Frailty transitions and healthcare use in Europe

New evidence from SHARE data

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PRELIMINARY DRAFT
Introduction

Motivations

- Steady rise of health care expenditures (HCE) in GDP ⇒ concerns around sustainability of healthcare systems
- Two macroeconomic factors:
  1. Advances in medical technology (Weisbrod, 1991)
  2. Ageing of the population
- But the relationship between ageing and increase in HCE has been critized
  - Overriding assumption of Zweifel et al (1999): HCE depends on remaining lifetime but not on age
- What are the ”true” drivers of HCE in the elderly ? ↔ important to prioritize cost containment policies
Introduction

Motivations

Determinants of health care use among the elderly

- Drivers of age-related increases in HCE:
  - Chronic conditions (Smith et al, 2014)
  - Impairments and proximity to death (Harza et al, 2017)
  - Multimorbidity and mental health (Heider et al, 2014)
Introduction

Motivations

Determinants of health care use among the elderly

- Drivers of age-related increases in HCE:
  - Chronic conditions (Smith et al, 2014)
  - Impairments and proximity to death (Harza et al, 2017)
  - Multimorbidity and mental health (Heider et al, 2014)

- Physical frailty?
  - Well-established concept in the medical literature (since the seminal articles of Fried, 2001, 2004)
  - Assumption: missing variable in the relationship between age and HCE (Sirven et Rapp, 2016)
Introduction
Theoretical background

Conceptualizations of frailty

- **Definition**: "Clinically recognizable state of increased vulnerability resulting from aging-associated decline in reserve and function across multiple physiologic systems".

- Key variable to take into account in models of HCE for the following reasons:
  1. Highly prevalent in the elderly
     - Estimated prevalence in EU: 17% among 65+ and ≃ 30% among 80+ (Santos-Eggimann et al, 2009)
  2. Associated with negative health-related events (e.g., falls, hospitalization)
  3. Potentially reversible
Introduction

Theoretical background

Figure 1

Relationship among sarcopenia, frailty, and physical function impairment.
Introduction
Theoretical background

Frailty and healthcare demand: Theory

- Frailty is associated with a loss of physical function \(\Leftrightarrow\) depreciation of health capital.
- Theoretical predictions from the Grossman model (1972):
  1. Ageing should \(\downarrow\) the demand for health (lower return on investment)
  2. Ageing should \(\uparrow\) the demand for health services (to compensate higher depreciation rate)
- Health deficit accumulation model (Dalgaard and Strulik, 2014):
  - Frailty explicitly incorporated into the theoretical model
**Introduction**

Research question

Is frailty **independently** associated with health care use?
( after controlling for the main correlates of frailty and HC use )

- Should prevention actions (€) be used to try and reverse (or at least, delay) frailty transitions?
- → study in parallel to the SPRINTT project: multicomponent interventions to prevent frailty in 70+ european population
Introduction

Literature review

Frailty and healthcare demand: Empirical results

1. Studies using cross-sectional data:
   - Hoeck et al (2012): frail and pre-frail are more likely to contact a GP, a specialist, or an emergency department
   - Sirven et Rapp (2016): in France, frailty has an incremental impact on ambulatory spending of about €1,500

2. Studies using panel data:
   - Sirven and Rapp (2017): dynamic model to investigate association between frailty and hospital admission
Introduction

Aims

1. Analyse the impact of frailty on a wider range of outcomes
   - (i) Hospitalization, (ii) ambulatory care, and (iii) dental care use
   - Association between frailty and **dental care** has been under-researched (Cheng et al, 2013)

2. Use the 5 regular waves of SHARE survey
   - More insights into frailty transitions

3. Assess robustness of results to various empirical issues
   - Attrition in panel data
   - Reflect on reverse causality and endogeneity issues
Frailty transitions and healthcare use in Europe

J. Sicsic, T. Rapp

Outline

1 Data and methods
2 Results
3 Discussion
1 Data and methods

2 Results

3 Discussion
Data and methods

Source and sample

- **SHARE** (Survey of Health, Ageing, and Retirement in Europe)
  - Representative sample of non-institutionalised adults aged 50+ in 11 countries
  - Five regular waves (wave 3 = retrospective data)
    - Wave 1 in 2004/05
    - Wave 6 in 2015
- **Inclusion / exclusion criteria**
  - Having participated to all waves ⇒ 9 countries
  - Having participated to the first wave (exclude ‘refreshing samples’)
- **Sample size**
  - Unbalanced sample: 64,784 obs (21,601 units)
  - Balanced sample: 30,880 obs (6,176 units)
Data and methods

Dependent variables

1. Hospital admission (0/1)
   - At least one hospital overnight during the last 12 months

2. Ambulatory care visits (0/1)
   - At least one GP or specialist visit in the last 12 months
   - **NB:** Since wave 5, we cannot distinguish the health care professional

3. Dental care use (0/1)
   - At least one visit with a dentist in the last 12 months
   - **NB:** Not available in wave 4
Data and methods

Independent variables

Variable of interest

- **Fried’s frailty score** based on 5 dimensions (0-5 scale):
  - (1) low energy, (2) slowed walking speed, (3) unintentional weight loss, (4) low grip strength, (5) low physical activity
  - **Pre-frail**: score = 1 or 2
  - **Frail**: score $\geq 3$
Data and methods

Independent variables

Variable of interest

- **Fried’s frailty score** based on 5 dimensions (0-5 scale):
  - (1) low energy, (2) slowed walking speed, (3) unintentional weight loss, (4) low grip strength, (5) low physical activity
  - **Pre-frail**: score = 1 or 2
  - **Frail**: score \(\geq 3\)

Controls

- **Socio-demographic variables**
  - Age, gender, education, living with spouse, subjective material deprivation

- **Need for care**
  - Self-reported health, multimorbidity, ADL limitations, IADL limitations, depressive symptoms
Data and methods

Balanced or un-balanced panel?

- Trade-off between (potential) bias and precision:
  1. Balanced panel: loss of information ($\approx 50\%$ of observations) $\Rightarrow$ loss of precision
  2. Unbalanced panel: bias if attrition is not exogeneous, i.e. individuals do not drop out of the sample at random

Tests of attrition bias

- $H$: Individuals remaining in the panel are healthier
- Test $H_0$: $E(y_{it} | Attr_{it} | X_{it}) = 0 = \text{variable addition tests}$
  (Nijman and Verbeek, 1992)
  - Rejected for all models except Pr(doctor visits)
  - Estimations on the balanced sample are preferred
Data and methods

Patterns of attrition

- Frail are more likely to be attriters $\Rightarrow$ biased estimates in the unbalanced panel
## Data and methods

### Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>Balanced sample (NT = 30,880)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>wave 1</td>
</tr>
<tr>
<td><strong>Socio-demographics</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.564</td>
</tr>
<tr>
<td>Age</td>
<td>62.0</td>
</tr>
<tr>
<td>Living with partner</td>
<td>0.621</td>
</tr>
<tr>
<td>Upper secondary education</td>
<td>0.307</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>0.227</td>
</tr>
<tr>
<td>Resources (make ends meet)</td>
<td></td>
</tr>
<tr>
<td>With difficulty</td>
<td>0.287</td>
</tr>
<tr>
<td><strong>Need for care</strong></td>
<td></td>
</tr>
<tr>
<td>Pre-frail</td>
<td>0.381</td>
</tr>
<tr>
<td>Frail</td>
<td>0.059</td>
</tr>
<tr>
<td>Poor self-rated health</td>
<td>0.224</td>
</tr>
<tr>
<td>Limitations ADL 2+</td>
<td>0.020</td>
</tr>
<tr>
<td>Limitations IADL 2+</td>
<td>0.023</td>
</tr>
<tr>
<td>Chronic conditions 2+</td>
<td>0.285</td>
</tr>
<tr>
<td>Depressive symptoms 3+</td>
<td>0.348</td>
</tr>
</tbody>
</table>
Data and methods

'Stylized facts’

- Frailty seems to be correlated with our dependent variables independently of age.
Data and methods

Econometric specifications (1)

General specifications

\[ P(y_{it} = 1|X_{it}, c_i) = F(X_{it}\beta + c_i) \]  

- \( F() = \text{identity : linear probability models} \)
  - Because we are interested in AMEs and not predictions
  - Interpret \( \beta_k \) as % point increase

- 'Fixed' effect model: only consider within-individual variability
  - Appropriate to analyse 'frailty transitions'
Data and methods

Econometric specifications (1)

General specifications

\[ P(y_{it} = 1|X_{it}, c_i) = F(X_{it}\beta + c_i) \]

1. 'Fixed' effect model: only consider within-individual variability

2. Random effect model: optimal weighted average of between and within-individual variability
   - Strong assumption: \( \text{Cov}(X_{it}, c_i) = 0 \)
   - Relaxed by introducing \( \tilde{X}_{it} \) in the model
   - 'Mundlak-Chamberlain' correction \( \simeq 'fixed effects' \) interpretation
Data and methods
Econometric specifications (2)

- Dynamic RE models with Mundlak-Chamberlain correction
  \[ P(y_{it} = 1|y_{it-1}, X_{it}) = \rho y_{it-1} + \rho_0 y_0 + X_{it}\beta + \tilde{X}_{it}\gamma + c_i \]  

- Initial condition \((y_0)\): health problems in adult life (retrospective wave)

- Distinction between state dependence and unobserved heterogeneity (Heckman, 1984)

- A step to deal with the issue of reverse causality, i.e,
  \[ y_{it-1} \rightarrow frailty_t \]
  - (in particular no dentist_{it-1} \rightarrow frailty_t)
  - Reverse causality = problem of variable omission (but no convincing instrument)
Introduction

Data and methods

Results

Discussion
## Results

### Hospital use (Preliminary)

<table>
<thead>
<tr>
<th>Static models</th>
<th>Dynamic model</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Fixed effects</td>
<td>(2) Correlated random effects (GLS)</td>
</tr>
<tr>
<td></td>
<td>Est</td>
</tr>
<tr>
<td>Hospital stay (t-1)</td>
<td>-0.022***</td>
</tr>
<tr>
<td>Health problems in adult life (y0)</td>
<td>-0.003</td>
</tr>
<tr>
<td>Female</td>
<td>-0.021***</td>
</tr>
<tr>
<td>Age [60-69 y] (ref = 50-59 y)</td>
<td>0.006</td>
</tr>
<tr>
<td>[70-79 y]</td>
<td>0.026***</td>
</tr>
<tr>
<td>[80+ y]</td>
<td>0.043***</td>
</tr>
<tr>
<td>Living with partner</td>
<td>0.005</td>
</tr>
<tr>
<td>Secondary education</td>
<td>0.007</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>0.007</td>
</tr>
<tr>
<td>Make ends meet: with difficulty</td>
<td>0.006</td>
</tr>
<tr>
<td>Need for care</td>
<td>0.003</td>
</tr>
<tr>
<td>Pre-frail or frail (score&gt;=1)</td>
<td>0.037***</td>
</tr>
<tr>
<td>Frail (score&gt;=3)</td>
<td>0.052***</td>
</tr>
<tr>
<td>Poor self-rated health</td>
<td>0.082***</td>
</tr>
<tr>
<td>Limit. / ADL 2+</td>
<td>0.050**</td>
</tr>
<tr>
<td>Limit. / IADL 2+</td>
<td>0.074***</td>
</tr>
<tr>
<td>Chronic 2+</td>
<td>0.064***</td>
</tr>
<tr>
<td>Depressive sympt. 3+</td>
<td>0.017**</td>
</tr>
<tr>
<td>+ Time * country fixed effects</td>
<td>30,885</td>
</tr>
</tbody>
</table>
## Results

### Dental care use (Preliminary)

<table>
<thead>
<tr>
<th></th>
<th>Static models</th>
<th>Dynamic model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Fixed effects</td>
<td>(2) Correlated random effects (GLS)</td>
</tr>
<tr>
<td></td>
<td>Est</td>
<td>(rob. SE)</td>
</tr>
<tr>
<td>Dentist visit (t-1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health problems in adult life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age [60-69 y] (ref= 50-59 y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[70-79 y]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[80+ y]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living with partner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tertiary education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make ends meet: with difficulty</td>
<td>0.008</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Need for care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-frail or frail (score&gt;=1)</td>
<td>-0.012*</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Frail (score&gt;=3)</td>
<td>-0.006</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Poor self-rated health</td>
<td>-0.016**</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Limit. / ADL 2+</td>
<td>0.011</td>
<td>(0.019)</td>
</tr>
<tr>
<td>Limit. / IADL 2+</td>
<td>-0.063***</td>
<td>(0.017)</td>
</tr>
<tr>
<td>Chronic 2+</td>
<td>0.012</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Depressive sympt. 3+</td>
<td>0.032***</td>
<td>(0.009)</td>
</tr>
<tr>
<td>+Time * country fixed effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obs.</td>
<td>27,244</td>
<td></td>
</tr>
</tbody>
</table>
### Results

**Ambulatory care use (Preliminary)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Static models (1)</th>
<th>(2) Correlated random effects (GLS)</th>
<th>Dynamic model (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est</td>
<td>(rob. SE)</td>
<td>Est</td>
</tr>
<tr>
<td>Doctor visit (t-1)</td>
<td>0.016*** (0.005)</td>
<td>0.002 (0.006)</td>
<td>0.182*** (0.006)</td>
</tr>
<tr>
<td>Health problems in adult life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.02 (0.006)</td>
<td>0.009 (0.007)</td>
<td>0.008** (0.004)</td>
</tr>
<tr>
<td>Age [60-69 y] (ref= 50-59 y)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[70-79 y]</td>
<td>0.01 (0.008)</td>
<td>0.011* (0.006)</td>
<td>0.004 (0.006)</td>
</tr>
<tr>
<td>[80+ y]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living with partner</td>
<td>0.012** (0.005)</td>
<td>0.011** (0.004)</td>
<td>0.012 (0.008)</td>
</tr>
<tr>
<td>Secondary education</td>
<td>0.007 (0.005)</td>
<td>0.005 (0.004)</td>
<td></td>
</tr>
<tr>
<td>Tertiary education</td>
<td>0.026*** (0.006)</td>
<td>0.018*** (0.005)</td>
<td></td>
</tr>
<tr>
<td>Make ends meet: with difficulty</td>
<td>0.009* (0.005)</td>
<td>0.003 (0.005)</td>
<td>-0.001 (0.006)</td>
</tr>
<tr>
<td>Need for care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-frail or frail (score&gt;=1)</td>
<td>0.009* (0.005)</td>
<td>0.008* (0.004)</td>
<td>0.012** (0.005)</td>
</tr>
<tr>
<td>Frail (score&gt;=3)</td>
<td>-0.004 (0.005)</td>
<td>-0.002 (0.005)</td>
<td>0.001 (0.007)</td>
</tr>
<tr>
<td>Poor self-rated health</td>
<td>0.024*** (0.004)</td>
<td>0.024*** (0.004)</td>
<td>0.027*** (0.006)</td>
</tr>
<tr>
<td>Limit. / ADL 2+</td>
<td>0.007 (0.008)</td>
<td>0.006 (0.008)</td>
<td>-0.004 (0.014)</td>
</tr>
<tr>
<td>Limit. / IADL 2+</td>
<td>-0.011 (0.008)</td>
<td>-0.011 (0.008)</td>
<td>-0.003 (0.012)</td>
</tr>
<tr>
<td>Chronic 2+</td>
<td>0.117*** (0.010)</td>
<td>0.119*** (0.009)</td>
<td>0.120*** (0.010)</td>
</tr>
<tr>
<td>Depressive sympt. 3+</td>
<td>-0.001 (0.006)</td>
<td>-0.000 (0.006)</td>
<td>-0.004 (0.007)</td>
</tr>
<tr>
<td>+ Time * country fixed effects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>30,410</td>
<td>30,410</td>
<td>24,328</td>
</tr>
</tbody>
</table>
Discussion

Summary of results (Preliminary)

- Frailty is independently associated with:
  1. Increase in the probability of hospitalization (9.7 % point)
     - Consistent with previous results (Sirven and Rapp, 2017)
     - Results robust to various specifications
  2. Small decrease in dental care use (by 3.5 % point)
     - Limitation: reverse causality: less dental care $\Rightarrow$ probability of becoming frail
  3. Small increase in ambulatory care use at the extensive margin (by 1.2 % point)
     - Limitation: Cannot distinguish between GP and specialist visits (substitution effects?)
     - This issue will be further investigated
Discussion

Strengths and limitations

- Large representative sample: 5 waves panel of data

1. Data mostly self-reported (e.g., frailty measure)
2. Frailty is not exogeneous \( \Rightarrow \) our estimates are not causal
   - But controlling for observed and unobserved time-varying covariates allows mitigating the OVB

Policy implication

- Rationale for interventions aimed at delaying frailty
- Will assess the cost-effectiveness of such strategies
Thank you for your attention

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