradient before retirement (age 60-64)
- Income-health gradient does not imply wealth-health gradient

R1 : The importance of the composition difference

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R2. Lifetime monetary losses due to bad health

	Over entire life-cycle (21-death)			
	All	η_1	η_2	η_3
% of time in bad health	15%	58%	23%	4%
Annual monetary losses	\$1,511	\$8,896	\$1,935	\$225
(% of avg earning)	*(3.9%)*	*(23%)*	*(5%)*	*(0.6%)*
Composition (%)				
Medical losses paid by insurance	36%	33%	39%	39%
Out-of-pocket medical losses	27%	22%	30%	36%
Income losses	37%	45%	31%	24%

- Monetary losses vary a lot across η
- Medical losses (Ins+OOP) is largest, but health insurance covers large portion
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R3. Lifetime welfare losses

	all	η_1	η_2	η_3
Compensated consumption equivalence	\$1,933	\$6,380	\$2,690	\$854
(% consumption equivalence, λ_c)	*(10.6%)*	*(36.8%)*	*(14.8%)*	*(4.4%)*
Contribution (%)				
- Only medical expenses channel	25%	39%	22%	17%
- Only income channel	38%	57%	42%	9%
- Only survival channel	44%	32%	33%	77%

- Welfare losses vary a lot across η
- Survival effect: main welfare loss
- Income channel most important for $\{\eta_1, \eta_2\}$ while survival channel most important for η_3

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R3. Lifetime losses due to bad health: concentration and contribution of η

	Concentration			variation
	top 5%	top 10%	top 20%	due to η
Monetary losses (21-death)				
- Income losses + medical losses (Ins+OOP)	38%	56 %	75%	69%
Welfare losses				
- Compensated consumption equivalence	24%	42%	71%	30%

Use 2% interest rate for monetary loss.

- Highly concentrated
- Health types η responsible for large variation in both monetary and welfare losses
- But variation due to η is lower for welfare losses

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Conclusions from paper with Pashchenko and Porappakkarm

- Health types key to capture health dynamics and income/health gradient
- Composition difference btw. the healthy and unhealthy key to capture wealth/health gradient
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- Composition difference btw. the healthy and unhealthy key to capture wealth/health gradient
- Large lifetime losses due to bad health
  i. Lifetime costs of bad health are highly concentrated
  ii. Survival channel key contributor to welfare loss
  iii A large part of lifetime losses are pre-determined in early stage of life (69% for monetary loss, 30% for welfare loss)

- Health inequality by race, ethnicity, and gender

  with Nicolo' Russo, Margherita Borella, and Ross Abram

Health inequality by race, ethnicity, and gender

- Focus on adulthood and by race, ethnicity, and gender, and ask
  1. How should we measure health?
  2. How large are health disparities?
  3. What are the effects of health on key economic outcomes?
  4. How should we model health by race, ethnicity, and gender? In progress

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How should we measure health?

- **Self-reported health status (SRHS)**
  - How would you rate your health? Poor, fair, good, very good, excellent
- **Frailty index**
  - Share of health deficits at a given age

Health deficits in our frailty index

ADLs	Difficulty lifting a weight heavier than 10 lbs
Difficulty bathing	Difficulty lifting arms over the shoulders
Difficulty dressing	Difficulty picking up a dime
Difficulty eating	Difficulty pulling/pushing large objects
Difficulty getting in/out of bed	Difficulty sitting for two hours
Difficulty using the toilet	
Difficulty walking across a room	**Diagnoses**
Difficulty walking one block	Diagnosed with high blood pressure
Difficulty walking several blocks	Diagnosed with diabetes
	Diagnosed with cancer
IADLs	Diagnosed with lung disease
Difficulty grocery shopping	Diagnosed with a heart condition
Difficulty making phone calls	Diagnosed with a stroke
Difficulty managing money	Diagnosed with psychological or psychiatric problems
Difficulty preparing a hot meal	Diagnosed with arthritis
Difficulty taking medication	
Difficulty using a map	**Healthcare Utilization**
	Has stayed in the hospital in the previous two years
Other Functional Limitations	Has stayed in a nursing home in the previous two years
Difficulty climbing one flight of stairs	
Difficulty climbing several flights of stairs	**Addictive Diseases**
Difficulty getting up from a chair	Has BMI larger than 30
Difficulty kneeling or crouching	Has ever smoked cigarettes

How should we measure health?

- **Self-reported health status (SRHS)**: ask people to rate their health
  - $\Rightarrow$ Measurement error and differential reporting by group
- **Frailty index**: share of health deficits at a given age
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How should we measure health?

- Measure of health that best predicts key **economic outcomes and welfare**
- Compare the predictive power of frailty and SRHS for
  - Disability claiming
  - Social Security claiming
  - Nursing home entry
  - Nursing home stay
  - Death

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Main findings, part 1

1. **SRHS key predictor of economic outcomes by race, ethnicity, and gender**
2. **Frailty somewhat more predictive than SRHS**
3. **SRHS and frailty jointly significant**

Measuring health disparities by race, ethnicity, and gender

		Women			Men		
		White	Hispanic	Black	White	Hispanic	Black
SDI recipient next wave	Basic controls	0.048	0.046	0.036	0.045	0.022	0.032
	SRHS	0.212	0.122	0.129	0.186	0.112	0.122
	Frailty	0.244	0.193	0.185	0.245	0.222	0.175
	Frailty and SRHS	0.268	0.202	0.199	0.264	0.241	0.196
SS Benefits Recipient Next Wave	Basic controls	0.118	0.081	0.083	0.134	0.101	0.120
	SRHS	0.128	0.110	0.102	0.140	0.128	0.126
	Frailty	0.126	0.091	0.097	0.142	0.112	0.139
	Frailty and SRHS	0.132	0.123	0.114	0.147	0.145	0.145
NH Entry Next Wave	Basic controls	0.241	0.172	0.169	0.220	0.144	0.122
	SRHS	0.285	0.209	0.206	0.266	0.194	0.176
	Frailty	0.315	0.231	0.214	0.303	0.272	0.234
	Frailty and SRHS	0.319	0.250	0.227	0.308	0.291	0.244
Currently in a NH	Basic controls	0.284	0.226	0.212	0.226	0.129	0.153
	SRHS	0.338	0.259	0.250	0.296	0.222	0.214
	Frailty	0.526	0.413	0.411	0.487	0.529	0.427
	Frailty and SRHS	0.533	0.437	0.417	0.492	0.540	0.449
Death Next Wave	Basic controls	0.166	0.157	0.120	0.140	0.157	0.109
	SRHS	0.240	0.194	0.169	0.219	0.212	0.151
	Frailty	0.266	0.221	0.189	0.237	0.244	0.176
	Frailty and SRHS	0.276	0.230	0.201	0.251	0.253	0.182

- McFadden Pseudo R^2. Health important determinant of all outcomes

▸ Percentage changes

Main findings, part 2

1. **Enormous health inequality by race and ethnicity**
   - $\Rightarrow$ On average, a 51 year old Black woman has the frailty of a 69 year old White woman

2. **Deficits prevalence**
   - $\Rightarrow$ Most deficits are more prevalent for Black and Hispanic people than for White people
   - $\Rightarrow$ Except for diagnosed ones, especially for Black men

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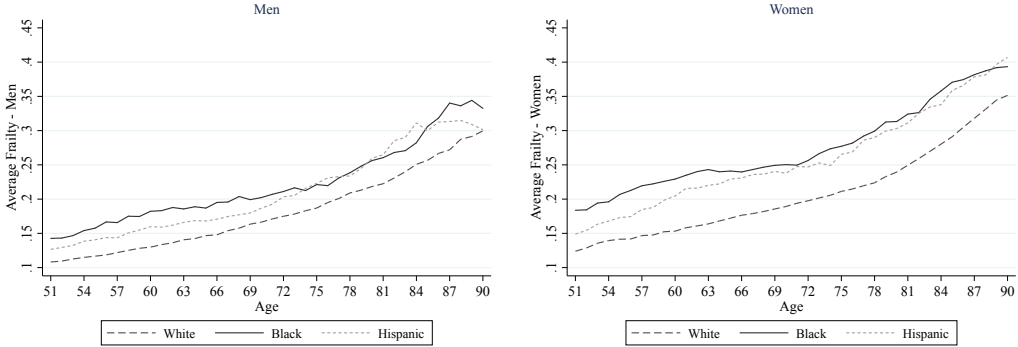
Enormous health inequality by race and ethnicity



- White people have the lowest frailty, Black people the highest

Prevalence of Deficits - Men, 55-59

	White	Hispanic	Black	White - Hisp.	White - Black
Has ever smoked cigarettes	0.650	0.657	0.678	-0.007	-0.028**
Diagnosed with HBP	0.424	0.437	0.608	-0.012	-0.184***
Diagnosed with arthritis	0.365	0.267	0.358	0.098***	0.007
Has BMI $\geq$ 30	0.327	0.404	0.354	-0.077***	-0.028**
Diff. kneeling or crouching	0.296	0.311	0.365	-0.016	-0.069***
Diff. getting up from chair	0.253	0.272	0.322	-0.020*	-0.070***
Diff. climbing several flights of stairs	0.233	0.330	0.355	-0.097***	-0.122***
Diagnosed with heart condition	0.152	0.114	0.146	0.038***	0.006
Hospital stay	0.148	0.146	0.207	0.002	-0.060***
Diff. walking several blocks	0.147	0.181	0.246	-0.034***	-0.099***
Diff. sitting for two hours	0.138	0.197	0.222	-0.059***	-0.084***
Diagnosed with diabetes	0.133	0.247	0.253	-0.114***	-0.120***
Diagnosed with psych. problem	0.119	0.112	0.134	0.008	-0.014*
Diff. pull/pushing large objects	0.118	0.187	0.233	-0.069***	-0.114***
Diff. lifting arms over shoulders	0.095	0.141	0.168	-0.045***	-0.072***
Diff. lifting >10 pounds	0.083	0.145	0.190	-0.062***	-0.107***
Diff. climbing flight of stairs	0.067	0.122	0.120	-0.055***	-0.053***
Diff. walking one block	0.066	0.073	0.114	-0.007	-0.047***
Diagnosed with lung disease	0.057	0.029	0.054	0.028***	0.003
Diagnosed with cancer	0.056	0.030	0.051	0.025***	0.005
Diff. dressing	0.050	0.107	0.090	-0.057***	-0.040***
Diff. using map	0.033	0.120	0.106	-0.086***	-0.073***
Diagnosed with a stroke	0.033	0.039	0.079	-0.006	-0.046***
Diff. picking up dime	0.032	0.039	0.045	-0.007	-0.013***
Diff. grocery shopping	0.032	0.052	0.065	-0.020***	-0.034***
Diff. getting in/out of bed	0.028	0.085	0.059	-0.057***	-0.031***
Diff. managing money	0.026	0.059	0.053	-0.033***	-0.027***
Diff. walking across room	0.025	0.033	0.054	-0.008*	-0.029***
Diff. bathing	0.022	0.040	0.047	-0.018***	-0.024***
Diff. using toilet	0.018	0.037	0.038	-0.019***	-0.020***
Diff. preparing hot meal	0.015	0.031	0.042	-0.016***	-0.027***
Diff. taking medication	0.013	0.031	0.028	-0.018***	-0.015***
Diff. making phone calls	0.011	0.041	0.026	-0.030***	-0.015***
Diff. eating	0.008	0.016	0.022	-0.008***	-0.014***
Nursing home stay	0.004	0.009	0.011	-0.005**	-0.007***

* p<.1, ** p<.05, *** p<.01

▸ Deficits women

Effects of frailty on key economic outcomes

- Outcomes: receiving disability benefits, receiving Social Security benefits, entering a nursing home, living in a nursing home, dying

Main findings

1. **Frailty has largest effect on the probability of death**

   $\Rightarrow$ $\uparrow$ 1 deficit increases probability of death by 0.8 p.p. for men and 0.6 p.p. for women. This is close to one year of life for each deficit.

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Effects of frailty on mortality

Life expectancy at age 55 by frailty percentile

	Men			Women		
Frailty	White	Hispanic	Black	White	Hispanic	Black
25%	84.8	86.4	79.9	89.9	91.7	85.8
55%	78.6	82.4	75.6	85.6	88.7	83.0
75%	71.1	76.7	70.7	78.8	83.8	78.6
99%	58.4	60.4	60.5	59.1	61.8	61.2

The frailty levels correspond to 2, 5, 9, and 26 conditions

- Large differences in life expectancy by frailty (20-30 years)
- Conditional on frailty, Hispanic people have the longest life expectancy and Black people the shortest (except at very high levels of frailty)

Conclusions

- Paper 1: the life time costs of bad health
  - Large health inequality even within high school men
  - Bad health has very costly consequences
  - A lot of it is predetermined as of age 21
- Paper 2: Health inequality by race and ethnicity
  - There is an enormous amount of health inequality by race and ethnicity
  - It implies very costly consequences
- Very important to model health and its consequences, including by race and ethnicity!

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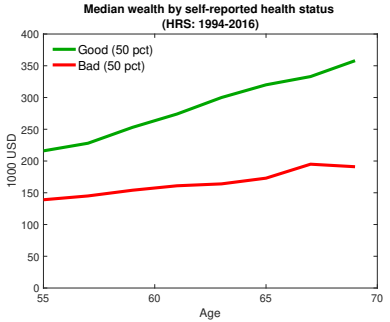
Wealth-health gradient among high school men



- Good health $\in \{excellent, very\ good, good\}$; bad health $\in \{fair, poor\}$

- Wealth controlled for year effects and family size

- The wealth gap is large even among a relatively homogeneous group

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Percentage Changes in R^2

		Women			Men		
		White	Hispanic	Black	White	Hispanic	Black
		Percentage change from basic controls					
SDI Recipient Next Wave	SRHS	341%	166%	260%	318%	412%	283%
	Frailty	407%	320%	416%	450%	916%	449%
	Frailty and SRHS	458%	341%	454%	492%	1,005%	514%
		Percentage change from basic controls					
SS Benefits Recipient Next Wave	SRHS	9%	37%	23%	5%	27%	5%
	Frailty	7%	13%	17%	6%	11%	16%
	Frailty and SRHS	12%	53%	38%	10%	43%	21%
		Percentage change from basic controls					
NH Entry Next Wave	SRHS	18%	21%	22%	21%	35%	44%
	Frailty	31%	34%	27%	38%	89%	92%
	Frailty and SRHS	32%	45%	34%	40%	102%	102%
		Percentage change from basic controls					
Currently in a NH	SRHS	19%	15%	18%	31%	72%	40%
	Frailty	85%	83%	94%	116%	311%	179%
	Frailty and SRHS	88%	93%	97%	118%	320%	320%
		Percentage change from basic controls					
Death Next Wave	SRHS	45%	24%	41%	57%	35%	39%
	Frailty	60%	41%	57%	69%	55%	62%
	Frailty and SRHS	66%	47%	67%	79%	61%	61%

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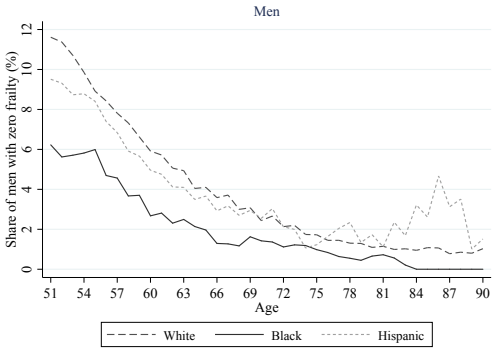
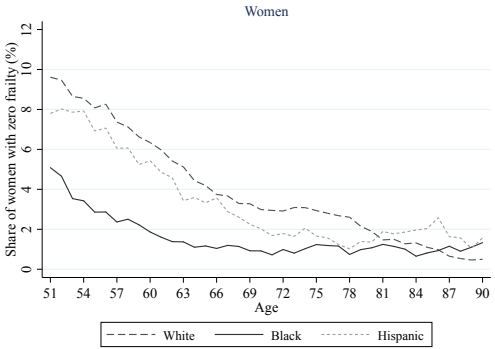
Share of People with Zero Frailty





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Deficits prevalence - Women, 55-59

	White	Hispanic	Black	White - Hisp.	White - Black
Has ever smoked cigarettes	0.545	0.406	0.553	0.140***	-0.007
Diagnosed with arthritis	0.474	0.430	0.521	0.044***	-0.047***
Diff. climbing several flights of stairs	0.388	0.515	0.535	-0.127***	-0.148***
Diff. kneeling or crouching	0.380	0.439	0.471	-0.059***	-0.091***
Diagnosed with HBP	0.352	0.448	0.672	-0.097***	-0.321***
Has BMI $\geq$ 30	0.336	0.443	0.554	-0.107***	-0.218***
Diff. getting up from chair	0.325	0.410	0.434	-0.085***	-0.108***
Diagnosed with psych. problem	0.213	0.201	0.175	0.012	0.038***
Diff. pull/pushing large objects	0.212	0.295	0.332	-0.084***	-0.121***
Diff. walking several blocks	0.198	0.266	0.332	-0.069***	-0.135***
Diff. sitting for two hours	0.184	0.276	0.256	-0.092***	-0.072***
Diff. lifting >10 pounds	0.180	0.290	0.320	-0.110***	-0.140***
Hospital stay	0.133	0.148	0.199	-0.015*	-0.066***
Diff. climbing flight of stairs	0.118	0.202	0.220	-0.084***	-0.103***
Diagnosed with diabetes	0.110	0.261	0.253	-0.151***	-0.143***
Diff. lifting arms over shoulders	0.106	0.192	0.217	-0.086***	-0.111***
Diagnosed with heart condition	0.104	0.087	0.156	0.016**	-0.053***
Diagnosed with cancer	0.100	0.068	0.067	0.032***	0.033***
Diff. using map	0.098	0.224	0.216	-0.126***	-0.118***
Diff. walking one block	0.081	0.091	0.163	-0.009	-0.081***
Diagnosed with lung disease	0.079	0.048	0.079	0.032***	0.000
Diff. grocery shopping	0.055	0.075	0.114	-0.019***	-0.059***
Diff. dressing	0.038	0.103	0.111	-0.065***	-0.073***
Diff. getting in/out of bed	0.037	0.107	0.097	-0.070***	-0.060***
Diff. picking up dime	0.036	0.040	0.055	-0.004	-0.018***
Diff. walking across room	0.034	0.042	0.080	-0.008*	-0.046***
Diagnosed with a stroke	0.030	0.033	0.067	-0.003	-0.037***
Diff. bathing	0.028	0.050	0.082	-0.022***	-0.054***
Diff. preparing hot meal	0.027	0.030	0.067	-0.003	-0.040***
Diff. using toilet	0.025	0.037	0.083	-0.012***	-0.058***
Diff. managing money	0.024	0.043	0.051	-0.019***	-0.027***
Diff. eating	0.012	0.021	0.024	-0.009***	-0.012***
Diff. taking medication	0.011	0.028	0.032	-0.017***	-0.021***
Diff. making phone calls	0.007	0.025	0.020	-0.017***	-0.012***
Nursing home stay	0.004	0.004	0.010	0.000	-0.006***

* p<.1, ** p<.05, *** p<.01

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