Fiscal Shocks and Mortality: Evidence from the Italian Municipalities

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Abstract

The Great Recession forced several countries into fiscal consolidation. An emerging consensus suggests that tax-based approaches tend to be further inside the Pareto frontier compared to expenditure-based approaches, as they generate larger short-run gaps in output. In this paper, we investigate downstream effects of expenditure-based fiscal consolidation leveraging a rushed reform of the Italian Domestic Stability Pact, introduced in 2011. We find that the unexpected budget tightening for small sized Italian municipalities led to an increase in mortality rates. This effect is driven by a sizeable, instantaneous reduction in welfare expenditure, especially for the old age, in those municipalities affected by the fiscal rule. A broader understanding of the welfare function thus introduces novel opportunity costs to expenditure-based fiscal consolidation. Critical appears to be not only whether budget cuts are preferred to tax increases, but which cuts are chosen within the budget menu.

Keywords – Public Health, Mortality, Fiscal Policy, Austerity
JEL codes – I18, E62

1 Introduction

In the aftermath of the Great Recession, several countries introduced austerity measures by increasing taxation (tax-based approaches, TB) and/or reducing social spending (expenditure-based approaches, EB). Alesina et al. (2019) study the implications of these two different approaches to austerity and establish three regularities: first, EB have significantly milder output effects compared to TB (Alesina, Azzalini, Favero, Giavazzi and Miano 2018). Second, private-sector demand is differentially affected, with EB and TB positively and negatively associated to investments respectively - a corollary of classic Say's law (Solow and Blinder 1973). Third, "[...] The effects of reduction in entitlement programs and other government transfers are very different from those of tax increases. They are accompanied by mild and short lived downturns." (Alesina, Favero and Giavazzi 2018; p.6). Although little is known about the taxonomy of preferences for policy-makers facing budget cuts (see Paulus et al. 2016; Venturini 2018), anecdotal evidence suggests that health spending was hit particularly hard by EB during the Great Recession (Stuckler et al. 2017*a*). Thus, a question connected to the implementation of EB has to do with their downstream welfare effects. Focusing on Greece, Perotti (2018) shows that health expenditure was reduced by more than one third in five years - which left the Greek populace adversly affected. A growing corpus of empirical studies has however mainly reported on spurious associations between 'austerity', widely defined, and an array of health outcomes (Kentikelenis et al. 2011; McKee et al. 2012; Karanikolos et al. 2013; Kentikelenis et al. 2014;

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Antonakakis and Collins 2015; Loopstra et al. 2016; Lima et al. 2016; Stuckler et al. 2017*b*; Toffolutti et al. 2018; Toffolutti and Suhrcke 2019). In this paper, we approach this question from a quasi-experimental perspective, aiming to test whether a causal link exists between reductions in welfare expenditure and increased mortality rates in Italy. To do so, we exploit a sudden reformation of the Domestic Stability Pact (DSP), which since 1999 has constrained the fiscal space of the Italian municipalities. Previous studies have shown that changes in the DSP at the threshold had significant impacts, from declines in public and private investments (Venturini 2018; Coviello et al. 2019) to reductions in spending and in the magnitude of the political budget cycle (Grembi et al. 2016; Bonfatti and Forni 2017). In particular, we leverage the fact that, in 2011, the Berlusconi IV cabinet, under financial distress due to soaring borrowing costs on the Italian debt, extended the DSP fiscal rule to previously exempted municipalities between 1,001 and 5,000 inhabitants, starting from 2013. Using a compendium of administrative data from the National Statistical Office (ISTAT) and from the Ministry of Interior and the Ministry of Economic and Finance, covering the period 2008−2015, our results show that the municipalities subject to the new fiscal rule experienced a sizable decline in welfare expenditure, and an increase in mortality rates. This effect is heterogeneous across age groups, with the oldest ones being the most affected, and geography, with municipalities in the South suffering the most. We offer a fourfold contribution to the literature. First, to the best of our knowledge, this is the first study that investigates the causal impact of EB on health outcomes. Second, by focusing on different age groups and geographical levels, we provide new evidence on heterogeneities in this relationship. Third, by identifying a specific expenditure channel, we offer a rationale to increase dimensionality in our thinking of EB. Fourth, by showing that policy-makers prioritised cutting welfare we help identifying local policy-maker priorities when faced with sudden external constraints on their budget. The remainder of the paper is organized as follows. We review the institutional context and the effects of the 2011 reform of the DSP in Section 2. In Section 2.2, we explore how the reform impacted expenditure in treated municipalities. This leads us to identify potential health channels, which we theoretically explore in Section 3. Section 4 discusses the identification strategy, while the main results are presented in Section 5. Section 6 concludes.

2 The 2011 Reform and the Fiscal Channel

2.1 The 2011 Reform in Context: the Domestic Stability Pact in Italy

Municipalities (*Comuni*) represent the third layer of Italian sub-national government and the lowest-tier unit among those with substantive administrative functions. They have traditionally played a prominent role in national expenditure, being responsible for a wide range of key social services, ranging from child-care and nursery schools to ancillary assistance to elderly and people in need. After Italy's adhesion to the European Stability and Growth Pact in 1999, the central government introduced the *Patto di Stabilità Interno*, or Domestic Stability Pact (DSP), to constrain the fiscal policy of Italian municipalities. The regulatory framework of the DSP, which was in force between 1999 and 2015, has changed several times, in terms of financial targets, strictness and coverage.[1] From its introduction and up to 2004, the DSP provided for balanced budget rules, aimed at limiting the growth rate of the fiscal gap, defined as deficit net of transfers from the above and debt service. Requirements were relatively soft as only current expenditure was accounted for the target, and several spending items were explicitly excluded. In 2005 and 2006, the DSP was modified to introduce a ceiling on final expenditure, encompassing both current and capital spending, as main financial objective. Rules changed again in 2007: since then, each municipality was expected to meet a specific target balance, computed following an automatic and rather convoluted mechanism. The required budget balance was computed based on the average (total) expenditure carried out in the last three years multiplied by a pre-defined, year-specific coefficient. Since 2012, the target for municipalities with population above 5,000 inhabitants has been adjusted for the reduction in transfers at the central level provided by Law Decree 78/2010 (Marattin et al. 2019). Several changes were applied through time also to accounting criteria, which oscillated between cash- and accrual-based methods. Eventually, a mixed competence criterion, whereby current and capital expenditure are measured respectively on an accrual and cash basis of accounting, was introduced in 2008. Amid all these changes, a lasting element of continuity was the exemption from the DSP of municipalities with population below 5,000, which applied

[1] From 2016 onward, a completely new regulatory framework rooted in the balanced budget principle apply to *all* municipalities (Law 243/2012) For a detailed analysis of the evolution of the DSP, see Venturini (2018).

from 2001 through 2011.[2] In this work, we focus on the 2011 reform of the *Patto*, as provided by Law 183/2011 (better known as the 2012 Budget Law). The 2012 Budget Law was drafted under exceptional circumstances, with contagion from the European government-debt crisis spreading to the country and borrowing costs on the Italian public debt soaring significantly (Baldwin 2015). The reform of the DSP brought municipalities with population between 1,001 and 5,000 inhabitants abruptly and unexpectedly back again under strict fiscal discipline, starting from 2013.

2.2 Identifying the Fiscal Channel

Building on previous studies (Grembi et al. 2016; Bonfatti and Forni 2017; Venturini 2018; Coviello et al. 2019), we posit that the 2011 reform of the DSP provides a quasi-experimental setting for causal research. First, the extension of the DSP to small-medium sized municipalities was sudden and unexpected. As said, its inclusion in the 2012 Budget Law was part of an (unsuccessful) attempt to alleviate strong financial pressures over Italy's public finances. Second, the reform affected neither municipalities with population above 5,000 inhabitants, which had always been subject to the DSP and continued to be so after 2011, nor municipalities with population below 1,001 inhabitants, which continued to be exempted.[3] In Figure 1, we qualitatively investigate the effects of the 2011 reform leveraging data based on certificates of final balance sheet accounts (*Certificati di Conto Consuntivo*), transmitted annually by each municipality to the Ministry of Interior. For each municipality and year, sheets 2, 4 and 5 of the certificates provide a detailed account of how revenues are raised and how spending is distributed across the various functions and services, distinguishing between current and capital items[4], and between cash and accrual basis of accounting.[5] We focus on the following fiscal outcomes: (i) total expenditure, (ii) welfare expenditure, (iii) specific welfare expenditure items, and (iv) total revenues. For each measure, we consider the sum of current items and capital items reported on a mixed competence basis, as provided by the DSP rules since 2008.[6] All fiscal outcomes are presented at constant 2015 prices.[7] In Figures 1a and 1b, we plot trends in total expenditure and (overall) welfare expenditure over the period 2008 to 2015. We show that both total and welfare expenditure fell abruptly across the DPS enforcement in treated municipalities, compared to those in the control group[8], in contrast with the fairly parallel patterns in the pre-reform period (see Section 6). Figure 2a shows that the fall in total expenditure in treated municipalities was driven by cuts in both welfare and non-welfare expenditure, measured on the right- and left-hand y-axis respectively. Still, the contraction in welfare expenditure was longer and the recovery milder compared to non-welfare expenditure: by 2015, welfare expenditure is about 15% lower than in 2012, a drop around three times larger than that recorded for other expenditure items. In Figure 2b, we further decompose trends in welfare expenditure in treated municipalities along its five sub-components: (i) services for infants and minors, (ii) prevention and rehabilitation, (iii) residential and shelter facilities for the elderly, (iv) cemeterial services, and (v) assistance, public charity, and other care services. In Figure 2b, the latter two sub-components are measured on the right-hand y-axis. Expenditure on residential shelters and facilities for the elderly experienced by far the sharpest and most prolonged drop among the welfare expenditure items. Figure 3a shows that such contraction in elderly-oriented spending was peculiar to treated municipalities. Last, we examine the evolution of total revenues over the 2008-2015 period in the two groups of municipalities. As one can see from Figure 3b, treated municipalities experienced only a moderate rise in revenues across the

[2]The sole exception to this exemption is 2005, when the DSP was extended to all municipalities with population above 3,000 inhabitants.

[3]Starting from 2012, individual budget requirements were determined based on criteria of financial virtuosity (Law Decree 138/2011). Still, this provision was suspended for the years 2013 and 2014 by the 2012 Budget Law (Corte dei Conti 2014). Also, starting from 2012, a series of measures were adopted to introduce some room of flexibility through horizontal and vertical pacts, which allowed municipalities to cede and acquire "fiscal spaces" to facilitate and speed up debt disposal. In this analysis, we do not address these potential confounders.

[4]Current expenditure includes personnel expenditure, purchase of goods and services (also from third parties), payment of taxes and tariffs and interest expense, whereas capital expenditure includes acquisitions of movable and immovable properties, real and financial investments. Current revenues include taxes, tariffs, transfers and contributions from the central and regional government, profits from public services, whereas capital revenues include economies from alienations, capital transfers from the central and regional government, credit collection.

[5]*Pagamenti* - cash - and *Impegni* - accrual - for expenditures, *Riscossioni* - cash - and *Accertamenti* - accrual - for revenues.

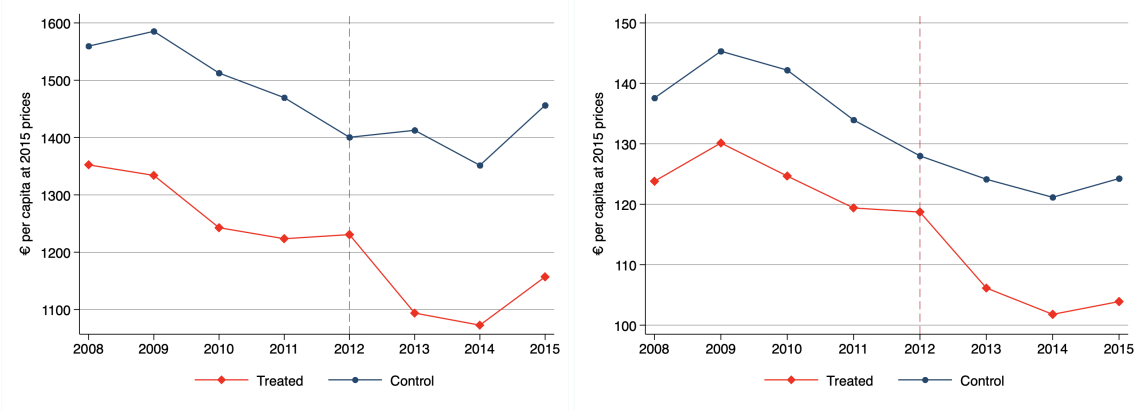
[6]As said, since 2008, DSP rules compelled municipalities to achieve a balanced budget wherein current fiscal items are measured on an accrual basis and capital fiscal items on a cash basis of accounting.

[7]The transformation from current to constant prices is performed on the basis of monetary coefficients provided by Istat.

[8]The control group includes municipalities with population below 1,001 and above 5,000 inhabitants.

implementation of the reform, the rise in revenues being actually much more pronounced in municipalities in the control group. These trends highlight how municipalities affected by the DSP reform preferred to cut expenditure rather than raising taxes to comply with fiscal discipline. Based on this descriptive evidence, we investigate the causal impact of fiscal tightening on public health by comparing mortality outcomes in municipalities with population between 1,001 and 5,000 inhabitants against municipalities with population below 1,001 or above 5,000 inhabitants, before and after the 2011 DSP reform. As further detailed in Section 4, we test for the existence of such fiscal channel through an instrumented difference-in-differences approach. In our analysis, we focus on the 2008-2015 period. Indeed, this is a period during which, coverage aside, DSP rules were overall stable both in terms of target and accounting criteria. To be sure, this is also a period during which many events occurred which may have affected both fiscal policy and mortality at the local level, first and foremost the economic crisis. Still, to the extent these concurrent events did not affect our treatment and control group heterogeneously, they do not pose a threat to our identification strategy.

Figure 1: Trends in fiscal outcomes (treated vs control)

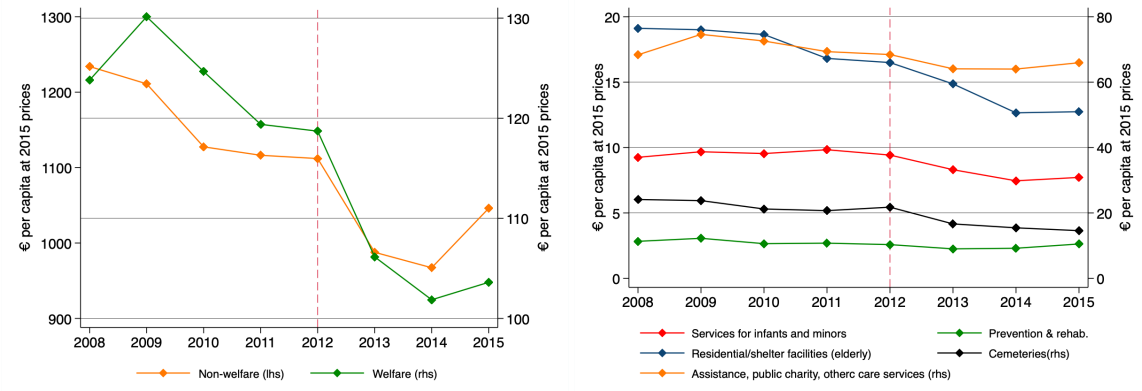


(a) Total Expenditure

(b) Welfare expenditure

Notes: The treatment group includes municipalities covered by the DSP since 2013 (between 1,001 and 5,000 residents), the control group includes municipalities covered by the DSP even before 2013 (above 5,000 residents) and municipalities exempted before and after 2013 (below 1,001 residents). All fiscal variables are expressed on a mixed accounting basis (current items considered on accrual basis, capital items on cash basis) at constant 2015 Euro.

Figure 2: Trends in fiscal outcomes (treated municipalities)

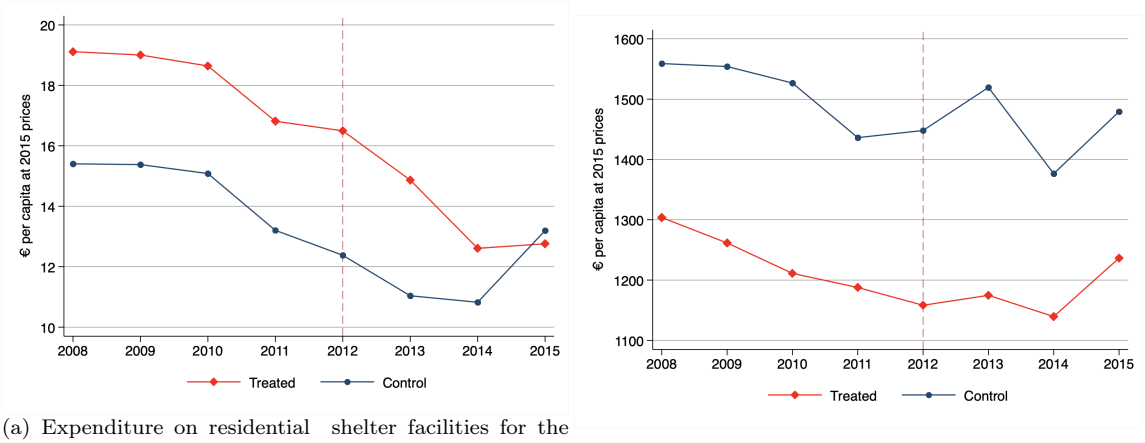


(a) Welfare vs Non-welfare expenditure

(b) Welfare expenditure items

Notes: The treatment group includes municipalities covered by the DSP since 2013 (between 1,001 and 5,000 residents). All fiscal variables are expressed on a mixed accounting basis (current items considered on accrual basis, capital items on cash basis) at constant 2015 Euro. In Figure 2a, welfare (non-welfare) expenditure is measured on the right-hand (left-hand) y-axis. In Figure 2b, expenditure on cemeterial services, and on assistance, public charity, and other care services is measured on the right-hand y-axis.

Figure 3: Trends in fiscal outcomes (treated vs control)



(a) Expenditure on residential shelter facilities for the elderly

(b) Total revenues

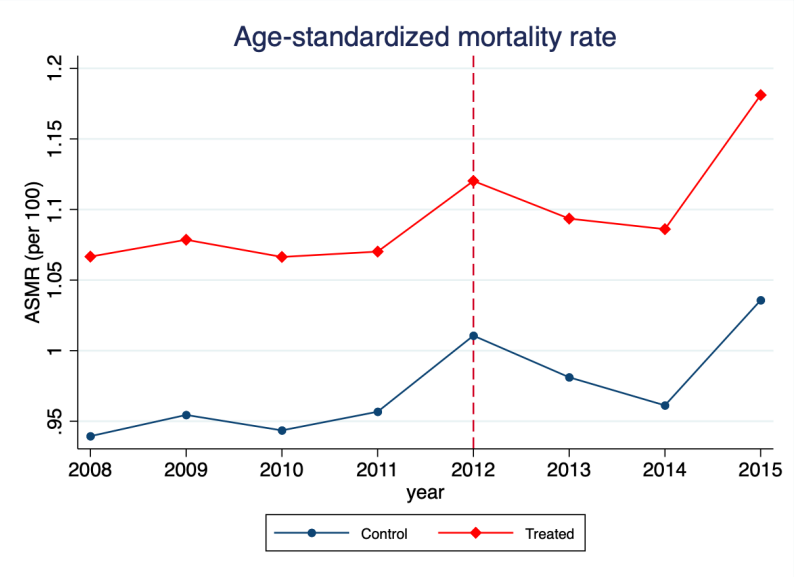
Notes: The treatment group includes municipalities covered by the DSP since 2013 (between 1,001 and 5,000 residents), the control group includes municipalities covered by the DSP even before 2013 (above 5,000 residents) and municipalities exempted before and after 2013 (below 1,001 residents). All fiscal variables are expressed on a mixed accounting basis (current items considered on accrual basis, capital items on cash basis) at constant 2015 Euro.

3 The Health Effects of Spending Cuts

In Italy, healthcare and welfare functions are provided through a multiplicity of channels. Italian municipalities are not responsible for healthcare, which is administered at the regional level. Rather, they are in charge of ancillary and paramedical services, mostly targeted to the elderly, including home care and provision of residential facilities. As we have seen, these were particularly impacted by the DSP reform. According to the literature, there are two main mechanisms through which austerity can impact health: first, the the so-called *'social risk effect'*, arising through cuts cutting social protection programs that might mitigate the negative effect of a recession (Karanikolos et al. 2013). Previous research has shown the detrimental effects on health, with focus on the most vulnerable groups (Kentikelenis et al. 2014) and particularly cuts to the health and social care budgets affecting support for older persons (Loopstra et al. 2016). As far as England is concerned, recent studies documents that local authorities have curbed their budget and these cuts included reduction in funding for residential care, day and domiciliary care and care management for older people (Loopstra et al. 2016). Those cuts increased the pressure to the National Health Service (NHS), which has resulted in rising in waiting periods for elective surgeries, lack of available beds in hospitals (Green et al. 2017). But England was not the only country to reduce its social and healthcare budget. Some studies suggest that reduction in healthcare access and the introduction of prescription charges might have been linked to increase in old-age mortality also in Portugal and Ireland. Likewise, recent findings linked the cuts in social care expenditure with an increment in unmet medical need across many European countries (Green et al. 2017). This increase has been concentrated among older people (Reeves et al. 2017). With some evidence documenting the potential detrimental effect on health of this increment (Porell and Miltiades 2001; Wang et al. 2012). Cuts to the public sectors have been linked to an increase in energy poverty, which might have led to 'the inability to afford adequate warmth because of the inefficiency of the home'. This is particularly concerning for older people who spend more time at home, have less subcutaneous fat and are in general more vulnerable to temperature swings (Thomson et al. 2017). The second mechanisms works through the so-called *'health effect'* by reducing health coverage or restricting access to the health care as well by cutting some healthcare services (Stuckler et al. 2017*a*). Many countries with the onset of the Great Recession have risen co-payments, for example by increasing the cost of outpatient care, visits and/or the cost of pharmaceuticals, hence creating barriers to healthcare access (Reeves et al. 2015). In some countries the budget cuts led to reduction in the healthcare services by reducing the opening hours and/or in the number of healthcare personnel (Kentikelenis et al. 2014). The most critical example is Greece, where individuals on low incomes reporting unmet medical need due to the cost of access doubled from 7% in 2008 to 13.9% in 2013 (Karanikolos and Kentikelenis 2016). As far as Italy is concerned, austerity measures have been linked with deteriorating mental health (Lora et al. 2012), reduced access to dental care (De Belvis et al. 2012), measles outbreak (Toffolutti et al. 2018). Figure 4

reports the evolution of age-standardized mortality rate for municipalities with population between 1,001 and 5,000 inhabitants (treated) and municipalities with population below 1,001 or above 5,000 inhabitants (control). We consider the annual number of deaths at the municipality level, disaggregated by age class, provided by Istat. Age-standardized mortality rate (ASMR) for any municipality and year is obtained by weighing crude mortality rates for each age group by the share that each age group represents out of the total population in that municipality and year (see Section A in the Appendix).[9]

Figure 4: Trends in age-standardized mortality rate



In Figure 4, the dashed red line signals that the 2011 version of the DSP entered into force after 2012. In the pre-reform period, trends for ASMR are essentially parallel. As one can notice, though, in the post-reform period trends look somewhat less parallel. Specifically, ASMR declines less between 2013 and 2014 and increase more sharply between 2014 and 2015 in "treated" municipalities as compared to municipalities in the control group. Admittedly, divergence in ASMR trends after the reform is not dramatic. Because of the nature of services offered by Italian municipalities, and in light of the discussion of Section 2, expenditure-based fiscal consolidation at the municipal level is more likely to channel into adverse health outcomes among the senior than the general population. We visually inspect whether this is the case by plotting the evolution of crude mortality rate among the 65+ and 75+ age groups (Figures 5a and 5b). As one can see, post-reform trends are more clearly diverging for the over75-elders, mortality in "treated" municipalities decreasing at a slower pace compared to municipalities in the control group.

4 Identification strategy

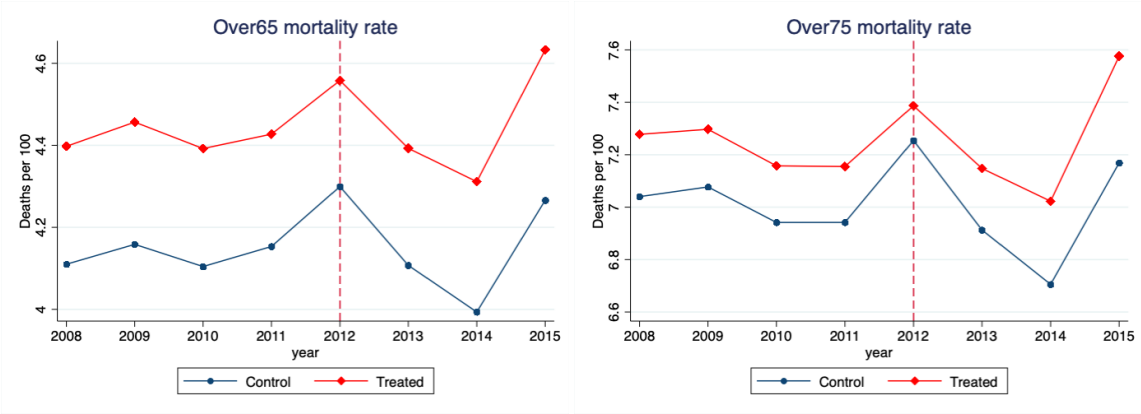
To explore the short-term impact of unexpected fiscal shocks on mortality, we rely on a combination of difference-in-differences and instrumental variable approach (Duflo 2001; Waldinger 2010). In principle, a plain difference-in-differences design, as reported in (1), would suffice to investigate the causal impact of being subject to fiscal discipline rules on our outcome of interest:

$$Y_{it} = \beta_0 + \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t * Treated_i + \epsilon_{it} \quad (1)$$

where i and t are subscripts respectively for municipality and year. Y_{it} is our mortality outcome of interest for municipality i in year t. *Post* is a dummy taking value 1 if $t > 2012$, as the extension of DSP rules to small-medium sized municipalities was enforced starting from 2013. *Treated* is a dummy taking

[9]Crude mortality rates are obtained by dividing the total number of deaths in the chosen age group by the resident population in any municipality and year in that age group. We further multiply this ratio by 100,000. Age classes are disaggregated as follows: 0, 1-4, then 5-year classes from 5-9 to to 95-99, and 100+. We calculate age-standardized mortality rate for the overall population and (crude) mortality rates, per 100 people, for the following age groups: 45-54, 55-64, 65+ and 75+.

Figure 5: Trends in mortality of elderly population



(a) Crude mortality rate in the 65+ age group

(b) Crude mortality rate in the 75+ age group

Notes: The treatment group includes municipalities covered by the DSP since 2013 (between 1,001 and 5,000 residents), the control group includes municipalities covered by the DSP even before 2013 (above 5,000 residents) and municipalities exempted before and after 2013 (below 1,001 residents).

value 1 if population in municipality i on December 31 of $t-2$ is between 1001 and 5,000, 0 otherwise[10]. Finally, $Post_t{*}Treated_i$ is an interaction term between the two dummies, and ϵ_{it} is the error term. Provided that standard assumptions for difference-in-differences hold, the coefficient β_3 identifies the causal impact of being subject to DSP rules on our outcome of interest. To verify the fiscal origin of such impact, if any, we rescale the difference-in-differences effect of being subject to DSP rules on our mortality outcome of interest by the difference-in-differences effect of being subject to DSP rules on (welfare) expenditure. In other words, we implement a two-stage system where in the second stage we regress mortality on the DSP-induced change in (welfare) expenditure obtained through difference-in-differences in the first stage. The system looks as follows:

$$Exp_{it} = \beta_0 + \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t * Treated_i + \epsilon_{it} \tag{2}$$

$$Y_{it} = \gamma_0 + \gamma_1 \widetilde{Exp}_{it} + \xi_{it} \tag{3}$$

First- and second-stage are reported respectively in equations (2) and (3). Notation for the first-stage equation is the same as the one for the reduced-form specification reported in (1). In this case, provided standard assumptions for difference-in-differences hold, β_3 captures the causal impact of being subject to DSP-rules on (welfare) expenditure. Turning to the second-stage equation, $\widetilde{Exp}_{it}$ identifies the DSP-induced change in expenditure from the first stage, while ξ_{it} is the error term. Our coefficient of interest, in this case, is γ_1, which captures the effect of the DSP-induced change in (welfare) expenditure on mortality. We expect γ_1 to be *negative*. That is, we expect a DSP-induced reduction in (welfare) expenditure to cause an *increase* in mortality. Of course, this approach is sensible only to the extent being subject to DSP-rules comes with a change in expenditure. This should not be necessarily the case, as municipalities may respond to imposed fiscal constraints by raising taxes rather than by cutting expenditure (Marattin et al. 2019). Still, as already shown in Section 2.2 and as further discussed in in Section 5, there is evidence that small-medium sized municipalities did react to the sudden extension of DSP-rules by cutting (welfare) expenditure. An additional requirement to sustain identification is that the exclusion restriction must hold, or that there is no other factor, correlated to the instrument, impacting the outcome. This is a somewhat strong assumption as, for what we have seen in Figure 2a, welfare expenditure was not the only budget item impacted by the treatment (although it was more impacted than average). In the next Section, we attempt to offer a more finely tuned system of equations by modeling the role of pre-post reform variations in expenditure for elderly facilities and shelters in increases in old-age mortality. Results appear to be robust to this specification.

[10] As provided by Art. 31, par. 2-quater, of Law 183/2011, the relevant population for determining whether a given municipality is subject to DSP rules in a given year is the population which was officially residing in the municipality at the end of the penultimate year according to Istat records.

5 Analysis

5.1 Reduced form regressions

In Figures 1a and 1b, and in Figures 4, 5a, 5b, we show that (i) there is a significant negative jump in expenditure for treated municipalities after the implementation of the 2011 DSP reform and (ii) the standard difference-in-differences assumption of parallel trends for both fiscal and mortality outcomes tends to hold (see Section 6 for a discussion). Table 1 reports results from reduced-form regressions where we apply a difference-in-differences design with year and municipality fixed effects using the logs of ASMR and mortality rate among the elderly per 100,000 as outcomes of interest. In all our analyses, we exclude municipalities located in the three autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli Venezia Giulia, as these were given the possibility to negotiate measures different from those imposed by the DSP with the central government since 2003. We keep, instead, municipalities from the two autonomous regions of Sicilia and Sardegna, formally subject to the DSP reform. The model implemented is the following:

$$log(Y_{it}) = \beta_0 + \beta_1 Post_t \times Treated_i + \gamma_i + \delta_t + \epsilon_{it}$$

where Y_{it} is the mortality outcome of interest in municipality i in year t, $Post_t \times Treated_i$ captures the standard difference-in-differences interaction term, and γ_i and δ_t stand for municipality and year fixed effects respectively. Column (1) reports results for age-standardized mortality rate, while Columns (2) and (3) report results for crude mortality rate in the over65 and in the over75 age group. Robust standard errors clustered at the municipal level are reported in parentheses. As said, analysis is carried over the 2008-2015 period. The estimated coefficients on the interaction of interest, *Post* × *Treated*, are positive, as expected, and strongly statistically significant in all of the three cases. The short-term effect of being subject to fiscal discipline rules is stronger among the elderly than in the overall population (Column 2 and Column 3). On average, municipalities affected by the DSP reform experienced an increase of 1.4% and 1.9% in the mortality rate per 100,000 individuals in the over65 and over75 population respectively between 2013 and 2015. The increase in the mortality rate in the general population is milder (+0.8%). We find analogous results, the effects being larger in magnitude, notably for age-standardized mortality rate, (i) when collapsing mortality outcomes for each municipality to pre- (2008-2012) and post-reform (2013-2015) average (Table B2 in the Appendix), using two periods only for the analysis, as suggested by Bertrand et al. (2004); and (ii) when restricting 'large' municipalities in the control group to those closer to the 5,000 threshold (Table B3 in the Appendix).

Table 1: Reduced form regression results

	(1) ASMR	(2) Over65	(3) Over75
Post x Treated	0.008***	0.014***	0.019***
	(0.002)	(0.004)	(0.005)
Constant	5.739***	6.265***	6.686***
	(0.001)	(0.003)	(0.003)
Observations	59,597	59,597	59,597
Municipalities	7,496	7,496	7,496
Municipality FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Period: 2008-2015. Dependent variables in Columns 1 to 3 are the logs of, respectively, age-standardized mortality rate, (crude) mortality rate in the 65+ age group and (crude) mortality rate in the 75+ age group, per 100,000. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

To further check for the robustness of our approach, we run a set of regressions where we include leads and lags of the treatment effect. That is, we interact the *Treated* dummy with year dummies for the pre- and post-reform period. The model implemented, in this case, is the following:

$$log(Y_{it}) = \beta_0 + \sum_{l=-4}^{2} \beta_l Year_{2013+l} * Treated_i + \gamma_i + \delta_t + \epsilon_{it}$$

where $Year_{2013+l}$ correspond to a series of dummy variables for the years in the pre-reform (2008, 2009, 2010, 2011, 2012) and in the post-reform period (2013, 2014 and 2015). These year dummies, interacted with the dummy $Treated_i$, identify treatment leads and lags respectively. Regression results are reported in Table 2, with robust standard errors clustered at the municipal level in parentheses. As one can notice looking at Columns 1 to 3, coefficients on treatment leads (up to 2012) are non-significant, providing indirect evidence that the parallel trends assumption for mortality outcomes holds in our setting. Instead, coefficient on treatment lags are larger in magnitude and, in the case of mortality in the over65 and over75 age group, they become statistically significant over time. These results add further evidence that the DSP reform impacted particularly on the elderly population. We reach analogous conclusions when collapsing treatment leads for the pre-reform period to the single regressor *Treated * Pre 2013*, the estimated coefficients for treatment lags being essentially unaltered (Columns 4 to 6).

Table 2: Reduced form regression results with treatment leads and lags

	(1)	(2)	(3)	(4)	(5)	(6)
	ASMR	Over65	Over75	ASMR	Over65	Over75
Treated * 2008	-0.006	0.010	0.016			
	(0.006)	(0.014)	(0.017)			
Treated * 2009	-0.005	0.012	0.013			
	(0.006)	(0.014)	(0.017)			
Treated * 2010	-0.001	0.015	0.016			
	(0.006)	(0.014)	(0.017)			
Treated * 2011	0.001	0.015	0.016			
	(0.006)	(0.014)	(0.017)			
Treated * 2012	0.002	0.015	0.013			
	(0.006)	(0.014)	(0.017)			
Treated * Pre 2013				-0.002	0.013	0.015
				(0.006)	(0.013)	(0.016)
Treated * 2013	0.003	0.019	0.019	0.002	0.019	0.019
	(0.006)	(0.014)	(0.017)	(0.006)	(0.014)	(0.017)
Treated * 2014	0.005	0.024†	0.033*	0.005	0.024†	0.033*
	(0.006)	(0.014)	(0.016)	(0.006)	(0.014)	(0.016)
Treated * 2015	0.010	0.038**	0.047**	0.009	0.038**	0.047**
	(0.006)	(0.014)	(0.016)	(0.006)	(0.014)	(0.016)
Constant	5.741***	6.260***	6.679***	5.740***	6.259***	6.679***
	(0.003)	(0.007)	(0.009)	(0.003)	(0.007)	(0.008)
Observations	59,597	59,597	59,597	59,597	59,597	59,597
Municipalities	7,496	7,496	7,496	7,496	7,496	7,496
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Period: 2008-2015. The dependent variable in Columns 1 and 4 is logged age-standardized mortality (per 100,000), in Columns 2 and 5 is logged mortality rate in the over65 age group (per 100,000), and in Columns 3 and 6 is logged mortality rate in the over75 age group (per 100,000). All specifications control for total resident population on January 1 of each year. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

5.2 Instrumented difference-in-differences

Previous results suggest that people residing in municipalities affected by the expansion of the DSP experienced an increase in mortality, especially at older ages. We now shed light on the mechanisms underlying this evidence. In order to assess whether a variation in local public expenditure acts as a mediating force of the DSP shock over mortality outcomes, we adopt a DDIV framework. Therefore, we instrument expenditure with exposure to the DSP so as to explore whether (i) expenditure declined in medium-sized municipalities following the onset of the DSP, and (ii) the exogenous reduction in expenditure affected mortality. Table 3 reports first-stage estimates. Our dependent variables are total expenditure, welfare expenditure and expenditure on residential and shelter facilities for the elderly (services for the elderly, from now onward). In Columns 1 to 3, we regress the three expenditure items on the standard difference-in-differences interaction term. On average, treated municipalities experienced significant reductions ranging from € 76 in total expenditure, to € 5.5 in welfare expenditure, and to € 2 in expenditure on services for

the elderly in per capita terms after the DSP enforcement. Columns 4 to 6 include leads and lags of the main effect, obtained by interacting the *Treated* dummy with year dummies for the pre- and post-reform period. The model implemented is the following:

$$Y_{it} = \beta_0 + \sum_{l=-4}^{2} \beta_l Year_{2013+l} * Treated_i + \gamma_i + \delta_t + \epsilon_{it}$$

where $Year_{2013+l}$ correspond, as before, to a series of dummy variables for the years 2008 and 2009, 2010, 2011, 2012 (pre-reform), 2013, 2014 and 2015 (post-reform) which, interacted with the dummy $Treated_i$, identify treatment leads and lags respectively; γ_i are municipality fixed effects, δ_t are time fixed effects. Non-significant coefficients on the treatment leads (up to year 2012) provide indirect evidence that the parallel trends assumption for fiscal outcomes holds in our setting, corroborating the visual intuition in Figures 1a, 1b and 3a, and that the reform produced no anticipatory effects.[11] The treatment lags show instead negative and more sizeable coefficients compared to the respective leads, highlighting that a significant drop occurred soon after the introduction of the DSP in total expenditure, while welfare and elderly expenditure become significantly affected over time. Columns 7 to 9 specify a more parsimonious model where the treatment leads to be used as instruments are collapsed into a single regressor (*Treated * Pre 2013*), without any major difference in first-stage results. The Kleibergen-Paap statistics reported at the bottom of the table measure the strength of the correlation between instruments and expenditure variables. In the case of total expenditure the statistic always exceeds standard critical values of acceptability, while it suggests weak identification when welfare and elderly expenditure are instrumented. Nevertheless, significant Anderson-Rubin tests in all specifications suggest that the identification of the effects is robust to weak instruments.

Table 3: First-stage results

	(1) Total	(2) Welfare	(3) Elderly	(4) Total	(5) Welfare	(6) Elderly	(7) Total	(8) Welfare	(9) Elderly
Post x Treated	-0.761***	-0.055**	-0.020†						
	(0.125)	(0.019)	(0.011)						
Treated * Pre 2010				-0.099	-0.034	0.002			
				(0.382)	(0.055)	(0.014)			
Treated * 2010				-0.552	-0.063	-0.000			
				(0.384)	(0.056)	(0.015)			
Treated * 2011				-0.274	-0.030	-0.000			
				(0.398)	(0.055)	(0.014)			
Treated * 2012				0.551	0.026	0.010			
				(0.383)	(0.055)	(0.015)			
Treated * Pre 2013							-0.101	-0.028	0.002
							(0.372)	(0.054)	(0.013)
Treated * 2013				-0.970*	-0.065	0.003	-0.979*	-0.067	0.003
				(0.388)	(0.055)	(0.015)	(0.388)	(0.054)	(0.015)
Treated * 2014				-0.643	-0.079	-0.016	-0.651	-0.080	-0.016
				(0.409)	(0.054)	(0.015)	(0.407)	(0.054)	(0.015)
Treated * 2015				-0.935*	-0.099†	-0.039*	-0.944*	-0.100†	-0.039*
				(0.403)	(0.059)	(0.017)	(0.404)	(0.059)	(0.017)
Observations	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489
Municipalities	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kleibergen-Paap stat.	37.2	8.6	3.3	23.8	5.6	1.4	10.8	2.3	2.2
Anderson-Rubin test	22.1***	22.1***	22.1***	4.5***	4.5***	4.5***	6.0***	6.0***	6.0***

Notes: Period: 2008-2015. Dependent variables in Columns 1-4-7, 2-5-8 and 3-6-9 are, respectively, municipal total expenditure, welfare expenditure and expenditure on residential and shelter facilities for the elderly. Expenditure variables are expressed in hundred 2015 Euro on a mixed accounting basis. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

Table 4 shows results from second-stages of systems presenting the difference-in-differences interaction term as instrument for expenditure variables. Column 1 highlights that total expenditure is strongly and negatively correlated with age-standardized mortality rate, the more so with mortality among over-65 and

[11] We can thus rule out the possibility that municipalities acted strategically prior to the entering into force of the 2011 version of the DSP in order to benefit from provisions set forward by Law Decree 138/2011, which granted greater fiscal space to financially virtuous municipalities (in fact, as already mentioned, these provisions were not applied in 2013 and 2014).

over 75-elders as shown in Column 2 and 3. Provided that the DSP fiscal shock had no effect on local mortality but through the fiscal channel of expenditure, these correlations can be interpreted as causal. In other words, the reduction in expenditure induced by the DPS in treated municipalities resulted in higher mortality rates. A cut of € 100 per person in total expenditure to comply with fiscal discipline is associated with an increase of 1% in deaths among 100,000 people of average age, 1.9% among 100,000 people older than 65 and 2.5% among those older than 75 years of age. Columns 4 to 6 and 7 to 9 Table 4 report significant negative causal relationships between cuts in welfare expenditure and expenditure on elderly, respectively. Cutting specific categories of expenditure has detrimental effects on people's health which are much more sizeable. Focusing on over-75 elders, a cut of € 100 per person in welfare expenditure (elderly expenditure) increases mortality by 35% (98%). We then decompose the difference-in-differences interaction term into treatment leads and lags to instrument expenditure. Results, presented in Table B4 and Table B5 in the Appendix, remain similar to the case where the difference-in-differences interaction term is used as instrument for expenditure variables. In the Appendix, we provide preliminary evidence that the effect of spending cuts on mortality is heterogeneous at both the geographical and local income level. Specifically, we show that municipalities located in the North of Italy, and characterized by a relatively affluent citizenry, are partially shielded from the adverse health consequences of expenditure-based fiscal tightening (Tables C8 to C10). We link these findings to the availability of private resources which allowed Northern and richer municipalities to better cope with the sharp and unexpected contraction in publicly provided social services.

Table 4: Second-stage results, Diff-in-Diff interaction as instrument

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	ASMR	Over65	Over75	ASMR	Over65	Over75	ASMR	Over65	Over75
Total expenditure	-0.010***	-0.019**	-0.025***						
	(0.003)	(0.006)	(0.008)						
Welfare expenditure				-0.141*	-0.265*	-0.348*			
				(0.059)	(0.114)	(0.147)			
Expenditure on elderly							-0.398†	-0.746†	-0.978†
							(0.238)	(0.453)	(0.587)
Observations	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489
Municipalities	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variables in Columns 1-4-7, 2-5-8 and 3-6-9 are, respectively, logged age-standardized mortality rate, logged crude mortality rate among people older than 65 and loged crude mortality rate among people older than 75 (per 100,000). Expenditure variables are expressed in hundred 2015 Euro on a mixed accounting basis. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

5.3 Robustness and placebo checks

Graphical analysis presented in Section 2.2 suggests that municipalities affected by the 2011 reform of the DSP reacted by cutting expenditure rather than by raising taxes. Still, to control for the possibility that the the reform impacted differentially on public health in treated and control municipalities along the revenues side, in Table 5 we present second-stage results for our DDIV where we control for total revenues expressed on a mixed basis of accounting. As one can notice, coefficients on the expenditure variables of interest remain statistically significant (in the case of expenditure on elderly at the 10% level). In Table 6, we present second-stage results controlling for cash transfers from the Central Government. This is to account for the fact that since 2012 the computation of the individual balanced budget requirement for municipalities with population above 5,000 inhabitants was adjusted to account for the large cuts in transfers at the central level provided by Law Decree 78/2010 (smaller municipalities were unaffected by large cuts). Again, our key results remain essentially unaltered. In the Appendix, we provide further evidence that the impact of the DSP reform was not channelled through a change in taxes/transfers by using total revenues as placebo fiscal outcome in place of expenditure. In this case, the analysis delivers non-significant results as of the first stage (Tables B6 and B7). Next, we carry out some placebo tests on the reduced-form based both on time and treatment definition. In Table 7, we restrict the analysis to the 2008-2012 period, setting 2011-2012 as (fictitious) post-reform period. As one can see, coefficients

on *Post*× *Treated* are statistically non-significant across all mortality outcomes.[12] In Table 8, we present results basd on specifications where we set municipalities with population between 5,000 and 10,001 as treatment group. These municipalities were already subject to the DSP before the 2011 reform. As such, they were not confronted with sudden fiscal tightening. We allow for three different control groups: (i) municipalities with population above 10,000 (Columns 1 to 3), (ii) municipalities with population between 10,000 and 50,001 (Columns 4 to 6), and (iii) municipalities with population between 10,000 and 20,001 (Columns 7 to 9). Reassuringly, the difference-in-differences interaction factor is not significant in any of these specifications. These results corroborate our main finding that the spike in mortality experienced by municipalities with population between 1,000 and 5,000 inhabitants are ascribable to the 2011 reform of the DSP.

Table 5: Second-stage results, controlling for total revenues

	(1) ASMR	(2) Over65	(3) Over75	(4) ASMR	(5) Over65	(6) Over75	(7) ASMR	(8) Over65	(9) Over75
Total expenditure	-0.010***	-0.019***	-0.025***						
	(0.003)	(0.005)	(0.007)						
Total Revenues	0.005**	0.010**	0.012**	0.001	0.002†	0.003	0.001	0.002	0.002
	(0.002)	(0.003)	(0.004)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Welfare expenditure				-0.141*	-0.265*	-0.347*			
				(0.058)	(0.113)	(0.146)			
Expenditure on elderly							-0.397†	-0.745†	-0.977†
							(0.237)	(0.451)	(0.584)
Observations	59,488	59,488	59,488	59,488	59,488	59,488	59,488	59,488	59,488
Number of code_munic	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variables in Columns 1-4-7, 2-5-8 and 3-6-9 are, respectively, the logs of age-standardized mortality rate, crude mortality rate among people older than 65 and crude mortality rate among people older than 75, per 100,000. Fiscal outcomes are expressed in hundred 2015 Euro on a mixed accounting basis. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

Table 6: Second-stage results, controlling for cash transfers from the central government

	(1) ASMR	(2) Over65	(3) Over75	(4) ASMR	(5) Over65	(6) Over75	(7) ASMR	(8) Over65	(9) Over75
Total expenditure	-0.010***	-0.019**	-0.025***						
	(0.003)	(0.006)	(0.008)						
Transfers from Central Gov. - cash	-0.000	-0.000	-0.000	0.000	0.000	0.000	-0.000†	-0.000†	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Welfare expenditure				-0.137*	-0.257*	-0.337*			
				(0.056)	(0.108)	(0.139)			
Expenditure on elderly							-0.402†	-0.753	-0.986†
							(0.241)	(0.459)	(0.594)
Observations	59,488	59,488	59,488	59,488	59,488	59,488	59,488	59,488	59,488
Number of code_munic	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variables in Columns 1-4-7, 2-5-8 and 3-6-9 are, respectively, the logs of age-standardized mortality rate, crude mortality rate among people older than 65 and crude mortality rate among people older than 75, per 100,000. Expenditure variables are expressed in hundred 2015 Euro on a mixed accounting basis. Transfers from the central government are expressed in hundred 2015 Euro on a cash accounting basis (accounted only as current revenues). Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

[12] We obtain analogous results, not shown here, setting 2010-2012 as fictitious post-reform period.

Table 7: Placebo test based on time

	(1) ASMR	(2) Over65	(3) Over75
Post x Treated	0.005	0.004	0.003
	(0.006)	(0.006)	(0.006)
Constant	4.652***	6.043***	6.553***
	(0.003)	(0.003)	(0.003)
Observations	37,179	37,299	37,196
Municipalities	7,469	7,469	7,469
Municipality FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Period: 2008-2012. Fictitious pre-reform (2008-2010) and post-reform period (2011-2012). Dependent variables in Columns 1 to 3 are, respectively, age-standardized mortality rate, (crude) mortality rate in the 65+ age group and (crude) mortality rate in the 75+ age group. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

Table 8: Placebo tests based on fake treatment group

	(1) ASMR	(2) Over65	(3) Over75	(4) ASMR	(5) Over65	(6) Over75	(7) ASMR	(8) Over65	(9) Over75
Post x Treated	-0.002	0.003	0.004	-0.003	0.004	0.004	0.000	0.006	0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Constant	4.465***	5.999***	6.550***	4.461***	5.998***	6.549***	4.464***	5.999***	6.549***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Observations	18,377	18,377	18,377	17,285	17,285	17,285	14,411	14,411	14,411
Municipalities	2,353	2,353	2,353	2,221	2,221	2,221	1,870	1,870	1,870
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Period: 2008-2015. Treatment group consists of municipalities with population between 5,000 and 10,000 inhabitants. Control group consists of (i) municipalities with population above 10,000 (Columns 1 to 3), (ii) municipalities with population between 10,000 and 50,001 (Columns 4 to 6), and (iii) municipalities with population between 10,000 and 20,001 (Columns 7 to 9). Dependent variables in Columns 1 to 3 are, respectively, the logs of age-standardized mortality rate, (crude) mortality rate in the 65+ age group and (crude) mortality rate in the 75+ age group (per 100,000). Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

6 Discussion and Conclusions

Before discussing the significance of our findings and future research direction, we review the limitations of our identification strategy. First, the plausibility of the parallel trend assumption in fiscal outcomes is put into question by an emerging differential behaviour in treated- and control-municipalities arising in 2012. As we showed in Figure 1a and Figure 1b, the longer-run rate of decline in both total and welfare expenditure appear reduced in treated-, compared to control-municipalities. One reason for this differential might be that, anticipating the budget cuts expected in 2013 due to the 2012 Budget Law (approved in 2011), administrators in treated municipalities avoided cutting expenses further throughout 2012. This represents a threat to our identification, in the form of a) a break in our parallel trends assumption; and b) an upward bias to our estimates. Second, an additional weakness of our identification rests on the fact that, in our baseline analysis, treatment- and control-groups are very widely defined, as we leverage the full population of Italian municipalities. Restricting around the threshold(s) will allow us to define a more plausible control group. Third, our definition of the treatment itself is rather coarse, as we do not address potential sorting of municipalities across the threshold. On the one hand, this threat is relatively mild, as by virtue of existing DSP rules only municipalities around the 1,000 residents threshold can be expected to have incentives into sorting themselves below the threshold. On the other hand, since we define control- and treatment-group by their population at the start of the period, we are blind to municipality characteristics that might correlated with their position relative to the threshold and our outcomes of interest. Fourth, our approach does not take into account potential compounded treatment effects (due to contextual variations at the thresholds) and thus relies on a strong exclusion restriction. Although the demographic composition of the mortality change at the threshold appears to be conducive to the conclusion that the identified channel is valid, a wider exploration of alternative and contextual potential channels is necessary. Despite

these shortcomings, in this paper we have shown that variations in expenditure, driven by sudden fiscal constraints, appear to be correlated to adverse health outcomes in Italy. Vis-a-vis a large literature in public health, this is the first causal exploration on the health impact of expenditure-based approaches to fiscal consolidation. Importantly, we show that these effects do not appear to impact the population across the board, but have specific effects on certain exposed groups. In the future, we plan to integrate our data with causes of death and mortality by socio-economic status to delve even further into the mechanisms of these differential effects. Our results also suggest that further attention should be devoted to the quality of expenditure cuts, and introduce questions on the taxonomy of preferences of policy-makers externally imposed facing budget cuts. Why did health expenditure for particularly vulnerable categories decrease the most? Did political budget cycles interact with the composition of the reduction in spending? We plan to address these questions in the future.

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Appendix

A Descriptive statistics

Table A1: Descriptive statistics

	Mean	SD	Min	Max	N
Resident Population	7754.66	42806.59	31.00	2.87e+06	59597
Age-standardized mortality rate (per 100,000)	3.16	0.55	2.00	16.37	59597
Over65 mortality rate (per 100,000)	5.44	1.47	1.18	44.14	59597
Over75 mortality rate (per 100,000)	8.27	2.48	1.00	92.67	59597
Total Exp. per capita (mixed basis)	13.51	12.69	2.87	864.98	59491
Welfare Exp. per capita (mixed basis)	1.25	1.53	0.00	52.96	59491
Elderly Exp. per capita (mixed basis)	0.15	0.84	0.00	29.37	59491
Total Rev. per capita (mixed basis)	13.59	13.59	0.72	880.54	59499
Total Transfers Gov. per capita (cash basis)	12265.94	168499.72	0.00	1.84e+07	59499
Income per capita	16780.12	3910.46	5096.84	63894.68	59470
Share of taxpayers income >75,000EUR	0.01	0.01	0.00	0.18	59470

Notes: Period 2008-2015. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

B Regression results

B.1 Reduced-form

Table B2: Reduced form regression results (pre- and post-reform averages)

	(1) ASMR	(2) Over65	(3) Over75
Post x Treated	0.030***	0.094***	0.157***
	(0.007)	(0.023)	(0.040)
Post	0.009	-0.086***	-0.177***
	(0.006)	(0.018)	(0.032)
Treated	-0.024	0.036	0.167
	(0.025)	(0.083)	(0.140)
Constant	1.162***	4.422***	7.190***
	(0.012)	(0.039)	(0.066)
Observations	14,960	14,960	14,960
Number of municipalities	7,496	7,496	7,496
Municipality FE	Yes	Yes	Yes

Periods: 2008-2012 (pre-reform) & 2013-2015 (post-reform). Dependent variables in Columns 1 to 3 are, respectively, the logs of age-standardized mortality rate, (crude) mortality rate in the 65+ age group and (crude) mortality rate in the 75+ age group. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

Table B3: Reduced form regression results (restricting control groups)

	(1) ASMR	(2) Over65	(3) Over75	(4) ASMR	(5) Over65	(6) Over75	(7) ASMR	(8) Over65	(9) Over75
Post x Treated	0.015**	0.018***	0.018***	0.018***	0.019***	0.018**	0.023***	0.019**	0.018**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
Constant	4.655***	6.044***	6.553***	4.666***	6.046***	6.553***	4.690***	6.052***	6.554***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	58,257	58,468	58,290	55,381	55,592	55,414	49,993	50,204	50,026
Municipalities	7,363	7,363	7,363	7,010	7,010	7,010	6,354	6,354	6,354
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Period: 2008-2015. Treatment group consists of municipalities with population between 1,000 and 5,000 inhabitants. Control group consists of (i) municipalities with population below 1,000 and between 5,000 and 50,000 inhabitants (Columns 1 to 3), (ii) municipalities with population below 1,000 and between 5,000 and 20,000 inhabitants (Columns 4 to 6), and (iii) municipalities with population below 1,000 and between 5,000 and 10,000 inhabitants (Columns 7 to 9). Dependent variables in Columns 1 to 3 are, respectively, the logs of age-standardized mortality rate, (crude) mortality rate in the 65+ age group and (crude) mortality rate in the 75+ age group (per 100,000). Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

B.2 Instrumented difference-in-differences

Table B4: Second-stage results, full leads and lags as instruments

	(1) ASMR	(2) Over65	(3) Over75	(4) ASMR	(5) Over65	(6) Over75	(7) ASMR	(8) Over65	(9) Over75
Total expenditure	-0.005**	-0.012**	-0.016**						
	(0.002)	(0.004)	(0.005)						
Welfare expenditure				-0.064*	-0.172**	-0.246**			
				(0.027)	(0.060)	(0.080)			
Expenditure on elderly							-0.245*	-0.556*	-0.777*
							(0.106)	(0.235)	(0.318)
Observations	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489
Municipalities	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variables in Columns 1-4-7, 2-5-8 and 3-6-9 are, respectively, logged age-standardized mortality rate, logged crude mortality rate among people older than 65 and loged crude mortality rate among people older than 75 (per 100,000). Expenditure variables are expressed in hundred 2015 Euro on a mixed accounting basis. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

Table B5: Second-stage results, collapsed leads and lags as instruments

	(1) ASMR	(2) Over65	(3) Over75	(4) ASMR	(5) Over65	(6) Over75	(7) ASMR	(8) Over65	(9) Over75
Total expenditure	-0.010***	-0.019**	-0.024***						
	(0.003)	(0.006)	(0.007)						
Welfare expenditure				-0.142*	-0.297*	-0.393*			
				(0.058)	(0.121)	(0.157)			
Expenditure on elderly							-0.273*	-0.586*	-0.802*
							(0.121)	(0.258)	(0.344)
Observations	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489
Municipalities	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variables in Columns 1-4-7, 2-5-8 and 3-6-9 are, respectively, logged age-standardized mortality rate, logged crude mortality rate among people older than 65 and loged crude mortality rate among people older than 75 (per 100,000). Expenditure variables are expressed in hundred 2015 Euro on a mixed accounting basis. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

B.3 Robustness checks

Table B6: First-stage results (total revenues)

	(1) Total Revenues	(2) Total Revenues	(3) Total Revenues
Post x Treated	6.107		
	(13.385)		
Treated * Pre 2010		-40.607	
		(31.342)	
Treated * 2010		-83.777**	
		(32.109)	
Treated * 2011		-6.372	
		(32.593)	
Treated * 2012		-45.707	
		(30.848)	
Treated * Pre 2013			-43.413
			(29.871)
Treated * 2013		-96.391**	-96.420**
		(37.123)	(37.008)
Treated * 2014		-2.272	-2.297
		(34.057)	(33.909)
Treated * 2015		-7.443	-7.471
		(32.668)	(32.720)
Observations	59,287	59,287	59,287
Municipalities	7,493	7,493	7,493
Municipality FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Kleibergen-Paap stat.	0.2	4.4	4.0
Anderson-Rubin test	10.2**	2.4*	4.2**

Notes: Period: 2008-2015. Dependent variable in Columns 1-3 is total revenues, expressed in hundred 2015 Euro on a mixed accounting basis. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

Table B7: Second-stage results - Diff-in-diff interaction term as instrument (total revenues)

	(1) ASMR	(2) Over65	(3) Over75
Total Revenues	0.376	0.697	0.912
	(2.570)	(4.754)	(6.218)
Observations	59,497	59,497	59,497
Municipalities	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: Dependent variables in Columns 1 to 3 are, respectively, the logs of age-standardized mortality rate, crude mortality rate among people older than 65 and crude mortality rate among people older than 75, per 100,000. Total revenues are expressed in hundred 2015 Euro on a mixed accounting basis and are instrumented using the difference-in-differences interaction term. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

C Heterogeneous effects

C.1 Spatial heterogeneity

In this section, we carry out preliminary analysis of heterogeneous effects. For this purpose, we interact our expenditure variables of interest with a series of potentially moderating factors. In each specification, we instrument the interaction between the expenditure variable and the moderating factor of interest, by interacting the difference-in-difference interaction factor, $PostxTreated$, with the moderating factor itself. We report second-stage results in Tables C8 to C10, including also the minimum and maximum values of the F-statistics for excluded instruments from first-stage regressions, as well as the Kleibergen-Paap and Anderson-Rubin test statistics. We first investigate heterogeneity on a geographical basis. That is, we interact expenditures variables with a dummy, labelled *North*, taking value 1 if the municipality is located in a Northern region.[13] Italy's North is richer and more economically developed than South. In 2017, income per capita in North-Western and North-Eastern regions was respectively 60% and 56% higher than income per capita in Southern regions (Istat, 2018). We therefore expect fiscal tightening to yield less harmful consequences for health in municipalities located in Northern regions as compared to municipalities located in the South. The rationale is that in the former greater availability of private resources may counteract the sudden cut in public expenditure. Second-stage results are reported in Table C8. Coefficients on the interaction between total/ welfare expenditure and the *North* dummy are, indeed, positive (Columns 1 to 6). These results are in line with our expectations that health consequences of the DSP-induced cuts in (welfare) expenditure were less harsh in Northern municipalities as compared to Southern ones. Coefficients on the interaction between elderly expenditure and the *North* dummy are also positive, suggesting that analogous dynamics may be at play. Still, they are imprecisely estimated.

[13]Northern regions are Liguria, Lombardia, Piemonte, Veneto, Emilia-Romagna, Friuli-Venezia Giulia, Trentino-Alto Adige and Valle d'Aosta.

Table C8: Heterogeneity - North vs South

	(1) ASMR	(2) Over65	(3) Over75	(4) ASMR	(5) Over65	(6) Over75	(7) ASMR	(8) Over65	(9) Over75
Total expenditure	-0.014***	-0.029***	-0.037***						
	(0.004)	(0.008)	(0.010)						
Total exp. x North	0.010***	0.026***	0.030***						
	(0.002)	(0.005)	(0.007)						
Welfare expenditure				-0.206*	-0.420*	-0.529*			
				(0.090)	(0.183)	(0.231)			
Welfare exp. x North				0.127*	0.305**	0.358**			
				(0.051)	(0.105)	(0.131)			
Expenditure on elderly							-0.851	-1.791	-2.225
							(0.651)	(1.363)	(1.692)
Welfare exp. x North							0.749	1.725	2.060
							(0.555)	(1.165)	(1.445)
Observations	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489	59,489
Municipalities	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-Stat. Excl. Instr. (Max)	790.8	790.8	790.8	188.0	188.0	188.0	30.1	30.1	30.1
F-Stat. Excl. Instr. (Min)	67.2	67.2	67.2	16.5	16.5	16.5	6.0	6.0	6.0
Kleibergen-Paap stat.	16.0	16.0	16.0	3.3	3.3	3.3	0.9	0.9	0.9
Anderson-Rubin test	17.9***	24.6***	22.1***	17.9***	24.6***	22.1***	17.9***	24.6***	22.1***

Notes: Period: 2008-2015. Second-stage results. Dependent variables in Columns 1-4-7, 2-5-8 and 3-6-9 are, respectively, logged age-standardized mortality rate, logged crude mortality rate among people older than 65 and logged crude mortality rate among people older than 75 (per 100,000). Expenditure variables are expressed in hundred 2015 Euro on a mixed accounting basis. Expenditure variables are instrumented with the difference-in-difference interaction factor, *Post x Treated*. Interactions between expenditure variables and the *North* dummy are instrumented by the interaction between the different-in-difference interaction factor, *PostxTreated*, and the *North* dummy itself. *North* is a dummy taking value 1 if the municipality is located in one of the following regions: . Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

C.2 Income heterogeneity

To better investigate the moderating role of private resources, we interact expenditure variables with income per capita, expressed in thousand 2015 euro, computed at the municipal level. To compute income per capita, we combine population data from Istat with annual data from personal income tax declarations at the municipality level, provided by the Ministry of Economics and Finance. Data include figures on total taxable income and number of taxpayers, as well as a decomposition of total gross income in eight income classes along with the number of taxpayers in the respective income class. As with fiscal outcomes, we consider income at constant 2015 prices. We expect income per capita to have a protective effect on public health in the event of sudden, negative fiscal shocks, as citizens may recur to private resources to compensate for the drop in public expenditure. We report second-stage results in Table C9. Coefficients on the interaction terms between income per capita and our expenditure variables are, indeed, positive across all specifications, albeit imprecisely estimated in some cases. Specifically, there is evidence that municipalities with higher income per capita are partially shielded from cuts in total and welfare expenditure, at least when it comes to mortality among old people (Columns 2 and 3, and 5 and 6). Instead, coefficients on interaction terms between income per capita and expenditure on elderly people are never statistically significant (Columns 7 to 9). Along the same line of reasoning, we interact our expenditure variables with the share of taxpayers in the top two income brackets (annual income $> 75,000$ euro), measured at the municipal level, that that we label *Share of rich*. Second-stage results are reported in Table C10. As one can see, estimated coefficients on the interaction between expenditure variables and the share of rich taxpayers are always positive and statistically significant at least at the 10% level in all specifications but in one case (Column 7). These results provide evidence that cuts in expenditure, notably in welfare and elderly expenditure, are essentially inconsequential in terms of public health in municipalities characterized by a relatively affluent citizenry. Also in this case, we link our findings to the availability of private resources to cope with the unexpected reduction in publicly provided social services.

Table C9: Heterogeneity - Income per capita

	(1) ASMR	(2) Over65	(3) Over75	(4) ASMR	(5) Over65	(6) Over75	(7) ASMR	(8) Over65	(9) Over75
Total exp	-0.026*	-0.071*	-0.088*						
	(0.012)	(0.028)	(0.035)						
Total exp x Income pc	0.001†	0.002*	0.003*						
	(0.000)	(0.001)	(0.001)						
Welfare exp				-0.403	-1.004†	-1.271†			
				(0.264)	(0.582)	(0.742)			
Welfare exp x Income pc				0.013	0.038†	0.047†			
				(0.010)	(0.022)	(0.028)			
Elderly exp							-1.494	-4.166	-5.195
							(1.308)	(3.001)	(3.810)
Elderly exp. x Income pc							0.069	0.215	0.265
							(0.066)	(0.152)	(0.192)
Income per capita	-0.028***	-0.072***	-0.080***	-0.034**	-0.079**	-0.090**	-0.026***	-0.054***	-0.059***
	(0.006)	(0.016)	(0.019)	(0.011)	(0.025)	(0.032)	(0.006)	(0.014)	(0.017)
Observations	59,363	59,363	59,363	59,363	59,363	59,363	59,363	59,363	59,363
Municipalities	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-Stat. Excl. Instr. (Max)	88.9	88.9	88.9	42.1	42.1	42.1	6.2	6.2	6.2
F-Stat. Excl. Instr. (Min)	63.2	63.2	63.2	23.1	23.1	23.1	5.0	5.0	5.0
Kleibergen-Paap stat.	5.1	5.1	5.1	1.7	1.7	1.7	0.9	0.9	0.9
Anderson-Rubin test	9.8***	12.2***	12.7***	9.8***	12.2***	12.7***	9.8***	12.2***	12.7***

Notes: Period: 2008-2015. Second-stage results. Dependent variables in Columns 1-4-7, 2-5-8 and 3-6-9 are, respectively, logged age-standardized mortality rate, logged crude mortality rate among people older than 65 and loged crude mortality rate among people older than 75 (per 100,000). Expenditure variables are expressed in hundred 2015 Euro on a mixed accounting basis. Income per capita is expressed in thousand 2015 Euro (negative income excluded from computation). Expenditure variables are instrumented with the difference-in-difference interaction factor, *Post x Treated*. Interactions between expenditure variables and the income per capita are instrumented by the interaction between the different-in-difference interaction factor, *PostxTreated*, and income per capita. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.

Table C10: Heterogeneity - Share of rich taxpayers

	(1) ASMR	(2) Over65	(3) Over75	(4) ASMR	(5) Over65	(6) Over75	(7) ASMR	(8) Over65	(9) Over75
Tot. Exp.	-0.012***	-0.024**	-0.032***						
	(0.004)	(0.007)	(0.009)						
Tot. Exp. x Share of rich	0.077†	0.196†	0.253†						
	(0.043)	(0.114)	(0.143)						
Welf. exp.				-0.174*	-0.346*	-0.457*			
				(0.077)	(0.154)	(0.200)			
Welf. x Share of rich				2.384*	6.105*	7.906*			
				(1.168)	(2.651)	(3.326)			
Exp. on elderly							-0.528	-1.115	-1.464
							(0.339)	(0.695)	(0.906)
Exp. on elderly x Share of Rich							11.487	33.949†	43.574†
							(8.177)	(18.333)	(23.382)
Share of rich	-4.009***	-11.060***	-14.052***	-3.604**	-10.114***	-12.819***	-2.398†	-7.452**	-9.335**
	(1.004)	(2.115)	(2.663)	(1.344)	(2.786)	(3.544)	(1.302)	(2.665)	(3.480)
Observations	59,363	59,363	59,363	59,363	59,363	59,363	59,363	59,363	59,363
Number of code_munic	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494	7,494
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-Stat Excl. Instr. (Max)	30.5	30.5	30.5	11.8	11.8	11.8	3.9	3.9	3.9
F-Stat Excl. Instr. (Min)	8.1	8.1	8.1	6.2	6.2	6.2	2.2	2.2	2.2
Kleibergen-Paap stat.	13.9	13.9	13.9	3.4	3.4	3.4	1.3	1.3	1.3
Anderson-Rubin test	12.1***	14.9***	17.6***	12.1***	14.9***	17.6***	12.1***	14.9***	17.6***

Notes: Period: 2008-2015. Second-stage results. Dependent variables in Columns 1-4-7, 2-5-8 and 3-6-9 are, respectively, logged age-standardized mortality rate, logged crude mortality rate among people older than 65 and loged crude mortality rate among people older than 75 (per 100,000). Expenditure variables are expressed in hundred 2015 Euro on a mixed accounting basis. *Share of rich* measures the share of taxpayers in the top two income brackets (annual income above 75,000 euro). Expenditure variables are instrumented with the difference-in-difference interaction factor, *Post x Treated*. Interactions between expenditure variables and the share of rich taxpayers are instrumented by the interaction between the different-in-difference interaction factor, *PostxTreated*, and the share of rich taxpayers. Robust standard errors clustered at the municipality level in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Municipalities from the three special autonomous regions of Valle d'Aosta, Trentino Alto-Adige and Friuli-Venezia Giulia are excluded.