# Mystery of rising old-age mortality in Europe:
# Testing alternative explanations

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*Abstract:* Since 2015, mortality in persons over age 65 reversed historical declines and rose in 15 of 28 EU countries. The excess can be roughly translated into 217,000 extra deaths amongst the 94 million seniors over 65 in the 28 EU countries. Potential explanations include data artefacts, flu outbreaks, cold winter seasons, returning emigrant retirees, and large budgetary reductions to health and social care. Here we test alternative hypotheses using cross-national data covering the years 2003-2015. We focus, in particular, to the health and social care–cuts implemented during the Great Recession. We found that a decrease of one percent in the social care expenditure leads to an increase in old-age mortality by about 0.14 percentage points (95% CI: 0.06 to 0.21 percentage points). No significant effects have been found for public healthcare expenditure

Keywords: old-age mortality; healthcare spending;

## 1. INTRODUCTION

Europe is not growing old anymore. In 2015, life expectancy at the age of 65 fell by 0.3 years among the 28 EU-countries. This was the first the first decline since 2002. At the same time, recent studies have shown an increase in mortality among seniors for 15 out of 28 EU members. [1] The death toll amounted to roughly 217,000 extra deaths. [2] Are those extra deaths result of a particularly bad year? Apparently not. Figures for the early months of 2017 confirm the rising mortality rates and assess the extra mortality to roughly 137,000 extra deaths. [1]

The European monitoring of excess mortality for public health action (EuroMOMO) network attributes the spike in deaths to the rise of influenza and the mismatch of the flu vaccines. [1-3] However, the data show that the excess of mortality was throughout the year and influenza and its seasonal pattern can offer only a partial explanation. [3]

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Data artefacts have been considered widely by the literature. For example, changes in the numerators or denominators can lead to anomalies in the death rates computations. Most of them, however, can be easily discounted.[3 4] For example, problems with the numerators can occur in case of massive migration, but the excess deaths were registered among the very seniors, who are unlikely to be migrants. At the same time, coding errors might affect cause-specific mortality but are less likely to affect all-cause mortality.

Curiously, however, a growing body of research attributes this excessive death toll to the implementation of austerity measures e.g. cuts to the health and social care budgets. [4] As far as England is concerned, there were 10,375 extra deaths within the first seven weeks of 2018 compared with the same weeks in the previous five years. This extra rise, corresponding to an additional death every seven minutes, cannot be explained by changes in the population size and age structure. [5] Oddly, concomitantly the Coalition government reduced the net spending in welfare expenditure by 7% (£16.7 billions). [4] Likewise, Greece, the EU-country most severely hit by the Great Recession, cut the hospital budgets by more than 40% between 2008 and 2012. [6] Reports of health problems related to the economic crisis have, indeed, appeared widely in the academic literature, describing a rise in unmet need for healthcare, increasing suicides and a HIV outbreak in the country, with the oldest experiencing the most negative impacts in terms of access to healthcare. [6]

Whether and to what extent the failure to respond to the economic crises might lead to worsening health in older people has significant implications for government policy. Here, for the first time to our knowledge, we look for evidence of the possible association between health and social care expenditure, percentage of people with unmet healthcare needs and old age mortality among 28 EU-countries covering the period between 2003 and 2015. By using panel data we avoid the risk of biased outcomes, allowing us to account for unobserved heterogeneity.

We show consistently that higher rates social care are associated with lower rates of old-age mortality. Taken together, the proposed research will answer critical policy questions concerning the best policy responses for protecting health during current and future economic crises, especially as recovery is projected to evolve slowly and budgets to remain constrained over the next decade. In what follows we present the methods in section 2 and the preliminary results in section 3.

## 2. METHODS

### *2.1 Data Sources*

To assess the possible causes of the rise in old-age mortality we linked a compendium of different data sources. We drew age standardized mortality rates per 100,000 population for deaths over 65 from 28 EU countries from the World Health Organization European Detailed Mortality Database MDB covering the period 2000-2015. We used mortality rates for four different age categories, individuals aged 65 or above, 65 to 74, 75 to 84 and 85 older. For each age group we have the rate separately by gender and for both gender, giving to a total of 12 categories (three for each age group). [7]

These were integrated with data on health and out of pocket expenditure, from the Global Health Expenditure, released by WHO, the values represent expenditure per-capita and are expressed in Euro at constant prices 2010 . [8] Data on social care expenditure are taken by Eurostat, the values represent expenditure per-capita and are expressed in Euro at constant prices 2010. With the term health expenditure, we refer to the publicly financed healthcare expenditure and from now on we will use the two terms as synonyms.

Data on the total percentage of people with unmet healthcare needs are taken from Eurostat, those numbers represent the population who had unmet healthcare needs due to either financial reasons, distance or waiting times. Unfortunately, no data were available before 2003.

To control for the severity of the flu, we use the percentage of people who died for flu or any respiratory diseases aged less than 65, as younger people are less susceptible to flu and the data were taken from World Health Organization European Detailed Mortality Database MDB [9].

The time-series of the average temperature at month and country level was taken from the National centers for environmental information. [9] We use specifically two dummies to identify cold and heat waves. To generate them,we took for each year and country the three coldest months (December, January and February) and the three warmest ones (June, July and August). For each of the two groups (i.e. cold vis-à-vis warm) we generated the distribution between 2003 and 2014, we then defined as cold (heat) wave equal to 1 whether in that specific year the temperature was below (above) the $5^{th}$ ($95^{th}$) percentile of the temperature distribution.

Finally, to control for the macroeconomic environment we the GDP, values represent expenditure per-capita and are expressed in Euro at constant prices 2010 and the data were taken from Eurostat. Table 1 further describes the dataset.

[Table 1 about here]

*Statistical Modelling*

First, to assess the association of health and social care expenditure with old-age mortality we used within-group estimation model, as follows:

$$Eq.1: \log(M_{it}) - \log(\overline{M_i}) = \beta\,[\log(PHE_{it}) - \log(\overline{PHE_i})] + \gamma[\log(SC_{it}) - \log(\overline{SC_i})] + \delta(X_{it} - \bar{X}_i) + \tau_t + (\varepsilon_{it}\text{-}\bar{\varepsilon}_i)$$

Here *i* is the country at year *t*. *M* represents the mortality rate per 100,000 inhabitants by gender and age group (65+, 65-74, 75-84, 85+). *PHE* represents the publicly financed healthcare expenditure, SC the social care one. X represent a country and time-varying variables such as people unable to access medical care due to financial reasons, waiting times or distance (Unmet needs), the logarithm of out-of-pocket expenditure in healthcare at country level, a dummy for the years when the temperatures were below the lowest $5^{th}$ percentile (cold) or above the $95^{th}$ percentile of the entire time series (hot),the logarithm of the percentage of people who died because of influenza or respiratory diseases aged less than 65 and the logarithm of the GDP at country and year level. $\tau$ represents a time trend. $\varepsilon$ is the error term.

*Accounting for Endogeneity*

One of the most unresolved issues on the association between health and social care expenditure is the endogeneity in the association, in the sense they have to some extent been influenced by the levels of health outcomes achieved in the past. Aiming at tacking this issue, in line with Martin et al. 2008, [10] we use a 2SLS estimation strategy and we instrument healthcare expenditure using the proportion of unpaid careers in the population (UC) and the lone pensioner household (LH). As for healthcare, social care is likely to be endogenous as well and we instrumented it using the logarithm of the population (P) in line with Haile F, Niño-Zarazúa 2017. [11] All these three variables were taken from Eurostat.

Eq. 1 might be preferred approaches in the presence of heterogeneity-induced bias. However, they would lead to biased estimation in the presence of reverse causality, for which only a "Two Stage Least Square" 2SLS estimation will provide unbiased estimation results presented in table 3. The idea behind the 2SLS estimation is to regress each of the endogenous variables, namely social care and healthcare expenditure on some exogenous variables – instruments – namely UC, LH and P and use their predicted values to estimate eq. 1.

All data and models were estimated using Stata version 15. Robust standard errors were clustered by country to account for non-independence of sampling. [12].

## 3. PRELIMINARY RESULTS

Figure 1 highlights the mean change in old-age mortality indexed to year 2014, year in which England the first country to has exhibited an increment in its mortality rate , by age-group (65+, 65-74, 75-84, 85+) for the 28 EU in our analysis. It shows that the long-term declines in mortality among those aged 65 or more in Europe has reversed since 2011. The change has been particularly dramatic for those aged 85 or more in 2012 and in 2015. More precisely, our data show that the mortality rate for people older than 65 increased by 0.78 percentage points in 2012 and by 2.37 percentage points for those older than 85, then it declined again for 2013 and 2014 and rose again in 2015 by 2 percentage points for those older than 85.

[Figure 1 about here]

At the same time, both the long-term increasing trend in the publicly financed healthcare and social care expenditure appear to have reached their plateau around 2011, while the out-of-pocket expenditure is steadily increasing. More precisely, our data show a decrease by seven percentage points in the healthcare expenditure between 2013 and 2011 and then a slight increase by 0.5 percentage points in 2014. Looking at social care expenditure, it slightly fluctuated between 2012 and 2014, with a slight increase of almost two percentage points in 2014. Conversely, out of pocket expenditure surged in the same period by 18 percentage points.

[Figure 2 about here]

Table 2 shows the results of the statistical model presented in Eq. 1. First, our results suggest that publicly financed healthcare expenditure is uncorrelated with old-age mortality. Second, our findings consistently suggest that one percentage increase in the social care expenditure is associated with a significant decrease in old- age mortality by about 0.14 percentage points (95% CI: -0.21 to -0.06 percentage points). The magnitude is heterogeneous across age groups, with the oldest ones showing the largest effect, which amounts to -0.16 percentage points (95% CI: -0.27 to -0.04). For those aged 65-74 the effect amounts to -11 percentage points (95% CI: -0.21 to -0.02 percentage points) and for those aged 75-84 the effect amounts to -0.13 percentage points (95% CI: -0.20 to -0.06 percentage points)

[Table 2 about here]

As said above, eq. 1 might be preferred approaches in the presence of heterogeneity-induced bias. Table 3 presents the results when we consider both healthcare and social care as endogenous variables.

[Table 3 about here]

We first present in table 3a the first stage estimation. The Wu-Hausman test of exogeneity of the instrument indicates the validity of them, as well as the F-statistics. These results confirm the validity of the 2SLS estimation.

We now turn to the second stage estimation. Our results show that one percentage increase in the social care expenditure leads to a decrease in old-age mortality by about 0.25percentage points (95% CI: -0.53 to 0.03 percentage points). The magnitude is heterogeneous across age groups, with the youngest showing the largest effect More precisely one percentage increase in the social care expenditure leads to a decrease by 0.52 percentage points (95% CI: -0.93 to -0.10 percentage points) for individuals aged 65-74. The effect is mildly significant at 10% level only, for those individuals aged 75-84 and each one percent increase in the social care expenditure leads to a decrease by 0.30 percentage points (95% CI: -0.63 to 0.04 percentage points) in the mortality rate. No significant effect was found for people older than 85, neither for healthcare expenditure.

## DISCUSSION

Recently, scientist examined the role of the health and social system. In fact, many European countries have implemented large budget reduction to their welfare system during the Great Recession. How will these reduction impact on healthy ageing outcomes? This paper tries to answer this question, by examining the association between health and social care expenditure on old-age mortality among 28 EU-countries over the period 2003-2015. Our approach differentiate between the impact of cut in both the health and social care system. We found that a decrease of one percent in the social care expenditure leads to an increase in old-age mortality by about 0.14 percentage points (95% CI: -0.21 to -0.06 percentage points),

While the findings and approach add to the existing literature, there are important limitations that future work should seek to overcome. First, our model refrains from modelling any relationship between macro-economic shocks and fiscal policies, which even though relevant is beyond the scope of this paper. Second, our results can describe an association between mortality and two proxies of welfare (publicly financed healthcare expenditure and social care expenditure), but hey cannot claim any causal inference conclusion. Third, the effect might be different according to the population examined, for example, the effect might be different by gender. Forth, the absence of micro-data refrain us from speculating any underline mechanism.

## Bibliography


1. Vestergaard LS, Nielsen J, Krause TG, et al. Excess all-cause and influenza-attributable mortality in Europe, December 2016 to February 2017. Eurosurveillance 2017;**22**(14)
2. Mølbak K, Espenhain L, Nielsen J, et al. Excess mortality among the elderly in European countries, December 2014 to February 2015. Eurosurveillance 2015;**20**
3. Hiam L, Dorling D, Harrison D, McKee M. Why has mortality in England and Wales been increasing? An iterative demographic analysis. Journal of the Royal Society of Medicine 2017;**110**(4):153-62
4. Loopstra R, McKee M, Katikireddi SV, Taylor-Robinson D, Barr B, Stuckler D. Austerity and old-age mortality in England: a longitudinal cross-local area analysis, 2007–2013. Journal of the Royal Society of Medicine 2016;**109**(3):109-16
5. Hiam L, Dorling D. Rise in mortality in England and Wales in first seven weeks of 2018: British Medical Journal Publishing Group, 2018.
6. Kentikelenis A, Karanikolos M, Reeves A, McKee M, Stuckler D. Greece's health crisis: from austerity to denialism. The Lancet 2014;**383**(9918):748-53
7. WHO. European Health for All Database (HFA-DB), 2017.
8. WHO. Global Health Database, 2017.
9. Temperature.

10. Martin S, Rice N, Smith PC. Does health care spending improve health outcomes? Evidence from English programme budgeting data. Journal of health economics 2008;**27**(4):826-42
11. Haile F, Niño-Zarazúa M. Does Social Spending Improve Welfare in Low-income and Middle-income Countries? Journal of International Development 2017
12. Abadie A, Imbens GW. Matching on the estimated propensity score: National Bureau of Economic Research, 2009.

## Figures and Tables

Figure 1: Percentage change in mortality rates among seniors by age-groups in 28 EU countries before and after 2011 (base year). Source: Author's computation using WHO data, values represent percentages and are unweighted.

Figure 2: Trends in  healthcare, social protection and out of pocket expenditure across 28 EU countries, before and after 2011. *Notes:* Source: Author's computation using Eurostat data, values represent percentage changes.

Table 1: Descriptive Statistics

Table 2: The association between variation Healthcare/Social care Spending and Old-age Mortality

Table 3: The association between variation Healthcare/Social care Spending and Old-age Mortality

Figure 1: Percentage change in mortality rates among seniors by age-groups in 28 EU countries before and after 2011 (base year). Source: Author's computation using WHO data, values represent percentages and are unweighted.

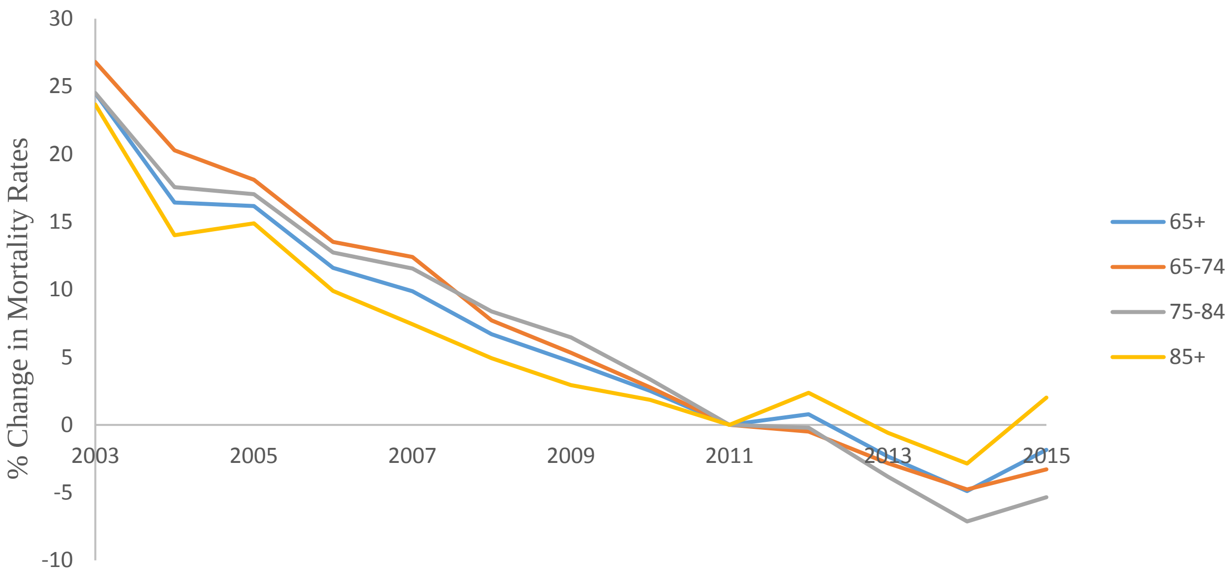

Figure 2: Trends in healthcare, social protection and out of pocket expenditure across 28 EU countries, before and after 2011. *Notes:* Source: Author's computation using Eurostat data, values represent percentage changes.

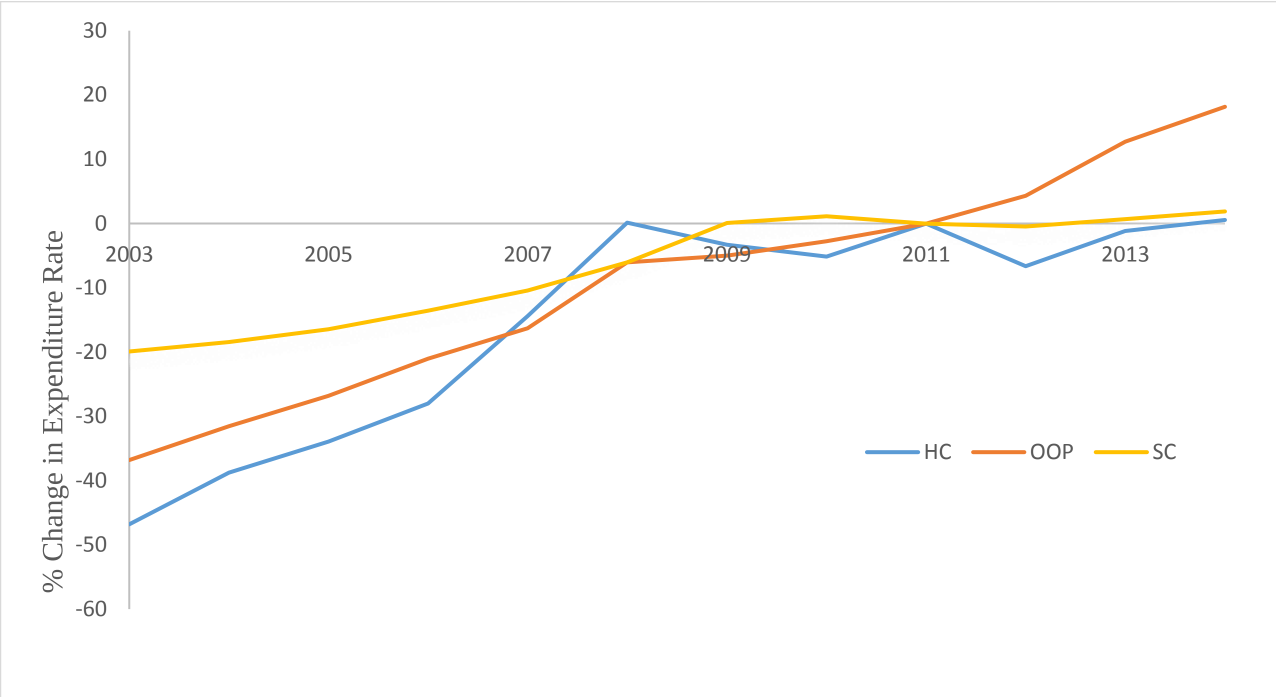

Table 1: Descriptive Statistics

| Variable | Number of Country Years | Mean | S.D. | Min. | Max. | Source |
|---|---|---|---|---|---|---|
| Log(Mortality 65+) | 305 | 8.51 | 0.18 | 8.12 | 8.99 | WHO |
| Log(Mortality 65-74) | 305 | 7.59 | 0.27 | 7.16 | 8.16 | WHO |
| Log(Mortality 75-84) | 305 | 8.60 | 0.21 | 8.10 | 9.12 | WHO |
| Log(Mortality 85+) | 305 | 9.71 | 0.12 | 9.41 | 10.1 | WHO |
| Healthcare Expenditure Euro Per-capita (2010 constant value), in Logs | 279 | 7.38 | 0.88 | 4.78 | 8.79 | WHO |
| Social Expenditure Euro Per-capita (constant value 2010) , in Logs | 300 | 8.46 | 0.82 | 6.31 | 9.81 | Eurostat |
| Out of pocket expenditure Euro Per-capita (constant value 2010) in Logs | 302 | 6.11 | 0.46 | 4.54 | 7.06 | WHO |
| Percentage people with unmet needs, total (i.e. due either to financial reasons, distance or waiting times), in Logs | 269 | 0.04 | 1.39 | -2.30 | 3.14 | Eurostat |
| Percentage of people who died for flue or respiratory diseases aged 0-64, in Logs | 284 | 2.06 | 0.48 | 1.07 | 3.13 | WHO |
| Percentage of unpaid careers | 303 | 3.27 | 3.51 | 0 | 23.9 | Eurostat |
| Percentage of lone pensioners household | 269 | 5.20 | 1.27 | 2.4 | 8.3 | Eurostat |

| | | | | | | |
|---|---|---|---|---|---|---|
| Population, in Logs | 307 | 15.90 | 1.42 | 12.89 | 18.22 | Eurostat |
| Temperature data | 307 | 9.45 | 7.99 | -20.47 | 29.98 | National Centers for Environmental Information |

*Notes:* Merged data from WHO and Eurostat and National Centers for Environmental Information, at country level covering the period 2003-2014

Table 2: The association between variation Healthcare/Social care Spending and Old-age Mortality using data from 28 Eru countries covering the period 2003-2015, Both genders

| | Percentage change in old-age mortality | | | |
|---|---|---|---|---|
| | Mortality 65+ | Mortality 65-74 | Mortality 75-84 | Mortality 85+ |
| Per 1 % increase in publicly financed healthcare expenditure | 0.003 | -0.04 | 0.04* | -0.02 |
| | [-0.04, 0.05] | [-0.10, 0.01] | [-0.001, 0.08] | [-0.08, 0.05] |
| Per 1 % increase in social care | -0.14*** | -0.11** | -0.13*** | -0.16*** |
| | [-0.21,-0.06] | [-0.21,-0.02] | [-0.20,-0.06] | [-0.27,-0.04] |
| Per 1 percentage point increase in mortality due to flue | 0.03** | 0.03* | 0.02* | 0.04* |
| | [0.00,0.06] | [-0.00,0.07] | [-0.00,0.05] | [-0.01,0.08] |
| Per 1 percentage point increase in people with unmet needs | 0.001 | 0.002 | -0.001 | 0.002 |
| | [-0.01,0.01] | [-0.01,0.01] | [-0.01,0.01] | [-0.01,0.01] |
| Heat waves | 0.00 | 0.00 | 0.00 | 0.00 |
| | [-0.01,0.01] | [-0.01,0.01] | [-0.01,0.01] | [-0.01,0.01] |
| Cold waves | 0.01*** | 0.01* | 0.01*** | 0.01** |
| | [0.00,0.02] | [-0.00,0.02] | [0.00,0.02] | [0.00,0.02] |
| Per 1 % increase in GDP | -0.04 | 0.07 | -0.02 | -0.08 |
| | [-0.14,0.06] | [-0.06,0.19] | [-0.11,0.07] | [-0.22,0.07] |
| N | 222 | 222 | 222 | 222 |

*Notes:* Source: Merged data at country level from Eurostat and WHO (2003-2015). The dependent variable represents the change in the all-cause the main explanatory variable represents the percentage point change in the publicly financed health care expenditure (per capita) and the percentage point change in the social care expenditure (per capita) . Controls represent the change in the mortality rates due to influenza and or respiratory diseases among those younger than 65 and the change in out-of-pocket healthcare expenditure, time-trends and yearly variation in % people unable to access medical care for financial reasons, distance or waiting times (Unmet needs), a dummy for the years when the temperatures were below the lowest 5$^{th}$ percentile (cold) or above the 95$^{th}$ percentile of the entire time series (hot). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: The association between variation Healthcare/Social care Spending and Old-age Mortality – Both genders, Using 2SLS

4a. First stage regression

| | (1)<br>Log(Healthcare) | (2)<br>Log(Social Care) |
|---|---|---|
| Unpaid careers | -0.01<br>[-0.02,0.003] | |
| Lone pensioners | 0.08***<br>[0.04,0.12] | |
| Out of Pocket expenditure | -0.06<br>[-0.15,0.03] | 0.05**<br>[0.005,0.09] |
| Unmet needs | -0.06***<br>[-0.09,-0.03] | -0.02**<br>[-0.04,-0.01] |
| Log(Population) | | 0.08***<br>[0.07,0.09] |
| F-statistic | 57.70 | 76.68 |
| p- value Wu-Hausman<br>Regressors are exogenous | 0.19 | 0.17 |
| *N* | 219 | 241 |

4b. Second Stage

| | Percentage change in old-age mortality | | | |
|---|---|---|---|---|
| | Mortality 65+ | Mortality 65-74 | Mortality 75-84 | Mortality 85+ |
| Per 1 % increase in publicly financed healthcare expenditure | -0.03 | 0.18 | -0.05 | -0.10 |
| | [-0.24,0.17] | [-0.12,0.49] | [-0.30,0.20] | [-0.28,0.09] |
| Per 1 % increase in social care | -0.25* | -0.52** | -0.30* | -0.10 |
| | [-0.53,0.03] | [-0.93,-0.10] | [-0.63,0.04] | [-0.34,0.15] |
| Per 1 percentage point increase in mortality due to flue | 0.14*** | 0.23*** | 0.15*** | 0.07*** |
| | [0.09,0.18] | [0.17,0.30] | [0.09,0.20] | [0.03,0.11] |
| Per 1 percentage point increase in people with unmet needs | 0.01 | 0.02* | 0.00 | 0.01 |
| | [-0.00,0.02] | [-0.00,0.03] | -0.01,0.01 | -0.00,0.02 |
| Heat waves | 0.01 | 0.01 | 0.01 | 0.01 |
| | -0.02,0.03 | -0.03,0.05 | -0.02,0.04 | -0.02,0.03 |
| Cold waves | 0.01 | 0.01 | 0.01 | 0.01 |
| | -0.02,0.03 | -0.02,0.05 | -0.02,0.03 | -0.02,0.03 |
| Per 1 % increase in GDP | 0.24*** | 0.28*** | 0.28*** | 0.18*** |
| | 0.11,0.36 | 0.09,0.47 | 0.12,0.44 | 0.06,0.29 |
| N | 219 | 219 | 219 | 219 |

*Notes:* Source: Merged data at country level from Eurostat and WHO (2003-2015). The dependent variable represents the change in the all-cause the main explanatory variable represents the change in the publicly financed healthcare expenditure (per-capita) and the change in the social care expenditure (per-capita) . Controls represent the change in the mortality rates due to flue and or respiratory diseases among those younger than 65 and the change in out-of-pocket healthcare expenditure, time-trends and yearly variation in % people unable to attend medical care because it was too expensive (Unmet needs), a dummy for the years when the temperatures were below the lowest 5th percentile (cold) or above the 95th percentile of the entire time series (hot). Publicly financed healthcare expenditure has been instrumented using the proportion of unpaid careers and the proportion of lone pensioners households. Social care has been instrumented with the logarithm of the population.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$