Nursing Homes and Mortality in Europe: Uncertain Causality

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June 8, International Conference on Public Economic Theory
A1: Economics of the elderly

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Introduction

- COVID-19 pandemic has raised the question of the high mortality of elderly living in nursing homes
  - About 66% of total COVID-related death in Spain, 48% in France, 34% in Germany and only 15% in the Netherlands
  - 50% in Belgium (CIHI, 2020)
- Low quality of care and physical proximity of residents have been pointed out
- The disparities among European countries question the quality and the institutional features of the nursing homes in Europe
- The recent ORPEA scandal has also cast doubt about care in nursing homes

Introduction

- This is a problem if nursing homes lead to higher mortality due to their very own characteristics
  - If the cause is the structure and organization of nursing homes, there is room for reform
- This is also important regarding the long-term care policies
  - How it is organized (NPO, FP, Public), delivered (home or institutional), financed (OOP, in kind, ...), resources generated (general taxation, mandatory social security and/or voluntary private insurance)
  - The role of informal care (Klimaviciute et al., 2017)
  - The type of care and the substituability between formal and informal care (Van Houtven and Norton, 2004; Bonsang, 2009)

Introduction

- Many studies have investigated the choice of housing at old age (Lindrooth et al, 1993; Laferrere et al, 2013; Angelini and Laferrere, 2012, Schmitz and Stroka-Welsch, 2020, Laferrere and Arnault, 2021)
  - They point prices, ADL, partneship, education, assets and quality as determinants of choice of nursing homes
- Studies have also tried to identify factors of mortality in the nursing homes (Lin, 2014; Sung, 2014; Levy et al., 2015; Falcone et al., 2018; Braggion et al., 2020; Antwi and Bowblis, 2018; Giudici et al., 2019; Bakx et al., 2020; Cronin and Evans, 2020)
  - They show the role of co-morbidity and limitations but also the quality of the nursing homes
  - Lack of causal evidence

This paper

- Using data from SHARE, we estimate if being in a nursing home leads to higher mortality
- This is done for years before the COVID 19 pandemic
- We use propensity score matching to compare treated (being in a nursing home) and untreated individuals (living at home)
- After controlling for the determinants of entry into a nursing home, the difference in mortality is to be attributed
  - to the way the nursing homes are designed and organized
  - or alternatively to the quality of aid and services one finds staying home

This paper

- Our results show a negative impact of being in a nursing home on life expectancy
- ...but differences among countries in our sample
  - Central and eastern countries display significant negative effect
  - ...this is not the case of southern and northern countries
- We identify differences in terms of the quality of these care facilities and the consideration given to nursing homes
- The results are robust to violation of the CIA

Data

- Data from the Survey of Health, Ageing and Retirement in Europe (SHARE)
- We use four waves 4, 5, 6 and 7
  - From wave 4, the survey includes nursing homes residents
- Sample of individuals aged 65+ with at least one ADL
  - Keeping people for whom we know place of residence in t and status (alive or dead) at $t+1$
  - Eliminating countries with too few observations in nursing homes
  - 13340 observations for 13 countries Gross sample Sample
- We look at mortality between two waves
  - From wave 4 to wave 5, from wave 5 to wave 6 and from wave 6 to wave 7 and pool these transitions together

Data

Mortality rates ratio in SHARE countries

		Deceased at time *t+1 (%)*			
		Both NH & AH at time *t*	Nursing Home at time *t*	At Home at time *t*	*Mortality ratio* (NH/AH)
North	Denmark	26.3	46.2	22.4	2.1
	Netherlands	11.5	29.4	9.8	3.0
	Sweden	19.6	48.0	16.4	2.9
Central	Austria	19.4	33.8	18.4	1.8
	Belgium	19.1	42.4	16.0	2.6
	France	17.3	42.2	15.5	2.7
	Germany	19.7	44.0	18.1	2.4
	Luxembourg	20.1	40.7	16.1	2.5
	Switzerland	15.3	44.7	12.4	3.6
South	Italy	19.6	20.0	19.6	1.0
	Spain	25.4	39.7	24.7	1.6
East	Czech Rep.	21.9	41.7	20.8	2.0
	Estonia	18.9	38.1	18.6	2.0
All		20.2	41.5	18.8	2.2

Data

- Higher mortality rates in nursing homes
- Important variations in the mortality ratio among countries
- But people in nursing homes may differ from people staying at home
  - in terms of health but also age, marital status, wealth, etc..
- Need to control for the possible simultaneous determination of health and housing

Data

Summary statistics of covariates

		Both NH & AH at time t	Nursing Home at time t	At Home at time t
Covariates				
Sex	Men (%)	39.0	30.9	39.6
	Women (%)	61.0	69.1	60.4
Age	65-74 (%)	34.0	12.4	35.5
	75-84 (%)	42.3	32.9	42.9
	85+ (%)	23.7	54.7	21.6
In couple	Yes (%)	47.8	7.6	55.2
	No (%)	52.2	92.4	44.8
Wealth	1st tercile (%)	50.0	89.6	47.3
	2nd tercile (%)	29.7	7.5	31.2
	3rd tercile (%)	20.3	2.9	21.5
ADLs	1 or 2 (%)	67.4	41.1	69.2
	3 or 4 (%)	17.6	20.4	17.4
	5 or 6 (%)	15.0	38.5	13.4
At least one child	Yes (%)	89.0	78.0	89.7
	No (%)	11.0	22.0	10.3
At least two chronic diseases	Yes (%)	81.4	75.1	81.8
	No (%)	18.6	24.9	18.2
Observations		13340	863	12477

Propensity score matching

- To control for the selection bias due to observables, we use a propensity score matching estimation method
  - Treatment group: individuals in a nursing home
  - Control group: individuals at home
- Individual in a nursing home is matched to individuals living at home with similar observable characteristics
  - It allows us to condition on sufficient observable information to obtain a counterfactual
  - The differences in outcomes of these matched pairs can then be attributed to the treatment (being in a nursing home)

Propensity score matching

- Conditional independence assumption (CIA)
  - The mortality of the individuals in the control group and in the treated group are independent of the residence status once we control for a set of observable characteristics
- This is done through the propensity score of being into a nursing home obtained from a Probit regression
  - Balancing variables : wave, gender, age, partnership status, wealth, number of ADLs, the fact of having at least on child and the fact of suffering from at least two chronic diseases

Propensity score matching

- Propensity score are obtained for the total sample and for each country separately PSM
  - Estimations achieve balance on covariates between treated and controls
- We match observations using Kernell matching methods with replacement
  - Results are robust to using the nearest neighbor matching method without replacement and radius and stratification matching

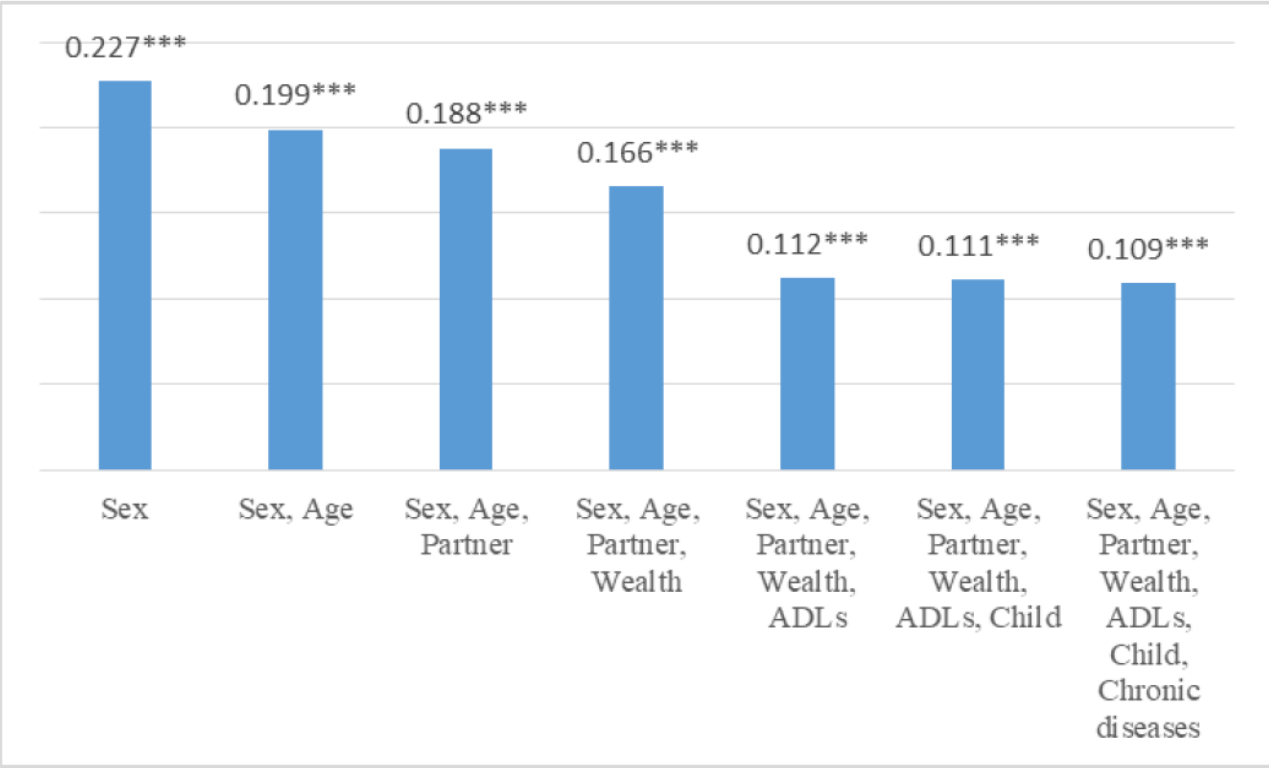
Results

Average Treatment Effects of the Treated (ATT)

		# treated	# control	ATT	Boot. S.E.
All		863	11455	0.109***	0.018
North	Denmark	93	427	0.056	0.067
	Netherlands	17	39	0.200	0.172
	Sweden	77	413	0.064	0.096
Central	Austria	68	514	0.051	0.067
	Belgium	198	996	0.083*	0.047
	France	83	430	0.112*	0.067
	Germany	50	314	0.211**	0.084
	Luxembourg	27	41	0.275**	0.130
	Switzerland	38	275	0.230**	0.095
South	Italy	20	826	-0.063	0.115
	Spain	78	807	0.033	0.060
East	Czech Rep.	72	790	0.122**	0.059
	Estonia	42	764	0.140*	0.083

Sensitivity analysis

- First by still assuming that the CIA is satisfied and looking at the stability of the ATT



Evolution of ATT by adding our matching variables

Sensitivity analysis

- We test if our ATT are robust to deviation from the CIA using simulated sensitivity analysis as proposed by Ichino et al (2008)
- Assume that the CIA is not satisfied given the considered observables but would be if one could observe an additional binary variable
  - The potential confounder can be simulated and added to the covariates
  - By comparing the results obtained with and without, we show to what extent the baseline results are robust to specific sources of failure of the CIA

Sensitivity analysis

- The assumption is that the CIA only holds given X and an unobserved binary variable U
- U may impact both the treatment and the outcome
- One can measure the effect of U on the relative probability to have a positive outcome in the absence of treatment
  - Γ is a measure of the outcome effect
- One can measure the effect of U on the relative probability to be assigned to the treatment
  - Λ is a measure of the selection effect

Sensitivity analysis

- We use two approaches to pick the parameters of the distribution of U
  - Make it similar to the empirical distribution of important binary covariates
  - Choose it such as the estimated average treatment effect would be driven to zero
- If very unlikely, the exercise supports the robustness of the estimates derived under the CIA

Sensitivity analysis

Sensitivity analysis: confounder-like and killer confounder

	Outcome Effect Γ	Selection Effect Λ	ATT
PSM (Kernell)	-	-	0.109
Confounder-like			
Being a woman	0.654	1.577	0.116
Having at least one child	0.965	0.401	0.106
Having at least 2 chronic diseases	0.919	0.674	0.108
Having a living partner	0.844	0.069	0.085
Killer confounder			
U' ($d = 0.1$ & $s = 0.68$)	1.725	30.062	0.031
U'' ($d = 0.2$ & $s = 0.56$)	2.343	16.518	0.015
U''' ($d = 0.3$ & $s = 0.44$)	3.516	9.713	0.019
U'''' ($d = 0.4$ & $s = 0.32$)	9.044	5.539	0.028

Sens1 Sens2

Mechanisms

- How to explain the cross-country differences in mortality?
  - Differences in terms of health
  - Differences in terms of long-term care
- We do not have micro data on care in nursing homes
- But figures about formal and informal long-term care at the national level show interesting evidence

(Being careful about issues of reverse causation and thus without concluding of any causal effects)

Information about Formal and Informal Care by country

	Formal LTC							Informal LTC	
	Public spending in LTC				Number of LTC workers per 100 individuals 65+	LTC beds per 100,000 inhabitants	Share of private NH for profit (%)	Share of population providing informal care (%)	Share of informal carers providing more than 20h care per week (%)
	% of GDP	Institutional care	Home care	Cash benefits					
Denmark	3.5	62.0	38.0	0.0	8.1	750	6.5[2]	15.2	8.1
Netherlands	3.7	51.0	16.4	32.6	8.0	1371	20.0	36.7	3.3
Sweden	3.3	52.6	44.7	2.6	12.4	1388	15.0	22.0	5.4
Austria	1.8	49.1	9.9	41.0	4.1	865	21.0	8.1	19.0
Belgium	2.2	62.5	26.8	10.7	4.8	1276	33.0*	11.6	15.0
France	1.9	69.6	24.8	5.6	2.3	981	22.0	14.1	10.5
Germany	1.6	35.7	23.5	40.8	5.1	1152	40.0	6.8	15.0
Luxembourg	1.0	63.8	35.6	0.6	7.9	1168	9.6[3]	6.2	17.8
Switzerland	2.4	82.9	17.1	n.a.	8.3	1170	40.0	n.a.	
Italy	1.7	28.2	19.5	52.3	1.9	416	22.0	5.8	40.5
Spain	0.7	50.2	25.9	23.9	4.5	830	53.0	11.5	52.9
Czech Rep.	1.5	57.0	15.4	27.5	2.3	687	3.0	4.6	33.3
Estonia	0.4	52.7	42.7	4.6	5.3	871	80.0	13.4	17.3

Note: Figures for the column "Private Nursing Home for profit" come from the European Network of Corporate Observatories (2021). When there is missing data, we use firstly STATISTA information (https://www.statista.com/statistics/1239811/distribution-of-nursing-home-care-beds-by-public-or-private-ownership/), indicated by the symbol "[2]", this is the case of Denmark. For Luxembourg, information is not available on STATISTA and data then comes from SPC and DG EMPL (2021), indicated by the symbol "[3]". For the other variables, data come from SPC and DG EMPL (2021) for countries from EU and from OECD (2021) or Office fédéral de la Statistique (https://www.bfs.admin.ch/bfs) for Switzerland. The data correspond to data collected between 2016 and 2019, prior to COVID.

Mechanisms

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Conclusion

- Using PSM methods we show that residing in nursing homes increases the probability to die earlier than staying at home
- This result is driven by differences among countries with central and eastern countries showing deadlier nursing homes
- These results can be related to country-specific features of the long-term care
  - Higher mortality in countries with lower public spending and resources devoted to long term care
  - The role of the for-profit sector needs to be investigated

Data

Waves, original data and selected sample

		W4	W5	W6	W7	Pooled Obs. of 65+ & 1 ADL at time *t (#)*	NH if 65+ & 1 ADL at time *t (%)*
North	Denmark	x	x	x	x	566	16.4
	Netherlands	x	x			200	8.5
	Sweden	x	x	x	x	760	10.1
Central	Austria	x	x	x	x	1018	6.7
	Belgium	x	x	x	x	1708	11.6
	France	x	x	x	x	1236	6.7
	Germany	x	x	x	x	823	6.1
	Luxembourg		x	x	x	164	16.5
	Switzerland	x	x	x	x	417	9.1
South	Italy	x	x	x	x	1134	1.8
	Spain	x	x	x	x	1761	4.4
East	Czech. Rep.	x	x	x	x	1331	5.4
	Estonia	x	x	x	x	2222	1.9
All						13340	6.5

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Probit

Propensity score estimations

		Female	Age categories	In couple	Wealth terciles	# ADLs	At least one child	At least 2 chronic diseases	Pseudo-R^2
North	Denmark	=	+	-	-	+	=	=	0.29
	Netherlands	-	+	.	=	+	=	=	0.29
	Sweden	-	+	-	-	+	=	=	0.39
Central	Austria	=	+	-	-	+	=	-	0.28
	Belgium	-	+	-	-	+	=	-	0.35
	France	=	+	.	-	+	=	-	0.27
	Germany	-	+	-	=	+	-	=	0.34
	Luxembourg	=	=	.	-	=	=	=	0.09
	Switzerland	=	+	-	-	+	=	=	0.25
South	Italy	=	=	-	-	+	-	-	0.29
	Spain	-	=	-	-	+	-	=	0.32
East	Czech Rep.	=	=	-	-	+	-	=	0.24
	Estonia	=	+	-	.	+	=	=	0.29
All		-	+	-	-	+	-	-	0.28

Notes: The sign "+" or "-" means that the results are significant at the 95% threshold and go in the direction of the symbol. If the symbol is an "=", it means that there is no correlation established between the variable and being in a nursing home.

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Gross data

Gross data and representativeness of nursing homes respondents samples

		Pooled Obs. of 65+ (#) at time t	NH if 65+ (%) at time t	ADL if NH (%) at time t
North	Denmark	4743	2.5	81.2
	Netherlands	2785	1.5	42.9
	Sweden	6849	1.5	76.7
Central	Austria	6721	1.8	55.3
	Belgium	7550	3.8	70.2
	France	6663	1.7	73.7
	Germany	5413	1.3	73.5
	Luxembourg	1098	4.4	56.2
	Switzerland	4820	1.7	47.5
South	Italy	6824	0.4	74.1
	Spain	8993	1.2	81.7
East	Czech. R.	8009	2.0	44.2
	Estonia	10202	0.6	73.8
All		80670	1.6	66.0

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Sensitivity explanations

- 1st simulation:
  - In a first step, we simulate an unobserved variable which would have a distribution similar to the empirical distribution of important binary covariates. Table presents the results for four binary covariates giving important selection and outcome effects: being a woman, having at least one child, having at least 2 chronic diseases or having a living partner. This does not confound our results and the ATTs for the total sample are very close to the ones presented with the simple estimations.
  - The selection effect and the outcome effects differ according to the simulations.
  - The results hold also when this method is used country by country.

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Sensitivity explanations

- 2nd simulation:
  - The values of s and d are associated with the estimated values of Λ and Γ, respectively. The table displays some examples of outcome and selection effects for which our main result would disappear . Results show that in order to find a effect of being in a nursing home on the probability to die that tends to zero, the potential confounder should have an outcome effect and a selection effect that are much higher than what we observe in the covariates distribution. In order to kill our results, the outcome and selection effects should be almost 10 and 15 times bigger which is very implausible.
  - The difference $d = p_{01}$ - p_{00} can be interpreted as a measure of the effect of U on the untreated outcome, and the difference $s = p_1$ -p_0 as a measure of the effect of U on the selection into treatment.

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