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APRIL 2025

ISSN: 2365-9793

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ABSTRACT

The Impact of Austerity on Mortality and Life Expectancy*

This paper studies the impact of austerity measures implemented by the UK government after 2010 on life expectancy and mortality. We combine administrative data sources to create a panel dataset spanning from 2002 to 2019. Using a difference-in-differences strategy, we estimate the effect of cuts to welfare benefits and changes in health expenditure on life expectancy and mortality rates. Our findings indicate that these austerity measures reduced life expectancy by 2.5 to 5 months by 2019. Women were nearly twice as affected as men. The primary driver of this trend is cuts to welfare benefits, although healthcare spending changes have a larger effect per pound spent. The results suggest that austerity policies caused a three-year setback in life expectancy progress between 2010 and 2019. This is equivalent to about 190,000 excess deaths, or 3 percent of all deaths. Taking into account the years of life lost, we conclude that the costs of austerity significantly exceeded the benefits derived from reduced public expenditure.

JEL Classification: H53, I18, I38, P16

Keywords: austerity, political economy, public economics, public health, welfare programs

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* We wish to thank David Cutler, Sherry Glied, Nathan Hendren, Adriana Lleras-Muney, Johannes Spinnewijn and Pierre-Louis Vézina for helpful comments and suggestions, along with seminar participants at FAIR/Norwegian School of Economics, King's College London, London School of Economics, Princeton University, University College London, University of Bristol, and the University of Exeter, and with conference participants at the 2024 NICEP Conference, the Annual Congress of the International Institute of Public Finance, the NBER Determinants of Mortality Spring 2025 Meeting, and the Policy Impacts Annual Conference. We thank KCL KURF for financial support.

1 Introduction

For decades, life expectancy in the United Kingdom and other high-income countries rose steadily, reflecting sustained improvements in healthcare, living conditions, and socioeconomic factors. However, this trend slowed markedly in the 2010s. In the United Kingdom, between 1999 and 2010, male life expectancy increased by an average of 3.7 months per year, while female life expectancy grew by 2.7 months per year. After 2010, however, the growth rate dropped to roughly one-third of these previous levels, with male and female life expectancy gains declining to about 1.2 and 0.9 months per year, respectively. As illustrated in the left panel of Figure 1, this shift raises critical questions about the economic, healthcare, and policy factors contributing to the observed slowdown in life expectancy improvements.

In 2010, following the global financial crisis and the UK general election, the British government implemented a contractionary fiscal policy by adopting an austerity program. Prior to this, between 1999 and 2010, real public expenditure per capita on health, education and social protection increased by 35 percent to 75 percent. In contrast, between 2010 and 2018 expenditures decreased (in the case of education and social protection) or remained flat (in health). This is shown in the right panel of Figure 1. The slowdown in life expectancy improvement during the post-2010 period, coinciding with these reductions in public expenditure, suggests that austerity measures may have led to increased mortality and contributed to the slow improvement in life expectancy.

This paper provides evidence that the austerity-induced cuts in welfare and changes in healthcare spending are important drivers of the slowdown in life expectancy after 2010. These cuts resulted in a decrease of 2.5 to 5 months in life expectancy by 2019, with women experiencing an impact twice as large as that on men. Between 2010 and 2019, austerity measures caused a three-year setback in life expectancy progress, equivalent to about 190,000 excess deaths, or 3 percent of all deaths.

We proceed as follows. First, we build a comprehensive dataset that combines administrative data on life expectancy and mortality with data on public spending at the local-authority district level. We then present a set of observations that highlight how life expectancy changed in the United Kingdom from 2002 to 2019. This period captures both the years before the introduction of austerity measures in 2010 and the years following their full implementation.[1]

We show that while most districts in the United Kingdom experienced a rise in life expectancy between 2002 and 2019, the extent of these increases varied significantly. Some areas achieved

[1] The paper stops at 2019 to avoid the strong effects of the COVID-19 pandemic on life expectancy and the complex policy responses to it.

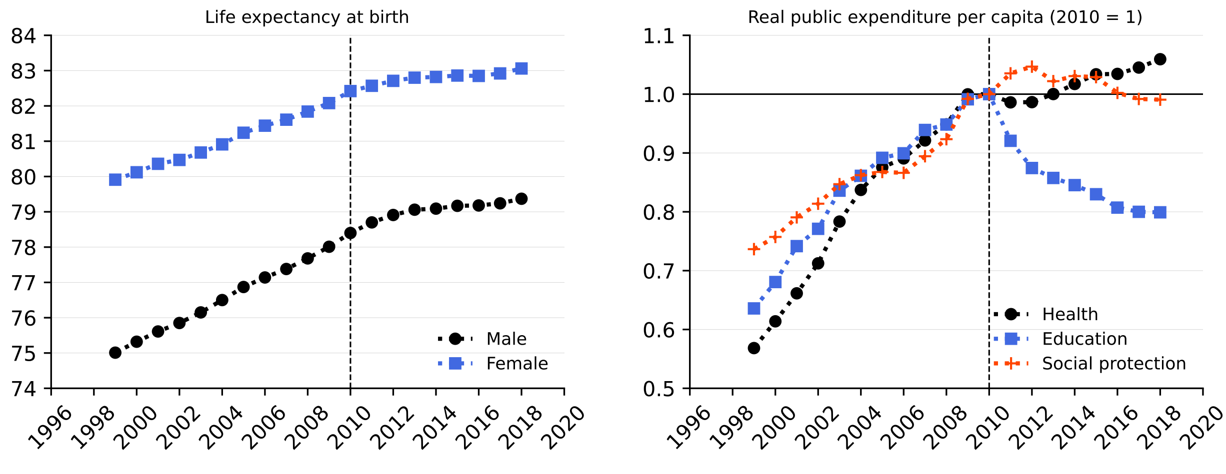

Figure 1: The evolution of life expectancy and public expenditure in the United Kingdom, 1999–2018.

Notes: Left) Male and female life expectancy at birth in the United Kingdom (source: Office for National Statistics (2021)); Right) UK-government real public expenditure per capita on health, education and social protection (normalized to 1 at 2010) (source: His Majesty's Treasury (2023)).

substantial gains, while others stagnated or even experienced declines. This led to a widening gap in life expectancy between districts, which only emerged after 2010. Similarly, we find a growing gap in overall mortality between these districts, again, only after 2010.

What caused the widening gap in life expectancy and mortality between districts after 2010? We show that the implementation of austerity measures after 2010, particularly welfare and healthcare reforms enacted between 2010 and 2015, substantially increased mortality rates and slowed down life expectancy growth.

Starting in 2010, the Conservative-led government's substantial fiscal contraction led to a per capita reduction of approximately 16 percent in aggregate real spending on welfare and social protection. At the district level, there was a 23.4 percent decline in real per-person welfare spending from 2010 to 2015. The magnitude of these reductions was highly heterogeneous across districts, spanning from 6.2 percent to 46.3 percent (equivalent to a 0.5 to 5 percent reduction relative to the district-average pay) (Innes and Tetlow, 2015; Fetzer, 2019).

Additionally, there were large regional disparities in real changes to public healthcare spending between 2010 and 2015. Despite a marginal overall change in spending per person, the variations across regions are notable, with Greater London seeing a £3 increase per person per year, and the North East experiencing a £9 decrease per person per year.

As described, we show that life expectancy increased slowly or decreased in areas with significant exposure to the cuts in welfare benefits after their implementation. Between

2002 and 2010, *i.e.*, before austerity measures were implemented, the average gap in life expectancy between the more austerity-exposed areas to the less exposed areas was stable at about 1.6 years at birth. Between 2010 and 2019, the gap had persistently grown to 1.9 years, a 19 percent increase, or 3.6 months in life expectancy at birth.[2]

The results provide a comparison between the impact of different fiscal measures on mortality outcomes. Notably, the overall decline in life expectancy resulting from reductions in welfare benefits was found to be much larger than that attributable to changes in healthcare spending. Yet, when considering the per-pound effect, healthcare spending had a much larger effect compared with the welfare benefit cuts.

These findings may represent a conservative estimate. Our analysis finds no statistically significant direct effects on mortality from cuts in public expenditure on education, police, infrastructure, and other services by 2019. However, these cuts may have latent effects. Specifically, reductions in education spending and changes in nutrition and lifestyle induced by austerity could plausibly have significant implications for mortality over an extended horizon, potentially spanning several decades. To address these issues, we study the impact of austerity on additional health outcomes – the prevalence of diabetes and child obesity – and find that austerity had a significant effect on both, with a particularly pronounced impact on child obesity.

Moreover, the adverse effects of reductions in welfare and healthcare expenditures on life expectancy intensified progressively from 2011 to 2019. This implies that the impact of austerity measures on mortality extends beyond the period of 2011–2019. It has a lasting effect that requires continued attention. This influence could also be relevant for recent public health crises, such as the COVID-19 pandemic. Furthermore, Fetzer (2019) showed that austerity contributed to Brexit, which in turn may have had adverse health impacts, potentially exacerbating the negative impact of austerity on life expectancy.[3]

Austerity measures also widened the disparities in life expectancy. The areas that were most reliant on welfare benefits, and therefore more exposed to the cuts, are also relatively poorer than the less-exposed areas. Their baseline life expectancy before 2010 was already lower than that of the areas least-exposed to cuts. Therefore, in addition to direct impact on mortality, austerity measures have increased inequality in health outcomes. Regions that

[2] In this calculation, more-exposed (less-exposed) areas are defined as areas with impact higher (lower) than the median exposure to the austerity measures (see Section 2).

[3] While a comprehensive analysis of how austerity measures affected specifically COVID-19 mortality and how Brexit affected overall mortality exceeds this paper's scope, we briefly address Brexit in Appendix A. We demonstrate that our identified austerity effects are not driven by a potential Brexit-related effect on mortality.

both suffered the most in life expectancy and were highly impacted by austerity include the North East of England, South Wales, and the Glasgow City Region.

We also study the causes of increased mortality brought about by austerity measures. Changes in healthcare spending and welfare cuts caused an increase in drug-poisoning deaths. These measures account for approximately 9,000 "preventable deaths" that would not have occurred in the absence of austerity, representing about 27 percent of all drug-poisoning deaths during the relevant period in England and Wales. Additionally, changes in healthcare spending led to a decline in the quality of ambulance response. This decline led to 4,000 fewer emergency calls per year where ambulances arrived within 19 minutes, placing tens of thousands of people at high risk of mortality over the past decade.

This paper is related to several strands in the literature. First, it highlights the substantial impact of austerity measures, and in particular cuts in welfare benefits and healthcare spending, on the slowdown of life expectancy growth in the United Kingdom. This adds to previous work on the topic. For example, in a recent paper, which served as the basis for a debate on the topic in the House of Lords (Scott, 2023), Walsh et al. (2022) found that "approximately 335,000 more deaths occurred between 2012 and 2019 than was expected based on previous trends, with the excess greater among men." Yet, this estimate is based on an extrapolation from trends preceding the onset of austerity measures. It may overestimate the actual contribution of austerity measures to mortality, and takes into account overall changes in longevity that occurred at the time, and in particular the slower improvements in cardiovascular disease (CVD) mortality (Mehta, Abrams and Myrskylä, 2020; Cheema et al., 2022).[4]

The literature on the health impacts of austerity measures has been growing over the past decade. Rajmil and Fernández de Sanmamed (2019), for example, found that countries with moderate austerity measures experienced an additional mortality rate of 40.2 deaths per 100,000 people annually compared to nations with low austerity by 2015. Toffolutti and Suhrcke (2019) showed that after adjusting for the impact of recession, austerity programs are linked to a 0.7 percent rise in death rates. van der Wel et al. (2018) found that austerity measures were associated with increasing disparities in individuals' perceptions of their health, and that this association grew stronger over time. Moreover, a study by Loopstra et al. (2016) attempted to differentiate the impacts of cuts in pension credits and social care among the older population. They showed that a reduction of 1 percent in spending on pension credit resulted in a 0.65 percent increase in death rates among individuals aged 85

[4]In Appendix A we address this issue and show that the excess deaths identified as caused by austerity measures are unlikely to be more accurately identified as CVD-related excess deaths.

and older. Additional similar papers include Stuckler et al. (2017); Dorling (2019); Alexiou et al. (2021); Crawford, Stoye and Zaranko (2021); McCartney et al. (2022); Seaman et al. (2024).

There are two main gaps in this literature that the current paper aims to fill. First, the paper improves the quality of identification. It advances the empirical design used in the literature to date by more accurately addressing the direct impact of austerity measures on mortality and life expectancy through a quasi-experimental design. Second, the paper discusses the impact of different austerity measures, enabling comparison without needing to bundle them together. It also offers a longer time frame than most previous studies on the topic by using data from 2002 to 2019.

Other studies have focused more on specific mortalities associated with austerity measures. For example, Friebel, Yoo and Maynou (2022) explored the relationship between opioid abuse and austerity. They found that an increase in total local expenditure on public services leads to a significant decrease in opioid-related hospital admissions. Their results emphasized the link between unemployment and opioid-related deaths, noting that a 10 percent increase in unemployment significantly raises opioid-related deaths. Also, they found that higher total local expenditure mitigates this negative effect. These results are in line with ours, which highlight the significance of drug-poisoning deaths as a result of austerity measures.

Another strand of literature has been dedicated to exploring other effects of austerity. Fetzer, Sen and Souza (2023) showed that austerity-related cuts in housing benefits increased homelessness by 6.4 percent and rough sleeping by 41.3 percent. In a seminal earlier paper, Fetzer (2019) studied the relationship between austerity-induced cuts in welfare payments and support for Brexit. He showed that the "EU referendum could have resulted in a Remain victory had it not been for austerity." We build upon and expand the methodology used in these papers, contributing to this strand of literature.

The paper also contributes to the literature on the impact of public spending, particularly in terms of the Marginal Value of Public Funds (MVPF) (Hendren and Sprung-Keyser, 2020, 2022). MVPF is a unified method of assessing the impact of policy changes on social welfare. A reduction or slower growth in public spending on healthcare and social protection is expected to slow the rate of increase in life expectancy. Access to better healthcare and the ability to afford a healthier lifestyle would influence mortality. However, from the perspective of optimizing welfare gains from government spending, it is possible that the marginal welfare gain from an additional pound spent on healthcare is lower than if allocated to other public services. Therefore, in addition to establishing a clear link between austerity measures and their effects on life expectancy and mortality, we translate the findings into the MVPF framework. This allows us to compare the results to other public policies. Taking into account the years of life lost, we conclude that the costs of austerity significantly exceeded the benefits derived from reduced public expenditure.

Recent work using the MVPF framework on UK austerity showed that austerity-driven closures of police stations in London "produced considerable distributional and efficiency losses, and generated costs that substantially outweigh the benefits in terms of lower public expenditure for the criminal justice system" (Facchetti, 2024). Similarly, Villa (2024) found that youth club closures in London increased youth crime, with every £1 saved leading to nearly £3 in losses from foregone educational returns and crime costs. These results are in line with our findings.

The paper contributes to the discourse surrounding the overall slowdown of life expectancy growth. In the United States, for example, "Deaths of Despair" (Case and Deaton, 2020, 2021) – from suicide, drug overdose, and alcoholism – have been identified as major contributing factors. However, their role in the overall slowdown of life expectancy growth is thought to be lower than that of the "stagnating decline in cardiovascular disease mortality" (Mehta, Abrams and Myrskylä, 2020). Our results show that a rise in deaths of despair has also occurred in Britain, and that a significant part of this increase could be attributed to austerity measures.

Finally, the paper also adds to recent work on the mortality and welfare outcomes of the Great Recession (Finkelstein et al., 2024), which largely coincides with the period considered in our context. Importantly, Finkelstein et al. (2024) find that the recession led to reduced mortality in the United States, primarily due to lower air pollution. These results, consistent with the seminal findings of Ruhm (2000), suggest that the increased mortality and reduced life expectancy we observe are unlikely to be driven by the income and unemployment shocks associated with the recession that preceded the implementation of austerity measures.[5]

The rest of the paper is organized as follows. Section 2 outlines the institutional background and describes the data. Section 3 details the empirical strategy and presents the main findings. Section 4 examines the role of drug-poisoning deaths and ambulance response quality in the observed rise in mortality associated with austerity measures, as well as impacts on other health outcomes. Finally, Section 5 concludes.

[5] See Appendix A. There is no correlation between the recession shock and the austerity shock across local authorities. Thus, even under the assumption that the recession had an effect on mortality, it would not interact with our treatment. We also verify this by jointly controlling for the austerity shock and the unemployment shock caused by the recession. Furthermore, a recent study shows that pollution levels in England during the relevant period exhibited no clear differential trends across regions that interact with austerity (Gadenne et al., 2024).

2 Context and data

2.1 Mortality and life expectancy in the United Kingdom

The key motivation for the paper is to better understand the evolution of life expectancy and mortality in the United Kingdom. Figure 1 above showed a clear slowdown in life expectancy improvement after 2010.[6]

This national-level stagnation conceals significant regional disparities in life expectancy. Southern England, as well as parts of Northern England, enjoy high life expectancy, nearing 90 (85) years for females (males) at birth. In contrast, many deprived areas, particularly in England and Scotland, suffer from poor health, with female (male) life expectancy as low as 78 (73) years at birth. The regional variation in life expectancy is presented in the left panel of Figure 2. The data are based on Office for National Statistics (2021) publications, and are reported at the local-authority district level. There are 382 local authorities in the United Kingdom, which are the main municipal unit in the country, and are the main unit of observation used in this paper.[7]

In addition to differences in baseline life expectancy, UK districts experienced large variation in life expectancy improvement in the past decades. The right panel of Figure 2 illustrates the change in female life expectancy at birth across local authorities between 2010 and 2019. They are only weakly correlated with the 2010 baseline levels ($\rho = 0.22$, $R^2 = 0.05$ for females; $\rho = 0.07$, $R^2 < 0.01$ for males).

The large regional variation, as well as the different trajectories of life expectancy over time across local authorities are useful for testing whether austerity had an effect on life expectancy and mortality. To conduct these tests, it is necessary to measure the regional variation in exposure to austerity.

2.2 Measuring the impact of austerity

The Conservative-led coalition assumed power after the May 2010 general election, and in the midst of an economic crisis. The newly-formed government instituted extensive austerity measures. They were aimed at drastically reducing government spending and limiting public debt.

[6] This trend can also be observed in the increase in crude mortality rates in the United Kingdom over the period 2010–2019. Appendix A provides these crude mortality trends.

[7] For data availability reasons, the inclusion of Northern Ireland in the dataset requires treating it as a single local authority, making it the most populated local authority in the dataset.

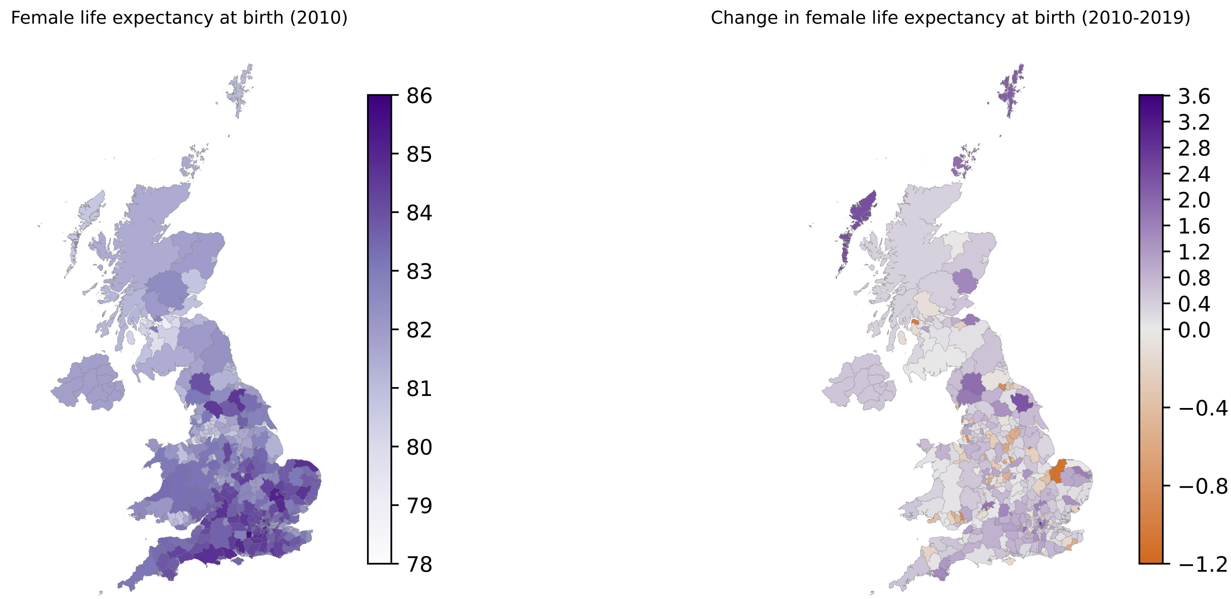

Figure 2: Geographic variation in life expectancy in the United Kingdom.

Notes: Left) Female life expectancy at birth in 2010 by local authority; Right) The change (measured in years) in female life expectancy at birth between 2010 and 2019 by local authority.

Austerity measures involved widespread reductions in expenditures across all spending categories. As shown in the right panel of Figure 1, real public spending per capita substantially decreased in education and essentially remained flat in health. Healthcare expenditures were not directly cut; they leveled off even as demands on health services rose due to an aging and growing population.

The government implemented a complex strategy to reduce expenditures. First, the 2010 budget created an immediate impact by introducing cuts to day-to-day spending in most government departments (Innes and Tetlow, 2015). Second, nominal freezes were implemented. Specifically, salaries for public-sector employees earning over £21,000 were frozen from 2011 to 2013. Then, a cap on wage growth at 1 percent was put in place from 2014 onwards. Similar freezes were instituted for most welfare benefits, leading to effective real-term cuts, as inflation averaged 1.8 percent over this time period.

The third and key part of austerity was a major welfare reform initiated by the Welfare Reform Act 2012. Beatty and Fothergill (2014) detail pre-reform data on the distribution of claimants across various benefit categories and calculate the total impact of the reform on the total saving on welfare spending per working-age adult. We use these data to estimate the incidence of different welfare cuts at the local-authority level.

The calculation presented by Beatty and Fothergill (2014) is based on 10 welfare-related austerity measures.[8] It relies on official statistics, combining data from the UK Treasury's estimates of expected savings, government impact assessments, and benefit claimant information. Using these data, we define exposure to the welfare reform as the real monetary loss in benefits per working-age adult per year in each local authority.

The left panel of Figure 3 shows the exposure to the welfare reform (which we consider as *total welfare impact*) as calculated by Beatty and Fothergill (2014). It displays significant geographical variation, driven by the uneven distribution of benefit claimants across the United Kingdom before the reforms. The overall annual monetary loss per working-age adult ranged between £914 in Blackpool and £177 in the City of London. As a share of district-level average worker's pay, these reductions varied across local authorities, ranging from an annual reduction of 0.5 to 5 percent.

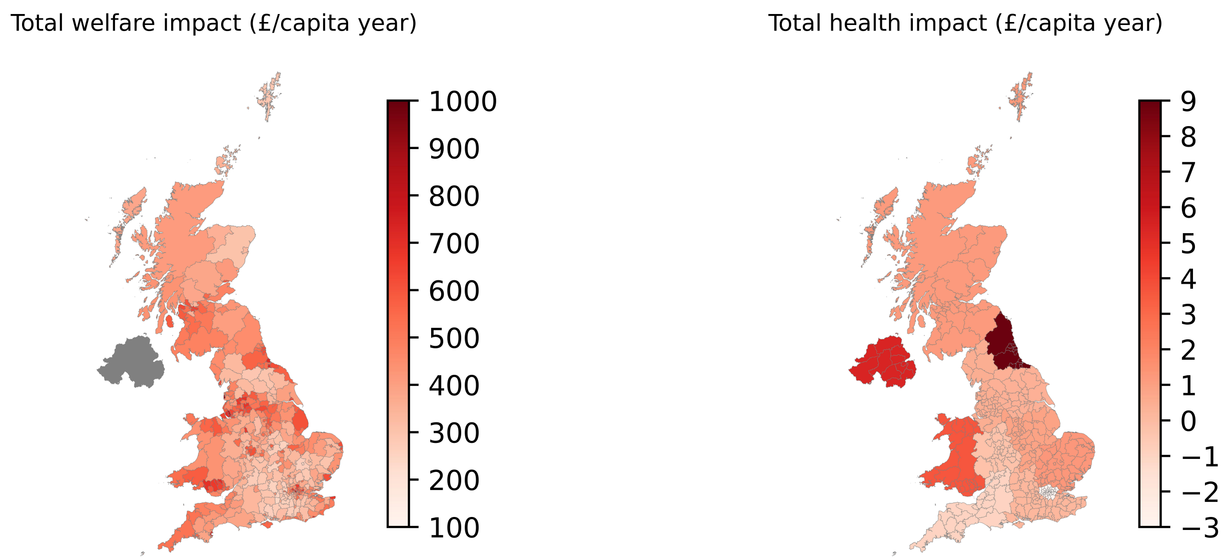

Figure 3: The distribution of austerity shocks across local authority districts in the United Kingdom.

Notes: Left) Total welfare impact – the average decline in welfare benefits per working-age adult per year by 2015 (no information available for Northern Ireland in Beatty and Fothergill (2014)); Right) Total health impact – the average decline in real healthcare spending per person per year between 2010 and 2015.

In addition to significant welfare reforms, austerity measures led to reductions in many public services, including education, policing, and public transportation. Although expenditure on these services varies across local authorities, fully redistributing funds at that level is

[8]These include changes to Local Housing Allowance (LHA), underoccupation or bedroom tax, non-dependant deductions, household benefit cap, council tax benefit disability living allowance, incapacity benefit, child benefit, tax credits, 1 percent uprating.

impractical, as spending typically occurs at broader geographic scales, such as counties or regions. To address this, the UK Treasury offers a detailed breakdown of spending by region (His Majesty's Treasury, 2023). There are 12 regions in the United Kingdom: 9 regions in England (North East, North West, Yorkshire and the Humber, East Midlands, West Midlands, East of England, London, South East, South West), Northern Ireland, Scotland, and Wales. Each region is divided into local authority districts, which is the main unit of observation, as discussed above.

We measure regional exposure to austerity in services similarly to the total welfare impact. Specifically, we consider the decrease in average spending on service s between 2010 and 2015. Thus, we define:

$$A_{r,s} = \frac{E_{r,s,2010}}{N_{r,2010}} - \frac{E_{r,s,2015}}{N_{r,2015}}\,, \tag{2.1}$$

where $E_{r,s,t}$ is the real total spending in region r on service s in year t, and $N_{r,t}$ is the population in region r and year t. The categories of services are: general services, public order, economic affairs, housing and community, health, education, and social protection. We consider the various categories both separately and combined. Yet, the most relevant to mortality and life expectancy, in addition to the major welfare reform, is healthcare spending.[9]

Our focus is on the exposure to changes in healthcare spending. Therefore, we consider the age composition of each region, as it can greatly influence the population's experience of spending cuts. For example, a reduction of one pound per person would have a smaller impact on a younger population than on an older population. To address this, we define the preferred treatment $A_{r,s}$ as weighted by the inverse of the working-age population in each region in 2010. This approach ensures that regions with a higher working-age population have relatively lower exposure compared to those with a smaller working-age population.[10]

The right panel of Figure 3 shows the exposure to changes in health spending by region ($A_{r,HEALTH}$, or *total health impact*). It shows large geographical variation in healthcare spending. In some regions, such as London, real annual spending per adult increased be-

[9]Exposure to police budget spending changes can also be estimated. This can be done in a finer geographical resolution than the regional. The local authority districts are divided into 44 police force areas, for which the annual spending by the UK government is detailed in the Police Grant Reports by the Home Office (UK Home Office, 2023). Each local authority is fully contained within a police force area, which in turn is fully contained within a region. This makes the police grant data compatible with the data described so far. Appendix A discusses this estimation.

[10]In Appendix A, we explore alternative definitions of the health treatment to verify that our results remain robust across different specifications. By demonstrating that the findings are not sensitive to how the treatment is defined, these variations help alleviate concerns about endogeneity arising from the fact that the treatment reflects realized (rather than only planned) changes in healthcare spending.

tween 2010 and 2015. In others, such as Northern Ireland and the North East, it decreased substantially. Figure 3 also shows that, as discussed above, the overall magnitude of the welfare reform was much larger than that of the changes in healthcare spending. The average British person lost £473 per year in benefits by 2015, and was exposed to a real reduction of only £0.59 in healthcare spending per year.

There exists a weak correlation between the total welfare impact and the total health impact. At the regional level, a positive correlation between the two austerity shocks emerges, however, this correlation disappears when outliers are excluded, and proves statistically insignificant, as illustrated in Figure 4.

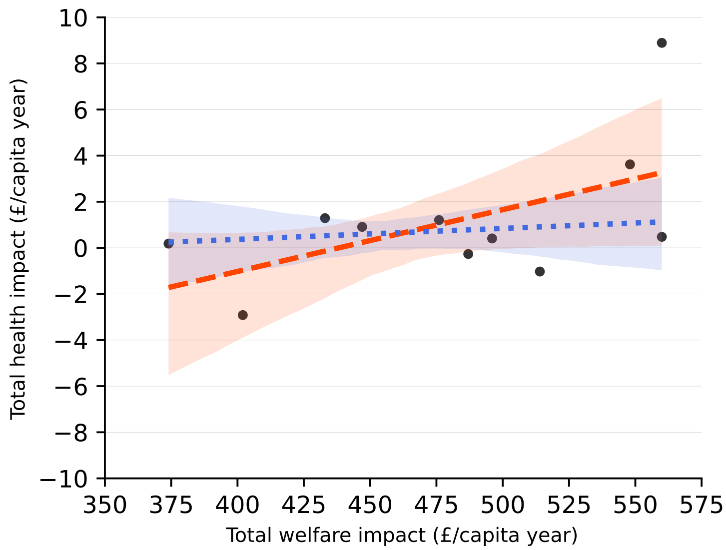

Figure 4: The association between total welfare impact and total health impact in the regional level.

Notes: The chart uses region-level averaged total welfare impact (Beatty and Fothergill, 2014) and the estimated total health impact. The chart excludes data for Northern Ireland, for which total welfare impact data are unavailable. The shaded areas represent 95 percent confidence intervals to the linear fits. The dotted linear fit excludes top and bottom outliers.

In addition to the information on life expectancy, and exposure to austerity measures, we use data on unemployment, average worker's pay, population, in- and out-migration and drug poisoning mortality rates by local authority. These are available from multiple datasets published by the Office for National Statistics (2023). We compile all the information described into a large panel dataset, which comprises of all local authority districts in the United Kingdom, covering the years 2002 to 2019. This now allows for addressing various questions related to the impact of austerity on life expectancy and mortality. Descriptive statistics of key variables in the dataset are presented in Appendix B.

3 Results

3.1 Empirical strategy

After constructing the dataset, the next step involves designing an appropriate empirical strategy. The key approach is using the large geographical variation in exposure to various austerity measures, alongside the variation in life expectancy and mortality. Given that austerity measures were primarily implemented between 2010 and 2015, and our dataset covers the years 2002 to 2019, we can employ a difference-in-differences design.

We make use of two main specifications. The first is a dynamic "event-study" design, which takes the following form:[11]

$$y_{i,r,t} = \alpha_i + \theta_{r,t} + \sum_{t \neq 2010} \delta_t \times Year_t \times Austerity_{i,j} + \mathbf{x}_{i,t}\beta + \epsilon_{i,r,t} \,, \qquad (3.1)$$

where $y_{i,r,t}$ denotes life expectancy (or mortality rate). $Austerity_{i,j}$ denotes the exposure of unit i to austerity measure j, which may be defined in terms of total welfare impact, total health impact, or another relevant metric of austerity exposure. The fixed effect α_i absorbs any time-invariant differences in the outcome variable across local authorities. Region-by-year fixed effects $\theta_{r,t}$ capture time trends specific to each of the regions across the United Kingdom. $\mathbf{x}_{i,t}$ are control variables. Standard errors are clustered at the local-authority level. The main coefficients of interest are the interaction terms (δ_t) between austerity measure j and a set of year dummies. This allows us to estimate the treatment effect dynamically, as well as testing for pre-trends.

In the case of the total health impact the treatment is by region. Thus, we replace r in Equation (3.1) from being a region to being either England if the local authority is in England, or other, if the local authority is in Scotland, Wales, or Northern Ireland. We discuss the sensitivity to these differences in Appendix A.

The second specification is a pooled difference-in-differences design that takes the following form:

$$y_{i,r,t} = \alpha_i + \theta_{r,t} + \delta \times \mathbf{1}_{t>2010}\,(t) \times Austerity_{i,j} + \mathbf{x}_{i,t}\beta + \epsilon_{i,r,t} \,. \qquad (3.2)$$

The main coefficient of interest is δ, which captures changes in the outcome variable $y_{i,r,t}$ following the exposure of unit i to austerity measure j. The pooled difference-in-differences specification allows estimation of the overall effect of each austerity measure on mortality

[11]This assumes that all units, *i.e.*, local authorities, are treated at the same time. This follows, in a similar context, from Fetzer (2019).

and life expectancy.

This design, including both specifications, follows closely Fetzer (2019), who used a similar strategy to estimate the effect of austerity on the support for Brexit. We expand it by using additional treatments to account for different austerity measures. Importantly, this allows a comparison of the effect that different austerity measures had on life expectancy both overall, but also per pound. This will also be used to estimate the marginal value of public funds (MVPF) of the welfare and health treatments.

The empirical design assumes that the exposure of local authorities to austerity measures does not vary in a way that is correlated with unobservables. Justification for these assumptions is discussed in detail in Fetzer (2019) and Fetzer, Sen and Souza (2023). A specific potential concern is if life expectancy increased more slowly due to slow improvements in cardiovascular disease mortality and if this effect is particularly observed in areas that are also more exposed to austerity measures, but not as a result of the austerity measures themselves. We address this concern in Appendix A. In addition, Equation (3.1) and Equation (3.2) incorporate continuous treatments. This implicitly requires strong parallel trends assumptions for the correct interpretation of the resulting coefficients (Callaway, Goodman-Bacon and Sant'Anna, 2024). To alleviate this as a concern to our results, we study alternative binary treatments in Appendix A.[12]

3.2 The welfare reform effect on life expectancy

We first consider the effect of the welfare reform.

The results from the pooled difference-in-differences analysis (Equation (3.2)) are presented in Table 1. The point estimates indicate a strong negative relationship between the austerity exposure and life expectancy. Computing the distribution of point estimates suggests that life expectancy decreased, on average, by 2.6–3.7 months for men and 4.8–5.2 months for women between 2010 and 2019 as a result of the welfare treatment. This indicates that austerity policies caused a three-year setback in life expectancy progress between 2010 and 2019 (*c.f.*, Figure 1 and Figure 7).

Importantly, the pooled difference-in-differences results are likely to underestimate the effect. The full effects of the welfare reform on health outcomes may take time to manifest, and

[12] Appendix A also examines whether the observed effect on life expectancy could be attributed to the Brexit referendum result rather than austerity measures. In addition, we apply the tests proposed by Rambachan and Roth (2023) to assess potential violations of the parallel trends assumption. We further address concerns about selection bias by showing that even when comparing local authorities with similar levels of deprivation but differing levels of austerity exposure, austerity still has a clear effect on life expectancy.

Table 1: The impact of austerity on life expectancy in the United Kingdom – welfare results

	Female at 65	Female at birth	Male at 65	Male at birth
$\mathbf{1}_{t>2010}(t) \times Welfare$	-0.012***	-0.011***	-0.008***	-0.006**
	(0.002)	(0.002)	(0.002)	(0.003)
Average effect (months)	-5.2	-4.8	-3.7	-2.6
Mean of dep. variable (years)	20.6	82.4	18.0	78.5
Local authorities	379	379	379	379
Observations	6822	6822	6822	6822

Notes: The table reports results from panel OLS regressions with the dependent variable being life expectancy in English, Welsh, and Scottish local authorities between 2002 and 2019. The regressions control for local-authority fixed effects, as well as region-by-year fixed effects, and for unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level and are presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

accumulate gradually over an extended period of time. As argued by Fetzer (2019), such results "may underestimate the effect of austerity [, since welfare] cut measures, such as freezing of benefits, or changes in inflation indexing, compound over time, while others only become fully effective at a later date."

In the event studies depicted in Figure 5, we present results for the dynamic specification (Equation (3.1)) for life expectancy at birth among females and males. We find no evidence of systematic divergence before 2010 that correlates with exposure to austerity. However, after the onset of austerity measures, we observe a clear reduction in life expectancy, with a more pronounced effect among females. The results indicate that every £100 per capita per year of lost benefits led to a decrease in life expectancy of approximately 0.5–2.5 months. The estimated coefficients for 2019 are larger compared to the pooled difference-in-differences estimates, as expected, given the cumulative nature of the effect. This reflects the compounding impact of austerity measures on life expectancy over time.

This lasting impact requires continued attention, and may also be important for recent public health crises, such as the COVID-19 pandemic. It is plausible that the exposure of specific local authorities to the welfare reform has implications for factors linked to an increased risk of COVID-19 mortality. However, an in-depth analysis of this relationship is beyond the scope of the present paper.

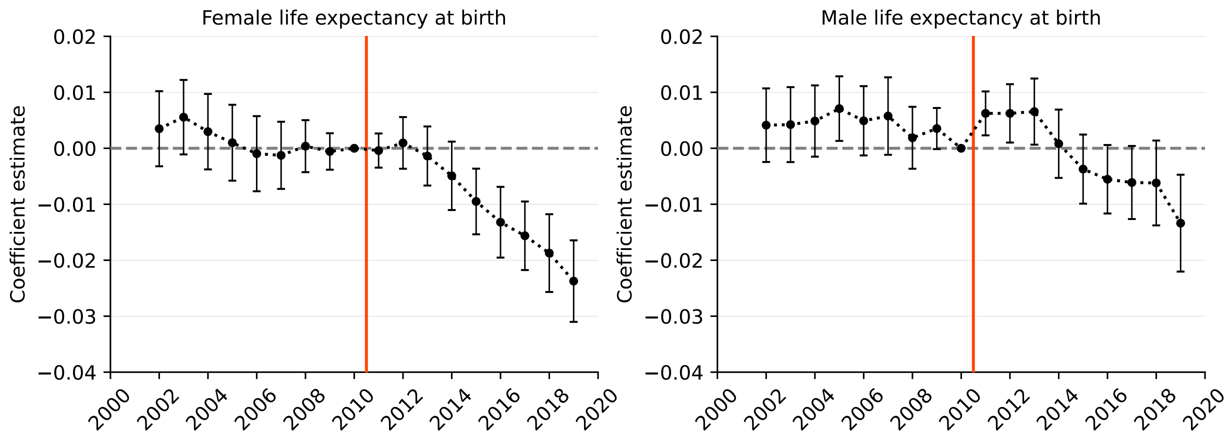

Figure 5: The effect of the welfare austerity shock on life expectancy at birth.

Notes: The dependent variable is female (left) and male (right) life expectancy at birth measured in months. The graph plots point estimates of the interaction between the incidence of the austerity measures and a set of year fixed effects across local authorities in England, Scotland, and Wales. The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

3.3 The healthcare spending effect on life expectancy

We now turn to the effect of changes in healthcare spending on life expectancy. We repeat the same estimation strategy used for the welfare impact, substituting in the total health impact.

There exists a crucial distinction between the welfare and health total impacts. Healthcare spending is defined at the regional rather than the local-authority level. Consequently, when considering the health treatment, we replace the term $\theta_{r,t}$ in Equation (3.2) and Equation (3.1) with $\theta_{c,t}$ to account for country-year fixed effects, rather than region-year fixed effects. Appendix A compares region-aggregated and local-authority-level treatments and finds only minor differences. This provides confidence that using the region-aggregated total health impact is both reliable and meaningful.

The results from the pooled difference-in-differences analysis (Equation (3.2)) are presented in Table 2. The point estimates indicate a strong negative relationship between the exposure to healthcare spending reductions and life expectancy (apart from life expectancy at 65 for males). The effect, measured per pound, is much stronger than in the case of the welfare treatment. This result is expected, since healthcare spending has a clearer direct impact on life expectancy compared with welfare spending.

However, the average overall effect is smaller for the health treatment than for the welfare

Table 2: The impact of austerity on life expectancy in the United Kingdom – healthcare results

	Female at 65	Female at birth	Male at 65	Male at birth
$\mathbf{1}_{t>2010}(t) \times Health$	-0.22**	-0.33**	-0.12	-0.47***
	(0.10)	(0.14)	(0.11)	(0.17)
Average effect (months)	-0.1	-0.2	-0.1	-0.3
Mean of dep. variable (years)	20.5	82.4	18.0	78.4
Local authorities	378	378	378	378
Observations	6536	6536	6536	6536

Notes: The table reports results from panel OLS regressions with the dependent variable being life expectancy in English, Northern Irish, Welsh, and Scottish local authorities between 2002 and 2019. The regressions control for local-authority fixed effects, as well as country-by-year fixed effects, and for unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level and are presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

treatment. Computing the distribution of point estimates suggests that life expectancy decreased, on average, by 0.1–0.3 months between 2010 and 2019 as a result of the health treatment. The reason for this relatively small effect is that healthcare expenditures were not reduced as dramatically as welfare benefits.

In the event studies depicted in Figure 6, we present results for the dynamic specification (Equation (3.1)) for life expectancy at birth among females and males. Again, similar to the case of the welfare treatment, there is no evidence of systematic divergence before 2010 in a way that is correlated with exposure to the austerity measure. After the onset of austerity, a clear reduction in life expectancy is observed. In line with the pooled regression estimates, the results show that the effect of healthcare spending on life expectancy per pound is much larger than that of welfare spending.

In addition to the welfare and health treatments, other treatments can be defined. Specifically, public spending on other services, including police, education, and economic affairs, has also decreased following the onset of austerity. Appendix A presents the effects of these additional treatments on life expectancy, showing that they are small and not robust. Additionally, Appendix A explores alternative definitions for the health treatment, indicating the robustness of the results.

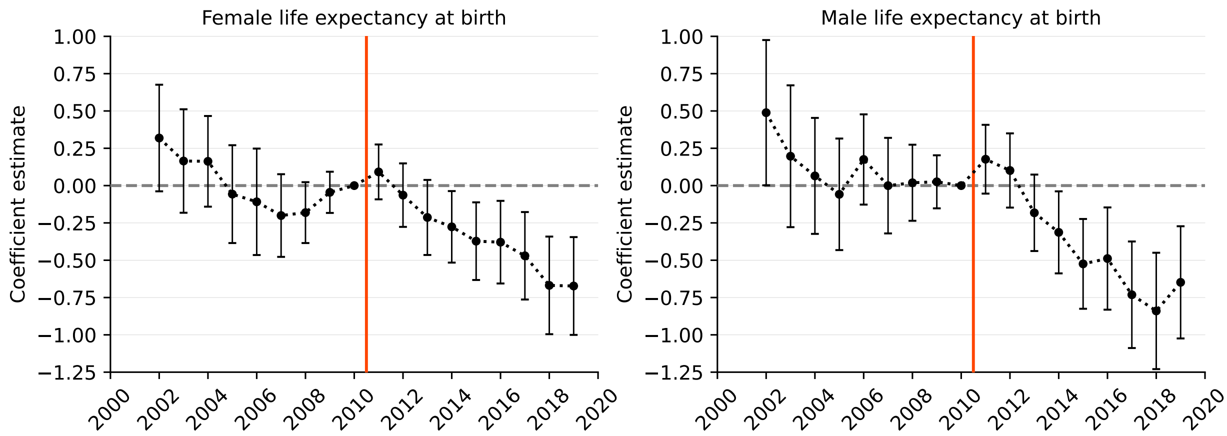

Figure 6: The effect of the healthcare austerity shock on life expectancy at birth.

Notes: The dependent variable is female (left) and male (right) life expectancy at birth measured in months. The graph plots point estimates of the interaction between the incidence of the austerity measures and a set of year fixed effects across local authorities in England, Northern Ireland, Scotland, and Wales. The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

3.4 The combined effect of austerity measures on mortality

The results so far show a strong effect of both welfare and health treatments on life expectancy and mortality. It is also possible to combine the effects, and consider the total impact of the two. In order to meaningfully combine the two treatments, we define the total relative impact RI_i:

$$RI_i = \frac{WelfareImpact_i}{Pay_i^{2010}} + \frac{HealthImpact_i}{Pay_i^{2010}}, \tag{3.3}$$

where $WelfareImpact_i$ is the total welfare impact in local authority i, $HealthImpact_i$ is the total health impact in local authority i, and Pay_i^{2010} is the average annual worker's pay in 2010 in local authority i.

This approach allows for the aggregation of welfare and health treatments at the local-authority level, enabling an accurate use of fixed effects by considering both region-year and local authority fixed effects. Additionally, the relative impact is an important alternative definition of the treatment, as the effect of a monetary reduction in welfare or health expenditures can be felt differently between richer and poorer areas. Dividing by the average pay accounts for these differences.

The left panel of Figure 7 presents event-study results for the dynamic specification (Equation (3.1)) with the total relative impact. The outcome considered is life expectancy at birth. As before, there is no evidence of systematic divergence before 2010 correlated with exposure to austerity. However, after the onset of austerity measures, a clear reduction in life expectancy is observed. A pooled difference-in-differences specification (Equation (3.2)) also indicates a clear reduction in life expectancy, showing a decrease of up to four months for a one percent decline in spending per person per year between 2010 and 2019. Computing the distribution of point estimates indicates that the combined treatment led to an average decline of 2.2 to 4.1 months in life expectancy from 2010 to 2019. This closely mirrors the effect estimated using the total welfare impact alone.[13]

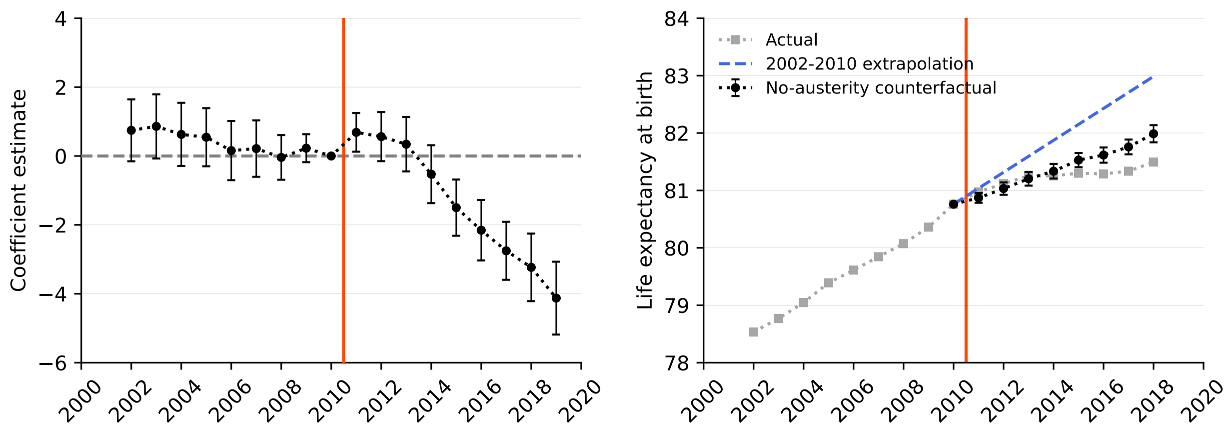

Figure 7: The effect of the combined healthcare and welfare austerity shock on life expectancy at birth.

Notes: Left) The dependent variable is life expectancy at birth measured in months. The graph plots point estimates of the interaction between the incidence of the austerity measures and a set of year fixed effects across local authorities in England, Scotland, and Wales. The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated; Right) The evolution of life expectancy in the United Kingdom (gray) and two counterfactual scenarios after 2010: linear extrapolation (blue) and no-austerity counterfactual (black), where the estimated effect of the total relative impact is subtracted from the actual evolution.

The right panel of Figure 7 illustrates the effect of austerity on life expectancy by comparing its evolution against two counterfactual scenarios. The first scenario is a naïve linear extrapolation after 2010, based on the average rate of life expectancy improvement between 2002 and 2010. The second scenario involves adjusting the life expectancy variable from 2011 onwards by subtracting the estimated average effect of austerity. According to Equation (3.1), we subtract $\hat{\delta}_t \mathbb{E}[RI_i]$ from the life expectancy variable for each year after 2010.

[13] In Appendix A, we address the robustness of these estimated coefficients by jointly controlling for the austerity shock and the unemployment shock induced by the recession, resulting in highly similar coefficient values.

The linear extrapolation shows that, even in the absence of austerity, life expectancy would have increased at a slower rate after 2010 than in the preceding decade. As discussed above, this could be due to slower improvements in cardiovascular disease (CVD) mortality, "probably due to a combination of factors including a rise in risk factors such as obesity and diabetes." (Cheema et al., 2022).

Yet, the austerity effect is still significant and substantial. The no-austerity counterfactual scenario indicates that austerity caused a three-year setback in life expectancy progress between 2010 and 2019, with the austerity effect accounting for a five-month reduction in life expectancy by 2019.

Figure 8 presents a summary of the effects estimated for the different treatment definitions. There are two key observations:

- The overall effect of health spending reduction on life expectancy is generally small
- The overall effect of the total welfare impact is very close to the overall effect of the total relative impact

In addition, as described above, the effect of healthcare spending reduction per pound is substantially larger than that of welfare spending reduction.

3.5 Excess mortality and heterogeneous effects

A similar approach can be used to estimate the effect on overall mortality rates. This would enable calculating the number of excess deaths caused by the austerity measures. Using the total relative impact (RI_i) as the treatment variable we estimate a dynamic specification for the mortality rate $MR_{i,r,t}^{a,s}$ as the outcome variable. $MR_{i,r,t}^{a,s}$ is the mortality rate in local authority i, which belongs to region r, at year t for age group a and sex s.[14] The estimation follows the specification

$$MR_{i,r,t}^{a,s} = \alpha_i^{a,s} + \theta_{r,t}^{a,s} + \sum_{t \neq 2010} \delta_t^{a,s} \times Year_t \times RI_i + \mathbf{x}_{i,t}\beta + \epsilon_{i,r,t}^{a,s}\,, \tag{3.4}$$

similar to Equation (3.1).

[14] $MR_{i,r,t}^{a,s}$ is defined as $D_{i,t}^{a,s}/P_{i,t}^{a,s}$, where $D_{i,t}^{a,s}$ is the number of deaths in local authority i and year t for age group a and sex s, and $P_{i,t}^{a,s}$ is the relevant population of this demographic group. The mortality data are available for 11 age groups: < 1, 1–9, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, 80–89, > 90. The data are taken from the Office for National Statistics (2023). These data are only available for England and Wales. They cover approximately 90 percent of the entire UK population.

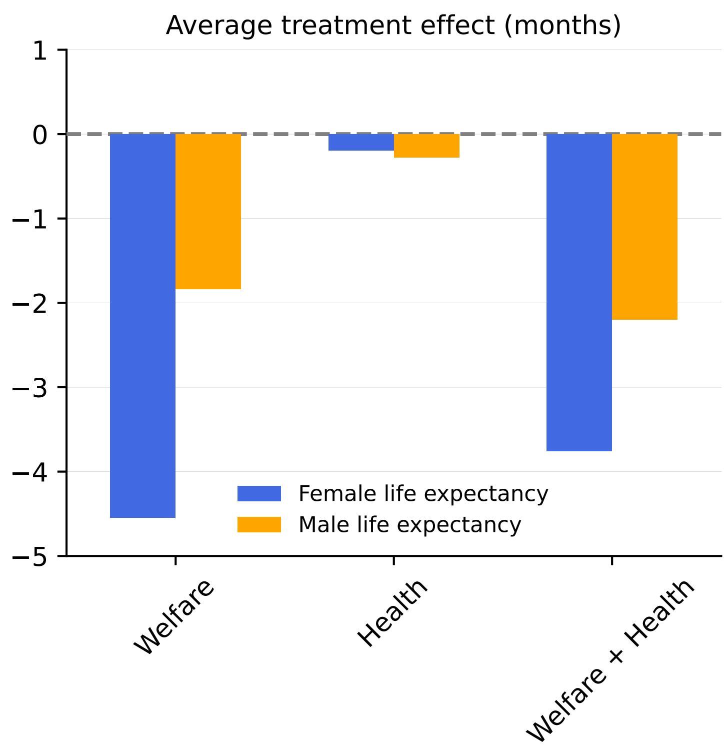

Figure 8: The effect of austerity measures on life expectancy in the United Kingdom.

Notes: The average effect of different treatments on female and male life expectancy at birth between 2010 and 2019. 'Welfare + Health' represents the total relative impact.

Estimating the specification in Equation (3.4) yields the coefficients $\hat{\delta}_t^{a,s}$, which capture the contribution of austerity to the mortality rate for each age group a and sex s in a given year t. By multiplying $\hat{\delta}_t^{a,s}$ by the corresponding age group and sex population and the intensity of austerity, we can derive the number of excess deaths attributable to austerity for each group in every year. Summing these excess death estimates across all age groups and sexes provides the total number of excess deaths caused by austerity in year t:

$$ED_t = \sum_s \sum_a \left(\hat{\delta}_t^{a,s} \sum_i RI_i \times P_{i,t}^{a,s} \right) . \tag{3.5}$$

The effect can also be presented in terms of the overall effect on the average mortality rate by dividing the number of excess deaths by total deaths. These effects are illustrated in Figure 9. It shows a clear increase in excess deaths due to austerity after 2010. As before, in the case of life expectancy and the different austerity measures, there is no evidence of systematic divergence before 2010 that correlates with exposure to austerity measures, indicating the absence of pre-trends.[15]

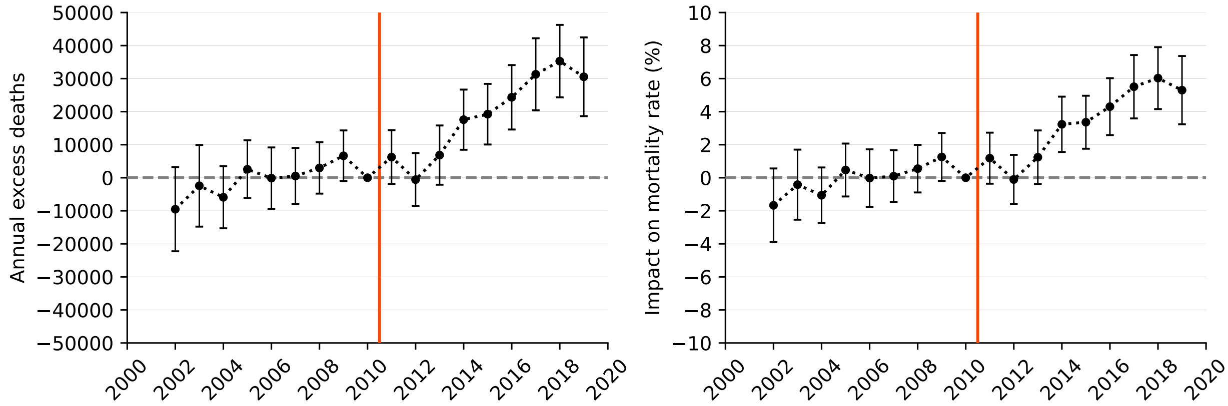

Figure 9: The effect of the combined healthcare and welfare austerity shock on mortality.

Notes: The results are based on the estimation of Equation (3.4), where the dependent variable is mortality rate by local authority, age group and sex. The effect by group is then multiplied by the group population and the treatment intensity and summed over all age groups and sexes to yield total excess mortality (left) and divided by the total number of deaths to show the effect on the mortality rate (right). The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated, aggregated under the assumption that errors are uncorrelated across age groups and sexes.

Figure 9 also illustrates that the impact on mortality has progressively increased since 2012. This trend suggests that the effects of austerity measures on mortality rates may extend well beyond the 2011–2019 timeframe and potentially have enduring consequences.

The impact of austerity on mortality and the resulting excess deaths varied by age. In addition to calculating overall excess mortality by aggregating across age groups, it is possible to determine the excess mortality for each age group individually by summing over the post-treatment years, *i.e.*, from 2011 to 2019:

$$ED^a = \sum_s \sum_{t>2010} \left(\hat{\delta}_t^{a,s} \sum_i RI_i \times P_{i,t}^{a,s} \right) . \tag{3.6}$$

The results of this analysis are detailed in Figure 10. For most age groups, we find that the impact on mortality is minimal and not statistically significant, particularly for individuals

[15]The absence of pre-trends is crucial as it clarifies that pre-existing differences in age distribution across local authorities are not driving the results. By construction, the population ages at different rates in different local authorities due to variations in age distribution. Therefore, it is essential to verify that the increased mortality in some local authorities is indeed a result of austerity and not primarily due to a faster-aging population, which would lead to an over-representation of elderly in local authorities more affected by austerity. The absence of pre-trends addresses this concern. Furthermore, the correlation between the average age in 2010 and the total relative impact is small and, in fact, negative ($\rho = -0.02$; $p = 0.63$).

under 30, and those between 50 and 69. In contrast, there is a pronounced increase in mortality for individuals aged 40–49, as well as for those aged 70 and older. The increased mortality among older age groups contributes significantly to the overall excess deaths given their already higher baseline rates. The sharp increase in mortality among individuals aged 40 to 49 is particularly concerning and may be linked to a rise in "Deaths of Despair" (Case and Deaton, 2020, 2021), especially those resulting from drug-related poisonings. The potential mechanisms underlying these trends are further explored in Section 4.

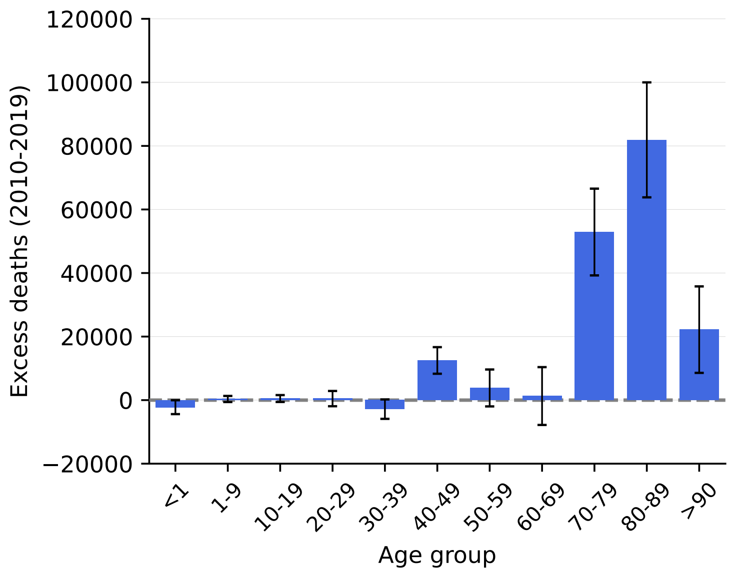

Figure 10: Excess mortality caused by austerity by age group (2010–2019).

Notes: The results are based on Equation (3.4), where age-group specific coefficients are estimated. The contribution of austerity measures to excess mortality for each age group at every year is then calculated and summed over the years 2011–2019 and over both sexes: $ED^a = \sum_s \sum_{t>2010} \left(\hat{\delta}_t^{a,s} \sum_i RI_i \times P_{i,t}^{a,s} \right)$. Standard errors were clustered at the local-authority level with 95 percent confidence intervals indicated, aggregated under the assumption that errors are uncorrelated across years.

Summing over all age groups as shown in Figure 10, we calculate the total excess deaths attributable to austerity policies:

$$ED^{tot} = \sum_a \sum_s \left(\sum_{t>2010} \left(\hat{\delta}_t^{a,s} \sum_i RI_i \times P_{i,t}^{a,s} \right) \right) . \tag{3.7}$$

This calculation estimates 171,000 ($\pm 15,000$) excess deaths in England and Wales between 2010 and 2019, accounting for 3.1 percent of all deaths during this period. Extending the analysis to include Scotland and Northern Ireland, and assuming the proportion of excess deaths remains consistent, the estimate rises to 194,000 excess deaths in the United Kingdom overall.[16]

3.6 Calculation of the marginal value of public funds

The results enable the calculation of the MVPF – the Marginal Value of Public Funds (Hendren and Sprung-Keyser, 2020, 2022). MVPF is a unified method of assessing the impact of policy changes on social welfare. In our setup, it can be done separately for the two treatments – the total welfare impact and total health impact. The MVPF is defined as the ratio between the effect of a policy change on the welfare of the affected population and the overall costs of the policy change to the government. In our case, both the effect and the cost are negative, and therefore, their ratio is positive, as is typically the case in MVPF calculations. Yet, an MVPF greater than 1 in our context implies that the value of life lost exceeds the saved expenditure.

First, we consider the numerator (or Aggregate Willingness to Pay). It accounts for the cost in years of life lost brought about by each policy intervention. We make use of the Value of Life Year (VOLY) defined in the United Kingdom to guide budgetary planning (in the United States it is typically referred to as value of statistical life-year or VSLY). HM Treasury estimated the VOLY as £60,000 in 2020 (Chilton et al., 2020). We also need to take into account the total years of life lost (YLL). To calculate the total YLL for each treatment j, we calculate the excess mortality in each sex s and age group a caused by this treatment in every year t:

$$ED_t^{a,s,j} = \hat{\delta}_t^{a,s} \sum_i Austerity_{i,j} \times P_{i,t}^{a,s}\,, \tag{3.8}$$

where $Austerity_{i,j}$ is the treatment intensity of unit i to austerity measure j (welfare or health). Denoting the life expectancy of sex s and age a in year t as $EX_t^{a,s}$ we can define the aggregate willingness to pay as

$$WTP^j = \sum_a \sum_s \sum_t ED_t^{a,s,j} \times (EX_t^{a,s} - a) \times 60000 \times DEF_t\,, \tag{3.9}$$

where DEF_t is the inflation deflator (the VOLY in 2020 was estimated at £60,000).[17]

This calculation provides an approximation of the overall costs to welfare due to excess

[16] The 95 percent confidence bounds are calculated by clustering standard errors at the local-authority level, and then aggregating under the assumption that the errors are uncorrelated across years, age groups and sexes.

[17] Since the excess deaths are calculated by age group and not age, we use life expectancy values at the ages 0, 5, 15, 25, 35, 45, 55, 65, 75, 85, and 95, for the age groups < 1, 1–9, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, 80–89, > 90, respectively. The data are taken from Office for National Statistics (2021).

deaths for each austerity measure.[18]

The next step in the MVPF calculation is determining the denominator (or Net Cost). We use a simplified approach using only direct costs. We do not account for numerous indirect costs of austerity measures, such as higher incarceration rates, increased prevalence of health issues that incur costs on the healthcare system, and various other costs.

In our case, the net cost is essentially savings. For welfare savings, we use the official value reported to the House of Commons (Keen, 2016), amounting to £38.4 billion between the 2010-2011 and 2019-2020 fiscal years.

To account for the overall saving for the health treatment we use the following formula:

$$Saving = \frac{9 \times P_{2015}}{N} \sum_{i=1}^{N} Impact_i \, , \tag{3.10}$$

where i indexes the local authorities. The multiplication by 9 accounts for the impact being per year, and we are interested in the overall savings between 2011 and 2019. P_{2015} is the total population in 2015, the middle point between 2011 and 2019, and N is the number of local authorities. This calculation amounts to £0.35 billion.

We also consider the total relative impact as the overall austerity treatment, including both welfare and health treatments. In this case, the overall savings would be the sum of both treatments: £0.35 billion + £38.4 billion = £38.75 billion.

Table 3 summarizes these calculations. As expected, all treatments had positive MVPFs greater than 1, indicating that the welfare value of lives lost exceeds the government's savings. For the total relative impact, combining both health and welfare treatments, the MVPF was 2.3.

The health treatment, while relatively small in overall magnitude, had a higher MVPF compared to the welfare benefit cuts and the total relative impact. This aligns with the per-pound effects shown in Figure 6, suggesting that a marginal pound spent on healthcare is more effective in saving lives than a marginal pound spent on welfare benefits. Notably, the MVPF of 9.9 for health-related interventions is high relative to other policy changes reported in the literature (Policy Impacts, 2023). This is unsurprising, as health-related policy changes typically have high MVPFs, and in some cases, they even pay for themselves through negative net costs and positive benefits.

The MVPF for the welfare reform is 2.8. This is also lower than the MVPF calculated for

[18] This is a conservative estimate, as the years of life lost are actually greater than the difference between life expectancy and age at death in a given year. Nonetheless, we adhere to this standard convention.

Table 3: Calculation of marginal value of public funds

	Total	Welfare	Healthcare
	Value (Billion £)		
Aggregate Willingness to Pay	−89.6	−109.2	−3.45
Net Cost	−38.75	−38.4	−0.35
MVPF	**2.3**	**2.8**	**9.9**

Notes: The table reports the calculations of the marginal value of public funds (MVPF) as described above.

another austerity-related policy change – the closure of police stations in London, where the calculated MVPF is 7.17 (Policy Impacts, 2023; Facchetti, 2024). However, we note that the calculation of net costs, as described above, is simplified and conservative. In practice, accounting for additional costs would bring the overall savings closer to zero and increase the MVPF for both the combined treatment and the welfare reform.

3.7 Distributional impact

An additional important dimension of austerity measures was their distributional impact. Low-income areas in the United Kingdom experienced more significant reductions in welfare payments per adult compared to higher-income areas. This disparity was an inherent consequence of the austerity policies, as the share of welfare recipients and the proportion of household income derived from welfare benefits were higher in economically disadvantaged areas. Consequently, the austerity measures exacerbated income inequalities, with poorer local authorities becoming relatively poorer compared to richer local authorities, after accounting for taxes and transfers. The most negatively impacted areas include local authorities in the North East of England, South Wales, and the Glasgow City Region.

Figure 11 shows that poorer local authorities saw smaller increases in life expectancy between 2010 and 2019, or even decreases, compared to richer local authorities (defined by average pay in 2010). These results indicate that austerity measures were not only regressive in their impact on post-tax and transfer income, but they also led to more unequal health outcomes. While descriptive, this highlights an important broader social welfare cost of austerity.

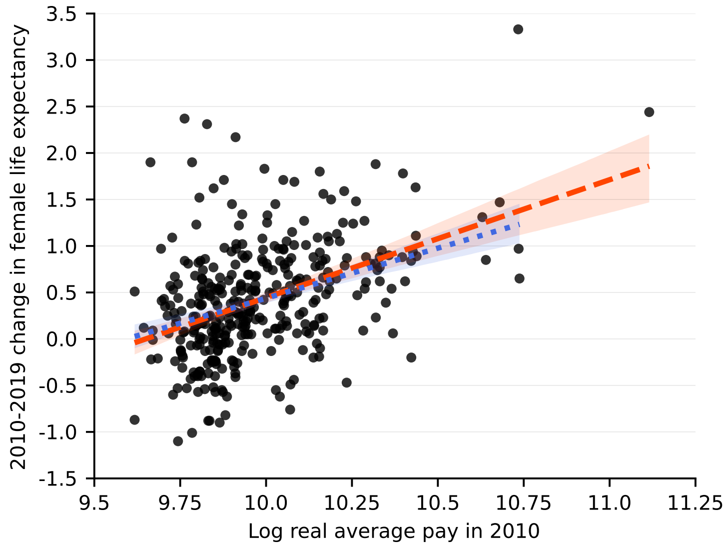

Figure 11: The association between life expectancy improvement and income in the United Kingdom, 2010–2019.

Notes: The chart shows the change (measured in years) in female life expectancy at birth from 2010 to 2019 across local authorities. It is plotted against the logarithm of the real average worker's pay in 2010. The shaded areas represent 95 percent confidence intervals for the linear fits. The dotted linear fit excludes outliers, defined as the top and bottom 1% of observations sorted by their y-axis values.

4 Mechanisms and channels

So far, we have quantified the impact of austerity measures on life expectancy and overall mortality. In this section, we examine the mechanisms that drive these effects.

The impact of healthcare spending cuts on mortality is quite direct. It results in fewer or less-qualified health professionals, fewer hospital beds, fewer ambulances, and so on. Yet, it remains an empirical question whether healthcare spending cuts can indeed be linked to such channels that directly affect mortality, a question we aim to address.

In contrast, the mechanisms by which cuts to welfare benefits result in increased mortality are less direct. These could potentially involve lifestyle changes due to a decline in benefits, such as poorer nutrition, homelessness, increased stress, and the development of addiction.

To test these mechanisms, we will examine three specific channels. First, drug-related deaths, which we hypothesize are rising primarily in areas with greater exposure to austerity. Second, an income effect, to assess whether welfare benefit cuts indeed impacted people's incomes, particularly among women and the elderly. Third, ambulance response quality, which we expect to decline more sharply in areas facing deeper healthcare cuts; however, this may not be directly attributable to welfare benefit reductions.

We also study the impact of austerity on additional health outcomes, which may contribute to a future rise in mortality beyond the effects documented above.

4.1 Drug-related deaths

First we consider drug-related deaths. As discussed above, "Deaths of Despair" (Case and Deaton, 2020, 2021) – from suicide, drug overdose, and alcoholism – have been identified as major contributing factors to the decline in life expectancy in the United States over the past few decades. The United Kingdom has seen a rise in drug-related deaths since 2012, as illustrated in Figure 12.

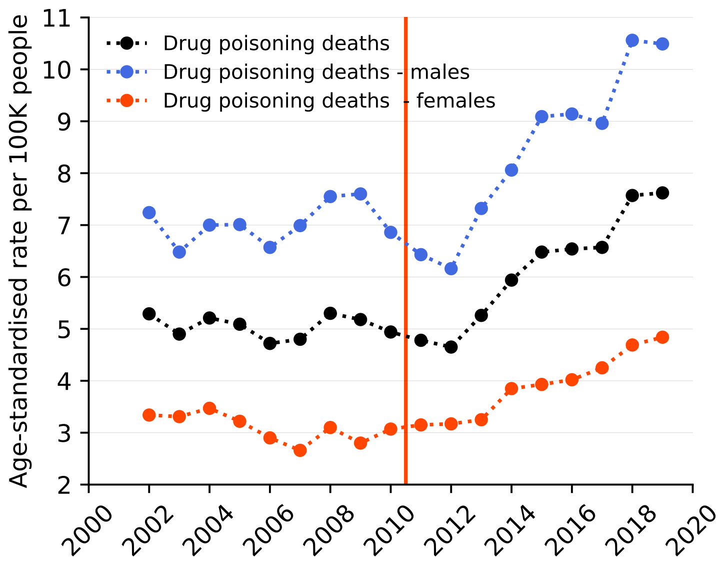

Figure 12: Age-adjusted drug-poisoning mortality rate per 100,000 people in England and Wales between 2001 and 2019.

Notes: Drug-poisoning deaths are defined as all deaths coded to accidental poisoning and intentional self-poisoning by drugs, medicaments, and biological substances, whether or not a drug listed under the UK Misuse of Drugs Act was present in the body.

To assess the effect of austerity measures on drug-related mortality we repeat the same calculations as presented above using the difference-in-differences specifications defined in Equation (3.1) and Equation (3.2). One caveat is that the drug-poisoning data are limited to England and Wales, thus excluding about 10 percent of the UK population living in Scotland and Northern Ireland. Table 4 presents the pooled difference-in-differences results. The point estimates indicate a strong positive effect of austerity exposure and drug-poisoning mortality rate. Computing the distribution of point estimates suggests that the age-adjusted drug-poisoning mortality rate per 100,000 people increased, on average, by 1.9 for the welfare impact and 0.1 for the health impact between 2010 and 2019. The total relative impact, *i.e.*, the sum of the relative welfare and health impact, yields an average effect of 1.5 drug-poisoning deaths per 100,000.

Table 4: The impact of austerity on drug-poisoning deaths in the United Kingdom

	Welfare impact	Health impact	Total relative impact	Total relative impact (with police shock)
$\mathbf{1}_{t>2010}(t) \times Impact$	0.004***	0.157***	0.84***	0.83**
	(0.001)	(0.041)	(0.151)	(0.362)
Average effect	1.9	0.1	1.5	1.5
Mean of dep. variable	6.1	6.1	6.1	6.1
Local authorities	341	341	336	336
Observations	5068	5068	5030	5030

Notes: The table reports results from panel OLS regressions with the dependent variable being the age-adjusted drug-poisoning mortality rate per 100,000 people in English and Welsh local authorities between 2002 and 2019. The regressions control for local-authority fixed effects, as well as region-by-year fixed effects throughout (country-by-year in the case of the health impact), and for unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level and are presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

Additionally, we estimate the total relative impact effect while jointly accounting for the decline in police spending between 2010 and 2015. As previously discussed, funding for services such as law enforcement was reduced in the United Kingdom during this period, alongside cuts to welfare and healthcare. However, as demonstrated in Appendix A, the decline in police spending did not significantly contribute to increased mortality. When controlling for both the police spending shock and the austerity shock, as shown in the right column of Table 4, the total relative impact coefficient and average treatment effects remain largely unchanged. This suggests that the rise in drug-related mortality is primarily driven by reductions in welfare and healthcare spending, rather than diminished law enforcement efforts.[19]

[19] The joint treatment effect is calculated using a regression in which the treatment effects of the austerity shock, the police spending shock, and their interaction are simultaneously estimated. This estimation follows the pooled difference-in-differences specification:

$$\begin{aligned} y_{i,r,t} &= \alpha_i + \theta_{r,t} \\ &+ \delta_1 \times \mathbf{1}_{t>2010}(t) \times RI_i \\ &+ \delta_2 \times \mathbf{1}_{t>2010}(t) \times PI_i \\ &+ \delta_3 \times \mathbf{1}_{t>2010}(t) \times RI_i \times PI_i \\ &+ \mathbf{x}_{i,t}\beta + \epsilon_{i,r,t}, \end{aligned}$$

The left panel of Figure 13 illustrates the event study results for the dynamic specification (Equation (3.1)), considering the total relative impact. As before, there is no evidence of systematic divergence before 2010 in a way that is correlated with exposure to the austerity shock. After the onset of austerity measures, a clear increase in drug-poisoning mortality is observed. The results indicate an increase of 1–2 drug-related deaths per 100,000 for a one percent decline in healthcare or welfare spending per person per year between 2010 and 2019.

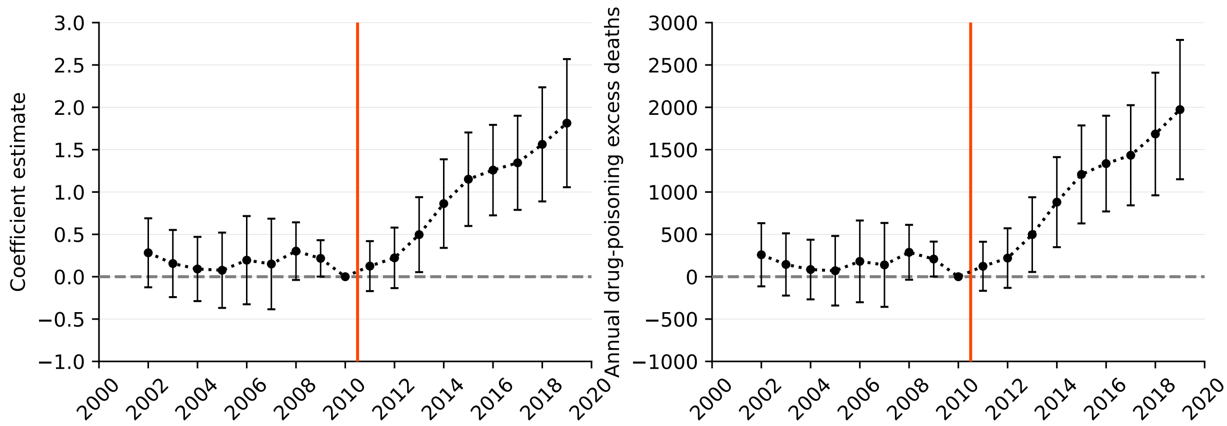

Figure 13: The effect of the combined healthcare and welfare austerity shock on drug-poisoning mortality.

Notes: Left) The dependent variable is the age-adjusted drug-poisoning mortality rate per 100,000 people in English and Welsh local authorities between 2002 and 2019. The graph plots point estimates of the interaction between the incidence of the austerity measures and a set of year fixed effects across local authorities in England and Wales. The regressions control for local authority unemployment, in- and out-migration relative flows, the log of average wages, and the log of population. Standard errors are clustered at the local authority level, with 95 percent confidence intervals indicated; Right) The results are based on the estimation of an adjusted form Equation (3.4), where the dependent variable is the age-adjusted drug-poisoning mortality rate per 100,000 people in English and Welsh local authorities between 2002 and 2019. The effect by year is then multiplied by the local authority population and the treatment intensity and summed over all local authorities to yield total excess mortality. The regressions control for local authority unemployment, in- and out-migration relative flows, the log of average wages, and the log of population. Standard errors are clustered at the local authority level, with 95 percent confidence intervals indicated, aggregated under the assumption that errors are uncorrelated across local authorities.

The right panel of Figure 13 presents the effect in terms of excess drug-poisoning deaths. This analysis is based on a calculation similar to the one used for excess mortality in Figure 9,

where the notation follows Equation (3.2). Here, δ_1, δ_2, and δ_3 represent the estimated treatment effects of the austerity shock, the police spending shock, and their interaction, respectively. Notably, the coefficients δ_2 and δ_3 – corresponding to the police spending shock and the interaction term – are not statistically significantly different from zero.

using the following formula:

$$ED_t = \hat{\delta}_t \sum_i RI_i \times P_{i,t}\,, \tag{4.1}$$

where ED_t represents the excess drug-poisoning deaths in year t, $\hat{\delta}_t$ is the estimated coefficient for year t, RI_i is the total relative impact in local authority i, and $P_{i,t}$ is the population of local authority i in year t.

This calculation results in approximately 9,000 (±850) excess deaths from drug-poisoning over the period 2010–2019. These "preventable deaths" account for about 27 percent of all drug-poisoning deaths in England and Wales during this period. This share represents a much larger increase compared to the 3 percent increase in all-cause mortality, highlighting the significant impact of austerity on drug-poisoning mortality.

The strong connection between austerity measures and the rise in drug-related deaths aligns with the findings of Friebel, Yoo and Maynou (2022), which focus on opioid abuse in England. Nevertheless, while these results shed light on many excess deaths attributed to austerity, they offer only a partial explanation, accounting for just 5 percent of overall excess mortality. This highlights the need to explore additional mechanisms that may have contributed to the increased mortality in the United Kingdom following the implementation of austerity measures.

4.2 Public social benefits: Testing an income effect

The reductions in welfare benefits, quantified through the welfare treatment and the total relative impact, have led to increased mortality. As illustrated in Figure 10, excess mortality is primarily concentrated among the elderly. This outcome is expected, given that older individuals are more vulnerable to economic and health-related shocks. It is also possible that the elderly were disproportionately affected by welfare cuts. In addition, our findings, particularly those presented in Figure 5, indicate that the austerity shock had a more pronounced effect on women's life expectancy than on men's.

To examine these trends in greater detail, we analyze household survey data, where households report their income from various sources. Specifically, we observe the amount of public social benefits received by each household in the survey. Our analysis relies on data from the Family Resources Survey (Department for Work and Pensions, 2024), which has been harmonized and made available through Luxembourg Income Study (LIS). This dataset enables us to address the income effect – that is, whether the groups most affected by austerity-related mortality also faced a significant reduction in social benefits.

For this purpose, we apply a difference-in-differences approach using repeated cross-sections and estimate a dynamic specification similar to Equation (3.1), as follows:

$$y_{i,t} = \alpha_{a,s} + \theta_t + \sum_{t \neq 2010} \delta_t \times Year_t \times Treatment_{i,j} + \epsilon_{i,t}\,, \tag{4.2}$$

where i represents a household or an individual (each observed only once), and t denotes the survey year (2002–2019). The term $\alpha_{a,s}$ captures fixed effects for combined age and sex in the case of individual-level analysis, whereas for household-level analysis, we adjust these fixed effects accordingly (see below). The variable $Treatment_{i,j}$ is a binary indicator for whether unit i is subject to treatment, which varies across two definitions described below. The outcome variable, $y_{i,t}$, represents the real annual value of social benefits received per adult by unit i at year t. Our primary coefficients of interest are the interaction terms (δ_t) between the treatment and a set of year dummies, allowing us to estimate the dynamic impact of austerity on benefit income while testing for pre-trends.

Public benefits are distributed through both household-level and individual-level mechanisms. Some benefits are allocated to the household as a whole, while others, such as parental leave payments, unemployment benefits, sickness/temporary work injury payments, and disability/permanent work injury benefits, are assigned to specific individuals.

Given these distinctions, we define two separate treatments. First, to better understand the effect of austerity on women, we analyze individual-level data and focus on women aged 40–49. This group is particularly vulnerable to fluctuations in personal benefit incidence, and as Figure 10 suggests, they experienced the highest excess mortality outside of the elderly. In this case, an individual is classified as treated if they are a woman within the 40–49 age bracket.

The second treatment addresses elderly households. Here, we use household-level data and define treated households as those in which all members are aged 65 or older. Instead of applying age and sex fixed effects, we use fixed effects for household size and age group. In this case, the value of public social benefits also includes those administered at the household level, such as minimum income guarantees, housing assistance, and other in-kind public benefits.

Figure 14 illustrates that both treatment effects – for 40–49-year-old women and for elderly households – are significant and persistent. In both cases, there is a clear decline in social benefits following the onset of austerity. Women aged 40–49 received £300 less in social benefits per year due to austerity, beyond the effects observed for other age groups and for men. Meanwhile, social benefits for elderly households decreased substantially, by £790 per adult per year. Importantly, there are no clear pre-trends, and a pooled difference-in-differences specification confirms that these average treatment effects are statistically significant, supporting the robustness of our findings.[20]

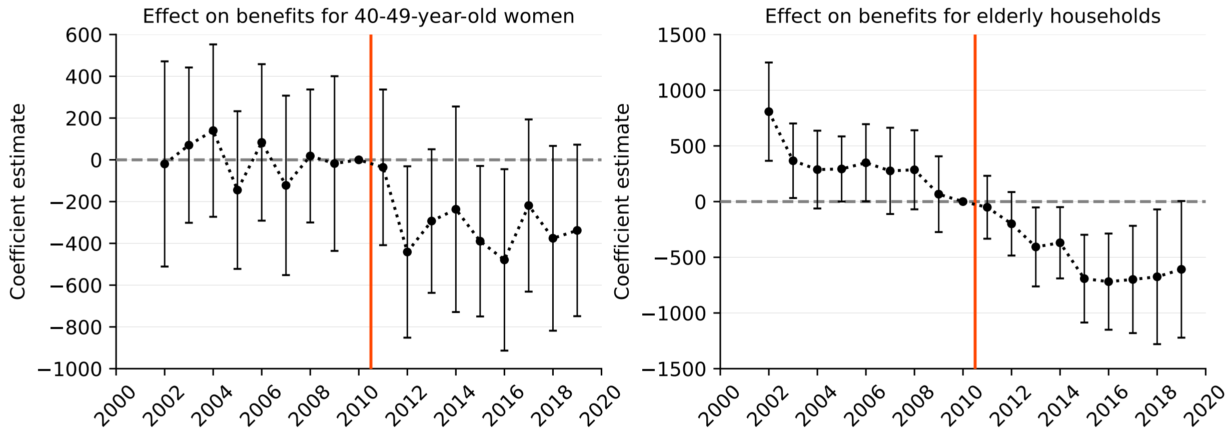

Figure 14: The impact of austerity on social benefits for women aged 40–49 and elderly households.

Notes: The dependent variable is annual social benefits per adult, measured in 2019 £. The graph presents point estimates of the interaction between being a woman aged 40–49 (left panel) or being an elderly household (right panel) and a set of year fixed effects, using data from individuals and households surveyed in the Family Resources Survey (Department for Work and Pensions, 2024). Standard errors are clustered at the year-age-sex level for the left panel and at the year-age group-household size level for the right panel, with 95% confidence intervals shown. Data are sourced from Luxembourg Income Study (LIS).

The results provide strong evidence of an income effect. Groups that experienced the highest excess mortality due to austerity – based on geographical variation in the intensity of austerity measures – also faced significant reductions in social benefits, as shown in both individual- and household-level data.

These findings may help explain the greater impact of austerity on women's life expectancy relative to men's. Women aged 40–49 faced steeper declines in social benefits, and women are also overrepresented in elderly households, which were particularly vulnerable to austerity-related cuts in social benefit income.

[20]The pooled specification follows a similar equation to Equation (4.2):

$$y_{i,t} = \alpha_{a,s} + \theta_t + \delta \times \mathbf{1}_{t>2010}(t) \times Treatment_{i,j} + \epsilon_{i,t}\,, \tag{4.3}$$

where δ represents the average treatment effect. We estimate $\delta \approx -£300$ for the treatment group of women aged 40–49 and $\delta \approx -£790$ for elderly households. In both cases, the results are statistically significant at $p < .001$.

4.3 Declining ambulance response quality

Another important channel that can explain rising mortality resulting from changes in healthcare spending is related to ambulance responses to emergency calls. The left panel of Figure 15 documents how the quality of ambulance responses declined between 2008 and 2017. It shows the percentage of category A calls (emergency calls of highest mortality risk) that resulted in an emergency response arriving at the scene of the incident within 19 minutes in England. In 2008, emergency responders arrived within 19 minutes for 96.6 percent of these calls. In 2017, this indicator declined to only 89.6 percent. The data are based on the Ambulance Quality Indicators dataset of the National Health Service (NHS, 2024).

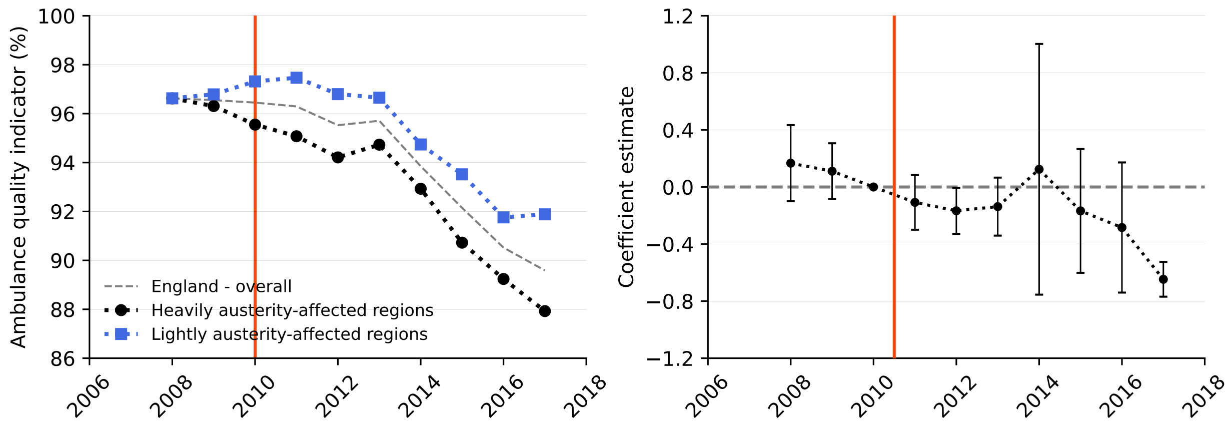

Figure 15: Ambulance response quality in the England 2008–2017.

Notes: Left) Average ambulance response indicator for English regions where health impact intensity is above and below the median (see Figure 3), and for England overall. The data are based on the Ambulance Quality Indicators dataset of the National Health Service (NHS, 2024). They are given by NHS Trust in England, which are matched with the local-authority level data, making it at the regional level for the nine regions of England. Due to changes in the way response quality was measured, we only consider the years 2008 to 2017. The indicator corresponds to the share of responses classified as category A, *i.e.*, immediately life-threatening incidents, where an ambulance vehicle capable of transporting the patient arrived at the scene within 19 minutes; Right) The dependent variable is the ambulance quality indicator. The graph plots point estimates of the interaction between the incidence of the total health impact and a set of year fixed effects across local authorities in England. The regressions control for local authority unemployment, in- and out-migration relative flows, the log of average wages, and the log of population. Standard errors are clustered at the local authority level, with 95 percent confidence intervals indicated.

Figure 15 also shows that in 2008 and 2009, there was a small difference in the quality of ambulance responses between regions in England more impacted by changes to healthcare spending due to austerity and those less affected. However, after 2010, a substantial gap emerged between these regions, reaching approximately four percentage points by 2017. This suggests a possible causal effect of healthcare spending changes on the quality of ambulance responses. The most negatively impacted areas were the North East of England and the

East Midlands.

The right panel of Figure 15 presents an event-study plot based on the total health impact as treatment in 2010. It shows that there indeed seems to be a clear, yet potentially small, negative effect of the health treatment on ambulance response quality, mainly after 2014.

Table 5 presents results from a pooled difference-in-differences analysis (Equation (3.2)) using the ambulance response quality indicator (percentage of category A calls that resulted in an emergency response arriving at the scene of the incident within 19 minutes) as the outcome. We consider three different treatment specifications. The point estimates indicate a strong negative relationship between the exposure to the health treatment and ambulance response quality. There is no clear effect of the welfare treatment, which is essentially a placebo treatment, and for the total relative treatment, in which the welfare treatment is more dominant due to its magnitude.[21]

Table 5: The impact of austerity on ambulance response quality in England

	Welfare impact	Health impact	Total relative impact	Health impact (8 min.)	NHS personnel shock
$\mathbf{1}_{t>2010}(t) \times Impact$	0.001	-0.28***	-0.12	-0.18***	-0.14***
	(0.001)	(0.02)	(0.09)	(0.03)	(0.03)
Average effect (pp)	-0.23	-0.10	-0.21	-0.06	-0.08
Mean of dep. variable (%)	94.4	94.4	94.4	82.8	94.4
Regions	9	9	9	9	9
Observations	3036	3036	3007	3036	3036

Notes: The table reports results from panel OLS regressions with the dependent variable being the percentage of category A calls that resulted in an emergency response arriving at the scene of the incident within 19 minutes in the regions of England between 2008 and 2017 (8 minutes for the fourth column). The regressions control for region fixed effects, as well as year fixed effects, and for unemployment, median age, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level and are presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

Table 5 also shows similar results for an alternative outcome – the percentage of category A calls that resulted in an emergency response arriving at the scene of the incident within 8 minutes. While this outcome is a better predictor of mortality risk than the equivalent criterion for 19 minutes due to the urgency of response, the quality and completeness of data for the 8-minute criterion is limited (NHS, 2024). Nevertheless, a similar analysis using this criterion also resulted in a clear reduction in the ambulance response quality for the health treatment.

[21] The data for ambulance quality indicators are only available in the regional level in England. Therefore, we are only considering region fixed effects and year fixed effects, and not local-authority fixed effects and region-year fixed effects as done in the previous calculations.

This confirms that the decline in healthcare services' ability to respond quickly to emergency calls is partially caused by austerity measures. This is an important channel in explaining the increase in mortality. On average, the reduction in the response quality indicator by 0.1 percentage points results in 4,000 emergency calls per year where ambulances fail to arrive at the scene within 19 minutes (NHS, 2024). Over the past decade in the United Kingdom, this delay has placed more than 35,000 people at high mortality risk, primarily due to the critical importance of early intervention following a cardiac arrest (Larsen et al., 1993).

4.3.1 NHS workforce decline

The changes in healthcare spending since 2010 led to a sharp decline in the NHS workforce (see Appendix C). This decline is likely to have had significant consequences for the quality of healthcare services available to the public and may, in particular, help explain the observed deterioration in ambulance response times. To examine this relationship, we use the relative decline in NHS workforce size across English regions between 2010 and 2015 as a treatment variable (NHS personnel shock). The results, presented in the fifth column of Table 5, indicate a statistically significant negative effect of workforce reductions on ambulance response quality.

While this effect is somewhat weaker than the overall impact on healthcare service provision, this is expected. The decline in ambulance response times can be attributed not only to a reduction in the number of qualified ambulance personnel but also to constraints on ambulance availability, both of which are shaped by broader healthcare spending patterns.

4.4 Impact on additional health outcomes

We have documented the effect of austerity on mortality, as well as on specific causes of death, such as drug poisoning. Austerity affected additional health outcomes that could contribute to future increases in mortality. In particular, we find that austerity led to increases in child obesity and the prevalence of diabetes. These outcomes, in turn, could be linked to higher mortality risk in the future.

To test the effect of austerity measures on child obesity, we replicate the previous calculations using the difference-in-differences specifications defined in Equation (3.1) and Equation (3.2). A limitation is that the local authority-level obesity data are available only for 2007–2019 and only in England. Adult obesity data, available by local authority only after 2014, prevent us from similarly testing austerity's impact on adult obesity. However, the correlation between child and adult obesity across local authorities in the United Kingdom after 2014 is 0.4.

Therefore, a clear effect on child obesity is likely to lead to future increases in adult obesity, and consequently, increased mortality.

Figure 16 presents the event study results for the dynamic specification (Equation (3.1)), showing the total relative impact on child obesity (among 10–11-year-olds). As before, there is no evidence of systematic divergence before 2010 that correlates with exposure to the austerity shock. However, following the onset of austerity measures, an increase in child obesity is observed. The results indicate an increase of up to 1 percentage point in obesity prevalence for every 1% decline in per capita healthcare or welfare spending per year between 2010 and 2019.

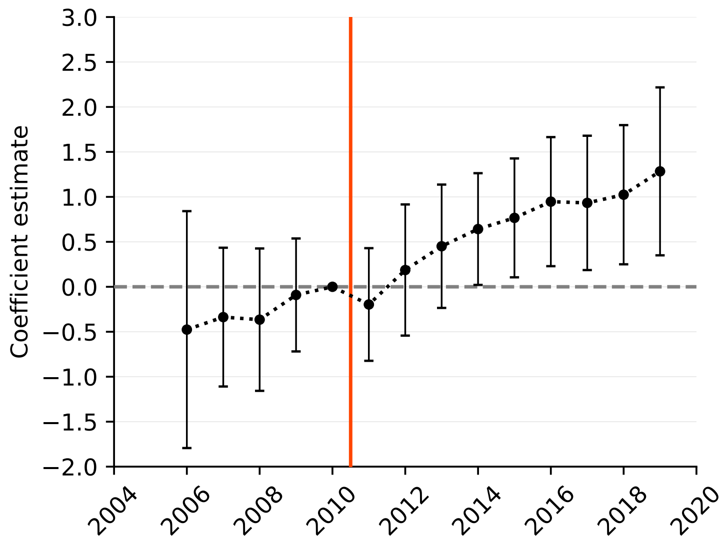

Figure 16: The effect of the combined healthcare and welfare austerity shock on prevalence of obesity among 10–11-year-olds.

Notes: The dependent variable is prevalence of obesity among 10–11-year-olds measured in percent. The graph plots point estimates of the interaction between the incidence of the austerity measures and a set of year fixed effects across local authorities in England. The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

Table 6 presents the pooled difference-in-differences results for child obesity and overall prevalence of diabetes. The point estimates suggest a significant effect of austerity exposure on both conditions. Specifically, the average prevalence of obesity among 10–11-year-olds increased by 1.5 percentage points (or 8%) between 2010 and 2019. Similarly, diabetes prevalence rose by 0.07 percentage points (or 1%) on average. These findings support the notion that austerity measures negatively impacted both health outcomes, indicating that austerity has not only contributed to increased mortality by 2019, but is likely to cause higher mortality rates in the future as well.

Table 6: The impact of austerity on child obesity and diabetes in England

	Child obesity	Diabetes
$\mathbf{1}_{t>2010}(t) \times Impact$	0.86***	0.038***
	(0.11)	(0.009)
Average effect	1.5	0.07
Mean of dep. variable	18.3	6.3
Local authorities	319	319
Observations	4119	3424

Notes: The table reports results from panel OLS regressions with the dependent variable being obesity among 10–11-year-olds and diabetes in English local authorities between 2006 (for obesity, 2009 for diabetes) and 2019. The regressions control for local-authority fixed effects, as well as region-by-year fixed effects throughout (year in the case of diabetes), and for unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level and are presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

5 Conclusion

This paper studies the effects of austerity measures enacted by the UK government after 2010 on life expectancy and mortality. First, we create a comprehensive panel dataset spanning from 2002 to 2019, based on administrative data. We then apply a difference-in-differences strategy to assess the impact of welfare benefit cuts and changes in health expenditure on life expectancy and mortality rates.

The findings revealed a decrease of 2.5 to 5 months in life expectancy by 2019, attributed to the austerity measures. Compared to men, women experienced nearly double the impact. Welfare benefit reductions were the main cause of the decline, having a larger impact than the relatively minor changes in healthcare spending.

This reduction in life expectancy translates into a significant setback of three years in life expectancy progress from 2010 to 2019. This is equivalent to about 190,000 excess deaths over the same period.

To better understand specific drivers of excess deaths, we study drug-related mortality. We identify a clear effect of austerity, accounting for approximately 9,000 drug-poisoning deaths between 2010 and 2019. Additionally, we find that changes in healthcare spending led to a clear decline in ambulance response quality, putting more than 35,000 people at high mortality risk over the past decade. These channels account for only a fraction of the overall excess deaths. Further exploration into additional mechanisms behind this increased mortality is thus necessary. Such mechanisms can include changes in nutrition or lifestyle induced by austerity, and additional quality measures of healthcare services.

Additionally, our findings suggest that these estimates are conservative. We find no direct clear effects on mortality from cuts in public expenditure on education, police, infrastructure, and other services by 2019. Yet, recognizing their potential latent effects is crucial. Reductions in education spending and delayed changes in lifestyle induced by austerity may have significant mortality implications over an extended horizon, spanning several decades.

We also find that the adverse effects of reductions in welfare and healthcare expenditures on life expectancy intensify progressively from 2011 to 2019. This is indicative of a lasting impact which is still at play. This impact may be relevant for recent public health crises, such as the COVID-19 pandemic. The broader socio-political implications are further demonstrated by the link between austerity and Brexit, as explored by Fetzer (2019). This, in turn, could exacerbate the negative impact of austerity on life expectancy.

Furthermore, the impact of austerity measures extends beyond mortality. Areas more reliant on welfare benefits, and thus more exposed to welfare cuts, were relatively poorer than less-exposed areas. Thus, our results highlight a regressive impact of austerity measures not only on income post taxes and transfers but on health outcomes as well. This adds an additional dimension to the social welfare impact of austerity.

We also calculate the marginal value of public funds (MVPF) for the austerity measures studied. Our findings suggest that, after accounting for years of life lost, the costs of austerity substantially outweigh the benefits of reduced public expenditure. This is evident for both welfare and health treatments.

Austerity, implemented by the British government in response to a financial crisis, aimed to cut spending and reduce national debt. Paradoxically, this fiscal strategy appears to have contributed to an increase in mortality, potentially offsetting its financial gains. However, it is possible that without austerity, the economic recession in the early 2010s might have been more severe. Hypothetically, this could have resulted in a higher mortality rate. While this is unlikely (see Appendix A), this interplay and the general equilibrium properties of policy changes such as austerity measures remain a subject for future research, extending beyond the scope of this paper.

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A Robustness Checks

This appendix details various robustness checks for ensuring the validity of the results in the paper. It addresses the following aspects:

- Addressing possible parallel trends violations using the "honest" difference-in-differences approach (Rambachan and Roth, 2023)
- Testing for interaction between austerity and recession shocks
- Addressing the impact of selection in treatment
- Adding various specifications to the analysis:
  - Binary treatment instead of continuous treatment
  - Sensitivity to region-aggregated welfare treatment
  - Robustness to alternative definitions of the health treatment
  - Defining treatment using other public services
  - Restriction of results to the period before the Brexit referendum
- Addressing the impact of cardiovascular disease mortality

A.1 "Honest" difference-in-differences calculations

Rambachan and Roth (2023) offer "tools for robust inference in difference-in-differences and event-study designs where the parallel trends assumption may be violated." We use these tools to test the robustness of the estimates presented in the paper. This allows confirming a limited sensitivity of the results to violations of parallel trends.

Specifically, we follow the sensitivity analysis laid out by Rambachan and Roth (2023), and "report confidence sets that allow the maximum post-treatment violation of parallel trends to be up to $\bar{M}$ times larger than the maximum pre-treatment violation for different values of $\bar{M}$." We set $\bar{M}$ to 0.6. While this choice is quite arbitrary, we would still be able to check how sensitive the results are to violations of parallel trends. In Figure A.1, we present such analysis for different specifications, including three different treatments and two different outcomes. In all cases, there exists a certain value of M where the violations become significant enough that the estimated coefficient would no longer be significant. However, in all cases, for low values of M, such as $M = 0.3$, the fixed length confidence intervals are all completely above zero or completely below. This gives confidence in the parallel trends assumption for the main analysis (Rambachan and Roth, 2023).

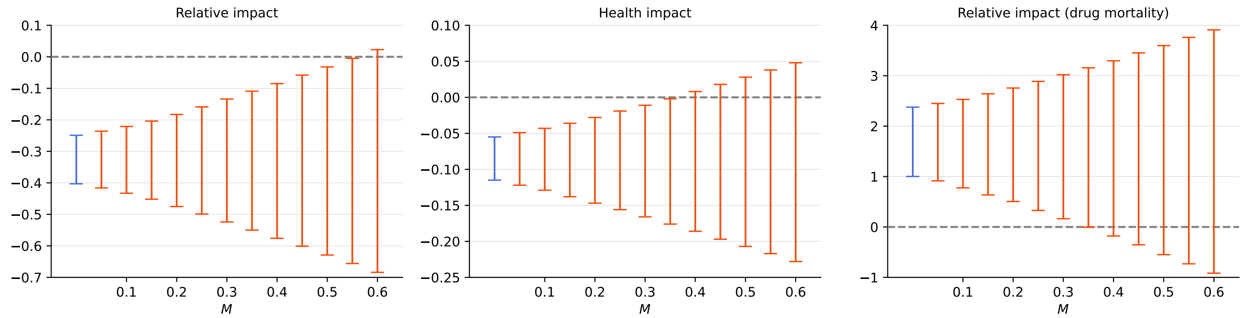

Figure A.1: Sensitivity analysis for different treatments and outcomes in the main analysis.

Notes: The blue confidence intervals refer to the original estimates. The different panels present a sensitivity analysis of the event study results for the total relative impact on life expectancy at birth (left); total health impact on life expectancy at birth (middle); total relative impact on drug-poisoning mortality rate (right).

A.2 Austerity shocks and recession shocks

The 2010s austerity in the United Kingdom was, to a large extent, a response to the global financial crisis (Fetzer, 2019). Austerity measures were put in place to avoid increasing government debt and help boost economic recovery. Furthermore, the recession that followed the global financial crisis, and the ongoing European debt crisis in the early 2010s, might have an effect on mortality in and of itself. This is supported by some evidence from the United States, arguing that the Great Recession led to reduced mortality across age groups and most causes of deaths, primarily due to reduced pollution (Finkelstein et al., 2024).

To test that possible similar effects do not invalidate our findings, we verify that the recession-induced economic shock in the local level is not related to the austerity shock. Figure A.2 shows that indeed, the welfare shock and the economic shock, measured by the relative decrease in real wages between 2009 and 2013, are uncorrelated across local authorities ($\rho = -0.044$; $p = 0.4$; $R^2 = 0.002$). Therefore, it is unlikely that the estimated effects of austerity on mortality are in fact due to the economic shock.

In addition, we tested whether changes in unemployment could be driving our results. While a rise in unemployment due to the recession shock might be an additional mechanism leading to increased mortality, we wanted to exclude the possibility that unemployment increased as a result of austerity. The pooled difference-in-differences (Equation (3.2)) shows a small, statistically insignificant effect of the total relative impact on unemployment ($0.05\% \pm 0.05\%$ increase in unemployment per percentage point, with $p > 0.2$).

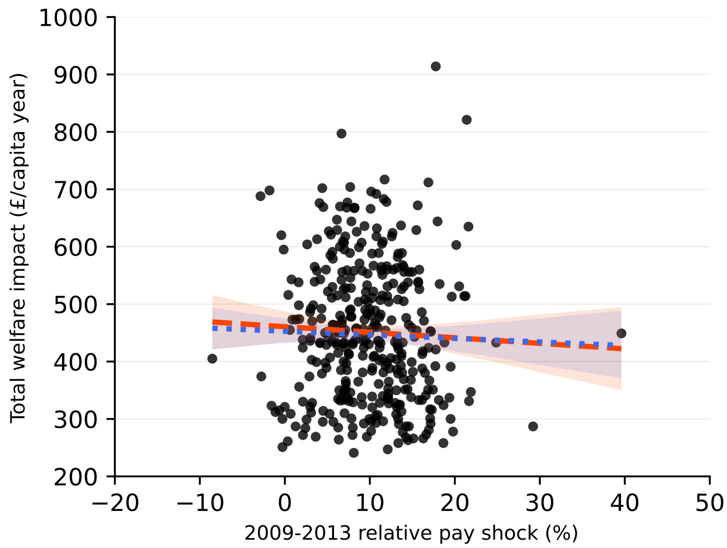

Figure A.2: The welfare shock and the recession economic shock across local authorities in the United Kingdom.

Notes: The austerity shock is taken as the welfare impact variable, as defined above. The economic shock, or relative pay shock, is defined as the relative decrease in real wages between 2009 and 2013 in the local-authority level. The dotted linear fit excludes top and bottom outliers.

Furthermore, we used the unemployment shock as treatment to estimate its effect on life expectancy. We considered the years 2005–2011, during which the unemployment shock was the largest in magnitude (an average increase of 3 percentage points across all local authorities). In this case as well, the pooled difference-in-differences (Equation (3.2)) shows a small, statistically insignificant effect on life expectancy (0.34 ± 0.22 years decrease in female life expectancy at birth per one percentage point increase in unemployment, with $p > 0.1$).

Table A.1 presents a series of estimates comparing the treatment effect of the total relative impact (RI_i) on life expectancy at birth across different scenarios. These scenarios jointly estimate the effects of austerity and the unemployment shock (UI_i), defined over either the 2005–2011 or 2010–2014 period. Across all scenarios, the estimated coefficients and average treatment effects remain consistent with the baseline estimate, indicating that the total relative impact is associated with a significant negative average effect on life expectancy of 3–5 months.

The results in Table A.1 are derived from a regression in which the treatment effect is estimated simultaneously for the austerity shock, the unemployment shock, and their interaction,

Table A.1: The impact of austerity on life expectancy in the United Kingdom – jointly estimating austerity and unemployment shocks

	Only austerity	Austerity + unemployment (2005–2011)	Austerity + unemployment (2010–2014)
$\mathbf{1}_{t>2010}(t) \times RI$	-1.87***	-2.77***	-1.97***
	(0.32)	(0.80)	(0.59)
$\mathbf{1}_{t>2010}(t) \times UI$		-0.42	-0.19
		(0.57)	(0.80)
$\mathbf{1}_{t>2010}(t) \times RI \times UI$		0.25	-0.05
		(0.24)	(0.35)
Average RI effect (months)	-3.4	-5.0	-3.6
Mean of dep. variable (years)	80.8	80.7	80.7
Local authorities	319	305	305
Observations	5215	5106	5106

Notes: The table reports results from panel OLS regressions with the dependent variable being life expectancy in English, Welsh, and Scottish local authorities between 2002 and 2019. The regressions control for local-authority fixed effects, as well as region-by-year fixed effects throughout. Standard errors are clustered at the local-authority level and are presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

using the following pooled difference-in-differences specification:

$$\begin{aligned} y_{i,r,t} &= \alpha_i + \theta_{r,t} \\ &+ \delta_1 \times \mathbf{1}_{t>2010}(t) \times RI_i \\ &+ \delta_2 \times \mathbf{1}_{t>2010}(t) \times UI_i \\ &+ \delta_3 \times \mathbf{1}_{t>2010}(t) \times RI_i \times UI_i \\ &+ \mathbf{x}_{i,t}\beta + \epsilon_{i,r,t}\,, \end{aligned}$$

where the notation follows Equation (3.2), with δ_1, δ_2, and δ_3 representing the estimated treatment effects of the austerity shock, the unemployment shock, and their interaction, respectively.

Figure A.3 presents the results of the joint estimation of the austerity shock's effect on life expectancy when accounting for unemployment shocks in a dynamic specification. The baseline series is taken from Figure 7. Including the unemployment shock and its interaction with the austerity shock yields results largely similar to the baseline. For the 2005–2011 unemployment shock, the pre-treatment coefficients are slightly positive, but a clear and steep decline in coefficient values is observed post-treatment.

These results indicate that overall, the relationship between unemployment and life expectancy, as well as between austerity and unemployment, is fairly weak and cannot be driving the main results.

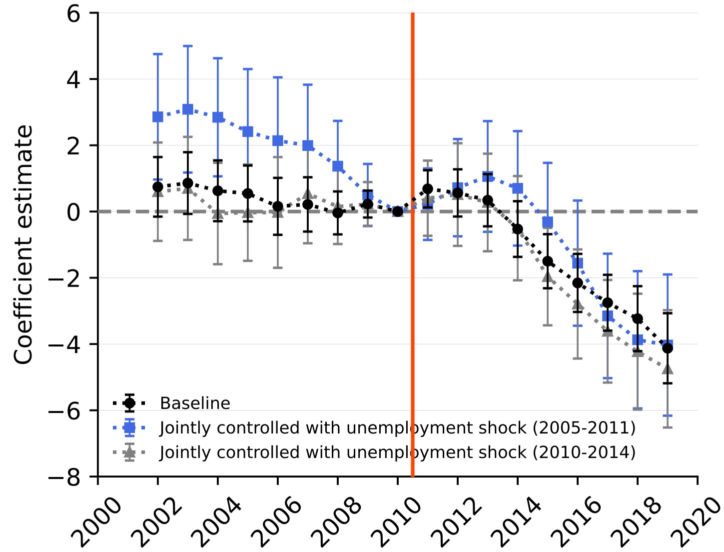

Figure A.3: The effect of the combined healthcare and welfare austerity shock on life expectancy at birth, with and without accounting for the unemployment shock.

Notes: The dependent variable is life expectancy at birth measured in months. The graph plots point estimates of the interaction between the incidence of the austerity measures and a set of year fixed effects across local authorities in England, Scotland, and Wales. The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

A.3 Addressing the impact of selection in treatment

The impact of austerity measures on benefits, as assessed by Beatty and Fothergill (2014), exhibits a clear correlation with life expectancy across local authorities. This is also true for the total health impact, although to a lesser extent. This is depicted in Figure A.4. Consequently, regions characterized by greater deprivation, where austerity measures had a more pronounced impact compared to other areas, demonstrated lower baseline life expectancy before the implementation of these measures.

The non-random assignment of treatment is generally addressed in our empirical design by using a difference-in-differences approach and verifying parallel trends. However, there remains a potential concern that the results may be driven by deprivation rather than by austerity measures specifically. If, for some reason, deprivation became more influential on mortality after 2010, this could affect our interpretation.

To address this concern, we conduct the analysis while excluding local authorities above a certain threshold in average wages. We repeat the analysis, progressively lowering the threshold, and calculate the treatment effect on the remaining subsample each time. The

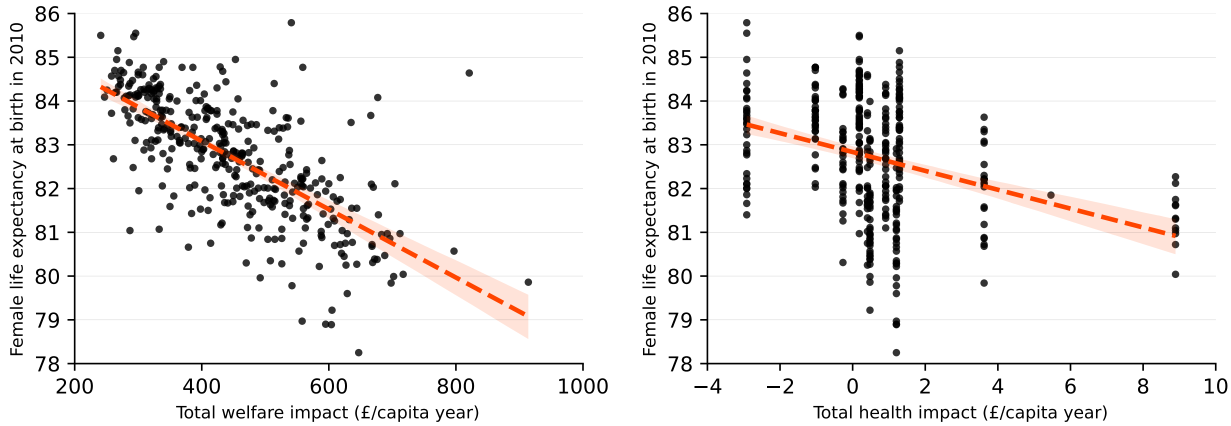

Figure A.4: The association between life expectancy and exposure to austerity.

Notes: Left) The chart displays female life expectancy at birth in 2010 and total welfare impact across local authorities in the United Kingdom. The shaded areas represent 95 percent confidence intervals to the linear fit; Right) Similar to left, with total health impact. The total health impact is defined by region and not by local authority. Life expectancy is by local authority.

results of this test are presented in Figure A.5.

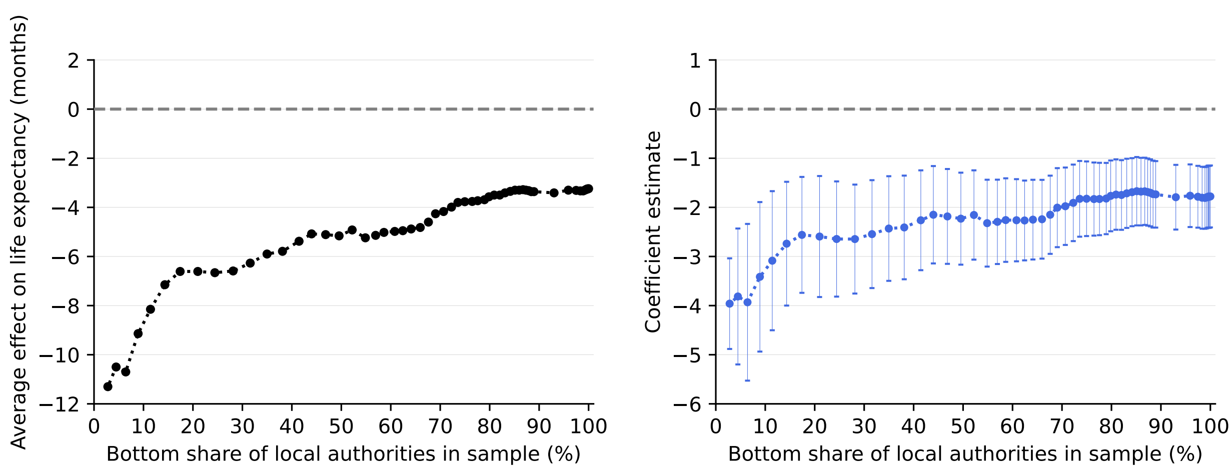

Figure A.5: The total relative impact effect on life expectancy by level of deprivation.

Notes: The figure shows the treatment effect of the total relative impact on life expectancy in the United Kingdom, measured as average treatment effect (left, in months), and the regression coefficient (right, in months per percent, *c.f.*, Figure 7). In each regression, we excluded from the sample the least deprived local authorities above a certain threshold of average wage. For example, 100% represents a case where none of the local authorities are excluded, and 10% represents a case where the top 90% of the local authorities in terms of wage are excluded. The results are based on regressions similar to Equation (3.2), in which a set of year fixed effects across local authorities in England, Scotland, and Wales. The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

Importantly, even when focusing only on the most deprived local authorities in terms of

2010 income – such as the bottom 10% or fewer (fewer than 40 local authorities) – the effect remains robust and substantial. In fact, the effect becomes almost monotonically larger as richer local authorities are excluded. However, due to the smaller sample sizes, the standard errors increase, and the coefficients are not significantly different for the most part.

As expected, when progressively including more local authorities, the average effect and the estimated coefficient converge to their baseline value.

These results suggest that the treatment effect is not driven by deprivation. Even when comparing local authorities with similar levels of deprivation but different levels of austerity shock, there is a clear effect of austerity on life expectancy.[22]

A.4 Alternative specifications

A.4.1 Binary treatment specification

The main specification we use in the difference-in-differences analysis is based on a continuous treatment variable since all units are treated. While this is intuitive, it is also useful to consider a specification where the treatment variables are binary. This allows using the intuition for binary treatment difference-in-differences, as well as using matching so that we create balanced treated-untreated subsamples.

To create the binary treatment we simply divide all the local authorities into two groups in terms of the welfare treatment – above median treatment intensity and below median treatment intensity. Then, we define the half above the median as treated, and the other half as non-treated. Similarly, we define another separation of the entire sample based on the health treatment. In each case we run a dynamic specification as follows:

$$y_{i,r,t} = \alpha_i + \theta_{r,t} + \sum_{t \neq 2010} \delta_t \times Year_t \times Treated_{i,j} + \mathbf{x}_{i,t}\beta + \epsilon_{i,r,t}\ , \tag{A.1}$$

where the notation is similar to Equation (3.1), with $Treated_{i,j}$ being 0 or 1, for each unit i for treatment j (welfare or health).

Additionally, we use nearest-neighbor matching with Mahalanobis distance (the distances are determined by all the control variables: unemployment, in- and out-migration relative flows, log of average wages, and log of population. We then re-run Equation (A.1) for the pruned sample.

[22] We further address this issue in the next subsection by using a binary treatment definition with matched treatment and control groups.

The results are presented at Figure A.6. They show very similar patterns to what have been found based on the continuous treatment. Matching changes only marginally the results and the error (less than 10 percent of local authorities are pruned).

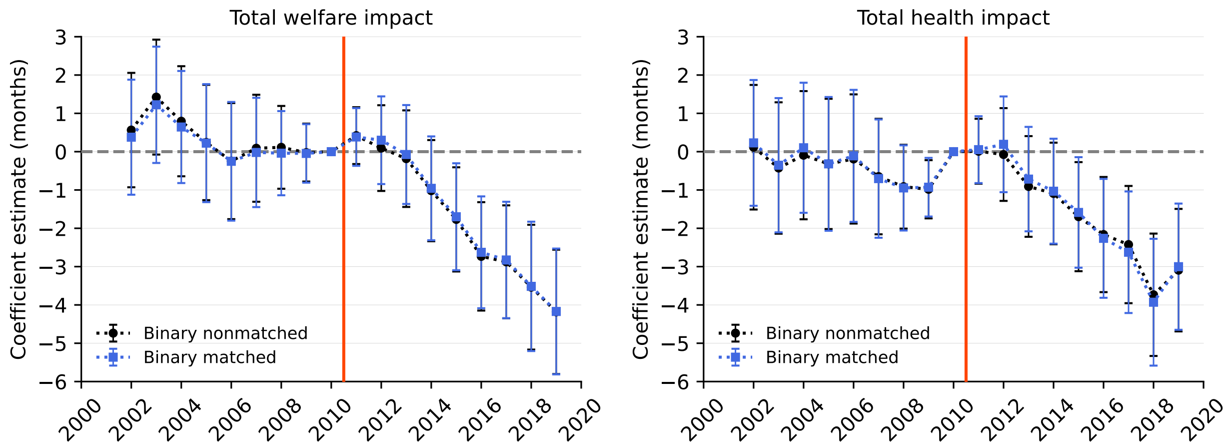

Figure A.6: The effect of binary treatment on female life expectancy at birth.

Notes: The dependent variable is female life expectancy at birth measured in months. The graph plots point estimates of the interaction between a binary measure of the incidence of austerity (welfare – left; health – right) and a set of year fixed effects across local authorities in England, Scotland, Wales and Northern Ireland (the latter only for the health treatment). For the non-matched samples, the regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

The results also confirm the parallel trends assumption in a binary setting. Our baseline specification uses a continuous treatment framework, which entails a strong parallel trends assumption for the resulting coefficients to have a valid causal interpretation (Callaway, Goodman-Bacon and Sant'Anna, 2024). The observed similarity between the results for continuous and binary treatments mitigates concerns that the continuous treatment assumptions may be overly restrictive or that the baseline coefficients might be misinterpreted.

A.4.2 Sensitivity to region-aggregated welfare treatment

There is a key difference between using welfare and health total impacts. Healthcare spending is defined in the region level rather than the local-authority level. Therefore, when considering the health treatment, the term $\theta_{r,t}$ in Equation (3.2) and Equation (3.1) needs to be replaced by $\theta_{c,t}$ which accounts for country-year fixed effects, and not region-year fixed effects. More specifically, since Wales, Scotland, and Northern Ireland are each both a region and a country, the c in $\theta_{c,t}$ would be considered as either England or not (*i.e.*, Wales, Scotland, or Northern Ireland). This difference, as well as the aggregation of the treatment into a regional level makes this specification potentially less accurate than in the case of the welfare treatment.

To ensure this change does not introduce substantial bias or error, we first replicate the calculations in Table 1 and Figure 5 using a regionally aggregated measure of welfare treatment. The region-aggregated total welfare impact values are also taken from Beatty and Fothergill (2014), and are essentially population-weighted averages of the local-authority level values. Table A.2 presents a comparison of the pooled difference-in-differences point estimates between the two welfare treatments. It shows the results are qualitatively identical.

Table A.2: The impact of austerity on life expectancy in the United Kingdom – welfare results; local authority vs. region results

	Female at 65	Female at 65 (region)	Female at birth	Female at birth (region)
$\mathbf{1}_{t>2010}(t) \times Welfare$	-0.012***	-0.012***	-0.011***	-0.019***
	(0.002)	(0.003)	(0.002)	(0.004)
Average effect (months)	-5.2	-5.6	-4.8	-9.0
Mean of dep. variable (years)	20.6	20.6	82.4	82.4
Local authorities	379	379	379	379
Observations	6822	6822	6822	6822

Notes: The table reports results from panel OLS regressions with the dependent variable being life expectancy in English, Welsh, and Scottish local authorities between 2002 and 2019. The regressions control for local-authority fixed effects, as well as region-by-year fixed effects throughout. Standard errors are clustered at the local-authority level and are presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

Figure A.7 shows a comparison between the dynamic estimates (Equation (3.1)). It shows some difference between the region-aggregated and local-authority level treatments. The region-aggregated treatment is qualitatively similar, but the overall estimated effect is somewhat larger. Taking errors into account, however, it is difficult to distinguish between the two treatments.

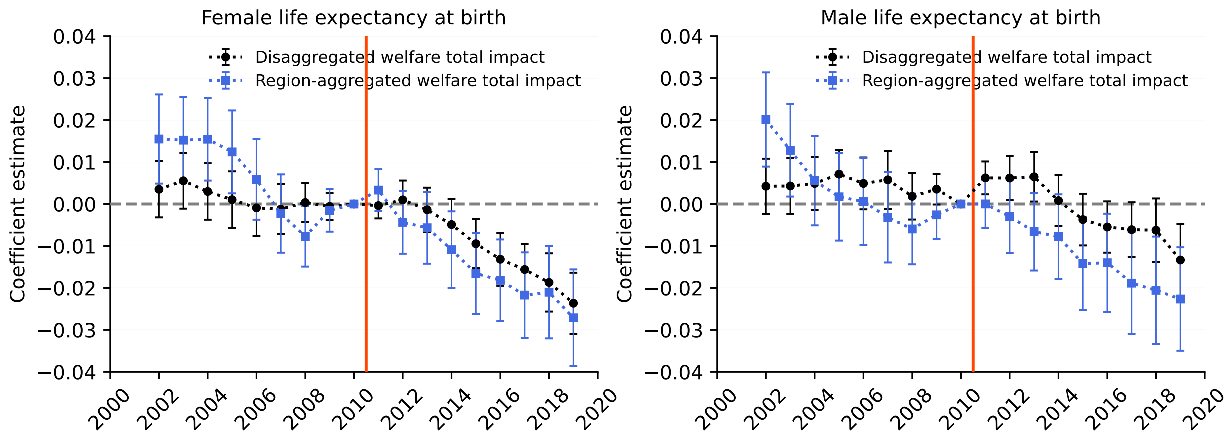

Figure A.7: The effect of the welfare austerity shock on life expectancy at birth.

Notes: The dependent variable is female (left) and male (right) life expectancy at birth measured in months. The estimates in black use total welfare impact in the local-authority level and region-year fixed effects. The estimates in blue use region-aggregated welfare impact values and country-year fixed effects. The graph plots point estimates of the interaction between the incidence of the austerity measures and a set of year fixed effects across local authorities in England, Scotland, and Wales. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

A.4.3 Alternative definitions for the health treatment

The total health impact defined in Section 2 and used throughout the paper is measured as the change in health expenditure per capita per year between 2010 and 2015 in each region. This measurement is weighted by the inverse of the working-age population in each region to account for the differential effects of changes in health expenditure on relatively younger or older regions.

To verify that this weighting does not drive the results, we compare the main results obtained using the health treatment to three alternative definitions. First, we consider the non-weighted change in health expenditure per capita per year between 2010 and 2015 in each region, defined as alternative A_1. The other two definitions, A_2 and A_3, are defined similarly to the preferred treatment (A_0) in the case of A_2 and to A_1 in the case of A_3, but instead consider the difference between 2009 and 2013. These alternatives help verify that the specific choice of years (*i.e.*, 2010 and 2015) is not driving the results.

Importantly, the average real decrease in health expenditure per capita per year between 2010 and 2015 was £0.59 (in 2010 pounds). Between 2009 and 2013 this decrease was £88 (in 2010 pounds). This is a substantial quantitative difference, which is expected to make the overall effect in alternatives A_2 and A_3 larger than for the other treatments. However, the main importance is in the robustness of the results in terms of statistical significance, rather than the effect size, as the choice in 2010 and 2015 was made for consistency with the welfare treatment.

To compare the definitions we first run the pooled difference-in-differences specification. Table A.3 presents a comparison of the point estimates between the four health treatments for female life expectancy at birth. Comparing the preferred treatment and the non-weighted treatment A_1 reveals minor differences. As expected, A_2 and A_3 provide results that are consistent with A_0 and A_1 qualitatively, but with a larger average effect, due to the higher average decrease in health expenditures per capita.

Table A.3: The impact of austerity on female life expectancy at birth in the United Kingdom – healthcare results; alternative treatment definitions

	Preferred (A_0)	A_1	A_2	A_3	$A_{placebo}$
$\mathbf{1}_{t>2010}(t) \times Health$	-0.33**	-0.32***	-0.01***	-0.01***	-0.003
	(0.140)	(0.060)	(0.003)	(0.002)	(0.003)
Average effect (months)	-0.2	-0.2	-0.6	-1.2	0.07
Mean of dep. variable (years)	82.4	82.4	82.4	82.4	82.4
Local authorities	378	378	378	378	378
Observations	6536	6536	6536	6536	6536

Notes: The table reports results from panel OLS regressions with the dependent variable being life expectancy in English, Northern Irish, Welsh, and Scottish local authorities between 2002 and 2019. The regressions control for local-authority fixed effects, as well as country-by-year fixed effects, and for unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level and are presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

We also consider an event-study estimation to compare the different definitions. This comparison is presented in Figure A.8, where the results for A_0 and A_1 are compared, while A_2 and A_3 are compared separately, since the coefficient values themselves are not comparable across the periods 2010–2015 and 2009–2013, as explained above. The results, as expected, are qualitatively similar. The only notable difference is a brief pre-trend observed between 2002 and 2004 for A_1 and A_3. However, this occurs well before the main analysis period, and all definitions present clear parallel trends between 2005 and 2010. We therefore conclude that the choice of definition has only a marginal effect on the results, which remain qualitatively consistent.

Table A.3 also reports the results of a placebo test ($A_{placebo}$), in which the treatment is defined as the change in per capita healthcare spending between 2008 and 2010. This is

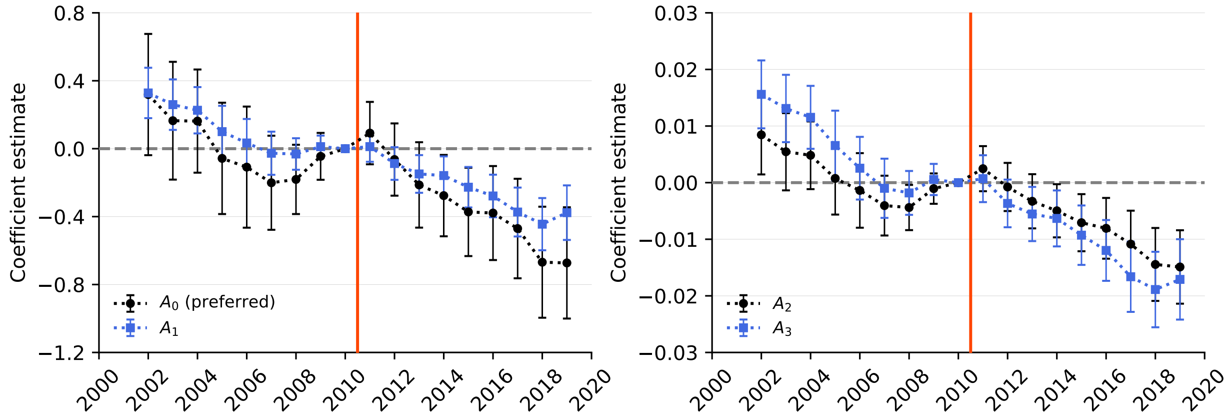

Figure A.8: The effect of the health shock on female life expectancy at birth.

Notes: The dependent variable is female life expectancy at birth measured in months. The left panel shows results for the health shock definitions A_0 and A_1, and the right panel shows results for A_2 and A_3. The graphs plot point estimates of the interaction between the incidence of the austerity measures and a set of year fixed effects across local authorities in England, Northern Ireland, Scotland, and Wales. The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

prior to the implementation of austerity measures. The choice of 2008 as the baseline year is dictated by data availability. The results indicate no significant effect on female life expectancy at birth after 2010 (or after 2008). This placebo test is particularly relevant, as the preferred specification accounts for realized changes in healthcare spending rather than planned changes.

In addition to the region-based specifications discussed above, we introduce an alternative definition of the health shock based on local authority data. The increased granularity of this approach allows for a more nuanced consideration of variation in treatment effects. However, as noted earlier, a limitation arises from the fact that many individuals receive healthcare outside their local authority of residence, though still within their broader region. Despite this limitation, this specification serves as an additional robustness check for the health treatment.

To construct the health shock variable under this definition, we use the division of NHS trusts in England into Clinical Commissioning Groups (CCGs). The overlap between CCGs and local authorities is substantial, enabling us to define a health shock for 289 local authorities. Each CCG is characterized by its *need population*, which adjusts the population size based on age distribution and the healthcare needs of the local demographic. Local authorities with older populations typically have a need population larger than their actual population, while those with younger populations often show the opposite pattern. Using these need-adjusted populations, we allocate regional health spending proportionally to each local authority's share of the total need population in the region. This process is conducted for the years 2010 and 2015. We then divide the allocated spending by the actual population of each local authority for both years and calculate the difference (adjusted for inflation) to derive the health shock, now weighted by the need population.

This alternative definition (A_{need}) allows us to estimate the effect of the health shock on life expectancy. The pooled difference-in-differences specification yields a coefficient of -0.0009 (years of life per pound per person year) with $p < 0.001$, further validating the robustness of our findings.

A.4.4 Defining treatment using other public services

In this paper, treatment is defined based on two dimensions of austerity: welfare benefit cuts and changes in healthcare spending. In practice, other publicly funded services such as policing, infrastructure spending, and education were also affected, and substantially decreased in real terms between 2010 and 2015. We defined two additional treatment specifications for police spending, and for total services excluding police and healthcare. The latter, like the health treatment defined in Section 2, is given only by region. The police expenditures are given by police force area, a geographical unit smaller than a region and larger than a local authority.

In the event studies depicted in Figure A.9, we present results for the dynamic specification (Equation (3.1)) for life expectancy at birth among females given the two additional treatment definitions. The case of police spending is indicative of a negative effect of the treatment on life expectancy, however it is not statistically significant. Estimating a pooled difference-in-differences also reveals an insignificant effect, albeit negative.

For the total services treatment Figure A.9 indicates that the parallel trends assumption is violated. This makes it difficult to attribute a clear effect to this treatment. While there seems to be a growing negative effect of the second half of the 2010s, it is inconclusive.

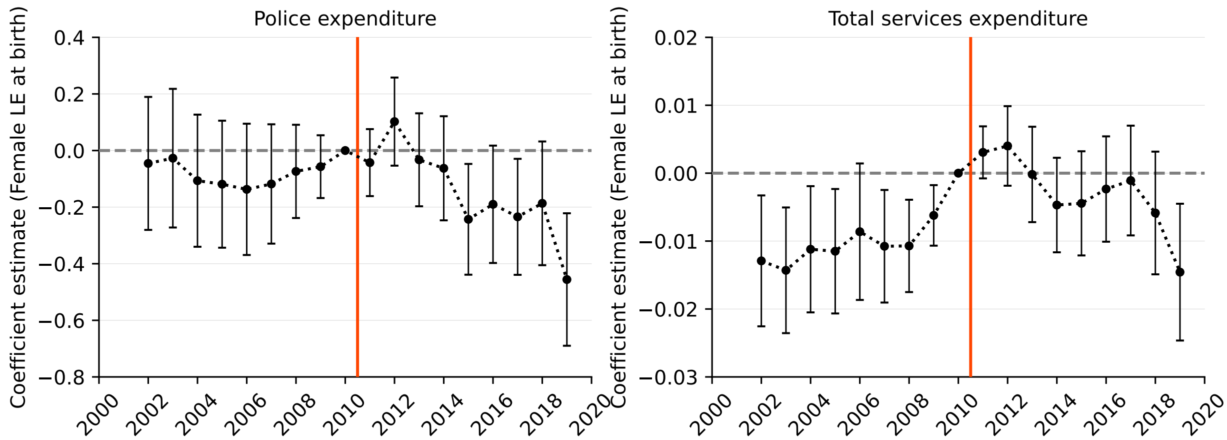

Figure A.9: The effect of additional austerity measures on female life expectancy at birth.

Notes: The dependent variable is female life expectancy at birth measured in months. The graph plots point estimates of the interaction between the incidence of the austerity measures (reduction in police spending in the left, and reduction in total services spending in the right) and a set of year fixed effects across local authorities in England, Northern Ireland, Scotland, and Wales. The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

A.4.5 Restriction of results to the period before the Brexit referendum

It is possible that the observed effect is, in part, an outcome of the Brexit referendum results, rather than of austerity measures. In the June 2016 Brexit referendum the British public voted in favor of leaving the European Union. This was a largely unexpected outcome with potentially negative effects on the British economy and the welfare of British people (Born et al., 2017; Kavetsos et al., 2021). If these effects are correlated with the treatment used in the main analysis, then it is possible that the effects estimated and discussed above, are partly explained by the Brexit referendum results. To address this concern we rerun the main analysis while limiting the years of the analysis to 2002–2015. This is displayed for the pooled difference-in-differences in Table A.4, and for the event study plot in Figure A.10. They both show that a significant effect already exists before the Brexit referendum. The referendum might have contributed further to the trends brought about by austerity, but it cannot explain the main results described above.

Table A.4: The impact of austerity on life expectancy in the United Kingdom before 2016

	Welfare impact	Health impact	Total relative impact
$\mathbf{1}_{t>2010}(t) \times Impact$	-0.004*	-0.157	-0.982***
	(0.002)	(0.131)	(0.010)
Average effect (months)	-1.8	-0.1	-1.8
Mean of dep. variable (years)	82.1	82.1	82.1
Local authorities	378	378	373
Observations	5051	5051	5005

Notes: The table reports results from panel OLS regressions with the dependent variable being female life expectancy at birth in English, Northern Irish, Scottish, and Welsh local authorities between 2002 and 2015. The regressions control for local-authority fixed effects, as well as region-by-year fixed effects throughout (country-by-year in the case of the health impact), and for unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level and are presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

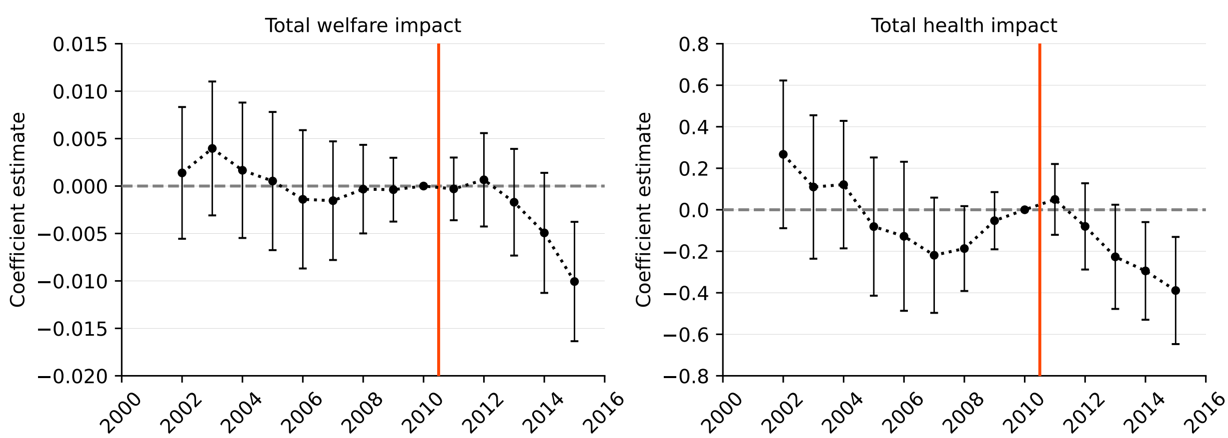

Figure A.10: The effect of austerity measures on female life expectancy at birth by 2015.

Notes: The dependent variable is female life expectancy at birth measured in months. The graph plots point estimates of the interaction between the incidence of the austerity measures and a set of year fixed effects across local authorities in England, Northern Ireland, Scotland, and Wales. The regressions control for local-authority unemployment, in- and out-migration relative flows, log of average wages, and log of population. Standard errors are clustered at the local-authority level with 95 percent confidence intervals indicated.

A.5 Cardiovascular disease mortality

A key motivation for this paper is the observed slowdown of the life expectancy improvements in the United Kingdom after 2010. This stagnation is also reflected in the dynamics of crude mortality rates, as presented in Figure A.11.

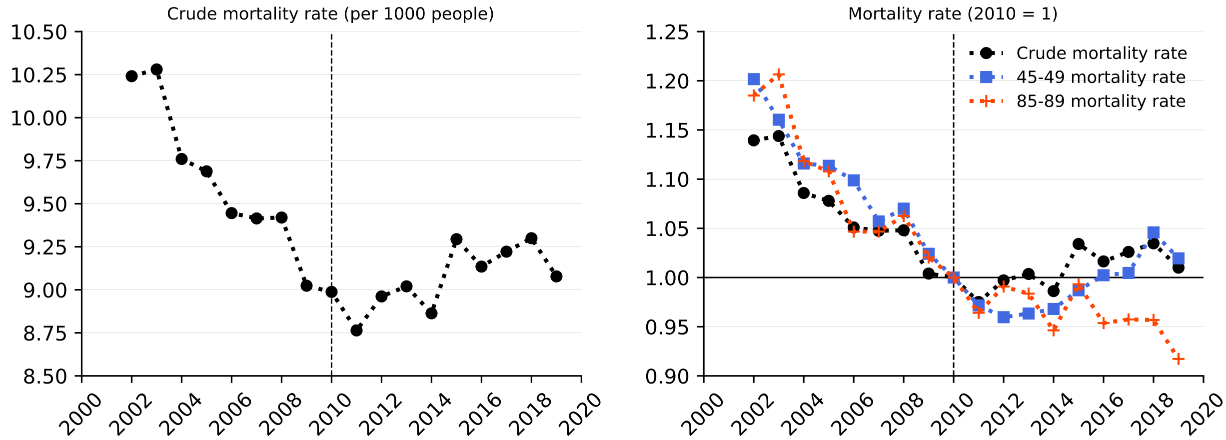

Figure A.11: Crude mortality rates in the United Kingdom, 2002–2019.

Notes: Left) Crude mortality rate per 1,000 people; Right) Crude mortality rates normalized to 1 at 2010 for all population (black), 45–49 year-olds (blue) and 85–89 year-olds (red) (source: Office for National Statistics (2023)).

The crude mortality rate decreased quickly in the United Kingdom between 2002 and 2011, and has since gone up from about 8.75 deaths per 1,000 a year to 9 deaths per 1,000 a year in 2019. The right panel of Figure A.11 shows that different age groups experienced varying dynamics over the observed time period. For example, 85–89 year-olds still saw some improvement in their mortality rate between 2011 and 2019. The dynamics for 45–49 year-olds, however, follow closely the dynamics for the overall population. The differences between the evolution of mortality rates across age groups are suggestive of interventions with a differential effect.

These trends (shown in Figure A.11) are not unique to the United Kingdom. Specifically, a similar trend has been observed in the United States. In the United States, in which there was no large scale austerity after 2010, the trend has been largely attributed to slower improvements in cardiovascular disease (CVD) mortality (Mehta, Abrams and Myrskylä, 2020). Other deaths, and in particular drug-related deaths have been substantially increasing as well (Mehta, Abrams and Myrskylä, 2020; Case and Deaton, 2021). Slower improvements in CVD mortality also occurred in the United Kingdom between 2010 and 2019 (Cheema et al., 2022; World Health Organization, 2023). However, the change is not as substantial as in the United States (Mehta, Abrams and Myrskylä, 2020). This is presented in Figure A.12, which illustrates the CVD mortality rates in the United Kingdom and the United States.

The data on CVD deaths by local authority in the United Kingdom are only accessible from 2013 (NOMIS, 2023). Consequently, the difference-in-differences methodology, as employed

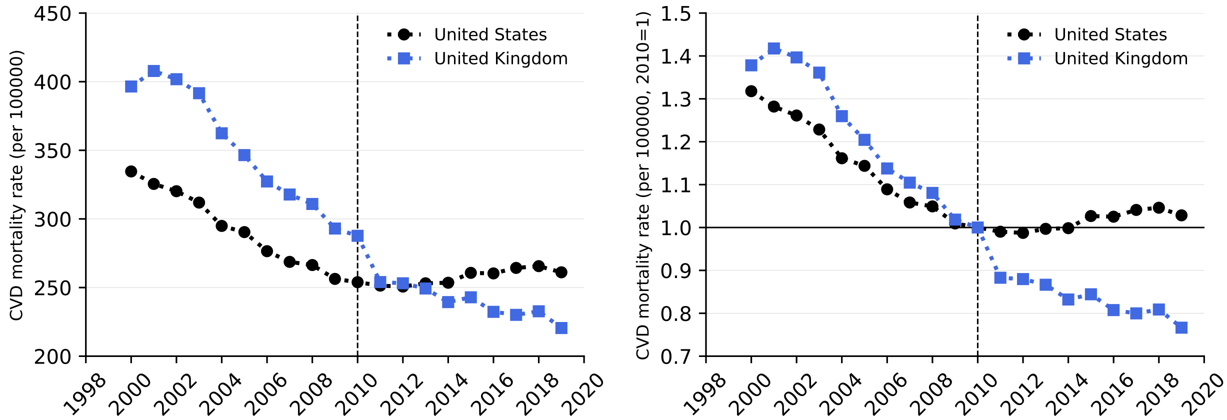

Figure A.12: Cardiovascular disease mortality rates in the United States (black) and the United Kingdom (blue), 2000–2019.

Notes: Left) Crude CVD mortality rate (per 100,000 people); Right) Crude CVD mortality rate normalized to 1 in 2010 (source: World Health Organization (2023)).

in the primary analysis of this paper, cannot be applied. However, we can descriptively check whether the change in CVD mortality rate between 2013 and 2019 correlates with the treatment variables employed in our primary analysis. Figure A.13 shows the lack of such correlation. The observed data suggest an inherent lack of association between exposure to austerity measures and the change in CVD mortality rate during the specified period. This ensures that the key results are not influenced by underlying, unobserved variations in CVD mortality, which could potentially be erroneously associated with exposure to austerity measures.

This can also be shown dynamically. Figure A.14 presents the average CVD mortality rate in high-exposure vs. low-exposure to austerity measures across local authorities. It shows that at least from 2013 to 2019, there is no indication of any divergence between the mortality rates over time, in neither of the treatments, welfare nor health.

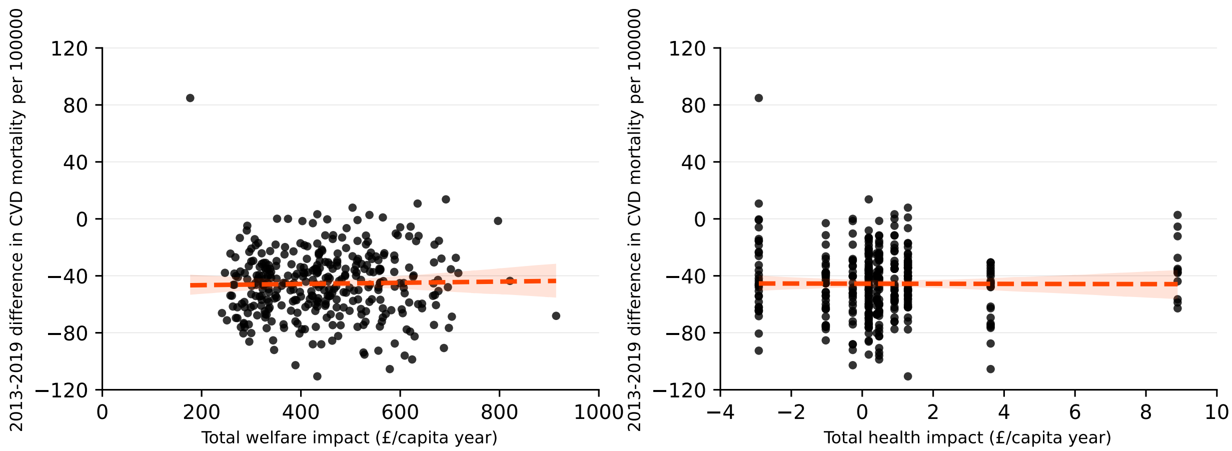

Figure A.13: The association between exposure to austerity and CVD mortality rate.

Notes: Left) A scatterplot showing the difference in CVD mortality rate (per 100,000 people) between 2013 and 2019 plotted against the total welfare impact across local authorities; Right) A scatterplot showing the difference in CVD mortality rate (per 100,000 people) between 2013 and 2019 plotted against the total health impact across local authorities.

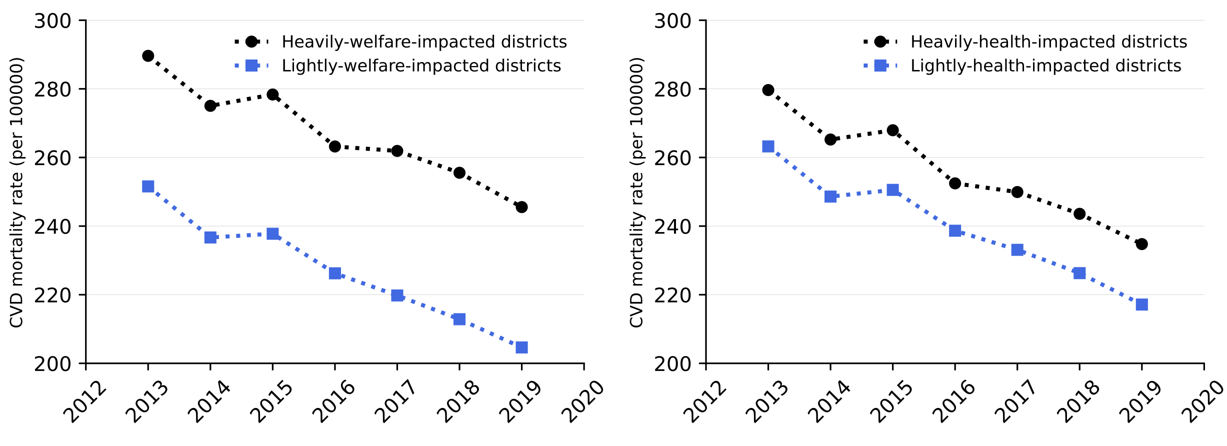

Figure A.14: Parallel trends in CVD mortality across exposure levels to austerity.

Notes: The charts show the average CVD mortality rate between 2013 and 2019 in a group of local authorities that are more exposed to austerity and less exposed to austerity. More-exposed (less-exposed) areas are defined as areas with impact higher (lower) than the median exposure to the austerity measures. The left panel considers exposure to the total welfare impact. The right panel shows exposure to the total health impact.

B Descriptive Statistics of Dataset

Table B.1 presents descriptive statistics of key variables in our dataset.

Table B.1: Descriptive statistics of key variables

	Observations	Mean	Std. Dev.	Min.	Max.
Population (2019)	381	175318	147505	2409	1893700
Log population (2019)	381	11.9	0.6	7.8	14.5
Inflow rate per 100,000 (2019)	381	6301.5	2511.9	0	24153.9
Outflow rate per 100,000 (2019)	381	5844.4	2544.9	0	18603.7
Life expectancy at birth (2019)	379	81.3	1.7	75.8	86.0
Female median age (2019)	377	43.1	5.1	29	55
Female life expectancy at birth (2019)	380	83.1	1.6	78.3	87.9
Female life expectancy at 65 (2019)	380	21.2	1.1	18.0	25.4
Male median age (2019)	377	41.1	4.9	28	53
Male life expectancy at birth (2019)	380	79.4	1.8	73.1	84.7
Male life expectancy at 65 (2019)	380	18.7	1.1	15.3	23.1
Drug poisoning mortality rate per 100,000 (2019)	333	7.8	4.0	2.5	31
Total relative impact (percent / year / capita)	373	1.82	0.72	0.55	5.07
Total welfare impact (£/ year / capita)	380	447.9	121.4	177	914
Total health impact (£/ year / capita)	381	0.59	2.07	-2.9	8.9
Total education impact (£/ year / capita)	381	60.7	19.3	37.3	167.0
Real pay (£2002)	373	21105	5081	14463	63914
Unemployment (2019)	379	3.59	1.1	1.5	8.2

C NHS Worforce 2009–2019

The changes in healthcare spending in 2010 and the subsequent years led to a sharp decline in the NHS workforce. Our results indicate that this had a significant impact on the quality of healthcare services available to the public. Figure C.1 displays the number of full-time equivalent NHS workers per million people in England from 2009 to 2019. The figure shows a steep decline between 2010 and 2013, followed by a slower recovery from 2013 to 2019. It was only in 2019 that workforce numbers returned to their pre-austerity levels.

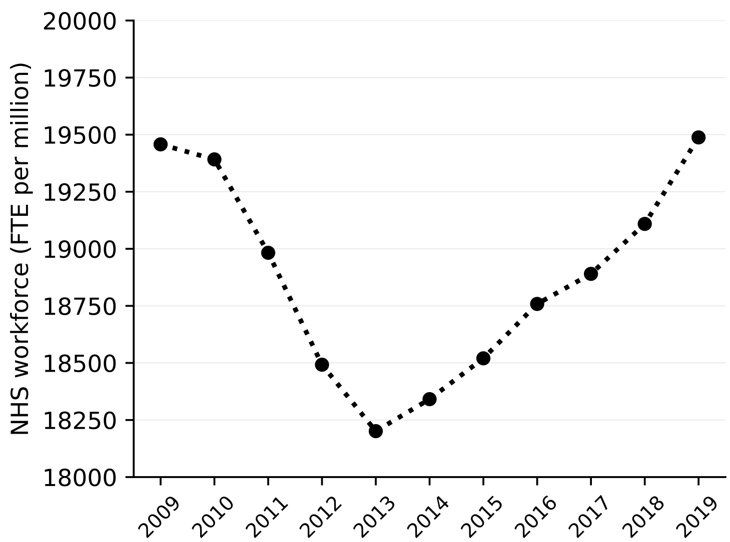

Figure C.1: Full-time equivalent NHS workforce per capita in England, 2009–2019.

Notes: The number of full-time equivalent (FTE) workers in NHS England per million people (source: NHS (2019)).