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Abstract

We investigate the health impacts of unemployment during the Great Recession and are the first to focus on incidence of chronic diseases in a unique individual-level longitudinal database of Electronic Health Records. We exploit the exogenous shock in the economic conditions occurred in 2008 in Italy to estimate heterogenous effects of unemployment in an individual fixed effects model. Our results document that economic downturns have a long-lasting effect on the incidence of cardiovascular diseases and a temporary effect on depression. The effects increase with age and are stronger right before retirement age. Women are disproportionally affected by cardiovascular diseases, while men are disproportionately affected by depression. An important recommendation emerging from this study is that policy makers should bear in mind that prolonged economic downturns constitute an additional external risk for individual health and not a temporary benefit.

Keywords: health status, unemployment, economic crisis, Great Recession.

JEL: I10, E32, J20, Q53.

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1 Introduction

In virtually all societies, socio-economic conditions are a key determinant of health. Individuals living in wealthier countries and individuals with high incomes are, on average, healthier and live longer. Moreover, those with better employment prospects are likely to enjoy better mental and physical health. Nevertheless, an influential body of research shows how economic expansions can exacerbate mortality rates by increasing environmental pollution and behavioral risks (McInerney and Mellor, 2012, Ruhm, 2015, 2016, Stevens et al., 2015, Toffolutti and Suhrcke, 2014, among others). The relationship between economic conditions and health is context dependent, can vary over time, and can be different in the short-term vs long-term. The context heterogeneity is related to both the type of economy and the healthcare system, and the severity of recessions and the strength of economic surges can play a substantial role as well. In particular, the effects of economic conditions are likely to differ substantially across health measures, since specific diseases can be a more timely short-run indicator than mortality.

Before the COVID-19 pandemic, the Great Recession (GR) was labelled the deepest global economic downturn since World War II. GDP fell significantly in most countries, with a dramatic increase in unemployment. The introduction of fiscal austerity to alleviate public debt favored a global slowdown, with important effects on several domains including health (OECD, 2016).

A number of studies have examined the effect of the GR on mortality, showing that the GR actually reduced the mortality rate in many European countries and in the US (Baker, 2014, Tapia Granados and Ionides, 2017). Yet, from both an economic and a health perspective, investigating the impact of economic downturns on diseases rather than on mortality is of crucial importance since several health complications may not lead to death in the short run. Progress during recent decades has transformed once deadly diseases into more manageable chronic conditions, which leads to substantial increases in life expectancy, but not in disease free life expectancy (Stuckler et al., 2009). Moreover, disease diagnoses are a more timely reflection of changes in individual health status than mortality, which is likely to occur with a substantial time lag. Analyzing disease incidence due to changes in economic conditions is particularly important from a policy perspective, since the medical cost of chronic diseases are often borne by the healthcare system for a long time. Therefore, the empirical evidence could offer relevant policy advice for designing targeted interventions.

Surprisingly, while mortality effects associated with economic downturns have been extensively studied, only a few studies focus on health outcomes. Currie et al. (2016) and Tekin et al. (2013) use longitudinal and repeated cross sectional surveys to show that the rise in the US unemployment rate during the GR worsened self-reported health status and behavioral outcomes, with stronger effects on the most fragile population groups, such as disadvantaged mothers and less educated individuals. These findings have been reinforced by Wang et al. (2018), who exploit six waves of the Panel Study of Income Dynamics in the US and find an overall health deterioration in terms of alcohol consumption, obesity, self-reported health and mental distress. In Europe, the main findings are summarized by Thompson et al. (2019), who consider forty-two studies analyzing the health effects of the GR in Europe and find that more than 60% of these studies point to health declines. In Italy, Colombo et al. (2018) use a cross-sectional setting to analyze the impact of economic fluctuations in Italy during the period 1993–2012, showing that higher unemployment rates are associated with a higher probability of experiencing self-reported chronic disease. Despite these contributions, the analysis of the effect of higher unemployment during the GR on health shows some limitations, such as the use of self-reported health conditions among small samples, and the lack of a causal interpretation of the results.

In this paper we estimate the causal effect of unemployment on the incidence of chronic disease during the GR, exploiting the heterogeneity in the province level unemployment rise that occurred in 2008 and analyzing how the slump in economic conditions has affected individual level incidence of disease. We consider incidence rates in cardio-vascular (CVDs), liver, pulmonary and mental diseases. Our approach improves on previous contributions in several ways. First, we employ a unique longitudinal dataset collected by general practitioners (GPs) between 2004 and 2017 for a large nationally representative sample of the Italian population. This dataset has several features that help our analysis. It allows us to observe patient level clinical histories, enabling us to estimate the incidence of specific groups of diseases using within-patient variation by means of individual fixed effects, ruling out potential confounding factors when analyzing the relationship between health and unemployment. Moreover, our data consists of diagnoses objectively assessed by physicians, providing more reliable information than self-reported health and mitigating measurement error.[1] In addition, our analysis benefits from the universal nature of the Italian healthcare system, where GP visits are free for all patients. Unlike studies in other settings, where the differential expected cost of treatment may influence the access to healthcare and objective assessments of health, our setting features homogeneous treatment costs and access to health services across all Italian residents. Finally, our large sample (over 16 million observations) allows us to explore heterogeneous effects by disease type, age and gender without loosing statistical power.

Our results point to a sharp and significant impact of unemployment on the incidence of two major disease groups, namely CVDs and depression. We find that these effects are not evenly distributed in the population, being stronger for individuals close to retirement age (56–64). This pronounced effect among older individuals is plausibly driven by their worse employment prospects in case of job displacement or loss. We also find that the effect on CVDs is stronger for women, while the effect on depression is mainly driven by men. We find no significant effects of the GR on pulmonary and liver disease incidence.

Our results contribute to the literature on the health effects of job loss. Numerous authors have studied the effect of job displacement on individual health, and the results vary across countries, age groups and, most importantly, gender. These heterogeneities, to a reasonable extent, might be driven by differences in healthcare sectors, generosity of welfare systems, social norms related to losing work role, but also by the underlying socio-economic health gradient. For instance, Sullivan and von Wachter (2009) find a strong increase in the mortality rate for male workers who lose their jobs, and this effect persists up to 20 years after job displacement in the US, while Browning and Heinesen (2012) find effects on overall mortality and mortality caused by circulatory disease, effects on suicide and suicide attempts, and on death and hospitalization due to traffic accidents, alcohol-related disease, and mental illness in Denmark. On the disease side, Black et al. (2015) show that job displacement leads to an increase in smoking behavior for both men and women, while Brand et al. (2008) find that

[1] The degree of measurement error is related to age, socio-economic status and income, hence correlated with the treatment variable in this type of analysis (Crossley and Kennedy, 2002, Johnston et al., 2009, Zajacova and Dowd, 2011).

men have significant increases in depression as a result of layoffs. Andreeva et al. (2015), who study organizational downsizing episodes in Sweden find that men are more like to suffer from depression as a consequence of job loss. While our setting exploits aggregate labor market conditions, we contribute to the previous findings showing that older workers are more likely to bear the negative effects of a higher risk of job loss. In particular, the psychological strain is more pronounced for men, who tend to consider work to have a central role in their lives and have a much more continuous employment career.

In order to validate our findings, we run robustness checks where we alter the treatment variable and the outcomes studied. First, we show that our results hold when we use employment rates instead of unemployment rates. While the two might diverge for demographic factors and labor market participation, we find equivalent results for the two measures. Secondly, we conduct a falsification test where we study another major group of chronic diseases, cancers, which are not likely to follow short- or mid-term economic fluctuations. In line with previous studies (Ruhm, 2000), we find that higher unemployment rates resulting from the GR did not cause significant changes in cancer incidence.

A number of studies examine the health impact of economically induced stress, pointing to a very high stress (cortisol hormone) response, comparable to around 70% of the stress induced by the loss of a family member (see the review in Persson and Rossin-Slater, 2018). Since the literature shows that the onset of CVDs and mental disorders is directly related to stress exposure (see the review in Colombo et al., 2018), our findings identify a relevant channel through which economic downturns are likely to affect not only individual health, but also the economic healthcare costs of higher unemployment. Since future improvements in health technology can delay the mortality risk for chronic patients, the monetary toll of other economic downturns is likely to impose an even greater burden on health expenditure. Until recently, the GR was seen as an unprecedented economic crisis, but the recent COVID-19 pandemic has overtaken the GR and has already been labelled the largest global recession in our history. While policymakers are now struggling with direct COVID health consequences, they are also trying to offset the economic slump. Our paper contributes to the cost/benefit analysis of COVID responses, shedding light on less striking but more subtle and persistent health effects of economic crises.

2 Data

2.1 Medical records

All Italian residents are covered by the National Healthcare System (NHS). The system requires all residents aged 15 and older to be registered with a GP practice, which is free of charge.[2] GPs also act as the so-called "gatekeepers" of the NHS, as they are the ones who issue all drugs, specialist visits and diagnostic prescriptions. This activity, together with all the diagnoses that the GPs or specialists make, is registered in the patient's electronic records. The database of each GP in every period contains records on all his patients (roughly 1500 for each GP), hence all Italian residents, both sick and healthy, making it representative of health status for the Italian population (Cricelli et al., 2003). These features are of paramount importance for our analysis since they ensure that our estimation sample is not affected by selection issues.

We exploit the Health Search (HS) database, which is a longitudinal observational dataset based on the Electronic Health Records (EHRs) collected by 795 GPs and on over 1.5 mln individuals representative of the Italian adult population by age and sex (Cricelli et al., 2003, Filippi et al., 2005).[3]

The panel of GPs is strongly balanced, while in a limited number of cases the corresponding panel of patients is unbalanced due to events such as mortality, migration or transitions from pediatrician to GP.

The EHRs contain information collected by GPs during each visit. The incidence of a specific chronic condition is recorded in the HS database as a diagnosis with a binary indicator. The HS maintains strict "up-to-standard" quality criteria in terms of coding levels and consistency in individual medical and clinical history. We focus on diseases that are relevant for both the epidemiological characteristics of the Italian population and for the cause-specific mortality statistics (Istat, 2017). Following the ICD-9 diseases classification, our health outcomes are represented by four chronic disease groups: cardiovascular (CVDs), pulmonary, liver

[2]The choice of GP is based on geographical proximity since individuals must register with a GP practice located within their Local Health Authority (LHA) of residence. For individuals under 15 years of age, the same rules apply for registering with a pediatrician.

[3]Data have been collected routinely since 2000. More details on the extent to which the database represents the adult Italian population can be found at `https://www.healthsearch.it/` (Official website of the HS database). Data from HS have been used in several publications, both in clinical and social sciences peer reviewed journals (see Atella et al., 2019, 2017, Atella and Conti, 2014, Atella and D'Amico, 2015, Atella and Kopinska, 2014b, Mazzaglia et al., 2009, among others).

and depression.[4] In addition, we consider another disease group, cancers, that is not likely to respond to economic shocks in the short run, thus representing a suitable placebo outcome (Ruhm, 2000). Overall, our selection of outcomes follows the literature analyzing the relationship between cause-specific mortality and economic cycles (see Gerdtham and Ruhm, 2006, Ruhm, 2000, 2015, among others).

For each individual we combine their visit specific records into annual aggregates. Furthermore, in our baseline specifications, we restrict the sample to individuals between ages 15 and 64 who represent the working-age population. We also require that our subjects are observed for at least 2 years in order to exploit the longitudinal dimension of our data. We restrict to individuals managed by their GPs between 2004 and 2017 in order to capture a sufficient pre- and post-crisis period.

Table 1 shows descriptive statistics for the health outcomes we examine. The prevalence rates are in line with the official Italian epidemiological statistics by age group (EpiCentro, 2016), with CVDs being the most frequent condition. The sample constructed according to this procedure includes 16,862,938 observations from approximately 1.5 million individuals.

The objective nature of the HS data is one of the strengths of this study, allowing us to limit the measurement error often associated with self-reported health indicators. In this respect, Zajacova and Dowd (2011), Crossley and Kennedy (2002) and Dowd and Zajacova (2007) show that when compared with objective measures, measurement error in self-reported health data is substantial and correlated with both socio-economic disadvantage and age. Additionally, Baker et al. (2004) report that the number of false negatives reported in health surveys amounts to around 50% for most of the examined chronic conditions, including diabetes and hypertension. Moreover, Johnston et al. (2009) find that the probability of false negatives is significantly higher for low-income groups. If understating individual disease status is more likely for low-income patients, studies that attempt to measure the impact of economic variables on health using self-reported disease are likely to underestimate the true effect.

[4] Appendix A reports the complete list of the included ICD-9 codes, together with their descriptions and aggregation into specific disease groups.

2.2 Unemployment data and contextual controls

As is standard in this literature, we capture macroeconomic conditions with the unemployment rate. We use the official Italian Statistical Office (Istat) data on province-level unemployment from 2004 to 2017.

The unemployment rate varied substantially over time and across provinces, from a minimum of 1.9% to a maximum of 31.4%, with an average of 10.4% during 2004–2017. The national average unemployment rate rose from 6.9% in 2007 to 13.9% in 2014, imposing significant psychological and financial strain on many Italians. Minimum and maximum unemployment rates in 2007 were 2.2% and 16.9%, while in 2014 they increased to 4.4% and 27.2%. Figure 1 plots these annual rates. By taking the national average unemployment rate as a reference, we identify three main periods. The pre-GR period, going from 2004 to 2007, was characterized by a slight decline in unemployment. From the onset of the GR in Italy, in 2008, the unemployment rates started to increase relatively slowly until 2010. During the third period, from 2011 to 2014, the GR had more significant impacts on Italian employment and the maximum unemployment rate increased more rapidly, moving from 17.6% to 29%. The second negative wave was likely generated by the sovereign debt crisis (Neri and Ropele, 2015). In 2015, the Italian economy started to recover (Istat, 2016b).

Along with the unemployment rate, we collect data on education attainment at province level as a socio-economic control, measured by the fraction of the population with tertiary education (Istat, 2016a).

3 Empirical strategy

Our goal is to estimate the likelihood of developing a chronic condition as a result of an abrupt change in unemployment. Since the GR represents a sudden economic shock, we exploit plausibly exogenous variation in province unemployment to gauge the effect of the GR on individual health. In particular, to capture heterogenous effects of unemployment over the crisis period, we estimate an incidence model that restricts the sample to individuals who are not affected by disease j in the previous period. We interact the unemployment rate with year dummies as follows:

$$
\begin{aligned}
H^j_{ipt} &= \alpha_i + \theta U_{pt} + \sum_{t=2005}^{2017} \beta_t D_t U_{pt} + \sum_{j=1}^{10} \delta_j AGE_{j,it} + \gamma EDU_{pt} + \\
&+ \sum_{t=2005}^{2017} \vartheta_t D_t + \varepsilon_{ipt} \quad \text{if} \quad H^j_{ip,t-1} = 0;\ t \neq 2008;\ \text{age} \leq 64,
\end{aligned} \tag{1}
$$

where H^j_{ipt}, $j = 1, \ldots, 4$, is a dummy variable equal to one if individual i in province p suffers from the jth condition in period t, U_{pt} is the annual unemployment rate in province p, $AGE_{j,it}, j = 1, \ldots, 10$ are a set of age dummies, and EDU_{pt} measures the education attainment at province level as the fraction of the population with tertiary education. The terms α_i and ϑ_t control, respectively, for individual and year fixed-effects (FEs), while ε_{ipt} is an idiosyncratic error term. We are interested in the interaction between the unemployment rate U_{pt} and a set of year dummies $D_t, t = 2005, \ldots, 2017$, which allow us to capture the time-heterogeneity of the unemployment effect.

Individual FEs α_i control for time-invariant patient characteristics that affect individual behavior and may be correlated with both unemployment and health. For instance, individuals may self-select by residing in provinces with specific characteristics, such as lower unemployment rates, or may engage in specific life styles determining their health, such as a healthy diet or regular exercise. Although the HS data do not provide information on individual level socio-economic status or life style preferences, the individual FEs control for this heterogeneity to the extent that these characteristics do not vary over time. Hence, when following individuals over the study period, individual fixed-effects isolate the time variation in individual health status as a response to changes in the unemployment rate in the province of residence.

We estimate the parameters of the model using the within-group estimator. The unemployment rate, along with education, enters the model in levels and the associated coefficients represent an approximation of average marginal effects.[5] We cluster standard errors at the province level.[6]

[5] Even though the linear functional form is almost certainly wrong, our choice to approximate the conditional probability of developing a chronic condition using a linear probability model (LPM) has the advantage of requiring neither the conditional independence of $y_{i1}, \ldots, y_{iT}, i = 1, \ldots, n$, nor any distributional assumption on the relationship between regressors and individual effects. Moreover, as pointed out by Wooldridge (2010), the within-group estimation of the LPM may provide reasonable estimates of average marginal effects.

[6] Our dataset includes 83 out of 103 Italian provinces. Due to low coverage, the HS database does not

4 Results

This section presents our estimates of the effect of the GR on disease incidence (4.1) and the GR's heterogeneous impacts by age and gender (Section 4.2). We present both sets of results graphically, where we plot the interaction terms between unemployment and time dummy variables. The complete estimation tables can be found in Appendix B. In Section 5.1 we provide a back-of-the-envelope calculation, where we use population weights to quantify the number of individuals significantly affected by the incidence of diseases due to the unemployment rise during the GR and the direct healthcare costs necessary to treat these new patients.

4.1 Effects of the Great Recession on health

In Panel A of Figure 2 we show the incidence dynamics for CVDs. During the years 2004–2007 before the onset of the GR, the effect of unemployment is not significantly different from its baseline in 2008. The incidence rate increases significantly from 2009 onward, when the crisis hits and remains positive and significant during the subsequent years. According to Table B1 in Appendix B, the impact of one additional percentage point in unemployment during the crisis on the incidence rate of CVDs grows steadily from 0.025 percentage point in 2009 to 0.044 percentage point in 2017, bringing the average incidence rate of CVDs from 0.536% to 0.580%.

Panel B of Figure 2 shows the corresponding effect on liver disease, for which we do not find any significant response to unemployment after the GR. Panel C of Figure 2 signals a small but significant impact for pulmonary diseases, even though this figure has a pre-trend that is significant in 2005. Notably, Panel D of Figure 2 shows a significant increase in the incidence of depression from 2009 on, as a response to unemployment, with a peak in 2011 when Italy faced the second and much harsher wave of the crisis (see Section 2.2). Table B1 in Appendix B shows that a one percentage point increase in the unemployment rate increased the incidence of depression of 0.011 percentage point, with respect to the average incidence of 0.253%.

include the provinces of two minor Italian regions, Valle d'Aosta and Molise.

4.2 Heterogeneous effects by gender and age groups.

In analyzing the effects of economic cycles on health, the literature has identified some differences across gender, race, education, and age groups (Currie et al., 2016, Haaland and Telle, 2015, Ruhm, 2000, Tekin et al., 2013, Wang et al., 2018). In what follows, we disentangle the impact of higher unemployment during the GR to identify the most fragile socio-economic groups in terms of observable characteristics such as gender and age.[7] In this heterogeneity analysis, we focus on CVDs and depression, the groups of diseases that emerge from our baseline specification as the most sensitive to short term economic conditions.[8]

Figure 4 shows estimates of the effects of increasing unemployment on CVDs by gender: females in the left-hand Panel and males in the right-hand panel, controlling for age and individual fixed effects. Although the effect is persistent for both sexes, we find that woman are disproportionately affected by CVDs after the GR, with an average magnitude that varies between 0.029 and 0.044 percentage points; the magnitude of these coefficients is higher than the effects for men over the period 2009–2017 (see Table B3 in Appendix B). The fact that higher unemployment during the crisis exerts a larger effect on Italian women is in line with the literature on socio-economic gradients in health inequalities among Italians. In a statistical sense, education and labour force participation are stronger predictors of several health related outcomes for women than for men (Atella and Kopinska, 2014a). Moreover, Pirani and Salvini (2015) shows that greater job instability is more harmful for self-assessed health among females in Italy.

The occupational structure has undergone several changes during the GR, with many women joining the labor market in response to male employment loss. National official statistics show that the proportion of families relying on the sole income of male household heads fell during the GR, with women becoming more likely to work even during pregnancy (Istat, 2014). The gender-specific responses to the GR reflected in our estimates are thus supported by actual events in the labor market. These findings are in line with results obtained for the United States by Currie et al. (2016), who restrict their analysis to mothers, and by Wang

[7] Apart from age and gender, the HS database does not include other socioeconomic information at individual level. In the HS data, stratified samples by gender and age are still representative of the Italian population.

[8] Full estimates tables for pulmonary and liver diseases are reported in Tables B4, B8, B5 and B9 in Appendix B.

et al. (2018).[9]

When it comes to the analysis by age class, we find that the effect of unemployment is particularly strong for individuals just before retirement age, for whom labor market mobility is very low. Figure 4 shows the effects of the rise in unemployment on CVDs for subsamples of 5-year age classes. For CVDs, we find significant coefficient estimates in all age classes, with large heterogeneity in the magnitude of the effects. The incidence of CVDs in younger individuals is less sensitive to unemployment increases than for individuals aged 40. The magnitudes of these effects are largest for individuals aged between 61 and 65, whose increase in the incidence of CVDs in response to increases in unemployment reaches 0.162 percentage points in 2017, being almost four times larger with respect to the baseline estimate of 0.044 percentage point in the same year. It is interesting that the effect is most pronounced when individuals reach retirement age. Therefore, the detrimental effect of labor market instability seems to be borne by individuals whose potential for labor mobility is very limited. This particular age also coincides with a major vulnerability for individuals, who are more subject to CVDs due to labor market downturns.

Figure 5 shows estimates of the effects of the rise in unemployment on the incidence of depression for females and males, respectively. In this case, the impacts are only significant for men. According to the results, one additional percentage point in unemployment rate had the most detrimental effects in 2011, a year in which the GR effects on the economy were the most pronounced (see Table B6 in Appendix B). Men tend to consider work to have a central role in their lives and have a much more continuous employment career. It is thus plausible that being subject to job loss for men results in a greater reduction in income and in well being, and as a result, a more adverse impact on mental health.

When exploring the effects by age classes, our estimates on depression, shown in Figure 6, are largest for individuals between 56 and 65 years of age. Moreover, the effect is stable and persistent at around 0.04 percentage points (see Table B10 in Appendix B). Hence, similar to CVDs, age becomes a major risk factor also for depression induced by the GR. This finding is in line with the existing literature on the relationship between labor market participation and

[9] We also tested if the coefficients obtained for females and males were significantly different by running the same model in Equation 2 for the two samples. We reject the null that the coefficients do not differ significantly. We repeated the same test when estimating the effect by age. These tests are not reported here and are part of the Online Appendix.

mental health. As argued by Green (2011), the detrimental effect of unemployment on mental health is weaker for individuals whose employability is higher. Employability however is lower for older individuals. According to Farber (2015), individuals closer to the retirement age are more likely to face longer spells of unemployment. Also according to Istat (2014), during the GR the proportion of individuals searching for employment without success was highest among individuals aged 50 and above. Economic downturns increase the need to relocate in the labor market, and younger individuals were more likely to succeed in finding a new job. This evidence suggests that the GR was indeed likely to have a more severe impact on mental health of older individuals.

5 Robustness checks

In this section we present additional robustness checks to strengthen our main results. First, we re-estimate our model specification, but instead of unemployment we use province level employment rates. Employment and unemployment rates differ mainly due to demographic factors, labor market participation, and policies such as retirement legislation. While unemployment rates are the most likely to capture labor market conditions in a timely manner, employment rates are an alternative measure that account for the portion of the population not seeking employment. Table B11 and Figure 8 present baseline estimates for the four main disease groups. We re-run the specifications from Equation 2, but we replace province level unemployment rates with province level employment rates. The results are qualitatively identical to the baseline specification, with similar temporal evolution in the pattern of the impact of the rise of unemployment on the incidence of CVDs and depression. Overall, despite capturing slightly different characteristics of the labor market, both measures deliver equivalent results and confirm our main findings.

Second, we carry out a specific falsification test. Following the health literature, we re-estimate our model specification on another major group of diseases, cancers, which are not likely to respond to economic shocks in the short run. Figure 7 shows that a province level surge in the unemployment rate during the crisis does not produce a significant effect on cancer incidence[10]; this evidence is also consistent with previous studies, which do not find any effects

[10] We report full estimates in Table B2 in Appendix B.

of macroeconomic shocks on cancer progression (Ruhm, 2000).

5.1 The health effects of the GR: a simple back-of-the-envelope calculation.

Based on our results in Figure 2 (see also Table B1), we provide a simple back-of-the-envelope calculation of the number of extra incident individuals due to the yearly changes in the unemployment rate in Table 2. First, we compute the population size of individuals at risk of each disease, pop_{jt} (i.e. the number of individuals not affected by disease j in year t). We then compute the marginal effect of unemployment on the predicted incidence rate for disease j and year t, $\delta_{jt} = \beta_{jt} - \theta$, as the difference between the effect of unemployment in year t and the general effect of unemployment θ. We then compute for each disease j and year t, for which the coefficient estimates in our analysis are statistically significant, the additional number of incident patients, $extra_{jt}$ according to the following formula: $extra_{jt} = pop_{jt} \times \delta_{jt}$.

At the national level, the increase in unemployment rate has translated into approximately 103,624 additional individuals affected by CVDs between 2009 and 2017, and more than 10,201 additional individuals affected by depression in the same period. We use estimates of the direct costs of both CVDs and depression in order to monetize the impact of the rise in incidence levels estimated in this study. Based on the estimates of Mennini (2017), we assume the average annual cost of a patient affected by CVDs is 1,668 Euro, while the cost of assisting a patient with depression is 2,236 Euro, following Senese et al. (2018). The cost of unemployment increases in terms of direct healthcare expenditures amounts to a total of 195.65 million Euro for the years considered. On annual basis, the total cost averaged over the 9 years under study is approximately 21.7 million euro annually, which represents 0.020% of the Italian National Healthcare Fund.

6 Conclusions

Since the seminal paper by Ruhm (2000), a wide body of literature has investigated the effects of economic cycles on mortality, assuming that mortality is a proxy for the population's health. A major finding from this influential body of literature is the negative (procyclical) association between unemployment and mortality rate. Using the same data and methods, these results have been confirmed in the case of the GR. One important limitation of these studies is the exclusive use of mortality rates for disease-related deaths as a proxy for health status, which is characterized by a relatively slow responsiveness when correlated with unemployment adjustments, in particular for short-run analyses.

Using an individual fixed effects model, our analysis exploits the economic downturn experienced since the starting of the GR in 2008, which represents a discontinuity that allows us to identify the heterogeneous effects of increasing unemployment on health. Our patient level analysis has several advantages. Unlike previous work that explores mortality rates, our analysis is based on a multidimensional and representative picture of the population health in terms of major chronic diseases, allowing us to study the health effects of the GR in a timely manner. Moreover, with respect to the literature which as analyzes self-reported health proxies, our study exploits information that systematically and objectively measured by GPs. Finally, the longitudinal nature of the data enables us to adopt individual fixed effects, which rule out potential confounding factors when analyzing the relationship between health and unemployment.

Our results show clear evidence of the detrimental health effects of higher unemployment experienced during the GR. In particular, we find that unemployment has a significant effect on the incidence of cardiovascular diseases and depression. We find no effects on liver diseases, while for pulmonary diseases our analysis documents a pre-trend that prevents us from identifying the effects. These results complement the few studies that correlate individual self-reported health proxies with the unemployment dynamics during the GR (Currie et al., 2016, Tekin et al., 2013, among others). Nevertheless, our individual fixed effects analysis shows that the increased incidence of cardiovascular diseases is long-lasting, while the effect on depression is only temporary. These impacts are characterized by large heterogeneity. Females and the elderly are the most affected by CVDs, while depression concentrates its effects on males and individuals close to the retirement age (56–64).

Based on our empirical findings, we calculate that the impact of the increase in the unemployment rate translated into 130 thousand additional individuals affected by CVDs and over 3.7 thousand additional individuals affected by depression during the period 2009–2017. The healthcare costs necessary to treat the additional patients amounts to 218.80 million euros for the years considered. More importantly, our cost estimates are a lower bound since they do not account for indirect costs such as productivity loss and other social expenditures.

From an economic policy perspective, the social costs of health deterioration in terms of higher disease incidence due to the GR will be dumped on younger generations and on those to come. Moreover, the individuals affected by these severe chronic diseases are likely to face an increased risk of mortality in the future. An important recommendation emerging from this study is that policy makers should bear in mind that prolonged economic downturns constitute an additional external risk for individual health—and not a temporary benefit.

Tables

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
Women	0.53	0.499	0	1
Age	50.229	19.39	15	95
Share of graduated (Province)	0.113	0.024	0.063	0.193
Unemployment rate (Province)	10.429	5.93	1.873	31.456
Employment rate (Province)	43.436	7.631	27.565	58.13
Cardio-Vascular diseases (CVDs)	0.155	0.362	0	1
Liver diseases	0.007	0.085	0	1
Pulmonary diseases	0.032	0.175	0	1
Depression	0.045	0.207	0	1
Cancer	0.036	0.186	0	1

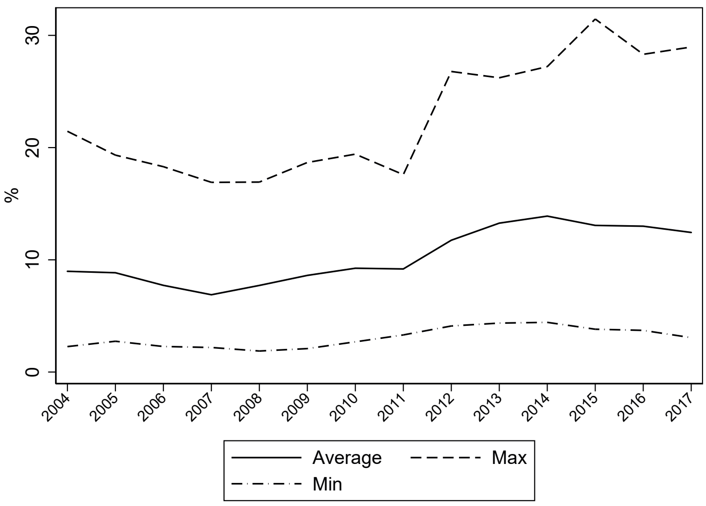
Notes: Sample size is 16,862,938 observations.

Table 2: Number of extra individuals due to changes in the unemployment rate.

	CVDs		Depression		
Year	Extra incident	Share of total incident	Extra incident	Share of total incident	Δ Unemployment rate
2009	19398	8.71	1846	1.63	0.92
2010	15003	7.77	1885	1.78	0.64
2011	-1702	-0.89	-278	-0.30	-0.07
2012	58745	33.10	5962	7.03	2.51
2013	35584	20.71	3307	4.13	1.51
2014	14352	8.29	1426	1.87	0.59
2015	-20470	-12.17	-1945	-2.61	-0.81
2016	-2419	-1.54	-271	-0.41	-0.10
2017	-14867	-9.92	-1731	-2.89	-0.61

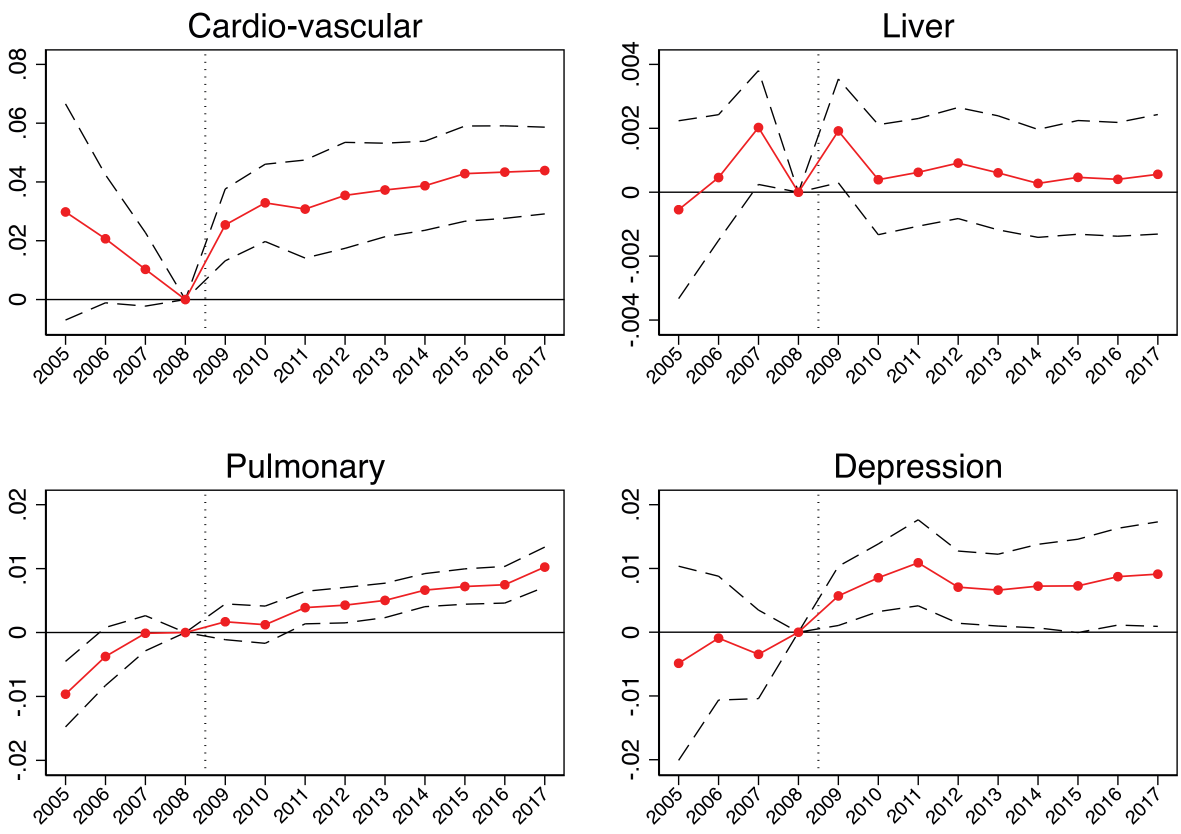
The table reports the number of additional individuals that are diagnosed with CVD's and depression respectively due to unemployment fluctuations in the GR period. The "extra incident" column represents the predicted additional number of patients that are diagnosed with CVDs/depression due year-on-year change in unemployment. The "share of total incident" expresses the proportion of the extra incident patients with respect to the total number of incident patients in each year. Δ Unemployment rate in is the year-on-year absolute change in unemployment rate. The "extra incident" patients are computed as a product between the population at risk of CVDs/depression and the relative marginal effect of unemployment on the predicted incidence rate for CVDs/depression in each year, and the change in unemployment rate. The estimates are obtained using population weights.

Figure 1: Minimum, Average and Maximum Unemployment Rate in Italy



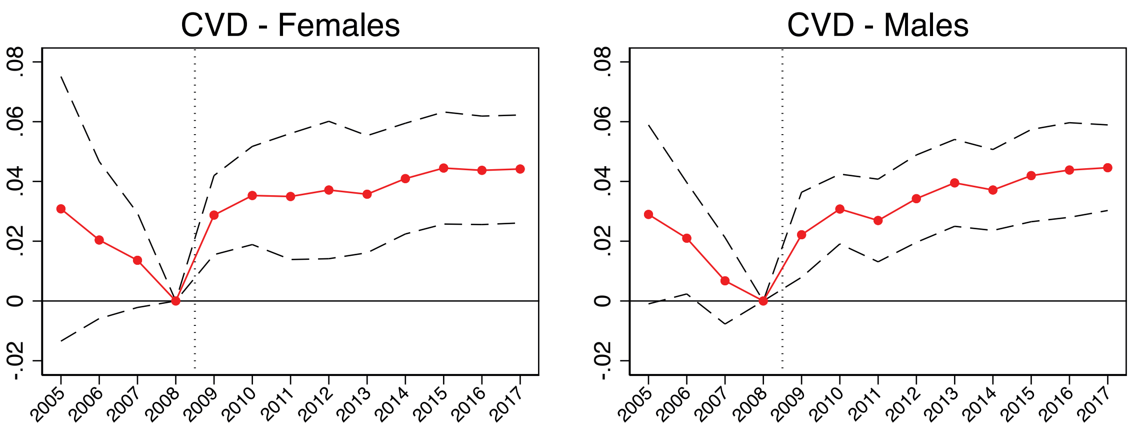
Notes: The graph shows the minimum, average and maximum province unemployment rate in Italy in between 2004 and 2017.

Figure 2: Effects of Unemployment on CVDs, Liver, Pulmonary and Depression Incidences



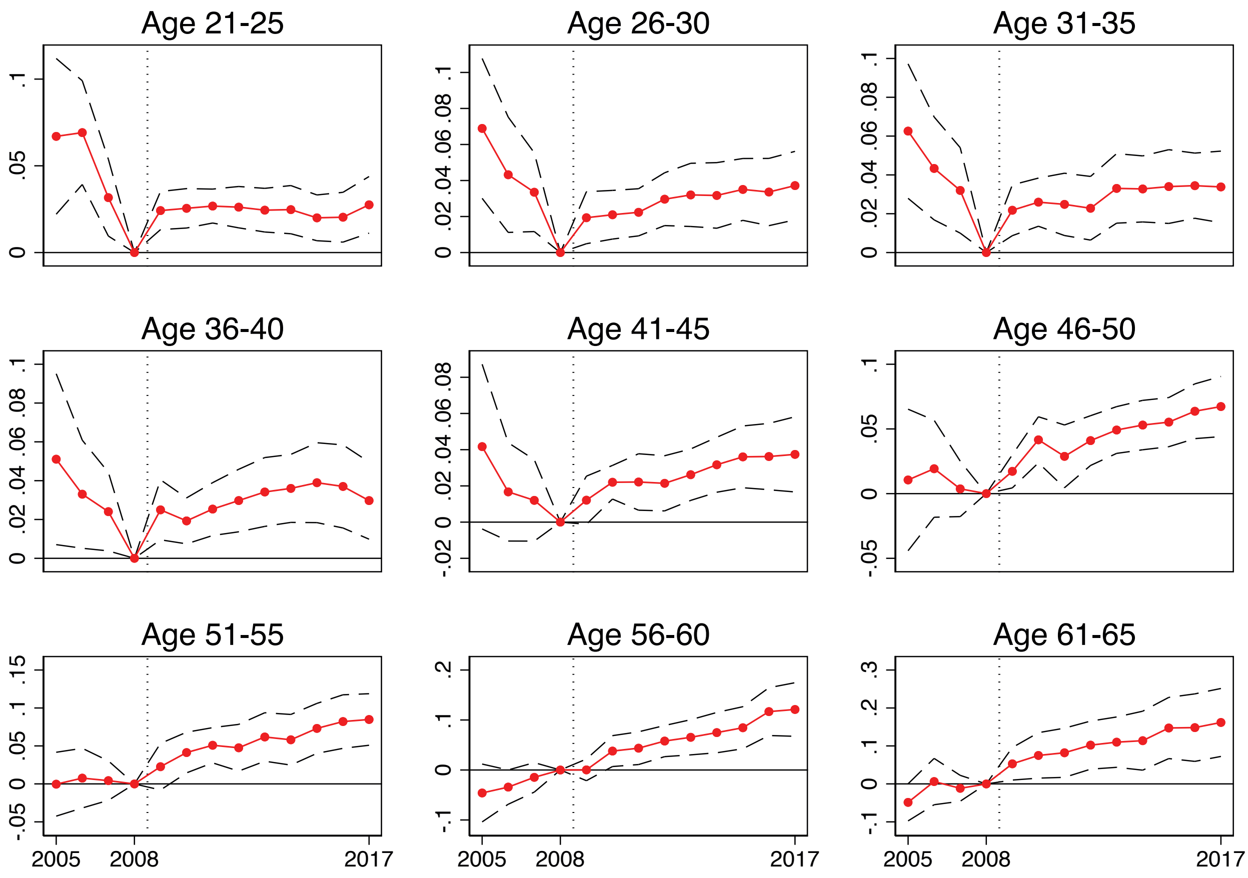
Notes: The graph shows the effects of province unemployment on CVDs, Liver disease, Pulmonary diseases and Depression incidences in an event study setting assuming 2008 as a reference year. Dash lines represent confidence intervals at 95%.

Figure 3: Effects of Unemployment on CVD Incidence by Sex



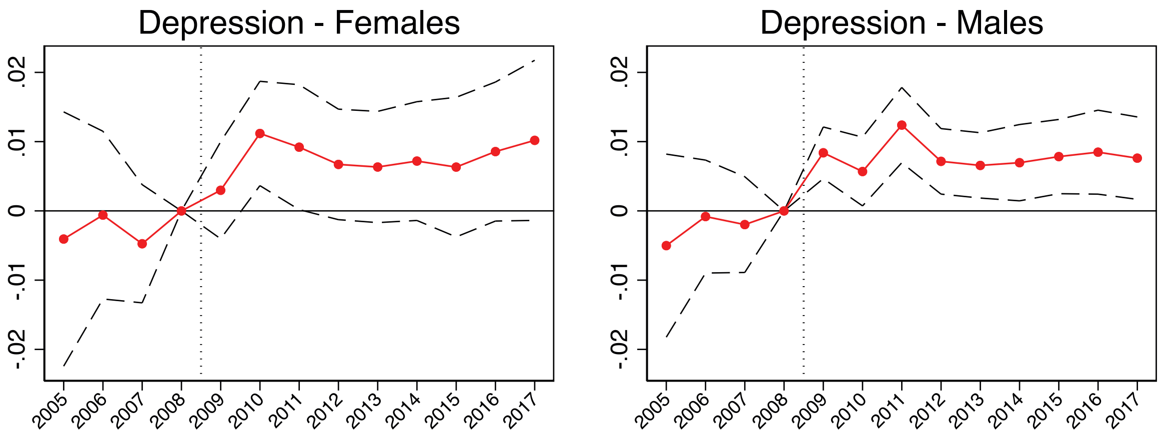
Notes: The graph shows the effects of province unemployment on CVD incidence by sex in an event study setting assuming 2008 as a reference year. Dash lines represent confidence intervals at 95%.

Figure 4: Effects of Unemployment on CVD Incidence by Age Class



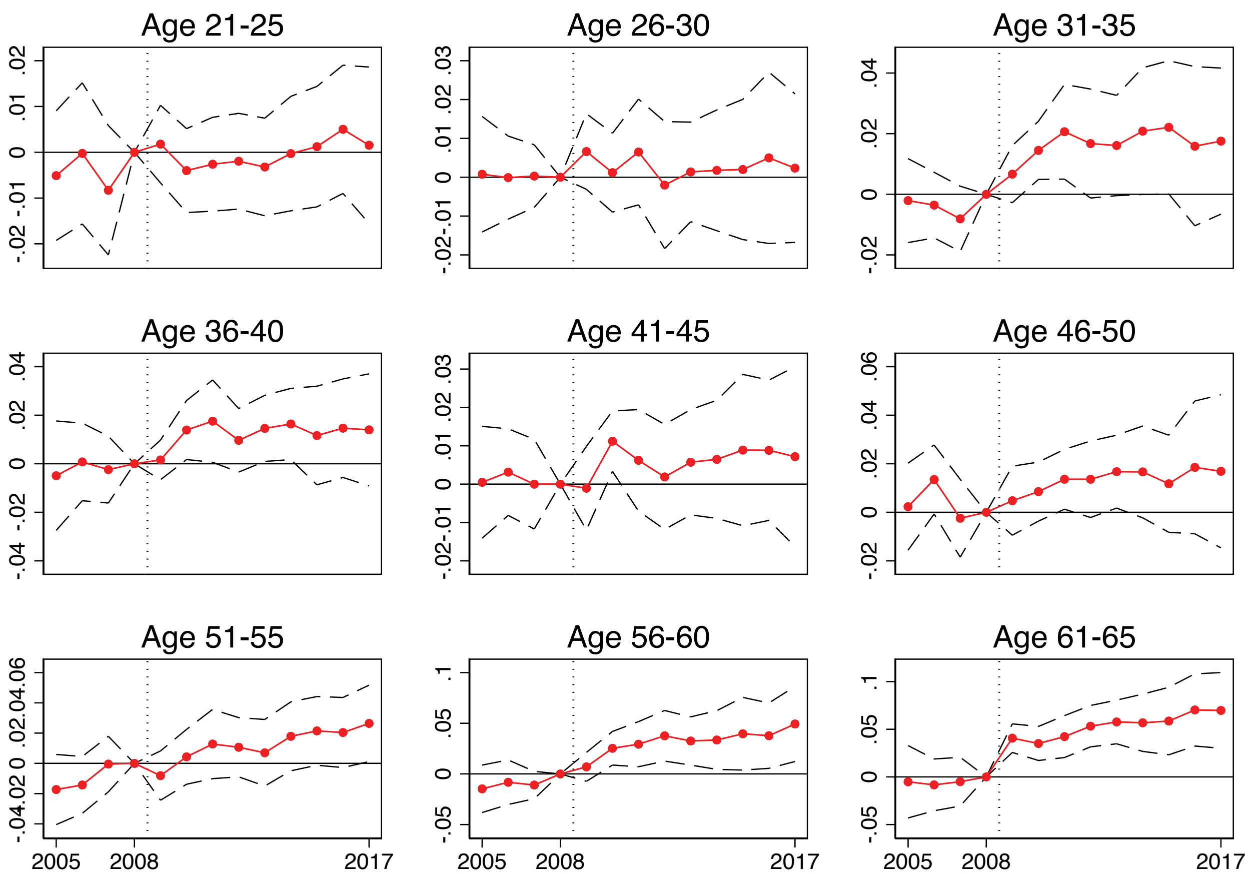
Notes: The graph shows the effects of province unemployment on CVD incidence by age class in an event study setting assuming 2008 as a reference year. Dash lines represent confidence intervals at 95%.

Figure 5: Effects of Unemployment on Depression Incidence by Sex



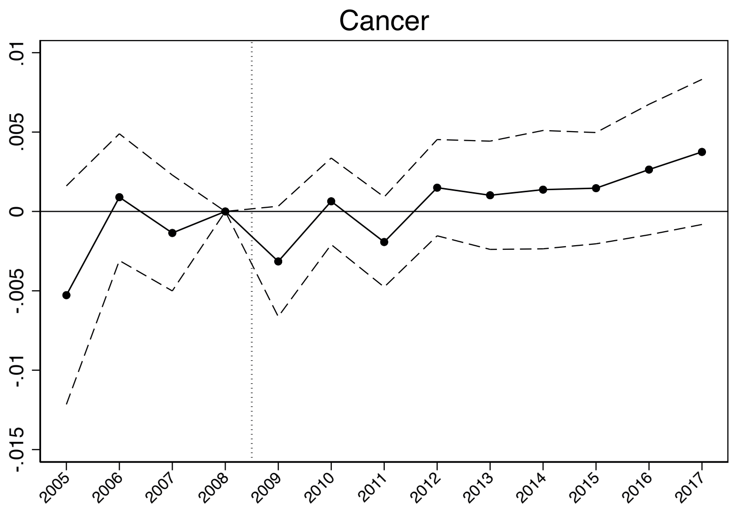
Notes: The graph shows the effects of province unemployment on depression incidence by sex in an event study setting assuming 2008 as a reference year. Dash lines represent confidence intervals at 95%.

Figure 6: Effects of Unemployment on Depression Incidence by Age Class



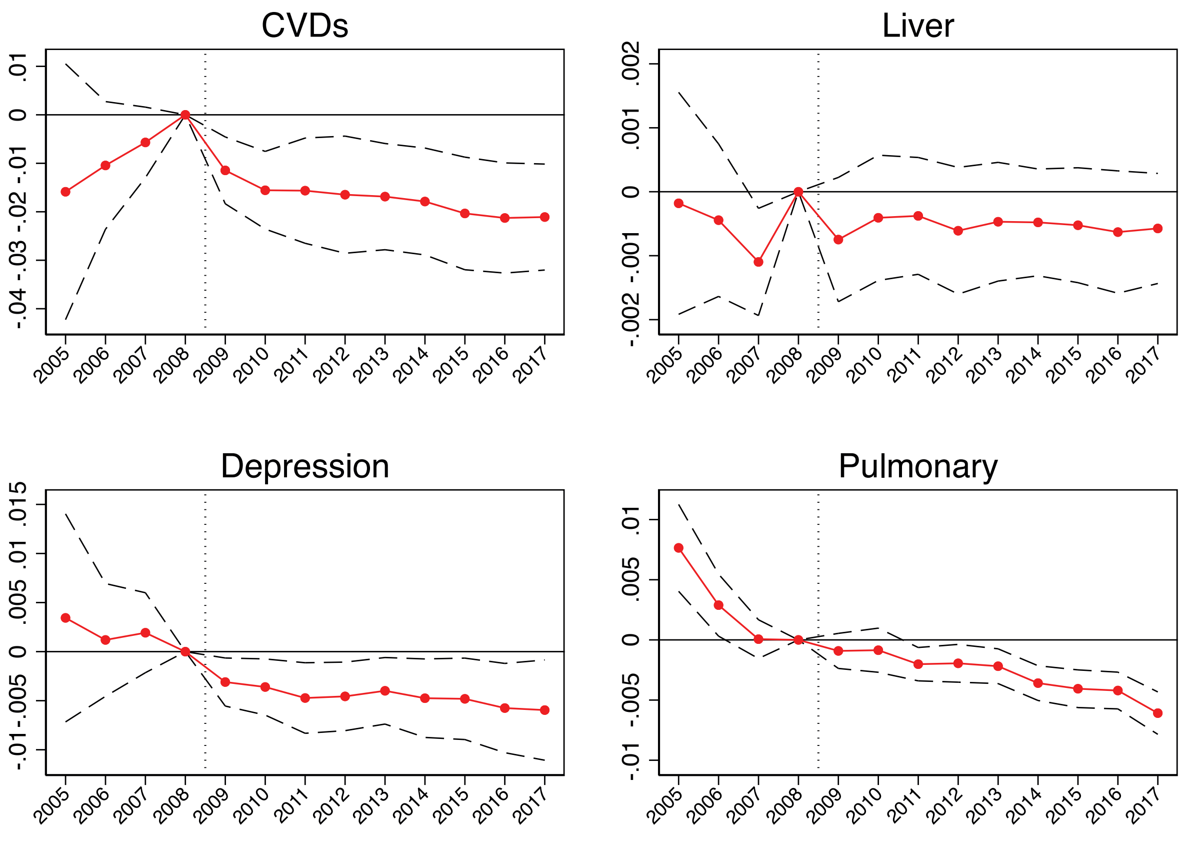
Notes: The graph shows the effects of province unemployment on depression incidence by age class in an event study setting assuming 2008 as a reference year. Dash lines represent confidence intervals at 95%.

Figure 7: Effects of Unemployment on Cancer as a Placebo Health Outcome



Notes: The graph shows the effects of province unemployment on cancer incidence in an event study setting assuming 2008 as a reference year. Dash lines represent confidence intervals at 95%.

Figure 8: Effects of Employment on CVDs, Liver, Depression and Pulmonary incidences



Notes: The graph shows the effects of province employment on CVDs, liver diseases, pulmonary diseases and depression incidences in an event study setting assuming 2008 as a reference year. Dash lines represent confidence intervals at 95%.

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We are grateful to Amithab Chandra, Joshua Angrist, Erich Battistin, Edoardo Di Porto, Marco Manacorda and Vincenzo Scrutinio for their valuable comments. We also thank the participants at the AIES conferences in Bologna, Pavia and Bocconi Universities, and those at the DEMS Bicocca University in Milan. All the remaining errors are ours.

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A Appendix

ICD9 codes for Cardiovascular diseases:

Ischemic Heart Disease:

410 411 412 413 414

Atrial fibrillation and flutter:

427.3

Diseases Of Arteries, Arterioles, And Capillaries:

440 441 442 443 444 445 446 447 448

Bypass or Coronary Angioplasty:

V45.81 V45.82

Cerebrovascular Disease:

430 431 432 433 434 435 436 437 438

Heart failure:

428

Hypertensive heart disease:

402.01 402.11 402.91

Hypertensive heart and chronic kidney disease:

404.01 404.91

ICD9 codes for Pulmonary diseases:

Chronic bronchitis:

491 496

Emphysema:

492

ICD9 codes for Depression disease:

Depression:

311 296.2 296.3

ICD9 codes for Kidney diseases:

Chronic liver disease and cirrhosis:

5571.4 571.5 571.8 571.9

ICD9 codes for Cancer diseases:

Esophagus Cancer:

150

Stomach Cancer:

151

Rectum Cancer:

154

Breast Cancer:

174

Prostate Cancer:

185

Colon Cancer:

153

Lung Cancer:

162

Hodgkin and non-Hogdkin Diseases:

201 200.0 200.1 200.2 200.3 200.4 200.5 200.6 200.7 202.0 202.1 202.7

Leukemia:

204 205 206 207 208

B Appendix

Table B1: Effects of Unemployment on CVDs, Liver, Depression and Pulmonary Incidences

	CDVs	Liver	Pulmonary	Depression
Unemployment rate	-0.0430***	0.0000	-0.0053*	-0.0004
	(0.0084)	(0.0013)	(0.0023)	(0.0041)
2005 × Unemp.	0.0298	-0.0005	-0.0096***	-0.0049
	(0.0185)	(0.0014)	(0.0026)	(0.0077)
2006 × Unemp.	0.0207	0.0005	-0.0037	-0.0009
	(0.0109)	(0.0010)	(0.0023)	(0.0049)
2007 × Unemp.	0.0103	0.0020*	-0.0001	-0.0035
	(0.0063)	(0.0009)	(0.0014)	(0.0035)
2009 × Unemp.	0.0254***	0.0019*	0.0017	0.0057*
	(0.0061)	(0.0008)	(0.0014)	(0.0023)
2010 × Unemp.	0.0329***	0.0004	0.0012	0.0085**
	(0.0066)	(0.0009)	(0.0015)	(0.0027)
2011 × Unemp.	0.0308***	0.0006	0.0039**	0.0109**
	(0.0084)	(0.0008)	(0.0013)	(0.0034)
2012 × Unemp.	0.0354***	0.0009	0.0043**	0.0071*
	(0.0091)	(0.0009)	(0.0014)	(0.0028)
2013 × Unemp.	0.0373***	0.0006	0.0050***	0.0066*
	(0.0080)	(0.0009)	(0.0014)	(0.0028)
2014 × Unemp.	0.0387***	0.0003	0.0066***	0.0072*
	(0.0076)	(0.0008)	(0.0013)	(0.0033)
2015 × Unemp.	0.0428***	0.0005	0.0072***	0.0073
	(0.0081)	(0.0009)	(0.0014)	(0.0037)
2016 × Unemp.	0.0434***	0.0004	0.0075***	0.0087*
	(0.0079)	(0.0009)	(0.0014)	(0.0038)
2017 × Unemp.	0.0439***	0.0006	0.0102***	0.0091*
	(0.0074)	(0.0009)	(0.0016)	(0.0041)
Obs	9,204,718	9,993,871	9,940,976	9,702,948
Individuals	1,100,218	1,146,163	1,142,742	1,129,182

Notes: All models include individual and year fixed effects and control for age groups and share of tertiary education at province level. Standard errors are clustered at province level.

Table B2: Effects of Unemployment on Cancer Incidence

	Cancer
Unemployment rate	0.0035
	(0.0027)
2005 × Unemp.	-0.0014
	(0.0035)
2006 × Unemp.	0.0038
	(0.0023)
2007 × Unemp.	0.0011
	(0.0018)
2009 × Unemp.	-0.0026
	(0.0019)
2010 × Unemp.	-0.0019
	(0.0016)
2011 × Unemp.	-0.0027
	(0.0015)
2012 × Unemp.	-0.0009
	(0.0018)
2013 × Unemp.	-0.0032
	(0.0018)
2014 × Unemp.	-0.0025
	(0.0020)
2015 × Unemp.	-0.0039
	(0.0021)
2016 × Unemp.	-0.0021
	(0.0022)
2017 × Unemp.	-0.0016
	(0.0027)
Obs.	11,141,082
Individuals	1,182,457

Notes: All models include individual and year fixed effects and control for age groups and share of tertiary education at province level. Standard errors are clustered at province level.

Table B3: Effects of Unemployment on CVD Incidence by Sex

	Male	Female
Unemployment rate	-0.0421***	-0.0444***
	(0.0083)	(0.0097)
2005 × Unemp.	0.0290	0.0308
	(0.0150)	(0.0223)
2006 × Unemp.	0.0210*	0.0204
	(0.0094)	(0.0132)
2007 × Unemp.	0.0068	0.0136
	(0.0073)	(0.0079)
2009 × Unemp.	0.0222**	0.0287***
	(0.0072)	(0.0067)
2010 × Unemp.	0.0308***	0.0353***
	(0.0059)	(0.0083)
2011 × Unemp.	0.0269***	0.0350**
	(0.0069)	(0.0106)
2012 × Unemp.	0.0342***	0.0371**
	(0.0073)	(0.0116)
2013 × Unemp.	0.0395***	0.0357***
	(0.0073)	(0.0099)
2014 × Unemp.	0.0371***	0.0409***
	(0.0068)	(0.0093)
2015 × Unemp.	0.0420***	0.0445***
	(0.0078)	(0.0094)
2016 × Unemp.	0.0438***	0.0437***
	(0.0080)	(0.0091)
2017 × Unemp.	0.0446***	0.0442***
	(0.0072)	(0.0091)
Obs.	4,525,073	4,679,645
Individuals	536,395	563,823

Notes: All models include individual and year fixed effects and control for age groups and share of tertiary education at province level. Standard errors are clustered at province level.

Table B4: Effects of Unemployment on Liver Disease Incidence by Sex

	Male	Female
Unemployment rate	0.0007	-0.0006
	(0.0022)	(0.0009)
2005 × Unemp.	-0.0010	-0.0002
	(0.0020)	(0.0011)
2006 × Unemp.	-0.0000	0.0009
	(0.0015)	(0.0009)
2007 × Unemp.	0.0016	0.0024*
	(0.0014)	(0.0010)
2009 × Unemp.	0.0022	0.0016*
	(0.0012)	(0.0007)
2010 × Unemp.	0.0006	0.0002
	(0.0015)	(0.0008)
2011 × Unemp.	0.0008	0.0005
	(0.0014)	(0.0008)
2012 × Unemp.	0.0003	0.0015
	(0.0015)	(0.0008)
2013 × Unemp.	0.0002	0.0010
	(0.0015)	(0.0007)
2014 × Unemp.	0.0002	0.0004
	(0.0014)	(0.0007)
2015 × Unemp.	0.0004	0.0006
	(0.0015)	(0.0007)
2016 × Unemp.	0.0002	0.0006
	(0.0014)	(0.0008)
2017 × Unemp.	0.0004	0.0008
	(0.0015)	(0.0008)
Obs.	4,891,773	5,102,098
Individuals	559,125	587,038

Notes: All models include individual and year fixed effects, and control for age groups and share of tertiary education at province level. Standard errors are clustered at province level.

Table B5: Effects of Unemployment on Pulmonary Disease Incidence by Sex

	Male	Female
Unemployment rate	-0.0067*	-0.0040
	(0.0028)	(0.0026)
2005 × Unemp.	-0.0132***	-0.0064*
	(0.0032)	(0.0029)
2006 × Unemp.	-0.0059*	-0.0018
	(0.0026)	(0.0023)
2007 × Unemp.	0.0016	-0.0017
	(0.0015)	(0.0016)
2009 × Unemp.	0.0010	0.0023
	(0.0016)	(0.0020)
2010 × Unemp.	0.0025	0.0001
	(0.0021)	(0.0013)
2011 × Unemp.	0.0061**	0.0020
	(0.0020)	(0.0013)
2012 × Unemp.	0.0046*	0.0041**
	(0.0022)	(0.0014)
2013 × Unemp.	0.0059**	0.0043**
	(0.0019)	(0.0014)
2014 × Unemp.	0.0077***	0.0058**
	(0.0022)	(0.0018)
2015 × Unemp.	0.0088***	0.0058**
	(0.0022)	(0.0018)
2016 × Unemp.	0.0089***	0.0062**
	(0.0023)	(0.0018)
2017 × Unemp.	0.0123***	0.0084***
	(0.0025)	(0.0017)
Obs.	4,863,256	5,077,720
Individuals	557,138	585,604

Notes: All models include individual and year fixed effects, and control for age groups and share of tertiary education at province level. Standard errors are clustered at province level.

Table B6: Effects of Unemployment on Depression Incidence by Sex

	Male	Female
Unemployment rate	-0.0013	0.0007
	(0.0032)	(0.0058)
2005 × Unemp.	-0.0050	-0.0041
	(0.0066)	(0.0092)
2006 × Unemp.	-0.0008	-0.0006
	(0.0041)	(0.0061)
2007 × Unemp.	-0.0020	-0.0047
	(0.0035)	(0.0043)
2009 × Unemp.	0.0084***	0.0030
	(0.0019)	(0.0035)
2010 × Unemp.	0.0057*	0.0112**
	(0.0025)	(0.0038)
2011 × Unemp.	0.0124***	0.0092*
	(0.0027)	(0.0045)
2012 × Unemp.	0.0072**	0.0067
	(0.0024)	(0.0040)
2013 × Unemp.	0.0066**	0.0063
	(0.0024)	(0.0040)
2014 × Unemp.	0.0070*	0.0072
	(0.0028)	(0.0043)
2015 × Unemp.	0.0078**	0.0063
	(0.0027)	(0.0051)
2016 × Unemp.	0.0085**	0.0086
	(0.0030)	(0.0050)
2017 × Unemp.	0.0076*	0.0102
	(0.0030)	(0.0058)
Obs	4,819,439	4,883,509
Individuals	555,466	573,716

Notes: All models include individual and year fixed effects, and control for age groups and share of tertiary education at province level. Standard errors are clustered at province level.

Table B7: Effects of Unemployment on CVD Incidence by Age Class

	Age 21-25	Age 26-30	Age 31-35	Age 36-40	Age 41-45	Age 46-50	Age 51-55	Age 56-60	Age 61-65
Unemployment rate	-0.0213*	-0.0400***	-0.0396***	-0.0361***	-0.0251*	-0.0417***	-0.0629***	-0.0631***	-0.0841*
	(0.0092)	(0.0098)	(0.0113)	(0.0101)	(0.0100)	(0.0106)	(0.0119)	(0.0161)	(0.0406)
2005 × Unemp.	0.0670**	0.0689***	0.0626***	0.0511*	0.0417	0.0106	-0.0004	-0.0459	-0.0486
	(0.0226)	(0.0195)	(0.0174)	(0.0221)	(0.0229)	(0.0275)	(0.0211)	(0.0291)	(0.0245)
2006 × Unemp.	0.0692***	0.0432**	0.0433**	0.0330*	0.0167	0.0192	0.0077	-0.0342	0.0063
	(0.0150)	(0.0161)	(0.0133)	(0.0140)	(0.0137)	(0.0188)	(0.0198)	(0.0172)	(0.0306)
2007 × Unemp.	0.0317**	0.0335**	0.0320**	0.0241*	0.0120	0.0037	0.0043	-0.0147	-0.0115
	(0.0111)	(0.0110)	(0.0111)	(0.0102)	(0.0113)	(0.0108)	(0.0131)	(0.0148)	(0.0171)
2009 × Unemp.	0.0242***	0.0194**	0.0218**	0.0250**	0.0121	0.0172**	0.0227	0.0003	0.0530*
	(0.0055)	(0.0073)	(0.0066)	(0.0078)	(0.0067)	(0.0064)	(0.0154)	(0.0109)	(0.0215)
2010 × Unemp.	0.0255***	0.0210**	0.0260***	0.0193**	0.0220***	0.0416***	0.0413**	0.0378*	0.0751*
	(0.0057)	(0.0068)	(0.0062)	(0.0059)	(0.0047)	(0.0090)	(0.0135)	(0.0155)	(0.0301)
2011 × Unemp.	0.0268***	0.0224**	0.0248**	0.0254***	0.0222**	0.0288*	0.0509***	0.0437**	0.0821*
	(0.0049)	(0.0066)	(0.0081)	(0.0068)	(0.0078)	(0.0122)	(0.0117)	(0.0165)	(0.0325)
2012 × Unemp.	0.0262***	0.0296***	0.0228**	0.0298***	0.0214**	0.0410***	0.0476**	0.0579***	0.1022***
	(0.0060)	(0.0074)	(0.0082)	(0.0081)	(0.0077)	(0.0097)	(0.0155)	(0.0157)	(0.0318)
2013 × Unemp.	0.0244***	0.0320***	0.0331***	0.0342***	0.0262***	0.0492***	0.0618***	0.0654***	0.1100**
	(0.0063)	(0.0088)	(0.0090)	(0.0089)	(0.0071)	(0.0091)	(0.0160)	(0.0177)	(0.0333)
2014 × Unemp.	0.0247***	0.0317***	0.0328***	0.0360***	0.0317***	0.0530***	0.0581***	0.0748***	0.1139**
	(0.0070)	(0.0092)	(0.0086)	(0.0088)	(0.0076)	(0.0096)	(0.0167)	(0.0203)	(0.0390)
2015 × Unemp.	0.0200**	0.0351***	0.0340***	0.0390***	0.0361***	0.0553***	0.0731***	0.0846***	0.1473***
	(0.0066)	(0.0086)	(0.0096)	(0.0103)	(0.0086)	(0.0095)	(0.0165)	(0.0211)	(0.0405)
2016 × Unemp.	0.0204**	0.0336***	0.0345***	0.0370***	0.0362***	0.0637***	0.0821***	0.1168***	0.1483**
	(0.0072)	(0.0094)	(0.0084)	(0.0108)	(0.0092)	(0.0106)	(0.0177)	(0.0240)	(0.0447)
2017 × Unemp.	0.0275**	0.0372***	0.0338***	0.0297**	0.0374***	0.0673***	0.0848***	0.1211***	0.1619***
	(0.0082)	(0.0096)	(0.0093)	(0.0100)	(0.0104)	(0.0117)	(0.0171)	(0.0270)	(0.0450)
Obs.	752,076	828,584	970,666	1,100,924	1,186,168	1,143,060	1,031,841	909235	792,630
Individuals	213,200	243,271	283,860	314,345	333,339	317,895	291,966	257421	226,755

Notes: All models include individual and year fixed effects, and control for share of tertiary education at province level. Standard errors are clustered at province level.

Table B8: Effects of Unemployment on Liver Incidence by Age Class

	Age 21-25	Age 26-30	Age 31-35	Age 36-40	Age 41-45	Age 46-50	Age 51-55	Age 56-60	Age 61-65
Unemployment rate	0.0003	0.0024	0.0038	-0.0001	-0.0010	0.0000	-0.0020	-0.0024	-0.0043
	(0.0017)	(0.0034)	(0.0029)	(0.0028)	(0.0030)	(0.0032)	(0.0026)	(0.0046)	(0.0046)
2005 × Unemp.	0.0012	-0.0052	-0.0004	0.0050*	0.0073**	0.0007	-0.0048	-0.0046	-0.0077
	(0.0015)	(0.0029)	(0.0025)	(0.0022)	(0.0025)	(0.0040)	(0.0039)	(0.0054)	(0.0044)
2006 × Unemp.	0.0018	-0.0043	-0.0004	0.0002	0.0037	0.0003	-0.0052	-0.0010	-0.0016
	(0.0012)	(0.0028)	(0.0018)	(0.0023)	(0.0023)	(0.0034)	(0.0040)	(0.0030)	(0.0070)
2007 × Unemp.	-0.0027*	-0.0027	0.0055**	-0.0001	0.0017	0.0011	-0.0006	0.0102***	0.0054
	(0.0012)	(0.0021)	(0.0021)	(0.0020)	(0.0019)	(0.0030)	(0.0033)	(0.0028)	(0.0038)
2009 × Unemp.	0.0006	0.0006	0.0024	0.0029	0.0036	0.0022	0.0026	0.0024	0.0045
	(0.0013)	(0.0019)	(0.0023)	(0.0020)	(0.0022)	(0.0028)	(0.0024)	(0.0026)	(0.0033)
2010 × Unemp.	-0.0024	-0.0020	0.0020	-0.0015	0.0030	0.0026	0.0009	0.0023	0.0050
	(0.0015)	(0.0021)	(0.0018)	(0.0025)	(0.0021)	(0.0025)	(0.0024)	(0.0020)	(0.0034)
2011 × Unemp.	-0.0016	-0.0023	0.0008	-0.0006	0.0019	-0.0004	0.0004	0.0042	0.0092*
	(0.0019)	(0.0022)	(0.0027)	(0.0024)	(0.0021)	(0.0024)	(0.0028)	(0.0027)	(0.0045)
2012 × Unemp.	-0.0023	-0.0014	-0.0010	-0.0005	-0.0004	0.0032	0.0020	0.0038	0.0046
	(0.0016)	(0.0022)	(0.0020)	(0.0023)	(0.0023)	(0.0030)	(0.0023)	(0.0034)	(0.0046)
2013 × Unemp.	-0.0016	-0.0026	-0.0006	-0.0008	0.0021	0.0028	0.0025	0.0030	0.0062
	(0.0018)	(0.0025)	(0.0023)	(0.0032)	(0.0023)	(0.0028)	(0.0026)	(0.0032)	(0.0042)
2014 × Unemp.	-0.0033	-0.0014	-0.0008	-0.0008	-0.0005	0.0031	0.0029	0.0027	0.0053
	(0.0017)	(0.0024)	(0.0022)	(0.0028)	(0.0027)	(0.0032)	(0.0023)	(0.0035)	(0.0043)
2015 × Unemp.	-0.0022	-0.0008	-0.0011	-0.0018	0.0002	0.0006	0.0024	0.0034	0.0050
	(0.0019)	(0.0026)	(0.0021)	(0.0032)	(0.0024)	(0.0033)	(0.0030)	(0.0037)	(0.0045)
2016 × Unemp.	-0.0010	-0.0020	-0.0011	-0.0009	0.0023	0.0004	0.0012	0.0025	0.0085*
	(0.0020)	(0.0023)	(0.0025)	(0.0033)	(0.0030)	(0.0030)	(0.0026)	(0.0040)	(0.0041)
2017 × Unemp.	-0.0020	-0.0021	-0.0018	0.0001	0.0021	-0.0002	0.0000	0.0045	0.0081
	(0.0019)	(0.0025)	(0.0024)	(0.0036)	(0.0031)	(0.0032)	(0.0028)	(0.0038)	(0.0050)
Obs	802,606	889,912	1,035,606	1,170,578	1,261,929	1,226,777	1,130,881	1,036,152	958,536
Individuals	224127	257,749	299,352	330,407	350,693	336,982	314,731	286359	264,559

Notes: All models include individual and year fixed effects, and control for share of tertiary education at province level. Standard errors are clustered at province level.

Table B9: Effects of Unemployment on Pulmonary Incidence by Age Class

	Age 21-25	Age 26-30	Age 31-35	Age 36-40	Age 41-45	Age 46-50	Age 51-55	Age 56-60	Age 61-65 e
Unemployment rate	-0.0012	-0.0017	-0.0006	-0.0055	0.0013	-0.0086	-0.0179*	-0.0250***	-0.0423***
	(0.0013)	(0.0014)	(0.0017)	(0.0034)	(0.0033)	(0.0056)	(0.0073)	(0.0073)	(0.0122)
2005 × Unemp.	-0.0010	-0.0032**	-0.0037	-0.0089**	-0.0066*	-0.0150***	-0.0170*	-0.0177*	-0.0367***
	(0.0021)	(0.0011)	(0.0027)	(0.0028)	(0.0033)	(0.0039)	(0.0074)	(0.0073)	(0.0097)
2006 × Unemp.	0.0010	0.0002	-0.0000	-0.0068*	-0.0029	-0.0086*	-0.0112	-0.0039	-0.0202
	(0.0008)	(0.0010)	(0.0018)	(0.0029)	(0.0031)	(0.0039)	(0.0063)	(0.0080)	(0.0108)
2007 × Unemp.	-0.0008	-0.0007	0.0009	-0.0022	0.0037	-0.0047	-0.0012	0.0103	-0.0249***
	(0.0010)	(0.0014)	(0.0015)	(0.0023)	(0.0034)	(0.0040)	(0.0058)	(0.0055)	(0.0069)
2009 × Unemp.	0.0006	0.0007	-0.0006	0.0004	0.0011	-0.0005	0.0086*	0.0122	0.0081
	(0.0005)	(0.0014)	(0.0012)	(0.0013)	(0.0027)	(0.0032)	(0.0041)	(0.0062)	(0.0093) =
2010 × Unemp.	0.0007	0.0003	-0.0007	0.0054**	0.0004	0.0005	0.0040	0.0125*	0.0177
	(0.0004)	(0.0011)	(0.0013)	(0.0019)	(0.0019)	(0.0038)	(0.0051)	(0.0061)	(0.0090)
2011 × Unemp.	0.0009*	0.0006	0.0036*	0.0026	0.0021	0.0056	0.0153**	0.0280***	0.0170
	(0.0004)	(0.0017)	(0.0015)	(0.0019)	(0.0028)	(0.0052)	(0.0047)	(0.0074)	(0.0125)
2012 × Unemp.	0.0007	0.0013	0.0035*	0.0032	0.0041	0.0042	0.0154**	0.0339***	0.0315*
	(0.0006)	(0.0013)	(0.0016)	(0.0021)	(0.0029)	(0.0047)	(0.0053)	(0.0065)	(0.0142)
2013 × Unemp.	0.0002	0.0006	0.0030*	0.0047	0.0012	0.0065	0.0149*	0.0368***	0.0338*
	(0.0007)	(0.0015)	(0.0014)	(0.0028)	(0.0026)	(0.0054)	(0.0057)	(0.0066)	(0.0130)
2014 × Unemp.	-0.0004	0.0012	0.0015	0.0053*	0.0028	0.0101	0.0220***	0.0429***	0.0421**
	(0.0008)	(0.0016)	(0.0014)	(0.0025)	(0.0025)	(0.0064)	(0.0057)	(0.0068)	(0.0129)
2015 × Unemp.	0.0000	0.0019	0.0025	0.0068*	0.0039	0.0134*	0.0247***	0.0464***	0.0474**
	(0.0010)	(0.0014)	(0.0016)	(0.0030)	(0.0028)	(0.0064)	(0.0063)	(0.0074)	(0.0161)
2016 × Unemp.	0.0003	0.0019	0.0017	0.0081**	0.0050	0.0143*	0.0255***	0.0479***	0.0520**
	(0.0008)	(0.0016)	(0.0015)	(0.0026)	(0.0035)	(0.0060)	(0.0061)	(0.0076)	(0.0173)
2017 × Unemp.	-0.0001	0.0031*	0.0036*	0.0100***	0.0058	0.0186**	0.0289***	0.0548***	0.0612***
	(0.0012)	(0.0015)	(0.0017)	(0.0029)	(0.0033)	(0.0064)	(0.0064)	(0.0076)	(0.0147)
Obs	802,032	889,932	1,036,217	1,171,829	1,262,868	1,224,280	1,121,769	1,016,940	927960
Individuals	223,962	257,749	299,501	330,750	351,012	336,542	312,963	282,293	257,625

Notes: All models include individual and year fixed effects, and control for share of tertiary education at province level. Standard errors are clustered at province level.

Table B10: Effects of Unemployment on Depression Incidence by Age Class

	Age 21-25	Age 26-30	Age 31-35	Age 36-40	Age 41-45	Age 46-50	Age 51-55	Age 56-60	Age 61-65
Unemployment rate	0.0050	0.0018	-0.0169*	-0.0035	-0.0075	-0.0139	-0.0102	-0.0195	-0.0521***
	(0.0062)	(0.0067)	(0.0080)	(0.0072)	(0.0072)	(0.0095)	(0.0095)	(0.0124)	(0.0104)
2005 × Unemp.	-0.0051	0.0008	-0.0021	-0.0049	0.0005	0.0023	-0.0173	-0.0147	-0.0051
	(0.0071)	(0.0075)	(0.0070)	(0.0113)	(0.0073)	(0.0090)	(0.0117)	(0.0118)	(0.0191)
2006 × Unemp.	-0.0002	-0.0001	-0.0036	0.0008	0.0031	0.0135	-0.0143	-0.0082	-0.0083
	(0.0077)	(0.0054)	(0.0054)	(0.0080)	(0.0057)	(0.0071)	(0.0095)	(0.0110)	(0.0136)
2007 × Unemp.	-0.0083	0.0003	-0.0081	-0.0024	-0.0000	-0.0024	-0.0005	-0.0110	-0.0049
	(0.0071)	(0.0041)	(0.0054)	(0.0069)	(0.0059)	(0.0081)	(0.0092)	(0.0068)	(0.0129)
2009 × Unemp.	0.0018	0.0066	0.0067	0.0016	-0.0011	0.0048	-0.0081	0.0070	0.0407***
	(0.0043)	(0.0049)	(0.0047)	(0.0041)	(0.0055)	(0.0071)	(0.0082)	(0.0072)	(0.0075)
2010 × Unemp.	-0.0040	0.0012	0.0145**	0.0139*	0.0112**	0.0085	0.0043	0.0253**	0.0351***
	(0.0046)	(0.0051)	(0.0048)	(0.0061)	(0.0040)	(0.0061)	(0.0091)	(0.0083)	(0.0090)
2011 × Unemp.	-0.0026	0.0065	0.0206*	0.0176*	0.0062	0.0136*	0.0128	0.0293*	0.0423***
	(0.0052)	(0.0068)	(0.0079)	(0.0085)	(0.0067)	(0.0062)	(0.0115)	(0.0112)	(0.0111)
2012 × Unemp.	-0.0019	-0.0020	0.0167	0.0097	0.0019	0.0136	0.0107	0.0377**	0.0533***
	(0.0053)	(0.0082)	(0.0090)	(0.0066)	(0.0069)	(0.0079)	(0.0098)	(0.0125)	(0.0109)
2013 × Unemp.	-0.0032	0.0014	0.0161	0.0146*	0.0057	0.0168*	0.0070	0.0325**	0.0577***
	(0.0054)	(0.0064)	(0.0083)	(0.0068)	(0.0069)	(0.0075)	(0.0111)	(0.0120)	(0.0115)
2014 × Unemp.	-0.0003	0.0018	0.0208	0.0164*	0.0065	0.0167	0.0179	0.0335*	0.0568***
	(0.0063)	(0.0078)	(0.0105)	(0.0074)	(0.0077)	(0.0095)	(0.0115)	(0.0146)	(0.0151)
2015 × Unemp.	0.0012	0.0020	0.0221*	0.0116	0.0089	0.0118	0.0215	0.0397*	0.0586**
	(0.0066)	(0.0091)	(0.0110)	(0.0102)	(0.0099)	(0.0101)	(0.0114)	(0.0180)	(0.0178)
2016 × Unemp.	0.0050	0.0050	0.0159	0.0147	0.0088	0.0185	0.0204	0.0378*	0.0703***
	(0.0070)	(0.0111)	(0.0132)	(0.0102)	(0.0092)	(0.0138)	(0.0116)	(0.0162)	(0.0190)
2017 × Unemp.	0.0015	0.0023	0.0175	0.0140	0.0072	0.0169	0.0264*	0.0493**	0.0697***
	(0.0086)	(0.0096)	(0.0121)	(0.0116)	(0.0118)	(0.0159)	(0.0127)	(0.0186)	(0.0199)
Obs	795,678	876,712	1,014,506	1,140,433	1,223,418	1,182,698	1,083,797	987,332	909,926
Individuals	222,639	254,718	294,476	323,501	341,606	326,617	303,516	274,696	252,856

Notes: All models include individual and year fixed effects, and control for share of tertiary education at province level. Standard errors are clustered at province level.

Table B11: Effects of Employment on CVDs, Liver, Depression and Pulmonary Incidences

	CDVs	Liver	Pulmonary	Depression
Employment rate	0.0144	-0.0003	0.0026	0.0002
	(0.0105)	(0.0010)	(0.0022)	(0.0049)
2005 × Emp.	-0.0159	-0.0002	0.0077***	0.0034
	(0.0133)	(0.0009)	(0.0018)	(0.0053)
2006 × Emp.	-0.0104	-0.0004	0.0029*	0.0012
	(0.0066)	(0.0006)	(0.0013)	(0.0029)
2007 × Emp.	-0.0057	-0.0011*	0.0001	0.0019
	(0.0037)	(0.0004)	(0.0008)	(0.0020)
2009 × Emp.	-0.0115**	-0.0007	-0.0009	-0.0031*
	(0.0035)	(0.0005)	(0.0007)	(0.0012)
2010 × Emp.	-0.0156***	-0.0004	-0.0009	-0.0036*
	(0.0040)	(0.0005)	(0.0009)	(0.0014)
2011 × Emp.	-0.0156**	-0.0004	-0.0020**	-0.0047*
	(0.0055)	(0.0005)	(0.0007)	(0.0018)
2012 × Emp.	-0.0165**	-0.0006	-0.0019*	-0.0046*
	(0.0061)	(0.0005)	(0.0008)	(0.0018)
2013 × Emp.	-0.0169**	-0.0005	-0.0022**	-0.0040*
	(0.0055)	(0.0005)	(0.0007)	(0.0017)
2014 × Emp.	-0.0179**	-0.0005	-0.0036***	-0.0047*
	(0.0055)	(0.0004)	(0.0007)	(0.0020)
2015 × Emp.	-0.0203***	-0.0005	-0.0041***	-0.0048*
	(0.0058)	(0.0005)	(0.0008)	(0.0021)
2016 × Emp.	-0.0213***	-0.0006	-0.0042***	-0.0057*
	(0.0057)	(0.0005)	(0.0008)	(0.0023)
2017 × Emp.	-0.0211***	-0.0006	-0.0061***	-0.0060*
	(0.0055)	(0.0004)	(0.0009)	(0.0026)
Obs.	10,405,323	11,229,979	11,176,444	10,922,795
Individuals	1,137,706	1,182,512	1,179,134	1,166,196

Notes: All models include individual and year fixed effects, and control for age groups and share of tertiary education at province level. Standard errors are clustered at province level.

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