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THE EFFECTS OF FINANCIAL CRISES ON MORTALITY AND HEALTH IN EUROPE

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ABSTRACT. This paper examines the effects of financial crises on health in the EU. Using a fixed effects approach, we study panel data on financial crises, unemployment rates, mortality and other health indicators for 28 EU countries during the period 1992–2014. We find that financial crises increase mortality by 1.3 % once time trends are controlled for. This effect appears to be largely driven by an increase in deaths from cardiovascular diseases. Estimated effects of macroeconomic conditions, proxied for by unemployment rates, are in line with existing literature and indicate that unemployment decreases mortality. Unemployment is also found to have a negative effect on several categories of disease incidence and disability-adjusted life years, while no such robust, significant effects of financial crises are found. Effects of crises on all-cause mortality are more pronounced in countries with low public healthcare spending and results are overall robust to a number of changes in specification. The main conclusion is that crises increase mortality. We also conclude that economic fluctuations do affect aspects of health other than mortality, but there is no evidence of financial crises having an additional effect.

Keywords: financial crises, health, mortality, unemployment

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1. Introduction

Health, both physical and mental, is a central factor in determining human happiness and well-being (Helliwell, Layard and Sachs 2017). It is also of importance for the economy, as a healthy population is more productive and costs less in terms of healthcare (WHO 2018a). At the same time, the state of the economy has significant effects on the health of the population, as evidenced by e.g. Stucker et al. (2009) and Toffolutti and Suhrcke (2014). Despite this, the understanding of the relationship between the state of the economy and health is limited and little is known about the health effects of more extreme economic fluctuations. While the topic was actualised by the global financial crisis in 2008, studies of the health effects of crises themselves are so far rather few. There is thus a need for further research on the topic.

When reading this paper, it is important to keep in mind that crises are generally distinct from typical economic downturns in several ways. Crises are generally more sudden and hard to predict and consequences are usually more severe (Kindleberger and Aliber 2005; Reinhart and Rogoff 2009b). As a result, it seems reasonable that financial crises could affect health in ways that differ from those of a typical recession.

While there is little evidence on the health effects of financial crises, there is a solid body of research on how economic conditions affect health, in particular through mortality. These studies generally conclude that mortality is procyclical.[1] In other words, they find that as unemployment rises, as is typical during a recession, mortality tends to decline (Karanikolos et al. 2013; Ruhm 2000; Toffolutti and Suhrcke 2014). However, though these studies often claim to study the effects of crises, they are generally only studying the effects of the economy on health *during periods of* crisis. They thus cannot draw conclusions regarding the health effects of crisis itself. Nonetheless, it may be important for policymakers to know how crises themselves, with their severe and unexpected nature, could affect health when deciding which policies to adopt.

In 2016, Ruhm published a first study on US data aiming to identify the specific effects of financial crises. Inspired by this study, we develop Ruhm's method further and investigate the health effects of all financial crises in the European Union (hereafter denoted the EU) between 1992 and 2014. In the literature on financial crises, there is no generally accepted definition of what a financial crisis is. To avoid arbitrary definitions, we therefore focus on crisis periods as defined in a new dataset constructed by the European Central Bank (hereafter denoted ECB). The resulting crisis dummy variables are combined with panel data on mortality rates for the 28 EU countries and the dataset is analysed using multivariate regressions with fixed effects.

Following our analysis, we conclude that financial crises increase mortality rates by approximately 1.3 %. We also find that this effect appears to be driven by an increasing number of deaths from

[1] Because higher mortality in general implies worse health, the concepts are opposites and so mortality being procyclical implies that health is countercyclical.

cardiovascular diseases. We do not, however, find evidence of any effects of crises on broader health indicators, such as incidence of different diseases. In contrast, the results suggest that unemployment does have an effect on these health indicators. Finally, we find that countries with public healthcare spending below the EU median appear to experience larger increases in mortality following a crisis than the EU countries overall.

The remainder of this report is organised as follows: Section 2 contains some background on financial crises and health. Section 3 and 4 summarise relevant previous research and economic theory. Section 5 describes our research focus and limitations of scope. Section 6 presents the data used and Section 7 outlines the econometric method. Section 8 describes our results and Section 9 provides a discussion of what we find. Finally, Section 10 presents our conclusions and final remarks.

2. Background

This section begins with a brief description of what a financial crisis, as opposed to a recession, is. It also provides an overview of existing approaches to defining crises, as well as a description of how health has evolved over time.

2.1 Financial crises and recessions

The acquired experience during the past decade would at a first glance make any introduction of financial crises redundant. To some extent, we have all experienced it and thus we all know what a financial crisis is about. Even in the academic literature, financial crises are often treated as a commonly known phenomenon and hence, no further explanation is given. However, distinguishing financial crises from normal recessions can be complicated and unfortunately, even in the academic literature the concepts are occasionally used interchangeably. Still, while there are similarities, crises and recessions are ultimately different phenomena. In order to study the implications of financial crises as opposed to those of natural economic downturns, we must understand what distinguishes these events from each other. This section therefore aims to outline the ways in which financial crises differ from recessions.

The most widely used definition of recessions, created by NBER (2007), defines a recession as “a significant decline in economic activity spread across the economy, lasting more than a few months”. A popular way to illustrate this is that recessions occur in the period between a peak and a trough in the business cycle. As for a more formal and precise definition, authors seem to agree that a recession occurs when a country is experiencing negative economic growth for at least two subsequent periods (Leamer 2008; Moore 1983, p. 19–22; NBER 2007; Reinhart and Rogoff 2009b). Recessions are thus, in general, brief and exist only for limited periods of time.

Financial crises also often involve decreased economic activity. The factors that distinguish financial crises from recessions are instead mainly the severity of consequences, the length and the link to financial systems (Mankiw 2003, p. 4; Moore 1983, p. 19–22). So far, the research related to financial crises has mostly focused on their effect on economic factors (Campello, Graham and

Harvey 2010; Casey and O'Toole 2014; Lemmon and Lins 2003; Love, Preeve and Sarria-Allende 2007). Also, while financial crises tend to vary in intensity and extent of hardship that they cause, conclusions in most studies remain similar. In general, the economic factors studied, such as trade credit and investment, have been found to be affected negatively by a crisis (Campello, Graham and Harvey 2010; Cornett et al. 2011; De Vogli 2014; Duchin, Ozbas and Sensoy 2010; Love and Zaidi 2010; McKibbin and Stoeckel 2010; Thomson et al. 2014).

Reinhart and Rogoff (2009b) find three consequences that financial crises in advanced economies tend to have in common. First, the collapse of the asset market is prolonged during a crisis compared to a recession. Equity prices decline approximately 55 percent over a period of three and a half years and house prices tend to decrease by on average 35 percent during the six years following the crisis. Second, crises are associated with, on average, a nine percent decrease in output and a seven percentage point increase in unemployment. Once the crisis is over, output generally reaches pre-crisis levels within two years, while unemployment tends to need four years to recover. Last, as a consequence of increased unemployment and decreased output, government debt increases by on average 86 percent in real values due to diminishing tax returns during the crisis period (Reinhart and Rogoff 2009b).

To summarise, financial crises tend to involve significant collapses and value decreases that may be perceived as sudden in comparison to a gradually occurring recessions. In addition, the consequences of financial crises are also more severe than those typically seen during recessions and they often last for a longer period of time. As a result, when compared to typical recessions, financial crises generally cause more hardship (Reinhart and Rogoff 2009b).

2.2 Defining financial crises

Since the definition of financial crises is important for the analysis that follows, this section will give an insight into how financial crises have been defined in the academic literature. This section will also explain why we prefer to use a newly developed definition and not those used in earlier studies.

In the economic literature, there is no straightforward or generally accepted definition of what a financial crisis is. Authors in general are struggling to find a precise and widely applicable notation (Baldacci, De Mello and Inchauste 2002; Claessens and Kose 2013). To remedy this problem, there are papers that aim to define financial crises. These papers, in contrast to those that only implement already existing definitions, generally conclude that financial crises can be divided into two categories based on how they are defined (Claessens and Kose 2013; Reinhart and Rogoff 2009a). The first type includes crises which can be defined within a quantitative framework. These are typically crises that manifest themselves through rapid currency falls or sudden stops in an economy. Early literature often focused on these types by, for example, defining a crisis as when the currency depreciates by a specific percentage or as when there is an immediate stop in external funding (Baldacci, De Mello and Inchauste 2002; Claessens and Kose 2013).

In contrast to the first classification of financial crises, the second type rely on more complex definitions. These crises include bank and debt crises where researchers must depend on qualitative or judgment-based analysis to determine whether a financial crisis has taken place or not. This is the case when, for example, a country does not take responsibility for its foreign debt or does not follow through on its own fiscal obligations domestically. A complicating factor is that the two categories are not completely distinct from one another. Rather, they tend to overlap since the economy is full of interconnections and, for example, a debt crisis can in some cases result in a currency crisis as well (Claessens and Kose 2013).

The overlap between different crisis types highlights the need for a broad definition that includes both types of crises when analysing the effects of financial crises over time. Unfortunately, such definitions tend to lack precision when applied in an analytical framework and have often lead authors to define crisis episodes differently, rendering these definitions impractical for several analytical purposes (Baldacci, De Mello and Inchauste 2002; Claessens and Kose 2013). Hence, simpler and more straightforward quantitative measures (more in line with the first type of crisis definition) have often been used in practice to analyse the effects of financial crises on health (Baldacci, De Mello and Inchauste 2002; Claessens and Kose 2013). However, we find that it is preferable to include both quantitative and qualitative aspects when possible. In the analysis that follows we therefore use a definition developed by the ECB that combines quantitative and qualitative measures. Our crisis definitions are further described in Section 6.1.

2.3 Health trends

Several trends are worth noting in order to facilitate understanding of the health fluctuations in the subsequent analysis. Since the beginning of the 20th century, the developing world has experienced a downward trend in death rates (Cutler and Meara 2001). Because of growing populations, the number of deaths worldwide has increased during the last decades, but death rates (from here on denoted mortality rates) keep going down. This is largely a result of improved healthcare and reduced risk exposure. Furthermore, during the last decade, disability adjusted life years, interpreted as the loss of healthy life years in the population, have also decreased. Altogether, this suggests that general health has improved and that the consequences of getting ill are not as severe as they have been historically (Ritchie and Roser 2018). Studying our data, these trends appear to exist also in the EU (see Figure 2).

For the past 15 years, cardiovascular diseases have been the most common cause of death in the world (WHO 2017). These diseases include common maladies such as ischaemic heart disease and stroke. During 2017, cardiovascular diseases accounted for more than 30 % of total deaths worldwide. Neoplasm, commonly known as cancer, was the second most common cause of death, accounting for 16 % of total deaths. Other common takers of lives are dementia, diabetes and traffic accidents, all among the top 10 causes of death worldwide (Ritchie and Roser 2018). However, the distribution of causes of death is often location-specific and there are large differences between high- and low-income countries. Mortality rates in, for example, neoplasm, cardiovascular diseases, maternal conditions and traffic accidents vary extensively between regions and income levels (Ritchie and Roser 2018; WHO 2017).

Looking more specifically at the EU, cardiovascular diseases and neoplasm are still the largest causes of death despite decreasing mortality rates in these diseases during the 21st century (Eurostat 2017a). Together, these diseases account for more than 60 % of all deaths (Eurostat 2017b, 2017c). Still, mortality rates differ substantially between countries within the EU. In 2015, Ireland had the lowest crude mortality rate in the EU, estimated to 630 deaths per 100,000 inhabitants, while Bulgaria had the highest crude mortality rate at 1530 deaths per 100,000 inhabitants (Statista 2018). This difference can likely be attributed at least to some extent to the age-composition of the population and hence, this is important to account for when conducting the analysis. However, despite differences in mortality rates between countries, the rankings of the causes of death remain similar.

While there is evidence regarding the long-term development of mortality, differences in mortality between countries and the commonness of death causes, little is known about the short-term fluctuations of mortality. In particular, health (as often measured by mortality in the literature) has been shown to co-move with economic factors, meaning that mortality fluctuates around the trend depending on temporary economic conditions. However, the impact of the economy on health is still somewhat ambiguous. We will investigate this further in the analysis that follows.

3. Previous research

While the focus of the literature concerning financial crises is still on economic factors, there is a growing body of research on how the economy affects the health of the population. The next few paragraphs summarise the findings in this area and provide an overview of the current state of research on the topic, both concerning the effects of the state of the economy in general and the effect of crises in particular. This distinction is important to keep in mind, not least because recessions and crises are often (and sometimes wrongly) used interchangeably in the studies quoted. In general, we use economic downturns as a term that includes both recessions and crises whenever it is uncertain if results are applicable to financial crises, recessions or both.

3.1 General findings

In the existing literature, one frequently replicated result is that health is positively affected by economic downturns (Karanikolos et al. 2016; Ruhm 2000, 2016; Stuckler et al. 2012; Tapia Granados and Roux 2009; Toffolutti and Suhrcke 2014). Within the literature that focuses on the relationship between business cycles and health, the general conclusion is therefore that health, with the exception of mental health, is countercyclical. This means that health tends to improve during recessions and worsen during booms, once general time trends have been controlled for (Forbes and McGregor 1984; Ruhm 2000; Xu 2013). However, though one of the more broadly accepted, the countercyclicality of health is not entirely undisputed. There are counterexamples such as the study by Tapia Granados and Rodriguez (2015) which finds no effects on mortality during the 2008 financial crisis in Greece, Iceland and Finland. It is also interesting to note that individual level studies often find negative effects on health of e.g. unemployment and lower income, though these studies do not generally focus on mortality (Eliasson, Lundborg and Vikström 2011; Gerdtham and Johannesson 2005).

Suggested reasons for the indicated countercyclicality of health include combinations of changing stress levels and altered behaviours. Ruhm (2000) suggests that during favourable economic times people work more, which can lead to increased stress levels and worsened health. Furthermore, studies have found that cigarette consumption increases while physical activity and physician visits decrease when people work more, all of which are related to worse health outcomes (Xu 2013). However, actual evidence is scarce and much remains to be uncovered when it comes to the mechanisms explaining the relationship between health and recessions.

Though the mechanisms behind the countercyclicality of health remain unknown, it is clear that health consequences associated with recessions and financial crises have been unevenly distributed within and across economies. The literature suggests that some groups are more exposed to the negative consequences than others. Examples of especially exposed groups include ethnic minorities, unskilled individuals, and individuals without a social network (Charles and DeCicca 2008; Friedman and Thomas 2008; Margerison-Zilko et al. 2016; Suhrcke et al. 2011; Thomson et al. 2014). Similarly, some groups also appear to be more exposed when it comes to specific causes of death. For example, men as well as individuals of working age tend to be more at risk of committing suicides during economic downturns (Barr et al. 2012; Chang et al. 2013; Economou et al. 2013; Luo et al. 2011; Reeves et al. 2015). In addition to social group belonging, economic context also appears to affect the relationship between economic downturns and health. As an example, Turner (1995) finds that becoming unemployed has more detrimental health effects when occurring in an unfavourable economic environment.

3.2 Effects on institutions

As a result of the 2008 financial crisis, several European countries, including Greece, Spain and Portugal, had to face declining GDP levels as well as increasing government debt. With worsening economic conditions came different austerity measures and this would also come to affect the healthcare systems (Parmar, Stavropoulou and Ioannidis 2016). In Greece, where a majority of country-specific studies have been conducted, savings in public health expenditure during the crisis in the late 2000s were made by reducing the number of health workers, increasing user charges, cutting pharmaceutical expenditure and reducing engagement in preventive actions, all together leading to lower access to medical care and worse health conditions (Economou et al. 2014). Similar patterns have also been seen in other countries, such as Spain and Portugal, during the 2008 financial crisis. Evidence regarding other crises is however scarce in this area (Karanikolos et al. 2013).

While some European countries have thus taken actions that may damage the functioning of their health systems, others, such as Austria and Belgium, introduced potentially health-improving changes during the 2008 financial crisis. These actions included extending health coverage to new groups, removing user charges and developing systems for more efficient use of health resources (Thomson et al. 2014). Karanikolos et al. (2013) draw the conclusion that, despite significant differences between countries and healthcare systems, weak social protection together with fiscal austerity is a factor behind worsened health during a crisis. This is also supported by Toffolutti and Suhrcke (2014) who find that countries with low social protection during the crisis in 2008 were more negatively affected in terms of health compared to countries with high social protection. However, similarly to the effects on institutions, little is known about the links between social protection and health effects during earlier crises.

3.3 Effects on behaviour

An aspect where economic downturns have not been exclusively negative for population health is health-related behaviours. While some studies find ambiguous results and unclear effects (Stuckler et al. 2009; Toffolutti and Suhrcke 2014), others find both positive and negative effects on health. Among the positives are decreased overall smoking and alcohol consumption, even though the consumption has been found to increase in some population groups (De Belvis et al. 2012; Karanikolos et al. 2016; Rivadeneyra-Sicilia et al. 2014). Others have also seen increased sleep and consumption of fish oil (Ásgeirsdóttir et al. 2014). A more negative effect is decreased consumption of fruits and vegetables, likely due to lower income during the crisis (Brinkman et al. 2009; De Belvis et al. 2012).

3.4 Mortality

A frequently studied indicator for health is overall mortality. One reason behind this is that the number of deaths is easily obtained. For other measures of health, measurement methods differ between sources and there is an increased risk for measurement errors which could cause problems in the analysis. Furthermore, mortality is also the ultimate measure of health since it shows the most severe consequences of changes in health; death.

Studies on the financial crisis in the late 2000s generally conclude that mortality decreases during economic downturns. This has been seen in the US as well as in Europe, where mortality has been estimated to decrease by as much as 3.4 % (Parmar, Stavropoulou and Ioannidis 2016; Ruhm 2016; Strumpf et al. 2017; Tapia Granados and Ionides 2017; Toffolutti and Suhrcke 2014). However, results are mixed and other studies, such as Baumbach and Gulis (2014), have found no effect of economic downturns on health. Also, when looking specifically at the effect of crises on mortality, no significant effects were found by Ruhm (2016) on the state level and Stuckler et al. (2009) on the national level. Ruhm (2016) does find that crises decrease mortality somewhat on the national level though.

When studying less developed areas, results are often opposite to those found in more developed areas. For example, during the 1990s crisis in Mexico mortality has been estimated to increase with as much as 0.4 % for certain age groups (Cutler et al. 2002) and similar results have also been seen in Russia, Madagascar, Peru, Colombia and South Korea during earlier crises (Falagas et al. 2009; Ruhm 2000). Furthermore, when studying longer series of data including more crises than only the late 2000s crisis, Stuckler et al. (2009) do not find a significant effect on all-cause mortality in Europe. These mixed results suggest that at this point, there exists no general conclusion applicable to a majority of countries for longer time periods.

Cause-specific mortality
Within the literature, studies often aim to identify causes of death that are driving overall mortality in a certain direction during economic downturns. Several authors study deaths related to the most common diseases, for example cardiovascular diseases, for which mortality is found to decrease during economic downturns (Laliotis, Ioannidis and Stavropoulou 2016; Strumpf et al. 2017; Toffolutti and Suhrcke 2014). In the study by Toffolutti and Suhrcke (2014) the decrease in cardiovascular mortality was estimated to 3.7 %, something that they claim is related to a decrease in deaths caused by job-related stress. Moreover, given that death from cardiovascular diseases is one of the most common causes of death, the estimated decreases in the disease have been suggested as the main driver of the decrease in all-cause mortality often found during recessions (Strumpf et al. 2017).

In contrast to the large number of studies on cardiovascular diseases, the literature is scarce when it comes to findings related to deaths in neoplasm during economic downturns. Despite neoplasm being a common cause of death, we only manage to find one study investigating the relationship. This study, conducted by Ruhm in 2000, claims that deaths in neoplasm increase during recessions. However, the analysis is purely correlational and does not detect a causal relationship.

In addition to the most common diseases, there are also studies on the spread of infectious diseases such as tuberculosis and malaria. Incidence in these diseases appears to increase during crises and as a result, mortality rates in epidemies tend to become higher (Economou et al. 2014; Freudenberg et al. 2006; Karanikolos et al. 2013; Simou and Koutsogeorgou 2014). However, there are also studies which find limited evidence for such a relationship (Thomson et al. 2014) and in cases the opposite effect has been found (Toffolutti and Suhrcke 2014), suggesting that the results are possibly location- and time-specific.

Probably the most studied cause of death in relation to economic downturns is suicides. In these studies, the relatively unanimous conclusion is that suicides increase during economic downturns (Economou et al. 2014; Kentikelenis et al. 2011). A reason often quoted for this is increased unemployment, but other economic variables such as GDP are often found to be correlated with suicide rates as well. Finally, a last popular health indicator is deaths in traffic accidents, which have been shown to decrease during economic downturns (Karanikolos et al. 2013; Stuckler et al. 2011; Toffolutti and Suhrcke 2014). The intuition behind this is that when unemployment increases, less people are driving between home and work, leading to a lower risk of traffic accidents.

3.5 Effects of crises specifically and other closely related studies
Most related to our study is the literature that specifically investigates the effects of crises on health. Though this literature is rather limited, there is a small number of studies on the topic. The most relevant of these, in our opinion, is the study by Ruhm (2016). This study has also been an important inspiration for the empirical setup of this thesis.

Using US data for the period 1976–2013, Ruhm (2016) employs a fixed effects approach to specifically estimate how crises on the state and national level affect mortality rates. The crisis definitions used involve national starting dates presented by the Federal Reserve, but end dates as well as crises on the state level are based on unemployment rates. Using this approach, Ruhm finds that on a national level, crises affect mortality in a similar fashion to that of normal economic fluctuations. Crises generally appear to be associated with lower mortality rates and the increase in suicides typically found during recessions is approximately offset by a decrease associated with the crisis variable. When it comes to state-level crises, Ruhm's results provide no evidence that crises affect mortality.

Following the study by Ruhm (2016), Laliotis and Stavropoulou (2017) study the relationship between mortality, unemployment and the 2008 financial crisis in Greece. They conclude that mortality is countercyclical once crises are controlled for and that crises themselves increase mortality, in contrast to the results of earlier studies. Another study that specifically attempts to include the effects of more severe crises is Stuckler et al. (2009). They are the earliest example we are aware of that investigate the effects of crises by including a dummy variable for crises in their model specification. This variable takes the value one when the unemployment rises by more than two standard deviations. Using this approach, they find that unusually large increases in unemployment lead to larger increases in suicides among the working age population, but no effect on all-cause mortality.

Finally, Toffolutti and Suhrcke (2014) study the effects of unemployment on mortality in 23 EU countries between 2000 and 2010. While they do not explicitly test for the effects of crises, their empirical setup and geographic area studied are similar to ours. They find that increasing unemployment is associated with an increase in the number of suicides, but decreased all-cause mortality and decreases in a number of cause-specific mortality rates including cardiovascular diseases, road accidents and parasitic infections. Their results also indicate that effects of unemployment are more pronounced in countries with a lower level of social protection.

4. Economic theory

The aim of this section is to present relevant economic models for the subsequent analysis. This will give an insight into how financial crises may affect health seen through a theoretical framework. We begin by presenting the dominant model explaining demand for health, the Grossman model, and then discuss how financial crises relate to the more general theory of consumption smoothing.

4.1 The Grossman model

First presented by Grossman in 1972, the Grossman model is still the most established model for the demand for health and healthcare. We will therefore describe this model in more detail. Once we have given an idea of how to think of health in terms of the model, we also present a variation of the basic setup that can help explain more complex mechanisms.

When formulating the model, Grossman (1972) made several assumptions of which three are key in this analytical setting:

1. Individuals are born with an initial health stock that can be increased by investment in health and depreciates over time with age. Together, these factors determine health.

This relationship is formulated as

$$\mathrm{H_{t+1}} = \mathrm{H_t} + \mathrm{I_t} - \delta_i \mathrm{H_t} \tag{1}$$

where $\mathrm{H_{t+1}}$ denotes health in the time period after t and is dependent on health at time t ($\mathrm{H_t}$), investment in health at time t ($\mathrm{I_t}$) and depreciation of health from time t to time t+1 ($\delta_i \mathrm{H_t}$). The intuition behind the equation is that individuals carry along a stock of health from one time period to another. Health in the next period can be improved by increased investment in health, but also decreases as the health stock depreciates from one period to another due to ageing. When the health stock has deteriorated to the extent that it falls below a specific threshold, death occurs. This implies that individuals can to some extent affect their length of life by investing in their health (e.g. by changing eating habits and buying health care).

2. Individuals have limited resources that they can use to invest in health.

This implies that there is a price for producing health and individuals may not be able to invest in it fully due to constrained budget or limited time. Hence, the investment decision is a choice in how to allocate resources, where investment in health is a function of medical care investment, input in health-related commodities, time spent on improving health, and education.

3. Health is valued by individuals, but consumption of other commodities is valued as well.

The utility of an individual is not only determined by health, but also consumption of other commodities. This explains why a person, for example, chooses to smoke, overeat or put him- or herself at other risk, knowing that it may have negative health consequences. According to Grossman (1972), an implication of this is that individuals demand health for two reasons. First, health itself features in the utility function and individuals thus gain direct utility when feeling healthy. Second, there is also indirect utility from health in the form of increased consumption opportunities. This is due to e.g. higher productivity at work or lower amount of sick days, resulting in higher disposable income. In the Grossman model, there is thus a utility trade-off between health improving activities and consumption of other goods.

Under the assumption that individuals want to maximise their lifetime utility, the setup of the Grossman model implies that individuals have to optimise the amount of resources invested in health given constraints concerning time and resources.[2] When maximising the utility function derived by Grossman subject to these constraints, the optimal choice of investment is found to be

[2] See Grossman (1972) for more detail.

where the marginal cost of investment in health is equal to the marginal benefit of investing. The marginal cost of investment is derived as

$$\mathrm{MC_i} = \mathrm{r} + \delta_\mathrm{i} \tag{2}$$

and is thus the sum of the interest rate on other investments (r) and the rate of depreciation of health (δ) given the age (i) of an individual. The depreciation rate is assumed to increase with age, so that the optimal level of the health stock changes over the life cycle.

The marginal benefit of investing in health is equivalent to the rate of return of investing in health. This can as a simplified expression be written as

$$\mathrm{MB_i} = (\mathrm{W_i} * \mathrm{G_i})/\mathrm{C_i} \tag{3}$$

which tells us that the marginal benefit of investing in health is equal to the wage rate (W) times the marginal return of health investment (G) divided by the marginal cost of investing in health (C). The marginal return of health investment (G) is diminishing in the health stock, meaning that each unit of health capital becomes less productive as the health stock improves.

Figure 1 illustrates the fact that in the Grossman model, individuals invest in health until the marginal cost is equal to the marginal benefit. The marginal benefit (MB_1) curve in Figure 1 thus represents the demand curve for health and shows the relationship between the rate of return on an investment, i.e. the marginal efficiency of health capital, and the health stock. Individuals choose their optimal level of health stock at point X where the marginal benefit equals the marginal cost r + δ. A higher marginal cost, as is the case e.g. if δ increases with age, would thus imply choosing a lower level of the health stock.

A complicating factor in the Grossman model is that not only health, but also different types of consumption, affect utility. This is clearly illustrated in an extension of the Grossman model by Phelps (2010), where consumption is divided into "goods", "bads" and "neutrals". While the "goods", such as fruits, vegetables and healthcare, increase both utility and health, the "bads", such as cigarettes and alcohol, increase utility but decrease health. The "neutrals" increase utility without affecting health. When income changes, consumption of all three categories will be affected, but not necessarily by as much. As a result, it is nearly impossible from a theoretical perspective to tell how changes in income will affect total health (Phelps 2010, p. 40–53). This is confirmed by, among others, De Belvis et al. (2012), Karanikolos et al. (2016) and Rivadeneyra-Sicilia et al. (2014), who find indications that consumption patterns change in response to economic downturns, but that the total effect on health is unclear. Some behaviours that improve health become more common and some become less common, and the same is true for behaviours detrimental to health. The resulting effect is thus hard to predict.

Figure 1
Effect of changes in wage on optimal health stock

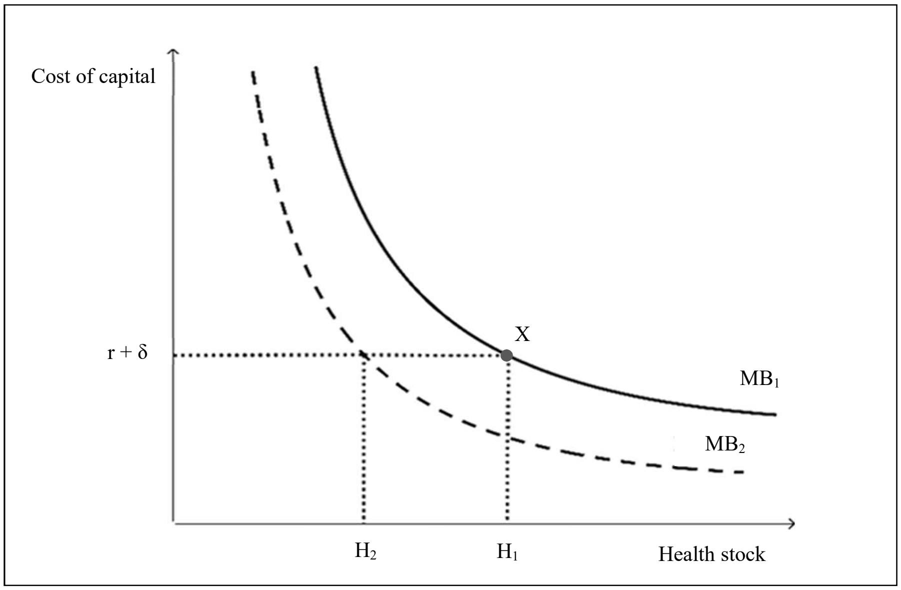

Figure 1. The figure shows how the marginal benefit of investing in health changes in response to lower wage, and how this in turn implies a lower optimal health stock. When wage decreases, the marginal benefit curve shifts from MB_1 to MB_2 and the new optimal health stock becomes H_2. Figure created by the authors.

However, disregarding the complicating factors and considering the effect of a change in wage in isolation, the Grossman model still provides some guidance on what to expect. During a financial crisis it is generally found that the economic activity decreases, leading to a decreased demand for productive workers and thus a lower expected average income for the population (Reinhart and Rogoff 2009b). When applied to the Grossman model, lower wage implies that the marginal benefit of investing in health decreases (see Equation 3). A decrease in wage thus lowers the return on healthy days and the optimal health level becomes lower. This can be seen in Figure 1, where MB_1 shifts towards the origin when wage decreases, leading to a lower health stock given that the marginal cost of investing in health is the same.

The Grossman model thus implies that, given unchanged market structure (e.g. same prices and age structure of the population) and behaviours during a financial crisis, investment in health decreases during a financial crisis and health deteriorates as a result. Furthermore, since a health stock below a specific threshold implies death for an individual, reduction of wage for a significant amount of the population is expected to increase the mortality rate according to the model. Then, once the financial crisis ends and unemployment goes back to normal levels, health is expected to improve since the increase in wage leads to higher investment in health and a higher optimal health stock. This conclusion also extends to normal recessions involving economic slowdown. The Grossman model hence gives a general idea of how economic conditions could affect health. However, when all factors are taken into account the resulting effects are unclear and the model is not particularly helpful in predicting differences in effects between recessions and more severe crises.

4.2 Consumption smoothing

While the Grossman model is indeed a life cycle model, the focus of the model is on factors that determine the demand for health and health services, such as age and wage. To our knowledge, there is no study that specifically examines the path of health stock in relation to the effect of income shocks in the model. We will therefore turn to more general economic theory to explain the differences between the effects of normal recessions and financial crises on health.

A relevant concept in this context is the permanent income hypothesis, which was first presented by Friedman (1957). Put simply, the hypothesis states that individuals consume a fraction of their expected current and future income, which Friedman denotes "permanent income", in each period. An implication of this is that it is changes in the permanent income that result in changed consumption, rather than changes in actual current income. Foreseeable, and thus expected, changes in income should consequently have no effect on consumption. Unexpected changes, in contrast, do affect the consumption pattern (Meghir 2004).

The intuition behind the hypothesis is that human beings, when possible, would want to smooth their consumption over time and avoid having it fluctuate with temporary fluctuations of income. However, in reality, this is rarely possible. Friedman himself recognised that this relies on there being no liquidity constraints. In other words, individuals must be able to borrow and save in order to shift consumption between periods.

Seen through this framework, financial crises thus differ from recessions in two ways. First, financial crises are unpredictable, and tend to occur suddenly and without warning, while recessions are easier to foresee as a natural part of the business cycle. Consequently, normal recessions can be taken into account when individuals make health- and consumption-related decisions and their occurrence should therefore not alter these decisions. In contrast, financial crises occur as a surprise and are not taken into account when individuals make their initial decisions. As a result, once crises occur they could change the initial decisions and have an effect on e.g. health. This has been found empirically in the studies by Dutt and Padmanabhan (2011) and Hurd and Rohwedder (2016) which show that short-term declines in income as during recessions did not affect consumption while more severe declines during crisis periods did. Second, financial crises tend to impact financial institutions to a larger extent than a typical recession. As a result, they could act to introduce, or increase existing, liquidity constraints, making it increasingly difficult for individuals to borrow and save in order to smooth their health-related consumption over time (Jappelli and Pistaferri 2010; Wilcox 1989). This would imply that consumption and health are affected more by changes in income during a crisis than they are during a recession.

5. Research focus

Based on economic theory, it seems reasonable that financial crises and normal recessions differ in the effects they have on health. This is also made probable by earlier findings regarding e.g.

how unemployment affects health in different economic contexts (Turner 1995). While the exact mechanisms are not yet known, empirical findings indicate that financial crises do indeed affect health through other channels than unemployment alone. As an example, Barr et al. (2012) find that increasing unemployment can only explain about 40 % of the additional suicides associated with the 2008 financial crisis in England. So far, we can only speculate as to why the effects of financial crises and recessions differ, but possible mechanisms include effects of multiple issues adding up during crises, such as losing your job and your house, and the reduced public health care spending observed in some countries (Economou et al. 2014).

We thus find it justified to investigate the effects of financial crises specifically in addition to those of normal recessions. Still, this has not been done to any larger extent in existing literature, so there is room for improvements. One problem with the existing literature that attempts to draw conclusions regarding the effects of financial crises on health is that the majority of studies, including the ones previously discussed, are limited in geographical scope, conducted in a narrow time range close to the recession itself and are concentrated around the 2008 financial crisis. This makes the results time- and location-specific and consequently hard to generalise.

However, in our opinion, there is an additional and larger problem than the not-so-generalisable results. This is that the majority of studies claiming to study financial crises in fact only study fluctuations in macroeconomic variables during periods of economic downturn and then assume that the results found are applicable also during crises. We find this to be an overly simplistic approach, as results found during what is generally considered crisis years cannot necessarily be interpreted as the effect of the crisis itself. There could be other factors and events that occur during these particular crisis periods driving the results. There are a handful of studies that explicitly study the effect of crises, but these usually define crises based on unemployment rates only, leading to simple crisis definitions which ignore episodes during which other macroeconomic factors may have been crucial determinants of the crisis. These studies also focus exclusively on mortality, ignoring any broader health effects.

Our study attempts to address the problems mentioned above. We add to the existing literature by including more countries and different crises in our analysis, as well as a longer time period in order to estimate an effect that can be more easily generalised. We also use a more comprehensive definition of crises which captures a number of aspects other than unemployment. This definition is based on a crisis dataset constructed by the ECB and consists of all crisis episodes detected in the EU between 1970 and 2016, including smaller crises only affecting single countries. Finally, we also include additional, non-mortality measures of health in our analysis to investigate whether financial crises have an effect on health beyond mortality.

The contribution of this study we view as twofold. First, we study the health effects of financial crises specifically. To our knowledge, this is the first study with the aim to do this in a European context. Compared to similar studies, we also have an improved crisis definition, enhancing the chances of meaningful results, and some technical advantages through e.g. the possibility to include year dummies. Second, we investigate the effects of both the economy and financial crises not only on mortality, but also on other measures of health. This should provide broader insights into the general effects of economic factors on population health.

The aim of this thesis is thus to fill the identified research gap by investigating whether financial crises affect health in ways other than the effects of recessions identified in earlier studies. More precisely, we will study whether financial crises have an effect on health beyond the simple effect of unemployment or other macroeconomic proxies. We specifically aim to answer the following research question:

Do financial crises have an effect on health in addition to the effects of recessions in the EU?

The analysis hence gives an indication of whether findings during economic downturns can be extended to financial crises, as often suggested in earlier literature. Based on economic theory, our initial expectation is that this is not the case and that effects should differ. However, due to a number of complicating factors, including government involvement and unclear effects on behaviour, it is virtually impossible to predict the outcome. We therefore choose not to form any specific hypotheses regarding the direction of the effects, but simply observe whether there appears to be an effect or not.

5.1 Limitations of scope

We limit our analysis to the 28 countries that were members of the EU as of January 1, 2018. To avoid distortions from breaks and gaps in the data series, we also limit the sample to the period 1992–2014. Among available measures of health, we limit ourselves to the study of effects on health indicators which can be measured in a reasonably objective manner. We will thus not study e.g. self-rated health, but rather mortality- and incidence-based measures. Finally, we limit ourselves to aggregate data on the population level and consequently do not study the effects for specific age groups or genders.

6. Data

To conduct our analysis, we compile a panel dataset consisting of health indicators, proxies for macroeconomic conditions and population characteristics from a number of different sources. The dataset consists of yearly observations and the countries included are the 28 member states in the EU as of January 1, 2018. Unless otherwise stated, all variables cover all ages and genders in the population. While some data series extend further back in time or in some cases include more recent data, we will focus on the years from 1992 to 2014. There are two reasons for this. First, due to lack of historical data combined with lags in the production of health statistics, this is the period for which we have been able to obtain reasonably complete data. Second, we wish to exclude the period up until the fall of the Soviet Union in 1991. Since several of the studied countries were part of the Soviet Union until the beginning of the 1990s, there are gaps and breaks in earlier data for these countries and we wish to eliminate any distortions this may cause. The following section describes the data and its sources in more detail.

All-cause mortality data as well as cause-specific mortality rates were obtained from the European Health Information Gateway, which contains data collected by the World Health Organization (WHO) in collaboration with the member states. The data is age-standardised[3] and stretches from 1980 to 2014. For both all-cause mortality and cause-specific mortality, the age-standardised mortality rates are measured as deaths per 100,000 people.

Data on incidence and disability-adjusted life years (hereafter denoted DALYs) for a number of diseases was obtained from the Global Health Data Exchange and include data from 1990 until 2016.[4] Incidence is estimated as the total number of new cases of a specific disease per 100,000 inhabitants. DALYs, which are a measure of the burden of disease, are estimated as the loss of healthy life years due to disease in a specific year, also per 100,000 inhabitants. Estimating DALYs involves measuring the number of cases of different health conditions and weighting them by severity. DALYs can be seen as the gap between the ideal health status of the population and the current health status, with a value of zero implying a perfectly healthy population (WHO 2018b).

As for the macroeconomic proxies, the unemployment rate has been obtained from the same source as the mortality data, i.e. the European Health Information Gateway. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the total working age population. Data on healthcare spending as a share of GDP as well as real GDP itself and government debt is collected from the Eurostat database. These data series contain observations from 1990 to 2016.

Finally, all population characteristics were downloaded from the European Health Information Gateway. This includes data on population as well as female share of total population and the share of the population above 65 years of age.

6.1 Definitions of financial crises used in the analysis

Within the field of health economics, frequently used definitions of financial crises are mainly based on macroeconomic variables that have been shown to react extensively during crises (Baumbach and Gulis 2014; Reeves et al. 2015; Reeves, McKee and Stuckler 2014; Stuckler et al. 2011). A problem with this research is that authors often define crises as when, for example, unemployment is high (Ruhm 2016). By using these simplified definitions, important aspects of crises are neglected which can potentially affect estimated results. Therefore, we will in our preferred specifications rely on the crisis definitions in a dataset published by the ECB in July 2017. This definition combines a number of factors to determine during which periods crises occurred in each EU country. The dataset is used to construct a dummy variable for whether or not

[3] In this context, age-standardised data means that it has been adjusted for the age structure of the population. This is done by recalculating the mortality rates using the same age group weights for all countries, rather than the actual weights of the different member state populations. The weights are based on the age distribution of an agreed upon European standard population.

[4] It is worth noting that while significant effort goes into producing this data, the numbers are nonetheless estimates rather than recorded cases and should be treated as such.

a particular country experienced a crisis in a particular year. Because of how crucial the crisis definition is for the results, the following section is dedicated to describing it in some detail.

ECB definition

We begin by noting that the crisis dataset in fact includes two types of crises. These are systemic crises and residual events. In the analysis that follows, the systemic crises are seen as more severe crises and the systemic crises together with residual events are seen as all financial crises in the EU. The crises are defined over a period from the 1970s until 2016, but as mentioned we limit our analysis to the period from 1992 to 2014. Inspired by Ruhm (2016), we define a year as a crisis year if a country has experienced a crisis for 6 months or more in that year according to the ECB dataset. However, unlike Ruhm (2016), who bases the crisis end dates on unemployment, we define the last year of the crisis as the year with at least 6 months of crisis according to the dataset.[5]

In contrast to definitions of financial crises used in earlier studies, which are often based on single variables, such as unemployment (Ruhm 2016; Stuckler et al. 2009) and GDP (Baumbach and Gulis 2014; Sobotka, Skirbekk and Philipov 2011), the ECB definition is more complex and relies on several conditions that must be satisfied in order to define a period as a crisis period. To identify financial crises, the ECB uses a two-step approach. The first step is a quantitative analysis of individual European countries, which is conducted to find historical events associated with severe financial stress and negative economic outcomes. This analysis involves using financial stress indexes which capture co-movements in key financial market segments, namely equity markets, bond markets and foreign exchange (Duprey, Klaus and Peltonen 2015). The resulting list of episodes from this analysis constitutes all residual events together with systemic crises (Lo Duca et al. 2017).

After compiling the preliminary list above, the ECB proceeds with the second step where the list of crisis episodes from the first step is reduced to only include systemic crises. To be seen as a systemic crisis, a detected crisis has to either include dysfunctional market infrastructure or bankruptcy among important institutions, adoption of policies in order to preserve financial stability or shocks that originated from the financial system, such as a currency crisis where foreign capital is withdrawn from the domestic market. To further improve the list of systemic crises, the ECB also includes other events that national authorities and previous literature have pointed out as crises (Lo Duca et al. 2017). These are what constitute the more severe crises in our analysis.

In total, 50 systemic crises and 43 residual events are found by the ECB. Together, the 93 events make up all crises found in the EU during the period analysed. The distribution of these events over time can be found in Figures A1 and A2 in the appendix. We find that these crisis definitions are more reliable than definitions used in previous literature. The reasoning for this is that these definitions provide a comprehensive list of crisis episodes based on not only sophisticated analytical techniques, but also specific knowledge from national authorities and earlier literature.

[5] Crises in the ECB dataset are originally defined with a monthly frequency.

Alternative definitions of financial crises

The approach for defining crises used by the ECB is relatively hard to operationalise and requires national expertise and data that may be hard for the average researcher to acquire. Therefore, we find that crisis definitions which can be more easily implemented using available data would be useful. While there is no such definition which we favour, we find it relevant to investigate whether definitions of financial crises used in previous literature produce comparable results. If they do, the simpler definitions could possibly be used as a substitute for more complex definitions, such as the one used by the ECB.

One alternative definition of financial crises is presented by Ruhm (2016). He defines state crisis periods in the US based on the unemployment rate divided by average unemployment by state, which he calls the unemployment ratio. According to this definition, there is a crisis if the estimated unemployment ratio is above the 90th percentile. Hence, under this definition a crisis occurs when the unemployment rate is notably higher than the state average. Ruhm (2016) also presents a second definition where a crisis is defined as occurring when both the unemployment ratio and the unemployment rate exceed their respective 90th percentiles.

A third alternative crisis definition is presented by Stuckler et al. (2009). Similarly to the definitions presented by Ruhm, this definition is based on unemployment. However, instead of using the absolute level of unemployment, Stuckler et al. define a crisis as when the change in the unemployment rate exceeds two standard deviations. Hence, this defines a period as a crisis if unemployment increases significantly more than normal.

In addition to our preferred crisis definition, namely the ECB one, we implement our basic specification using all three of these alternative definitions. However, it is important to note that the crisis definitions chosen by Ruhm (2016) and Stuckler et al. (2009) are likely not sufficient to capture all, or even the majority of, financial crises.[6] They are also unlikely to capture the whole crisis periods since a number of factors play important roles during different stages of financial crises. For these reasons, this analysis should only be seen as an exploratory analysis in order to evaluate whether these alternative definitions can be used as substitutes for more complex definitions, such as the one available from the ECB. We do not personally favour these alternative definitions since we find them likely to be too simplistic, but since they are easy to implement we nonetheless find it worthwhile to explore whether they could have some explanatory value.

6.2 Descriptive statistics

This section presents tables and descriptive statistics for the data used in the analysis, with a particular focus on the behaviour of the variables during financial crises. Table 1 presents country average statistics for all-cause as well as cause-specific annual mortality rates between 1992 and 2014. The mortality rates represent the number of deaths per 100,000 people. As seen in the table,

[6] The reason for this is that movements in unemployment or other single, macroeconomic proxies, are usually not enough to capture all crises. Crises in general are more complex and not all crises affect economic indicators in the same way.

Table 1
Distribution of mortality – country averages

	Mean	Standard deviation	Min	Max
All-cause mortality	785	193	568	1155
Cardiovascular diseases	340	151	149	678
Neoplasm	183	27	119	256
Infectious and parasitic diseases	8	3	4	15
Suicides	14	8	3	38
Traffic accidents	10	4	4	20

Mortality measured as deaths per 100,000 people. Summary statistics are for country averages for the period 1992–2014. For summary statistics for the non-averaged mortality variables, see appendix. Values rounded to integers.

Table 2
Descriptive statistics for the unemployment rate during periods with and without crises

	Observations	Mean	Standard deviation	Min	Max
Unemployment	634	9.11	4.49	1.6	27.5
Unemployment if crisis	185	10.02	4.81	1.9	27.5
Unemployment if no crisis	449	8.73	4.30	1.6	24.4
Unemployment if severe crisis	141	10.66	4.92	1.9	27.5
Unemployment if no severe crisis	493	8.66	4.26	1.6	24.4

Crisis and severe crisis is equivalent to a dummy = 1 and no crisis and no severe crisis is equivalent to a dummy = 0. The same principle applies for severe crises. Statistics are for the period 1992–2014. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. Unemployment rates are in percent.

average mortality rates vary substantially between countries. Furthermore, cardiovascular diseases and malignant neoplasm (hereafter denoted neoplasm) are the most common among the presented causes of death, while death due to drugs and infectious diseases are the least common.[7] In contrast, when it comes to incidence, infectious diseases are the most common while incidence in neoplasm and cardiovascular diseases are the least common, as seen in appendix Table A1. The reason for the high incidence of infectious diseases is that these include also minor infections, which are common. Further descriptive statistics of the total data sample, instead of country averages, can be seen in the appendix Table A1.

Descriptive statistics for unemployment, in relation to the main crisis variables discussed in Section 6.1, are presented in Table 2. The statistics indicate that unemployment is on average higher during both severe and all crises. However, the spread is almost as large during periods with crises as during periods with no crisis. This implies that there are crises with both high and low unemployment rates, and so we can conclude that crises are not always associated with higher unemployment rates. One explanation for this may be that unemployment tends to lag behind other macroeconomic variables and consequently remain high for a period after the crisis is over (Ruhm 2016). It is also possible that some crises do not affect unemployment very much. Furthermore,

[7] Cardiovascular diseases and neoplasm (commonly known as cancer) are also the most common of all causes of death, included in this analysis or not.

Table 3
Correlation between crisis variables and variables for unemployment and mortality

	Unemployment	Mortality					
		All-cause	Cardiovascular diseases	Neoplasm	Infectious and parasitic diseases	Suicides	Traffic accidents
ECB: All crises	0.131	-0.100	-0.097	-0.077	0.015	-0.030	-0.125
ECB: Severe crises	0.185	-0.083	-0.089	-0.037	0.044	-0.015	-0.139
Alternative crisis 1	0.425	0.046	0.019	-0.032	0.067	0.035	-0.068
Alternative crisis 2	0.465	0.064	0.073	-0.030	0.054	0.072	0.023
Alternative crisis 3	0.217	0.120	0.125	-0.045	0.060	0.099	0.079

Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. Mortality is measured as deaths per 100,000 people. ECB: All crises is the dummy that takes the value 1 if the ECB identified a crisis in a particular country and period. ECB: Severe crises is the dummy that takes the value 1 if the ECB identified a *systemic* crisis in a particular country and period. Alternative crisis 1 is a dummy that takes the value 1 when there is a crisis based on the unemployment ratio being over the 90th percentile. Alternative crisis 2 is a dummy that takes the value 1 when there is a crisis based on the unemployment ratio being over the 90th percentile combined with the absolute unemployment rate being over the 90th percentile. Alternative crisis 3 is a dummy that takes the value 1 when there is a crisis based on the increase in unemployment exceeding 2 standard deviations.

we find that the average unemployment rate during severe crises is approximately 0.6 percentage points higher than for all crises, suggesting that the more severe crises affect unemployment to a larger extent. Unemployment rates during crisis periods based on alternative definitions can be seen in appendix (Table A2) and are higher compared to crisis periods based on the ECB definition. This is expected since the alternative definitions are based on measures of unemployment.

It is also worth noting that the number of crises under the ECB definition is significantly higher than the number obtained when using the alternative crisis definitions. The fact that the number of crises is relatively low under all three of the alternative definitions may cause problems when using the variables in the analysis due to limited variation in the crisis variable. We take this into account by later performing robustness checks where the percentile cut-offs for defining a crisis are lowered in order to obtain a number of crises similar to the one under the ECB definitions.

Table 3 gives further insight into the correlations between the crisis variables, unemployment and causes of death, including overall mortality. As seen in the table, the correlation between the ECB definitions of crises and unemployment is lower compared to alternative crisis definitions. In other words, the crisis variable in our main specification does not co-move to any larger extent with unemployment, which is included in the model specification. This low correlation reduces the sensitivity of estimated coefficients to changes in model specifications and facilitates the estimation of the individual effect of each variable (Wooldridge 2013, p. 149). Furthermore, the correlation between all crisis variables and mortality is low as expected due to the declining trend in mortality while the crisis variables only take values 0 or 1 over time.

Figure 2 illustrates the development of unemployment and mortality over time. The indication from the graph is that detrended overall mortality and unemployment tend to move in opposite directions, where a high unemployment rate is associated with low mortality and vice versa. Moreover, the graph also depicts the development of overall mortality over the period. The average all-cause mortality rate can be seen to decrease with time.

Figure 2

Development of mortality and unemployment over time

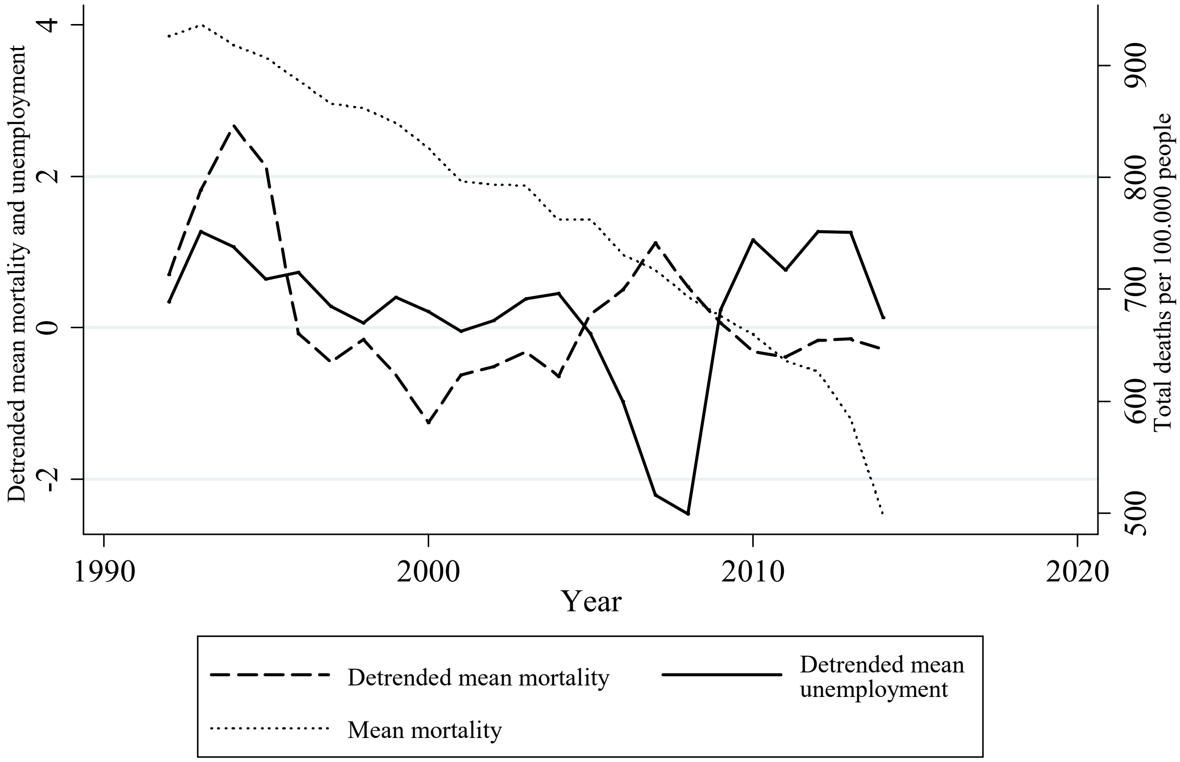

Figure 2. Mortality is measured as the average number of deaths per 100,000 people across the EU countries each year. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. Mean unemployment is the average of this rate across the EU countries each year. The detrended series are detrended using an HP filter.

7. Method

7.1 Econometric model

To investigate whether financial crises affect health, we employ a multivariate linear regression with fixed effects and ordinary least squares estimation (OLS). This is in line with other studies (Ruhm 2016; Stuckler et al. 2009; Toffolutti and Suhrcke 2014) concerning the effects of economic conditions on health. Our econometric specification is inspired by Ruhm (2016), but it differs in that it includes year dummies for the common time trend as well as a different crisis definition. The main specification is thus

$$ln(M_{ct}) = \beta C_{ct} + \gamma U_{ct} + \mu X_{ct} + \alpha_c + \lambda_t + T_{ct} + \varepsilon_{ct} \quad (4)$$

where $ln(M_{ct})$ represents the natural logarithm of the mortality rate in country c at time t. In later specifications, this is replaced by cause-specific mortality rates and other indicators of health. C_{ct} is a dummy variable that takes the value one if country c is defined as having experienced a crisis in year t, U_{ct} is a proxy for macroeconomic conditions, initially the unemployment rate, in country c and year t and X_{ct} is a vector of country characteristics (initially only share of females). α_c

represents country fixed effects and λ_t are time fixed effects (incorporated through dummy variables for each year). Finally, T_{ct} is a country-specific time trend and ε_{ct} is the error term. While β is our main coefficient of interest, it is also interesting to observe the estimates of γ, as these will capture the effects of macroeconomic fluctuations in the absence of a crisis.

In line with the majority of studies in the same field, we choose the natural logarithm of mortality rates as our main variable to measure health outcomes. There are several reasons for using mortality as the main measure of health. Most importantly, mortality represents the most extreme consequence of poor health and its definite nature makes it easy to measure, minimising the risk of measurement error. In addition to this, reliable data is widely available, something that is less true for other measures of health. The logarithmic transformation is done based on the assumption that a percentage point change in the macroeconomic proxy, or going from a year with no crisis to a crisis year, should cause a percentage change in mortality rather than an increase by a fixed number of deaths. While there is little theoretical foundation for this, it is a standard assumption (Ruhm 2016) and we do test for whether the results are sensitive to a specification in levels instead. Also, the logarithmic transformation is unproblematic from a mathematical perspective since the health indicators only take values larger than zero.

All dependent variables that undergo a logarithmic transformation are also multiplied by 100 in order to facilitate interpretation. This scales the coefficients and allows us to interpret them directly as the percentage change due to a one-unit change in the independent variables. Significance and statistical inference are not affected by this operation. Also, we generally refer to results as significant if they are found to be significant at least at the 5 % level, unless something else is specified.

The main crisis dummy variable is based on the ECB definition described in Section 6.1 and thus needs no further introduction. As a proxy for the macroeconomic conditions our main specification uses the unemployment rate. Given that we aim to investigate the effects of financial crises *in addition to* the effects of the normal business cycle found in a number of previously mentioned studies, such as Toffolutti and Suhrcke (2014), we control for the latter effects. We find that using the unemployment rate for this is not only in line with other studies, but also a theoretically and empirically sound choice. This is because it is easy to see how unemployment could have a direct impact on individual health through e.g. the stress imposed by losing one's job, and this effect has been suggested in earlier studies (Ruhm 2000; Toffolutti and Suhrcke 2014). However, this is not to say that other proxies for macroeconomic conditions completely lack importance and therefore we test robustness to using these instead in alternative specifications.

We follow related literature (Ruhm 2016; Stuckler et al. 2009) in controlling for unemployment, but it is worth noting that this is not necessarily unproblematic. It is entirely plausible that unemployment could be a channel through which crises affect health and in controlling for unemployment, we essentially remove this channel from the total effect of crises captured by the coefficient for the crisis dummy. The crisis coefficient should thus be interpreted as the effect of a crisis given a certain level of unemployment, or equivalently as the effect in addition to the effect of unemployment. Potential channels for the effect of crises on health, apart from unemployment, include stress related to declining house and asset prices as well as different austerity measures causing lower access to healthcare. The total effect of a particular crisis can be found by adding the crisis effect, which then captures factors other than unemployment, to any effect from a change in unemployment associated with the crisis. Given that the crisis variables and unemployment have low correlations, as described in Section 6.2, including or excluding the unemployment variable should not dramatically change the results. Nonetheless, given that the inclusion of unemployment could be problematic, we also perform our main regressions without the unemployment variable, as well as with unemployment only.

As country characteristics we only include the share of the population that is female. This is a control variable used earlier by among others Stuckler (2009). We control for the share of females to correct for differences in gender composition between populations, which are known to impact health and life expectancy (EIGE 2017). We do not, however, control for the age distribution of the populations since the data is already age-standardised and any effects of different age distributions are thus already removed. We also do not control for any measure of personal income, as this could be a channel through which unemployment and crises affect health.

One variable we would have preferred to include but have been unable to find sufficient data for is the level of education in the population. Unfortunately, data on this for the earlier part of our sample has frequent gaps and results in the loss of too many observations for estimation results to be reliable. From Eurostat, reasonably complete data is not available before 2004 and other sources only report data at 3- or 5-year intervals. Therefore, we have been forced to exclude education from our regressions. We do however find that it would be meaningful to include it in future studies, especially in a few years when longer data series are available.

As for the country fixed effects, we choose this type of specification to account for the fact that there are likely time-invariant, unobserved factors at the country-level that affect mortality rates. Part of the effect of excluding the education level mentioned above should be absorbed by these fixed effects, as should factors such as institutional structure. Time fixed effects are included to capture common time trends experienced by all countries in the analysis, such as the generally observed decrease in mortality rates. The ability to include these is an advantage of our setup compared to that of Ruhm (2016). While his analysis focuses on one country and national crisis dummies will therefore be collinear with year dummies, our crises vary depending on the country and allow for the inclusion of year dummies. Finally, the inclusion of country-specific time trends is motivated by the fact that countries are at different stages of development, implement different policies and therefore are likely to have their mortality rates develop differently over time. The country-specific time trends capture the effects of this and allow us to focus on the effects of crises themselves. Both common and country-specific time trends could potentially be important in this particular context considering that mortality is known to be decreasing over time.

As outlined by Wooldridge (2013, p. 500–501), we use cluster-robust standard errors to account for within-cluster correlation in the error terms within each country. Using cluster-robust standard errors should yield more conservative standard errors and allow for more reliable inference. In line with most related literature, we also weight the data by the square root of the population for each country. Since the 28 EU countries are different in size, not weighting the data could cause the results to be non-representative by giving countries such as Luxembourg, with a small share of the total EU population, the same importance as e.g. the significantly larger Germany. For the weighting, the square root is used instead of the population itself to avoid excessive influence of a small group of countries. To ensure the robustness of the results, we also run alternative specifications with different types of standard errors and alternative weighting.

7.2 Cause-specific mortality

In addition to all-cause mortality rates, we also include a number of cause-specific mortality rates as dependent variables as a first step to identifying potential underlying mechanisms for changes in mortality. The specific causes of death included have been chosen for two reasons. First, we have chosen to include the major causes of death, namely cardiovascular diseases and neoplasm, as any effect on these is likely to impact a large number of people. Second, we include causes of death that other authors have used in previous analysis and where there are indications that economic conditions have an effect, or the indicated effects have been ambiguous. This will provide us an indication of whether earlier results regarding the effect of standard economic downturns on these causes of death are consistent with our results when controlling for more severe crises.

7.3 Other indicators of health

Unlike earlier studies on this topic, we also have data on both incidence and DALYs for a number of diseases related to the cause-specific mortality rates. We use these instead of mortality, but in otherwise similar specifications to the basic one, in order to investigate effects on health that are not limited to cases that cause death. Here, it is important to keep in mind that this dataset consists of estimates rather than actual recorded cases. We therefore perform the same regressions also for the estimated upper and lower bounds of these estimates to obtain an indication of the robustness of the results.

An important difference compared to the basic specification is that we control also for the age structure of the population in the regressions with incidence and DALYs. We do so by including a variable for the share of the population that is above 65 years of age. The reason we now control for the age structure is that while the mortality data is age-standardised, the data on incidence and DALYs is not. The results in this section include those for total DALYs as these are measures of the total burden of disease weighted by its severity. They do not, however, include total incidence as the total number of cases of all diseases, without any information about their severity, provides little information of value.

While we focus on the effect of financial crises themselves when it comes to mortality rates, the effect of normal business cycles (measured mainly by unemployment) are also of interest in this part. This is because there is to the best of our knowledge no earlier study that estimates this relationship. As a result, we also present specifications that exclude the crisis dummy variable in this part.

7.4 Additional specifications

In addition to the ones mentioned above, we also run specifications that include subgroups of countries based on their level of public healthcare spending. Since we do know from economic literature that government involvement is an important factor in determining population health, it seems reasonable to investigate whether it is of any importance in this context. These additional specifications are thus included to provide some insight into potential mechanisms driving the results.

8. Results

8.1 Basic specification

Table 4 displays the results when estimating the effects of both all crises and severe crises on overall mortality. Columns (3) and (7) contain the results for our preferred specification with both year and country fixed effects as well as country-specific time trends. Columns (1), (2), (5) and (6) build up to this specification by gradually adding fixed effects. The estimated effects of crises on overall mortality are significant in both the main specifications and indicate that mortality is expected to increase with approximately 1.3 % both during all and severe crises. Moreover, the estimated effect of unemployment on mortality is significant in the main specifications and indicates that mortality decreases when unemployment increases. These results suggest that as a

Table 4
Main regressions

	All crises				Severe crises			
	ln(All-cause mortality)				ln(All-cause mortality)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crisis coefficient	-3.69^{*}	-0.07	1.29^{**}	1.06^{*}	-3.91	0.05	1.28^{*}	0.83
	(1.73)	(0.32)	(0.42)	(0.47)	(3.24)	(0.56)	(0.53)	(0.55)
Unemployment	0.42	-0.25^{***}	-0.31^{***}		0.47	-0.26^{***}	-0.33^{***}	
	(0.42)	(0.06)	(0.08)		(0.38)	(0.06)	(0.08)	
Share of females in	1656	1087^{**}	678	452	1600	1088^{**}	722	497
Population	(1289)	(389)	(381)	(388)	(1273)	(392)	(383.36)	(389)
Constant	-194	3926^{***}	1565^{***}	1507^{***}	-166	3928^{***}	1557^{***}	1475^{***}
	(660)	(230)	(56)	(65)	(652)	(229)	(63)	(70)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific time trend	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Year fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
N	573	573	573	573	573	573	573	573

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(All-cause mortality)*100. All-cause mortality in turn is measured as total deaths per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table 5
Main regressions with alternative crisis definitions

	ln(All-cause mortality)				
	All crises (1)	Severe crises (2)	Alternative crisis 1 (3)	Alternative crisis 2 (4)	Alternative crisis 3 (5)
Crisis coefficient	1.29**	1.28*	-0.64	-1.02	-0.10
	(0.42)	(0.53)	(0.61)	(0.93)	(0.63)
Unemployment	-0.31***	-0.33***	-0.25*	-0.26*	-0.29**
	(0.08)	(0.08)	(0.11)	(0.10)	(0.08)
Fixed effects and controls	Yes	Yes	Yes	Yes	Yes
N	573	573	573	573	573

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(All-cause mortality)*100. All-cause mortality in turn is measured as total deaths per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. Alternative crisis 1 consists of crises defined based on the unemployment ratio being over the 90th percentile. Alternative crisis 2 consists of crises based on the unemployment ratio being over the 90th percentile combined with the absolute unemployment rate being over the 90th percentile. Alternative crisis 3 consists of crises based on the increase in unemployment exceeding 2 standard deviations. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

contrast to the negative effect of unemployment on mortality, financial crises actually increase mortality. Also, when it comes to unemployment, the results in the main specifications (columns (3) and (7)) are similar to results obtained on US data by Ruhm (2016) where a one percentage point increase was also estimated to reduce overall mortality by approximately 0.3 %. As a side note, it is also worth noting that in columns (2) and (6), where year fixed effects are not included, the coefficients for both types of crises are not found to be significant. Results are thus somewhat dependent on the inclusion of these fixed effects, which are missing in the specification employed by Ruhm (2016).

Columns (4) and (8) in Table 4 present the results from the specifications excluding unemployment. Excluding unemployment causes the crisis coefficients to decrease slightly, but the coefficients for both all and severe crises still indicate that a crisis increases mortality with between 0.83 % and 1.06 % depending on severity. The coefficient for all crises is also still significant, while the one for severe crises is no longer significant when excluding unemployment. Given the results in columns (4) and (8) we can conclude that when it comes to all-cause mortality, it appears that excluding unemployment causes the crisis coefficients and their significance to decline slightly, but the general conclusions regarding the effects of crises remain the same.

When instead using the alternative crisis definitions discussed in Section 6.1, the effect of crises on mortality is no longer significant, as seen in Table 5. This is in line with earlier papers (Ruhm 2016; Stuckler et al. 2009) which also did not find a significant effect on all-cause mortality when using simpler definitions of crises based on extreme macroeconomic events. When changing the cut-offs for the alternative crises in order to obtain a number of crises corresponding to those under our preferred definition, still no significant effect is found (see Table A3 in appendix).

Table 6
Main regressions on cause-specific mortality

	All-cause mortality (1)	Cardiovascular mortality (2)	Neoplasm mortality (3)	Infectious and parasitic disease mortality (4)	Suicide mortality (5)	Traffic accident mortality (6)
Panel A– All crises						
Crisis	1.29**	1.38*	0.46	-0.47	0.19	0.38
	(0.42)	(0.54)	(0.38)	(3.99)	(1.13)	(1.25)
Unemployment	-0.31***	-0.11	-0.04	-0.87	0.23	-1.37***
	(0.08)	(0.14)	(0.10)	(0.65)	(0.23)	(0.33)
Share of females in Population	678	663	533	-1834	1718***	1837*
	(381)	(408)	(276)	(2497)	(425)	(736)
Constant	1565***	782***	751***	6012***	643***	1702***
	(56)	(56)	(42)	(419)	(95)	(109)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
N	573	629	629	570	627	624

	All-cause mortality (7)	Cardiovascular mortality (8)	Neoplasm mortality (9)	Infectious and parasitic disease mortality (10)	Suicide mortality (11)	Traffic accident mortality (12)
Panel B - Severe crises						
Severe crisis	1.28*	1.56*	0.50	-1.52	0.73	-0.02
	(0.53)	(0.63)	(0.47)	(4.96)	(1.27)	(1.79)
Unemployment	-0.33***	-0.13	-0.04	-0.84	0.21	-1.37***
	(0.08)	(0.15)	(0.10)	(0.64)	(0.22)	(0.33)
Share of females in Population	722	711	550	-1795	1713***	1861*
	(383)	(412)	(278)	(2481)	(422)	(739)
Constant	1557***	789***	752***	5907***	687***	1667***
	(63)	(65)	(51)	(488)	(97)	(132)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
N	573	629	629	570	627	624

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(Mortality rate)*100. The mortality rate in turn is measured as total deaths due to a particular disease category per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

8.2 Cause-specific mortality

To investigate which causes of death that may drive changes in mortality, we estimate the effects of financial crises on several causes of death. These results can be found in Table 6. Panel A displays results when including all crises and has estimates that indicate that among the included causes of death, crises only have a significant effect on death caused by cardiovascular diseases. A crisis is estimated to increase deaths due to cardiovascular disease by about 1.4 %. The coefficients for severe crises in Panel B are of similar magnitude and significance. Again, crises only have a significant effect on death caused by cardiovascular diseases, where severe crises are estimated to lead to an increase by 1.6 %. The coefficients for traffic accident mortality are somewhat peculiar as the coefficients for crises and severe crises have opposite signs, but due to the lack of significance this may not mean much.

Studying Table 6 further, we can also note that among the cause-specific mortality categories, the unemployment rate only has a significant effect on deaths in traffic accidents, regardless of which crisis type is included in the regression. The estimated effect is negative and highly significant, implying that a one percentage point increase in unemployment leads to an approximate 1.4 % decrease in traffic accident deaths.

Table A4 in the appendix shows variations of the main regressions for cause-specific mortality excluding either unemployment or the crisis variable. When excluding the crisis variable, both magnitude and significance of the unemployment coefficients are essentially unaffected. Similarly, the majority of the crisis coefficients remain similar when excluding unemployment.[8] Most importantly, both crisis coefficients for cardiovascular diseases decrease slightly, but remain similar in both magnitude and significance regardless of whether unemployment is included or not. The inclusion of unemployment thus does not appear to dramatically alter the results and we therefore proceed only with specifications including both unemployment and a crisis variable in the remainder of the analysis.

When regressing the cause-specific mortality rates on alternative crisis definitions, as for all-cause mortality no significant effect is found (see Table A5 in appendix). This could suggest that using single macroeconomic variables is not enough to capture the effects of financial crises, if there are any. Hence, in the analysis that follows, only our preferred crisis definition based on the ECB dataset will be used.

8.3 Robustness checks

To test whether the obtained results are sensitive to changes in specification, we estimate alternative specifications of the model. Results from these regressions can be found in Table 7. Weighting based on population, as in column (2) and (9), produces smaller coefficients for the crisis variables and renders the effect of severe crises insignificant. Removing the weighting instead produces larger coefficients for the crisis variables, both of which are still significant. However, regardless of weighting method the crisis coefficients remain fairly similar to the main specification, indicating that results are nonetheless fairly robust.

As expected, using non-robust and non-clustered standard errors decreases the size of the standard errors and leads to increased significance, while using wild cluster bootstrap[9] for the estimation

[8] Two previously insignificant coefficients, infectious diseases during severe crises and traffic accidents during all crises, change somewhat more in magnitude, but remain insignificant. In both cases the change is in the direction of the removed unemployment coefficient, indicating that these coefficients have incorporated the effect of the excluded unemployment variable. However, given the large standard errors of these particular coefficients and their lack of significance, the change in magnitude is not very surprising and we will not attempt to interpret it further.

[9] Wild-cluster bootstrap is a method of conducting reliable inference in settings where clusters are few and regressions include variables that, like dummy variables, contain few values (Cameron and Miller 2010). Both of these are

Table 7
Robustness checks all-cause mortality

Panel A – All crises

	All-cause mortality						
	Main specification	Alternative weights		Alternative standard errors		Levels	Autocorrelation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crisis	1.29**	1.06**	1.57**	1.29**	1.29***	12.14*	0.75**
	(0.005)	(0.008)	(0.006)	(0.009)	(0.000)	(0.010)	(0.005)
Unemployment	-0.31***	-0.33***	-0.30*	-0.31**	-0.31***	-2.31**	-0.20***
	(0.001)	(0.000)	(0.013)	(0.007)	(0.000)	(0.009)	(0.001)
Autocorrelation Term							0.52***
							(0.000)
Dependent variable	Log	Log	Log	Log	Log	Levels	Log
Weight	$Population^{1/2}$	Population	None	$Population^{1/2}$	$Population^{1/2}$	$Population^{1/2}$	$Population^{1/2}$
Standard errors	Cluster-robust	Cluster-robust	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Cluster-robust
N	573	573	573	573	573	573	566

Panel B– Severe crises

	All-cause mortality						
	Main specification	Alternative weights		Alternative standard errors		Levels	Autocorrelation
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Severe crisis	1.28*	0.75	1.96**	1.28*	1.28***	14.11*	0.71*
	(0.023)	(0.173)	(0.003)	(0.032)	(0.000)	(0.022)	(0.037)
Unemployment	-0.33***	-0.34***	-0.32**	-0.33**	-0.33***	-2.48**	-0.20***
	(0.000)	(0.000)	(0.008)	(0.008)	(0.000)	(0.007)	(0.000)
Autocorrelation Term							0.53***
							(0.000)
Dependent variable	Log	Log	Log	Log	Log	Levels	Log
Weight	$Population^{1/2}$	Population	None	$Population^{1/2}$	$Population^{1/2}$	$Population^{1/2}$	$Population^{1/2}$
Standard errors	Cluster-robust	Cluster-robust	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Cluster-robust
N	573	573	573	573	573	573	566

p-values in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions, except when levels are specifically specified, is ln(All-cause mortality)*100. All-cause mortality in turn is measured as total deaths per 100,000 people. The autocorrelation term is ln(All-cause mortality)*100 from the previous period. All regressions include a constant, share of females in population, country-specific time trends and country and year fixed effects. Wild cluster bootstrap standard errors are obtained through 1,000 replications. All coefficients, except when the dependent variable is in levels and that of the autocorrelation term, are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

produces somewhat larger standard errors. However, estimated crisis coefficients remain significant regardless of standard error estimates. Furthermore, to investigate whether the log transformation of mortality affects the results an additional analysis has been conducted where

applicable in our analysis. First introduced by Wu (1986), the method begins by resampling the cluster residuals through a number of replications where either the residual or the residual times minus one is drawn with equal probability for each cluster. In each replication, the drawn residuals are then used to calculate new values for the dependent variable, and these in turn are used to estimate new standard errors. Based on these, wald-statistics are calculated and p-values inferred (Cameron and Miller 2015).

mortality rates in levels instead of logs are used as the dependent variable. These specifications, found in columns (6) and (13), still produce significant estimated effects of crises on mortality, though the interpretation changes. For all crises, we now find that a crisis increases all-cause mortality with 12 deaths for every 100,000 people. The effect for severe crises is even larger with an estimated increase of 14 deaths per 100,000 people. For the average all-cause mortality rate of 785 deaths per 100,000 people, an increase by 12 to 14 deaths is equivalent to an increase by between 1.5 % and 1.8 %, so this effect is not dramatically different from the one found when using variables in logs.

Finally, in line with Toffolutti and Suhrcke (2014) we also test for whether the results are sensitive to including an autocorrelation term for mortality. While controlling for autocorrelation produces smaller coefficients for the crisis variables, the estimated effects remain significant. Coefficients now indicate that crises increase mortality by 0.8 %, while the corresponding coefficient for severe crises is 0.7 %.

Coefficients for unemployment are generally robust to all the specifications in Table 7 and remain significant throughout. Their magnitude also generally changes only to a limited extent in the first five columns for each crisis. When using mortality in levels instead of logs, the coefficient does of course become larger, and similarly to the crisis coefficients it becomes smaller when including an autocorrelation term.

We perform similar robustness checks for the specifications with cause-specific mortality. Changing the weighting and estimation of standard errors affects neither the magnitude of estimated coefficients, nor their significance, to a large extent (see Tables A6 and A7 in the appendix). The exception is mortality due to cardiovascular diseases, where weighting by population decreases the estimated effect by about as much as no weighting increases it. Though the magnitude of the crisis coefficients thus changes somewhat in response to changed weighting when it comes to cardiovascular diseases, the coefficients remain significant. Using levels instead of logs changes the interpretation of the coefficients, but not the conclusions regarding the effects (see Table A8). Finally, results are relatively robust to including an autocorrelation term also for cause-specific mortality, with the exception of the estimated effect of a severe crisis on death caused by cardiovascular diseases, which is no longer significant in this specification (see Table A9). The estimated effect of all crises is still significant, though smaller than before.

In addition to changes in specification, we also test robustness to using alternative macroeconomic proxies, namely real GDP and government debt as a share of GDP. Results from these regressions, which only include all-cause mortality, can be found in Table A10 in the appendix. This shows that the results are robust to replacing unemployment by real GDP as a macroeconomic proxy. Both crisis coefficients change little in both magnitude and significance when doing so. The coefficient for all crises is also robust to the use of government debt as a share of GDP and only becomes slightly smaller, but remains significant, in this regression. The effect of severe crises, in contrast, is no longer significant when replacing the unemployment rate by the government debt as a share of GDP. However, while no longer significant, the coefficient remains positive.

Figure 3

Distribution of coefficients when excluding one country at a time

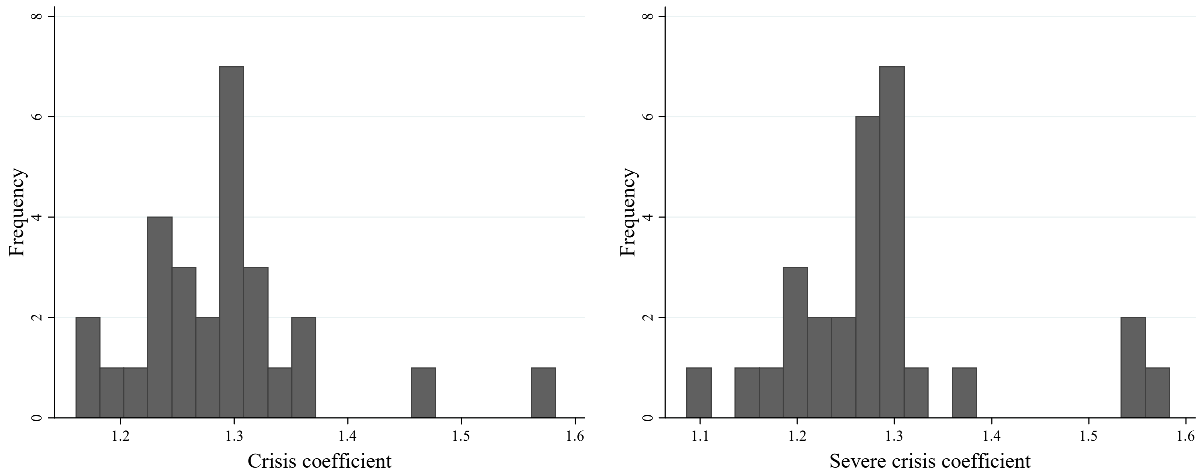

Figure 3. Coefficients on the crisis dummy variables from regressions when excluding one country at a time. The crisis coefficient is the coefficient on the dummy representing all crises included in ECB dataset. The severe crisis coefficient is the coefficient on the dummy representing all systemic crises included in the ECB dataset. The dependent variable in all regressions is ln(All-cause mortality)*100. All-cause mortality in turn is measured as total deaths per 100,000 people. All displayed coefficients are statistically significant at the 5 % level.

For our final robustness check, we note that earlier studies on mortality in Europe, such as Reeves et al. (2015) and Toffolutti and Suhrcke (2014), have excluded countries from their analysis based on arguments including missing data and small population sizes. Therefore, we examine whether our results are sensitive to the exclusion of certain countries. We do this by recording the coefficients from regressions under our main specification, excluding one country at a time. Hence, we perform 28 regressions where in each regression one EU country is excluded. As seen in Figure 3, the estimated effects vary, but only to a limited extent. The estimated effects are also in all cases significant. The largest change occurs when the Czech Republic is excluded from the analysis, leading to an estimated effect of 1.6 % compared to 1.3 % in basic specification, regardless of crisis severity. Furthermore, excluding single countries does not affect the estimated significance to any larger extent.

When excluding single countries in the estimation of the effect of crises on specific causes of death, the results remain similar to the results in our main specifications (see appendix Figure A7). The effect of both crisis variables on cardiovascular diseases remains significant for all 28 regressions. Also, the effects on the other causes of death remain insignificant, except for the one occasion when Germany is excluded in the estimation of the effect of severe crises on neoplasm. Then, the coefficient becomes significant and severe crises are estimated to increase deaths due to neoplasm with approximately 0.9 %.

8.4 Health indicators

Having presented the results from our main specifications, we extend the analysis by replacing mortality as our dependent variable with incidence and DALYs for the same, or most closely related, disease categories. These broader health indicators have, to the best of our knowledge, not

Table 8

Main regressions on incidence

	Incidence cardiovascular diseases	Incidence neoplasm	Incidence infectious and parasitic diseases	Incidence depression
Panel A – Unemployment only				
	(1)	(2)	(3)	(4)
Unemployment	-0.12***	-0.44***	0.02	0.08
	(0.03)	(0.08)	(0.02)	(0.07)
Share of females in population	354	305	-102*	-118
	(179.32)	(197)	(41)	(271)
Share of population over 65	96*	17	-23	92
	(39)	(45)	(14)	(48)
Country-specific time trend	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes
N	622	622	622	622

	Incidence cardiovascular diseases	Incidence neoplasm	Incidence infectious and parasitic diseases	Incidence depression
Panel B –All crises				
	(5)	(6)	(7)	(8)
Crisis	0.11	-0.48	-0.06	-0.01
	(0.21)	(0.29)	(0.10)	(0.23)
Unemployment	-0.12***	-0.43***	0.02	0.08
	(0.03)	(0.07)	(0.02)	(0.07)
Share of females in population	346	338	-98*	-117
	(179)	(194)	(41)	(279)
Share of population over 65	97*	13	-23	92
	(39)	(46)	(14)	(48)
Country-specific time trend	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes
N	622	622	622	622

	Incidence cardiovascular diseases	Incidence neoplasm	Incidence infectious and parasitic diseases	Incidence depression
Panel C– Severe crises				
	(9)	(10)	(11)	(12)
Severe crisis	0.01	-0.52	-0.04	-0.39
	(0.31)	(0.40)	(0.10)	(0.34)
Unemployment	-0.12***	-0.43***	0.02	0.09
	(0.03)	(0.08)	(0.02)	(0.07)
Share of females in population	353	327	-100*	-101
	(180)	(200)	(42)	(278)
Share of population over 65	96*	17	-23	92
	(39)	(45)	(14)	(49)
Country-specific time trend	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes
N	622	622	622	622

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(Incidence)*100. The incidence in turn is measured as new cases of a particular disease category per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. All regressions include a constant. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table 9
Main regressions on DALYs

Panel A – Unemployment only

	DALYs (1)	DALYs cardiovascular diseases (2)	DALYs neoplasm (3)	DALYs infectious and parasitic diseases (4)	DALYs depression (5)
Unemployment	-0.25***	-0.43***	-0.24***	-0.49**	0.09
	(0.06)	(0.10)	(0.06)	(0.17)	(0.07)
Share of females in population	518***	975**	711***	343	-104
	(124)	(275)	(163)	(539)	(252)
Share of population over 65	43	129*	17	75	66
	(22)	(50)	(30)	(136)	(45)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes
N	622	622	622	622	622

Panel B – All crises

	DALYs (6)	DALYs cardiovascular diseases (7)	DALYs neoplasm (8)	DALYs infectious and parasitic diseases (9)	DALYs depression (10)
Crisis	0.51	1.03*	0.19	0.97	0.08
	(0.26)	(0.47)	(0.23)	(0.95)	(0.21)
Unemployment	-0.26***	-0.45***	-0.25***	-0.51**	0.09
	(0.06)	(0.10)	(0.06)	(0.17)	(0.08)
Share of females in population	482***	902**	697***	274	-110
	(126)	(281)	(167)	(554)	(258)
Share of population over 65	46*	136**	18.07	82	66
	(21)	(48)	(30)	(133)	(45)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes
N	622	622	622	622	622

Panel C – Severe crises

	DALYs (11)	DALYs cardiovascular diseases (12)	DALYs neoplasm (13)	DALYs infectious and parasitic diseases (14)	DALYs depression (15)
Severe crisis	0.48	1.05	0.05	0.11	-0.29
	(0.37)	(0.66)	(0.28)	(1.01)	(0.30)
Unemployment	-0.26***	-0.46***	-0.24***	-0.49**	0.09
	(0.06)	(0.10)	(0.06)	(0.17)	(0.07)
Share of females in population	498***	930**	709***	339	-92
	(125)	(280)	(165)	(555)	(257)
Share of population over 65	43	130*	17	75	66
	(22)	(49)	(30)	(136)	(45)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes
N	622	622	622	622	622

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(DALYs)*100. The DALYs in turn are measured as new cases of a particular disease category times the years with full health lost due to the disease per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. All regressions include a constant. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

been included in related earlier studies, including those focusing solely on effects of unemployment. Therefore, we present also coefficients for unemployment with somewhat more care in this section.

The results from the specifications using incidence are presented in Table 8. While we find no significant effects of either crisis variable on incidence of the included diseases, unemployment appears to have a significant effect on incidence of cardiovascular disease and neoplasm. More precisely, a one percentage point increase in unemployment is estimated to decrease incidence of cardiovascular diseases by approximately 0.1 % and to decrease incidence of neoplasm by about 0.4 %.

Results from the specifications using DALYs can be found in Table 9. Here, we do find a significant effect of all crises on DALYs for cardiovascular disease, which are estimated to increase by about 1.0 % in response to a crisis. No other crisis coefficient is significantly different from zero. Unemployment, in contrast, is estimated to have a negative effect on DALYs from all included disease categories except depression. A one percentage point increase in unemployment is expected to reduce total DALYs by 0.3 %, DALYs from cardiovascular disease by 0.5 %, DALYs from neoplasm by 0.3 % and DALYs from infectious and parasitic diseases by 0.5 % (based on Panel B).

Since the data on incidence and DALYs consists of estimated numbers, we also analyse the effects when instead using the estimated upper and lower bounds of these numbers (see Tables A11 and A12 in appendix). These alternative specifications produce results similar to those obtained when using the estimates themselves, with two exceptions. First, the effect of all crises on cardiovascular diseases is no longer significant when using upper and lower bounds, indicating that this effect is not very reliable. Second, the effect of all crises and severe crises on incidence in neoplasm become significant when using the lower bound. Crises are then estimated to decrease incidence in neoplasm somewhat, as seen in Table A11. All coefficients for unemployment change very little when using upper or lower bounds, both with regards to magnitude and significance.

8.5 Additional analysis of public health care spending

In an attempt to shed some light on the mechanisms driving our results, we further investigate the effects of financial crises on mortality in different countries by dividing the EU countries into two groups based on public health care expenditure. One group consists of the 14 countries whose average public health care expenditure as a share of GDP was below the EU median, while the other group consists of the remaining 14 EU countries, i.e. those with an average public health care expenditure as a share of GDP above the median. We calculate country average healthcare expenditure by taking the mean over the analysed time period, i.e. 1992–2014. A breakdown of which countries are included in each group and their average healthcare expenditure over the period can be found in Table A13 in the appendix.

The results from the regressions with groups based on healthcare spending can be found in Table 10. They indicate that crises in general have a significant effect on mortality in low-expenditure

Table 10
Regressions for countries with high and low public healthcare spending

	ln(All-cause mortality)					
	All crises			Severe crises		
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis coefficient	1.29**	0.44	1.70**	1.28*	0.13	1.53
	(0.42)	(0.55)	(0.51)	(0.53)	(0.47)	(0.77)
Unemployment	-0.31***	-0.28**	-0.25	-0.33***	-0.28**	-0.27
	(0.08)	(0.07)	(0.13)	(0.08)	(0.07)	(0.14)
Share of females in population	678	981**	-132	722	983**	-41
	(381)	(304)	(294)	(383)	(308)	(313)
Constant	1565***	1639***	2005***	1557***	1595***	2037***
	(56)	(123)	(168)	(63)	(98)	(174)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Health care spending	All	High	Low	All	High	Low
N	573	243	241	573	243	241

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(All-cause mortality)*100. All-cause mortality in turn is measured as total deaths per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. High healthcare spending regressions include countries where the country average for 1992–2014 is above the EU median. Low healthcare spending regressions include countries where the country average for 1992–2014 is below the EU median. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

countries, but not in high-expenditure countries. The estimated crisis coefficient for low-expenditure countries is also higher than that of the pooled sample, as well as the one for high-expenditure countries. In low-expenditure countries, the estimated effect of a crisis on mortality is an increase of 1.7 %, while it is an increase of 1.3 % for the full sample. When it comes to severe crises, we find a significant effect in the full sample, but not for either of the two expenditure-based groups. Still, one can note that the coefficient for low-expenditure countries is again higher than the other two.

While unemployment is not our main focus, it is also worth noting that the coefficients for unemployment are significant for the full sample and for high-expenditure countries, but not for low-expenditure countries. The coefficients for high-expenditure countries are also smaller than those for the full sample.

Table A14 in the appendix presents results from the same analysis conducted for cause-specific mortality. Studying these specific causes of death, we find no significant effect for either of the groups. This is also the case for the estimated effects of crises on mortality from cardiovascular diseases, where we earlier found a significant effect in the full sample.

9. Discussion

The analysis presented in this thesis aims to establish the effects of financial crises on health. Contrary to existing studies, which find that crises either decreases mortality or have no significant effect (Ruhm 2016; Stuckler et al. 2009), our main analysis provides indicative evidence that once time trends are controlled for, a crisis increases mortality by approximately 1.3 % in the EU. While this effect may not seem large, in 2009 this would have corresponded to an additional 45,000 deaths[10]. To put this in perspective, 34,500 people died from road accidents in the EU the same year (Eurostat 2014).

While our results do not agree with those of previous studies when it comes to the effect of financial crises, we find similar effects of typical macroeconomic fluctuations as measured by unemployment. In all main specifications, we find significant, procyclical effects of unemployment on all-cause mortality. A one percentage point increase in the unemployment rate is generally estimated to decrease mortality by 0.3 % in our regressions. This is almost identical to the effect estimated by Ruhm (2016) on US data. Overall, the results of this empirical study thus partly confirm the findings of previous literature, in particular that mortality decreases during economic recessions, while also providing evidence that the relationship found during recessions cannot be fully extended to financial crises. Instead, we find that crises, unlike unemployment, increase mortality.

As seen from the results of the different robustness checks, the main results are generally robust to changes in specification as well as the exclusion of single countries and the unemployment variable. Both the magnitude and significance of coefficients remain similar to the original specification when changing types of weighting and using different methods to calculate the standard errors. This suggests that the results are not overly dependent on the choice of model specification. The results are also relatively robust to using different proxies for macroeconomic conditions. The one exception to this is that the effect of severe crises on all-cause mortality is no longer significant when replacing the unemployment rate by government debt as a share of GDP. However, we do not find this overly alarming since it is not entirely implausible that increases in debt and resulting austerity measures could be a channel through which the crises affect health, and therefore controlling for this could distort the estimate of the effect of crisis itself.

Investigating which causes of death may be driving the increase in mortality during crises, we only find a significant effect of crises on deaths in cardiovascular diseases. This effect indicates that a crisis increases deaths due to cardiovascular diseases by somewhere between 1.4 % and 1.6 %, depending on the type of crisis. Given that cardiovascular diseases cause close to half of all the deaths in our sample and that the estimated coefficients for this type of mortality are somewhat higher than those for all-cause mortality, results are likely driven by this disease category to a large extent. While we can only speculate about the reasons for why deaths in cardiovascular diseases appear to increase during financial crises, it seems plausible that lower access to health care as well as stress related to economic distress and uncertainty may contribute.

[10] Estimate provided for illustrative purposes. Based on the total population of 487 million people in the 24 countries that experienced either a systemic crisis or residual event in 2009 and an average mortality rate in these countries of 711 deaths per 100,000 people the year before (2008). 487,000,000 x (711/100,000) x 0.013 ≈ 45,000.

Studying the results for cause-specific mortality further, we find that the effects of unemployment are significant for deaths due to traffic accidents, which are found to decrease as a result of increasing unemployment. This is in line with results in existing literature. However, contrary to other studies that have found that increasing unemployment leads to fewer deaths caused by cardiovascular diseases (Laliotis, Ioannidis and Stavropoulou 2016; Strumpf et al. 2017; Toffolutti and Suhrcke 2014), we find no significant effect. The difference between these and our results may in part be explained by the fact that we control for crises themselves, while other studies do not. We thus find that crises, but not typical recessions as measured by unemployment, affect mortality caused by cardiovascular diseases. Moreover, when it comes to other categories of cause-specific mortality, our results are insignificant and we thus have no evidence of an effect of either crises or unemployment. However, this does not mean that we can reject the existence of an effect and we will thus refrain from drawing any further conclusion in this area.

While our results indicate that financial crises likely affect mortality, we find no consistent significant effects of crises on incidence in specific diseases or disability-adjusted life years (DALYs). We do, in contrast, consistently find significant effects of unemployment on some of these health indicators. This indicates that the business cycle does have an effect on health beyond mortality both when it comes to incidence and DALYs, while there is little evidence for an additional effect from a crisis. An aspect of these results worth noting is that while crises are found to have a significant effect on mortality from cardiovascular diseases, no robust such effect is found for incidence or DALYs of the same disease category. It would thus appear that it is only the number of people who die from these diseases that is affected during crises, not the number of people who get ill. However, the results concerning incidence and DALYs should be interpreted with some caution due to the increased risk of measurement error in the data, resulting from the fact that these numbers are estimates rather than recorded cases.

The additional analysis concerning public health care expenditure suggests that crises in general have a larger effect on mortality in countries where public health care spending as share of GDP was below the EU median. Specifically, the estimated results suggest that in these countries, financial crises increase mortality by 1.7 % in addition to the effect of typical recessions. This effect is larger than the effect found in the pooled sample with all countries included. We find no significant effect of crises in countries with public healthcare spending above the EU median. In addition to this, we find that the magnitude of effects of unemployment is smaller in countries with high public healthcare spending than in the pooled sample. While these results should only be seen as indicative, public healthcare spending thus appears to act to smooth out the effects of the economy on health. Our results are not particularly informative about why this is, but a possible explanation is that changes in personal income are of less importance for health-related decisions when there is more comprehensive public health insurance. It is then possible that by increasing health care spending, governments could reduce or avoid negative health effects of financial crises.

A question that could arise following the presentation of our results is why we find effects that differ from those found in earlier studies. In this context, it is important to keep in mind that when comparing our results to those of previous studies when it comes to the effect of unemployment, results are in fact similar. It is only when it comes to the effect of financial crises themselves that our results differ. Only the studies by Ruhm (2016) and Stuckler et al. (2009) actually attempt to control for crises on a national level and then find that crises either decrease mortality or have no significant effect. This stands in contrast to our results. However, we argue that the crisis definitions used in previous studies likely affect the results. This is supported by the fact that when using the same definitions in our analysis, we no longer find a significant effect. Based on this, we conclude that it may not be sufficient to define crises by changes in single macroeconomic variables, such as unemployment, to capture any additional effect of a financial crisis on mortality. A more comprehensive method to define crisis periods, such as the ECB definition used in our analysis, may be needed to fully understand how mortality changes during crisis periods.

In general, the theory does not give much guidance about the direction in which health should be affected by changes in income. The Grossman model does predict that changes in income affect the optimal level of the health stock, but consumption of goods that are both beneficial and harmful is also affected, resulting in unclear total effects. However, it is clear from a theoretical perspective that effects of unexpected income shocks, such as financial crises, should differ from those of predictable changes. This is also what we find and so our results are reasonably in line with theory. Financial crises appear to have an effect on health in the form of mortality and the effect remains when controlling for business cycle proxies such as the unemployment rate. The effects also appear to be going in opposite directions, but we do not put all that much weight on this particular aspect.

While the theory does not give clear predictions about the effects of unemployment on health, the conclusions in existing empirical literature are almost surprisingly unanimous. Most studies conclude that mortality is procyclical and that increasing unemployment is good for our health. Still, while the correlation is clearly there, we find that it is worth maintaining a dose of scepticism towards the causality of this relationship. Resting on individual level studies of the relationship between unemployment and health (e.g. Gerdtham and Johannesson 2005) as well as the fact that in theory, negative factors such as lower investment in health do appear to outnumber the positives, the intuitive causal relationship should be the inverse of the one generally found. One way to explain the large-scale effects found while not rejecting theory or individual relationships could be through the existence of lags in the process of translating economic factors to health outcomes. While we will leave the study of this potential mechanism for future research, Table A15 in the appendix provides a first indication that lagged effects may indeed exist. As seen in this table, unemployment five years ago has a significant effect on mortality of about the same magnitude as current unemployment, but in the opposite direction. We do not view this as proof of an effect, but it does provide an incentive to think about whether the effects found in earlier studies are causal or instead a result of health effects appearing slowly over time.

While our analysis has advantages in terms of the ability to test the effect of a number of actual crises using a comprehensive dataset of crisis periods as well as the inclusion of several countries and a reasonably long time period, the analysis does have drawbacks which must be taken into consideration when attempting to generalise the results. First, the findings are based on data from high- and middle-income countries in the EU exclusively. Joining the EU involves meeting a number of criteria, and this means that these countries are likely to be more similar than other countries in terms of e.g. economic and institutional structure. Hence, this must be kept in mind when trying to understand the implications of financial crises on health, especially in the developing world and other less rich geographical regions. These regions may have features that affect the health implications of financial crises and cause them to differ from the ones we find. Second, the results are only applicable to the whole population and they do not give any insight into how the health of specific age groups or genders are affected by financial crises. Third, just as different groups of the population may be affected differently, all financial crises are to some extent different. It is therefore worth keeping in mind that crises are unlikely to affect health in the exact same way. Last, due to a lack of adequate data we have not been able to control for education. Since Grossman (1972) theorises that education affects investment in health it would have been interesting to also control for education, and we encourage doing so once the data becomes available.

Despite these drawbacks, we believe that our analysis provides a contribution to the literature as the first study to thoroughly investigate the health effects of financial crises, in addition to those of typical recessions, in Europe. While we build on the analysis of Ruhm (2016), we improve his basic specifications by the inclusion of more comprehensive and well-researched crisis definitions as well as the possibility to include year dummies.[11] We also show that if the effect found is indeed causal, simpler crisis definitions are not enough to capture it. When it comes to broader health indicators, we find no robust effect of crises, but we do find an indication that public healthcare spending affects the effect of crises on health. We therefore believe that our results should be seen as a first indication that financial crises may have a negative effect on health in medium- and high-income countries, and that the level of public healthcare spending may affect this effect.

10. Conclusion

The results found in this paper suggest that in addition to the effect of natural economic downturns, financial crises lead to worsened health through increased mortality. This effect appears to be driven mainly by increased mortality from cardiovascular diseases. We find no additional effects of crises on broader measures of health, but these do appear to be affected by normal economic fluctuations. Thus, our main conclusion is that financial crises increase mortality, once time trends and general macroeconomic conditions are controlled for.

Assuming that financial crises do have a negative effect on health, there are a number of implications for policymakers, especially during times of extreme economic hardship. In most cases, a first step towards handling a problem is becoming aware that it exists. Until now, studies have generally suggested that economic downturns and crises have no or even positive effects on

[11] The inclusion of year dummies is not irrelevant for the results, as exemplified by the differences in estimates between columns (2) and (3) as well as (6) and (7) in Table 4.

health. In light of our results, this perception may need to change and possible negative effects of crises be taken into account by policymakers. However, mitigating the negative health effects of financial crises also requires knowledge about the mechanisms through which these effects occur. Our results provide little guidance regarding through which channels financial crises affect health and thus also say little about which precise measures should be taken. That said, we find indications that effects of crises are larger in countries with lower public healthcare spending, something that is also known to decrease during crises. Knowing that austerity measures such as cutting public healthcare spending could impact the effects financial crises have on health in a negative manner, policymakers could be encouraged to improve access to healthcare and try to avoid cutting spending to the extent possible during crisis periods. This could also serve as an additional reason to work extra hard with stabilisation policies in order to avoid crises altogether, in case the incentives to do so are not strong enough already.

In order to provide more precise recommendations, more research into the mechanisms through which crises affect health is needed. Future research could be done through the study of timing of effects as well as studies on how particular groups of the population are affected. This should include differences between e.g. age groups and genders as well as employed and unemployed people. It would also be of interest to perform similar studies in other contexts, both geographically and over longer time periods. In any future studies of this sort, we encourage the inclusion of measures of education. Finally, to make reliable analysis possible, consistent and comprehensive definitions of crises need to be developed also for other parts of the world. Without precise crisis definitions, identifying the effects of crises becomes significantly more challenging.

In the end, while further research regarding the effects of financial crises on health is needed, we believe that our analysis provides an initial indication that financial crises do adversely affect health. We are also hopeful that future research will shed some light on how and why this happens. Until then, we can at least add another likely reason to the list of why crises should be avoided.

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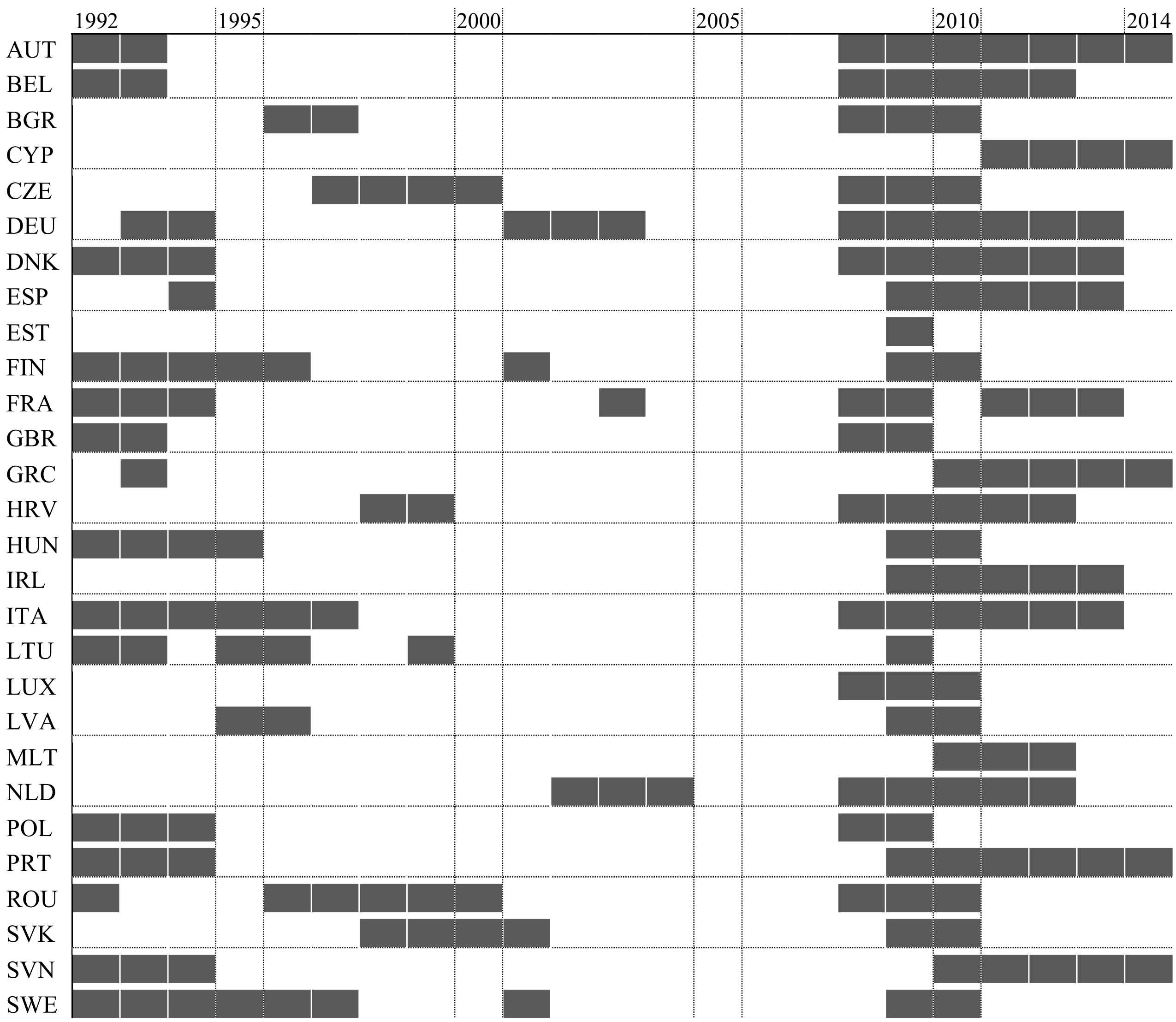
Appendix

Figure A1

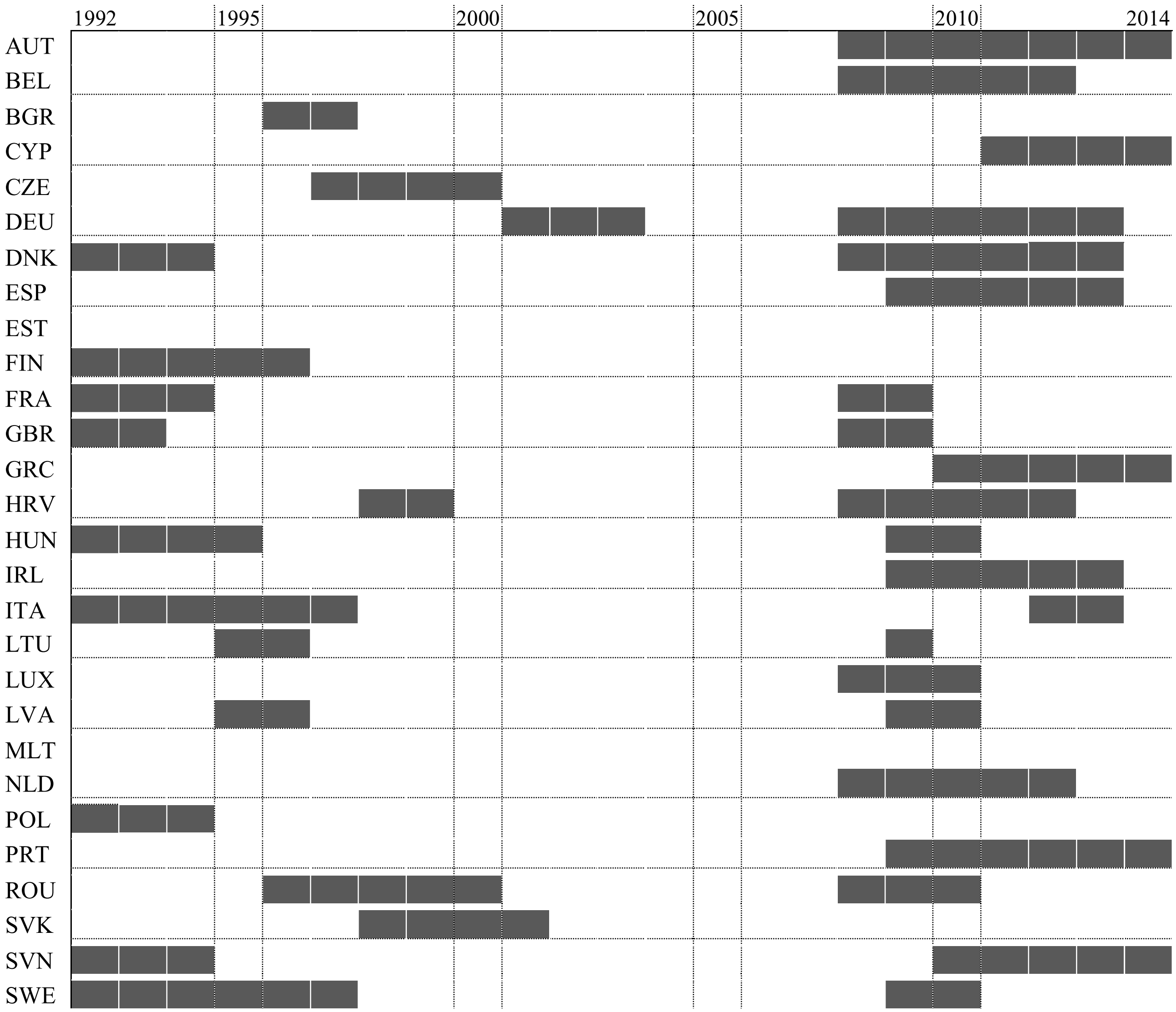
Distribution of crises over time – all crises



All crises are all crises included in ECB dataset. Dark years are crises, equivalent to the crisis dummy taking the value 1, and white years are years with no crisis.

Figure A2

Distribution of crises over time – severe crises



Severe crises are *systemic* crises included in the ECB dataset. Dark years are crises, equivalent to the crisis dummy taking the value 1, and white years are years with no crisis.

Table A1
Descriptive statistics

	Observations	Mean	Standard deviation	Min	Max	Median
Mortality all-cause	577	786	214	453	1492	729
Mortality cardiovascular diseases	622	346	166	97.0	814	299
Mortality neoplasm	622	185	29	114	278	184
Mortality infectious & parasitic diseases	574	8	4	0.9	20.7	7.3
Mortality suicides	620	15	9	1.0	49.1	13.0
Mortality traffic accidents	617	10	6	2.2	35.3	9.8
Incidence cardiovascular diseases	644	1318	204	855	1850	1342
Incidence neoplasm	644	494	111	207	766	501
Incidence infectious & parasitic diseases	644	326514	87767	177201	417644	372472
Incidence depression	644	4265	875	2449	6137	4144
DALYs	644	30940	5588	22114	51251	29317
DALYs cardiovascular diseases	644	7559	3298	3192	17612	6474
DALYs neoplasm	644	5030	834	2749	7703	5077
DALYs infectious and parasitic diseases	644	691	263	315	2143	644
DALYs depression	644	687	135	395	997	683
All crises	644	0.29	0.45	0	1	0
Severe crises	644	0.22	0.41	0	1	0
Unemployment	634	9.11	4.49	1.6	27.5	8.2
Share of females in population	644	0.51	0.01	0.50	0.54	0.51
Share of population over 65	631	0.15	0.02	0.10	0.21	0.16
Real GDP	629	25156	13623	4495	101832	23535
Public healthcare spending - % of GDP	550	5.8	1.4	1.9	8.9	6

Mortality rates, incidence and DALYs are all measured per 100,000 people.

Table A2
Descriptive statistics for unemployment during periods with and without crises

	Observations	Mean	Standard deviation	Min	Max
Unemployment	634	9.11	4.49	1.6	27.5
Unemployment if crisis	141	10.66	4.92	1.9	27.5
Unemployment if no crisis	493	8.66	4.26	1.6	24.4
Unemployment if severe crisis	185	10.02	4.81	1.9	27.5
Unemployment if no severe crisis	449	8.73	4.30	1.6	24.4
Unemployment if Alternative crisis 1	64	14.80	5.07	5.8	27.5
Unemployment if no Alternative crisis 1	570	8.47	3.94	1.6	22.9
Unemployment if Alternative crisis 2	21	20.37	3.61	16.4	27.5
Unemployment if no Alternative crisis 2	613	8.72	3.99	1.6	22.9
Unemployment if Alternative crisis 3	27	13.72	5.79	4.8	24.8
Unemployment if no Alternative crisis 3	607	8.90	4.32	1.6	27.5

Crisis is equivalent to crisis dummy = 1 and no crisis is equivalent to crisis dummy = 0. The same principle applies for severe crises and alternative crises. Alternative crisis 1 is a dummy that takes the value 1 when there is a crisis based on the unemployment ratio being over the 90th percentile. Alternative crisis 2 is a dummy that takes the value 1 when there is a crisis based on the unemployment ratio being over the 90th percentile combined with the absolute unemployment rate being over the 90th percentile. Alternative crisis 3 is a dummy that takes the value 1 when there is a crisis based on the increase in unemployment exceeding 2 standard deviations. Statistics are for the period 1992–2014. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population.

Table A3

Main regressions with alternative crisis definitions – adjusted number of crises

	ln(All-cause mortality)				
	All crises	Severe crises	Alternative crisis 1	Alternative crisis 2	Alternative crisis 3
	(1)	(2)	(3)	(4)	(5)
Crisis coefficient	1.29^{**}	1.28^{*}	-0.49	-0.14	0.42
	(0.42)	(0.53)	(0.41)	(0.51)	(0.38)
Unemployment	-0.31^{***}	-0.33^{***}	-0.24^{**}	-0.28^{**}	-0.31^{**}
	(0.08)	(0.08)	(0.08)	(0.09)	(0.09)
Fixed effects and controls	Yes	Yes	Yes	Yes	Yes
Number of crises	185	141	131	120	147
New cut-off			80^{th} percentile	70^{th} percentile	0.5 standard deviations
N	573	573	573	573	573

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(All-cause mortality)*100. All-cause mortality in turn is measured as total deaths per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. Alternative crisis 1 consists of crises defined based on the unemployment ratio being over the 80th percentile (originally 90th). Alternative crisis 2 consists of crises based on the unemployment ratio being over the 70th percentile (originally 90th) combined with the absolute unemployment rate being over the 70th percentile (originally 90th). Alternative crisis 3 consists of crises based on the increase in unemployment exceeding 0.5 standard deviations (originally 2). The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table A4

Regressions with and without unemployment and crisis dummies

Panel A – All crises

	All-cause mortality			Cardiovascular mortality			Neoplasm mortality			Infectious and parasitic disease mortality			Suicide mortality			Traffic accident mortality		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Crisis	1.29**	1.06*		1.38*	1.28*		0.46	0.41		-0.47	-0.92		0.19	0.45		0.38	-0.27	
	(0.42)	(0.47)		(0.54)	(0.57)		(0.38)	(0.40)		(3.99)	(4.38)		(1.13)	(1.17)		(1.25)	(1.26)	
Unemployment	-0.31***		-0.29**	-0.11		-0.09	-0.04		-0.03	-0.87		-0.87	0.23		0.23	-1.37***		-1.37***
	(0.08)		(0.08)	(0.14)		(0.14)	(0.10)		(0.10)	(0.65)		(0.68)	(0.23)		(0.24)	(0.33)		(0.33)
N	573	577	573	629	641	629	629	641	629	570	574	570	627	639	627	624	636	624

Panel B – Severe crises

	All-cause mortality			Cardiovascular mortality			Neoplasm mortality			Infectious and parasitic disease mortality			Suicide mortality			Traffic accident mortality		
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
Severe crisis	1.28*	0.83		1.56*	1.33*		0.50	0.44		-1.52	-2.54		0.73	1.09		-0.02	-1.44	
	(0.53)	(0.55)		(0.63)	(0.63)		(0.47)	(0.51)		(4.96)	(5.37)		(1.27)	(1.34)		(1.79)	(1.70)	
Unemployment	-0.33***		-0.29**	-0.13		-0.09	-0.04		-0.03	-0.84		-0.87	0.21		0.23	-1.37***		-1.37***
	(0.08)		(0.08)	(0.15)		(0.14)	(0.10)		(0.10)	(0.64)		(0.68)	(0.22)		(0.24)	(0.33)		(0.33)
N	573	577	573	629	641	629	629	641	629	570	574	570	627	639	627	624	636	624

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ The dependent variable in all regressions is ln(Mortality rate)*100. The mortality rate in turn is measured as total deaths due to a particular disease category per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. All regressions include a constant, share of females in population, country-specific time trends and country and year fixed effects. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one unit change in the independent variable.

Table A5

Main regressions on cause-specific mortality – Alternative crisis definitions

Panel A - Alternative crises 1

	All-cause mortality (1)	Cardiovascular mortality (2)	Neoplasm mortality (3)	Infectious and parasitic disease mortality (4)	Suicide mortality (5)	Traffic accident mortality (6)
Alternative crisis 1	-0.64	-0.49	-0.35	2.48	0.37	1.13
	(0.61)	(0.81)	(0.59)	(3.83)	(2.51)	(2.06)
Unemployment	-0.25^{*}	-0.06	-0.01	-1.02	0.21	-1.43^{***}
	(0.11)	(0.17)	(0.10)	(0.72)	(0.32)	(0.35)
Share of females in population	785^{*}	749	562^{*}	-1855	1729^{***}	1858^{*}
	(382)	(419)	(270)	(2553)	(423)	(758)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	573	629	629	570	627	624

Panel B - Alternative crises 2

	All-cause mortality (7)	Cardiovascular mortality (8)	Neoplasm mortality (9)	Infectious and parasitic disease mortality (10)	Suicide mortality (11)	Traffic accident mortality (12)
Alternative crisis 2	-1.02	-1.55	-1.35	1.14	1.84	-0.56
	(0.93)	(1.25)	(1.07)	(5.81)	(3.06)	(2.51)
Unemployment	-0.26^{*}	-0.05	0.02	-0.91	0.17	-1.40^{***}
	(0.10)	(0.16)	(0.11)	(0.70)	(0.28)	(0.37)
Share of females in population	794^{*}	794	613^{*}	-1880	1832^{***}	1859^{*}
	(382)	(435)	(276)	(2513)	(411)	(772)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	573	612	612	570	610	607

Panel C – Alternative crises 3

	All-cause mortality (13)	Cardiovascular mortality (14)	Neoplasm mortality (15)	Infectious and parasitic disease mortality (16)	Suicide mortality (17)	Traffic accident mortality (18)
Alternative crisis 3	-0.10	-0.43	-0.00	-2.64	0.68	2.68
	(0.63)	(1.14)	(0.57)	(3.08)	(1.78)	(2.46)
Unemployment	-0.29^{**}	-0.08	-0.03	-0.83	0.22	-1.41^{***}
	(0.08)	(0.14)	(0.10)	(0.67)	(0.24)	(0.32)
Share of females in population	790^{*}	743	561^{*}	-1893	1737^{***}	1886^{*}
	(384)	(423)	(272)	(2518)	(431)	(765)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	573	629	629	570	627	624

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(Mortality rate)*100. The mortality rate in turn is measured as total deaths due to a particular disease category per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. Alternative crisis 1 consists of crises defined based on the unemployment ratio being over the 90th percentile. Alternative crisis 2 consists of crises based on the unemployment ratio being over the 90th percentile combined with the absolute unemployment rate being over the 90th percentile. Alternative crisis 3 consists of crises based on the increase in unemployment exceeding 2 standard deviations. All regressions include a constant. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table A6

Robustness check - Different types of weighting cause-specific mortality

Panel A – All crises

	Cardiovascular mortality			Neoplasm mortality			Infectious and parasitic disease mortality			Suicide mortality			Traffic accident mortality		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Crisis	1.38*	1.01*	2.06**	0.46	0.19	0.66	-0.47	3.40	-2.41	0.19	0.53	-1.02	0.38	0.39	0.10
	(0.54)	(0.42)	(0.65)	(0.38)	(0.36)	(0.44)	(3.99)	(4.67)	(3.70)	(1.13)	(1.11)	(1.76)	(1.25)	(1.63)	(1.39)
Unemployment	-0.11	-0.12	-0.12	-0.04	-0.08	-0.01	-0.87	-1.27*	-0.21	0.23	0.06	0.35	-1.37***	-1.57***	-1.29***
	(0.14)	(0.15)	(0.15)	(0.10)	(0.13)	(0.07)	(0.65)	(0.50)	(0.67)	(0.23)	(0.23)	(0.22)	(0.33)	(0.32)	(0.28)
Share of females in population	663	616	888	533	708*	262	-1834	-1991	-258	1718***	1927***	1834***	1837*	1717	1621*
	(408)	(350)	(490)	(276)	(330)	(268)	(2497)	(2161)	(2392)	(425)	(505)	(496)	(736)	(969)	(783)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weight	Population 1/2	Population	None	Population 1/2	Population	None	Population 1/2	Population	None	Population 1/2	Population	None	Population 1/2	Population	None
N	629	629	629	629	629	629	570	570	570	627	627	627	624	624	624

Panel B – Severe crises

	Cardiovascular mortality			Neoplasm mortality			Infectious and parasitic disease mortality			Suicide mortality			Traffic accident mortality		
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Severe crisis	1.56*	1.07*	2.25**	0.50	0.25	0.60	-1.52	2.93	-3.70	0.73	1.33	-0.70	-0.02	-0.28	-0.32
	(0.63)	(0.52)	(0.69)	(0.47)	(0.46)	(0.56)	(4.96)	(5.09)	(5.17)	(1.27)	(1.29)	(1.98)	(1.79)	(2.13)	(1.98)
Unemployment	-0.13	-0.14	-0.15	-0.04	-0.08	-0.02	-0.84	-1.29*	-0.16	0.21	0.03	0.35	-1.37***	-1.55***	-1.28***
	(0.15)	(0.15)	(0.15)	(0.10)	(0.12)	(0.07)	(0.64)	(0.48)	(0.65)	(0.22)	(0.22)	(0.21)	(0.33)	(0.33)	(0.28)
Share of females in population	711	651	954	550	714*	289	-1795	-1871	-265	1713***	1945***	1783**	1861*	1731	1642*
	(412)	(346)	(490)	(278)	(327)	(273)	(2481)	(2169)	(2407)	(422)	(482)	(509)	(739)	(985)	(781)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weight	Population 1/2	Population	None	Population 1/2	Population	None	Population 1/2	Population	None	Population 1/2	Population	None	Population 1/2	Population	None
N	629	629	629	629	629	629	570	570	570	627	627	627	624	624	624

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(Mortality rate)*100. The mortality rate in turn is measured as total deaths due to a particular disease category per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. All regressions include a constant. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table A7

Robustness check - Different standard errors - Cause-specific mortality

Panel A – All crises

	Cardiovascular mortality			Neoplasm mortality			Infectious and parasitic disease mortality			Suicide mortality			Traffic accident mortality		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Crisis	1.38*	1.38*	1.38***	0.46	0.46	0.46	-0.47	-0.47	-0.47	0.19	0.19	0.19	0.38	0.38	0.38
	(0.016)	(0.014)	(0.001)	(0.245)	(0.237)	(0.058)	(0.907)	(0.920)	(0.837)	(0.866)	(0.859)	(0.835)	(0.765)	(0.7640)	(0.744)
Unemployment	-0.11	-0.11	-0.11	-0.04	-0.04	-0.04	-0.87	-0.87	-0.87*	0.23	0.23	0.23	-1.37***	-1.37**	-1.37***
	(0.449)	(0.452)	(0.075)	(0.709)	(0.725)	(0.297)	(0.193)	(0.388)	(0.010)	(0.329)	(0.335)	(0.095)	(0.000)	(0.005)	(0.000)
Share of females in population	663	663	663***	533	533	533***	-1834	-1834	-1834	1718***	1718**	1718***	1837*	1837*	1837***
	(0.116)	(0.120)	(0.000)	(0.064)	(0.056)	(0.000)	(0.469)	(0.485)	(0.123)	(0.000)	(0.003)	(0.000)	(0.019)	(0.035)	(0.001)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard errors	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Wild cluster bootstrap	Standard
N	629	629	629	629	629	629	570	570	570	627	627	627	624	624	624

Panel A – Severe crises

	Cardiovascular mortality			Neoplasm mortality			Infectious and parasitic disease mortality			Suicide mortality			Traffic accident mortality		
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Severe crisis	1.56*	1.56*	1.56***	0.50	0.50	0.50	-1.52	-1.52	-1.52	0.73	0.73	0.73	-0.02	-0.02	-0.02
	(0.020)	(0.021)	(0.000)	(0.300)	(0.326)	(0.053)	(0.761)	(0.781)	(0.548)	(0.569)	(0.575)	(0.460)	(0.991)	(0.987)	(0.986)
Unemployment	-0.13	-0.13	-0.13*	-0.04	-0.04	-0.04	-0.84	-0.84	-0.84*	0.21	0.21	0.21	-1.37***	-1.37**	-1.37***
	(0.394)	(0.414)	(0.037)	(0.657)	(0.676)	(0.229)	(0.202)	(0.432)	(0.014)	(0.345)	(0.373)	(0.124)	(0.000)	(0.003)	(0.000)
Share of females in population	711	711	711***	550	550	550***	-1795	-1795	-1795	1713***	1713***	1713***	1861*	1861*	1861***
	(0.096)	(0.100)	(0.000)	(0.059)	(0.060)	(0.000)	(0.476)	(0.503)	(0.128)	(0.000)	(0.000)	(0.000)	(0.018)	(0.030)	(0.000)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard errors	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Wild cluster bootstrap	Standard	Cluster-robust	Wild cluster bootstrap	Standard
N	629	629	629	629	629	629	570	570	570	627	627	627	624	624	624

p-values in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(Mortality rate)*100. The mortality rate in turn is measured as total deaths due to a particular disease category per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. All regressions include a constant. The data is weighted by the square root of the average population in each country during the period 1992–2014. Wild cluster bootstrap standard errors are obtained through 1000 replications. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table A8

Robustness check - Levels of cause-specific mortality

Panel A – All crises						
	All-cause mortality (1)	Cardiovascular mortality (2)	Neoplasm mortality (3)	Infectious and parasitic disease mortality (4)	Suicide mortality (5)	Traffic accident mortality (6)
Crisis	12.14^{*}	8.461^{*}	0.926	0.0929	0.0103	0.0264
	(4.408)	(3.157)	(0.824)	(0.284)	(0.129)	(0.115)
Unemployment	-2.312^{**}	-0.153	-0.0154	-0.0959	0.0326	-0.102^{**}
	(0.823)	(0.556)	(0.197)	(0.0590)	(0.0444)	(0.0309)
Share of females in population	5784.8	2996.6	1049.0	-146.7	102.8	238.1^{*}
	(3397.7)	(1832.7)	(585.3)	(223.4)	(96.74)	(109.5)
Constant	12099.3^{***}	4595.2^{***}	1161.5^{***}	520.7^{***}	187.0^{***}	542.6^{***}
	(507.2)	(266.2)	(87.39)	(34.72)	(13.91)	(10.63)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
N	573	629	629	570	627	624

Panel B – Severe crises						
	All-cause mortality (7)	Cardiovascular mortality (8)	Neoplasm mortality (9)	Infectious and parasitic disease mortality (10)	Suicide mortality (11)	Traffic accident mortality (12)
Severe crisis	14.11^{*}	11.00^{**}	0.954	0.189	0.187	0.0228
	(5.808)	(3.808)	(1.028)	(0.312)	(0.159)	(0.164)
Unemployment	-2.479^{**}	-0.311	-0.0266	-0.0992	0.0282	-0.102^{**}
	(0.855)	(0.575)	(0.193)	(0.0588)	(0.0426)	(0.0309)
Share of females in population	6094.2	3255.6	1083.2	-148.6	99.07	239.2^{*}
	(3428.8)	(1871.7)	(589.9)	(222.7)	(96.59)	(110.3)
Constant	12228.1^{***}	4757.0^{***}	1158.5^{***}	530.0^{***}	201.6^{***}	542.2^{***}
	(619.6)	(324.6)	(105.9)	(38.76)	(13.86)	(12.04)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
N	573	629	629	570	627	624

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is the mortality rate in levels. The mortality rate is measured as total deaths due to a particular disease category per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. The data is weighted by the square root of the average population in each country during the period 1992–2014.

Table A9

Robustness check - Cause-specific mortality with autocorrelation

Panel A – All crises

	All-cause mortality (1)	Cardiovascular mortality (2)	Neoplasm mortality (3)	Infectious and parasitic disease mortality (4)	Suicide mortality (5)	Traffic accident mortality (6)
Crisis	0.75**	0.79*	0.30	0.16	0.78	0.23
	(0.24)	(0.33)	(0.22)	(2.65)	(0.74)	(1.00)
Unemployment	-0.20***	-0.09	-0.02	-0.48	0.10	-0.75***
	(0.05)	(0.06)	(0.04)	(0.29)	(0.11)	(0.19)
Share of females in population	441	446*	286	-605	844	1591**
	(254)	(214)	(171)	(1495)	(532)	(488)
Autocorrelation term	0.52***	0.66***	0.62***	0.56***	0.44***	0.47***
	(0.03)	(0.04)	(0.03)	(0.07)	(0.11)	(0.05)
Constant	814***	319***	288***	2915***	628***	879***
	(55)	(36)	(41)	(545)	(60)	(113)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
N	566	623	623	563	620	616

Panel B – Severe crises

	All-cause mortality (7)	Cardiovascular mortality (8)	Neoplasm mortality (9)	Infectious and parasitic disease mortality (10)	Suicide mortality (11)	Traffic accident mortality (12)
Severe crisis	0.71*	0.60	0.32	-0.95	0.55	0.38
	(0.32)	(0.40)	(0.22)	(3.15)	(0.81)	(1.13)
Unemployment	-0.20***	-0.10	-0.03	-0.46	0.09	-0.75***
	(0.05)	(0.06)	(0.04)	(0.29)	(0.11)	(0.19)
Share of females in population	466	479*	296	-543	883	1596**
	(258)	(224)	(173)	(1491)	(510)	(506)
Autocorrelation term	0.53***	0.66***	0.62***	0.56***	0.44***	0.47***
	(0.03)	(0.04)	(0.03)	(0.07)	(0.11)	(0.05)
Constant	802***	299***	288***	2803***	605***	889***
	(65)	(41)	(43)	(592)	(63)	(99)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
N	566	623	623	563	620	616

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(Mortality rate)*100. The mortality rate in turn is measured as total deaths due to a particular disease category per 100,000 people. The autocorrelation term is ln(Mortality rate)*100 from the previous period. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients except the autocorrelation term are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table A10

Main regressions with alternative macroeconomic proxies

	All crises			Severe crises		
	ln(All-cause mortality)			ln(All-cause mortality)		
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis coefficient	1.29**	1.35**	1.01*	1.28*	1.20*	0.66
	(0.42)	(0.47)	(0.41)	(0.53)	(0.55)	(0.42)
Unemployment	-0.31***			-0.33***		
	(0.08)			(0.08)		
Real GDP		0.49*			0.50**	
		(0.00)			(0.00)	
Government debt			-0.04			-0.04
			(0.03)			(0.03)
Share of females in population	678 (381)	506 (328)	339 (319)	722 (383)	551 (331)	359 (313)
Constant	1565***	1282***	1527***	1557***	1254***	1478***
	(56)	(123)	(204)	(63)	(128)	(199)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
N	573	562	484	573	562	484

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(All-cause mortality)*100. All-cause mortality in turn is measured as total deaths per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. Real GDP is measured in 1000s of dollars per capita. Government debt is measured as percentage of GDP. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table A11

Incidence upper and lower bounds

Panel A – Unemployment only

	Incidence cardiovascular diseases			Incidence neoplasm			Incidence infectious/parasitic diseases			Incidence depression		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Unemployment	-0.10**	-0.12***	-0.13***	-0.45***	-0.44***	-0.46***	0.04	0.02	0.03	0.06	0.08	0.07
	(0.03)	(0.03)	(0.03)	(0.07)	(0.08)	(0.11)	(0.02)	(0.02)	(0.02)	(0.08)	(0.07)	(0.07)
Dependent variable	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound
N	622	622	622	622	622	622	622	622	622	622	622	622

Panel B – All crises

	Incidence cardiovascular diseases			Incidence neoplasm			Incidence infectious/parasitic diseases			Incidence depression		
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Crisis	0.14	0.11	0.02	-0.53*	-0.48	-0.47	-0.14	-0.06	0.06	0.08	-0.01	-0.11
	(0.21)	(0.21)	(0.21)	(0.24)	(0.29)	(0.51)	(0.14)	(0.10)	(0.11)	(0.23)	(0.23)	(0.23)
Unemployment	-0.11***	-0.12***	-0.13***	-0.44***	-0.43***	-0.45***	0.04	0.02	0.03	0.06	0.08	0.07
	(0.03)	(0.03)	(0.03)	(0.07)	(0.07)	(0.10)	(0.02)	(0.02)	(0.02)	(0.08)	(0.07)	(0.07)
Dependent variable	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound
N	622	622	622	622	622	622	622	622	622	622	622	622

Panel C – Severe crises

	Incidence cardiovascular diseases			Incidence neoplasm			Incidence infectious/parasitic diseases			Incidence depression		
	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
Severe crisis	0.02	0.01	-0.07	-0.68*	-0.52	-0.32	-0.03	-0.04	0.07	-0.36	-0.39	-0.43
	(0.31)	(0.31)	(0.30)	(0.32)	(0.40)	(0.67)	(0.15)	(0.10)	(0.13)	(0.34)	(0.34)	(0.35)
Unemployment	-0.10**	-0.12***	-0.12***	-0.43***	-0.43***	-0.45***	0.04	0.02	0.03	0.07	0.09	0.08
	(0.03)	(0.03)	(0.03)	(0.07)	(0.08)	(0.11)	(0.02)	(0.02)	(0.02)	(0.08)	(0.07)	(0.07)
Dependent variable	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound
N	622	622	622	622	622	622	622	622	622	622	622	622

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(Incidence)*100. The incidence in turn is measured as new cases of a particular disease category per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. All regressions include a constant, share of females in population, country-specific time trends and country and year fixed effects. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table A12

DALYs upper and lower bounds

Panel A – Unemployment only

	DALYs			DALYs cardiovascular diseases			DALYs neoplasm			DALYs infectious/parasitic diseases			DALYS depression		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Unemployment	-0.24***	-0.25***	-0.26***	-0.43***	-0.43***	-0.42***	-0.23***	-0.24***	-0.26***	-0.48**	-0.49**	-0.44**	0.07	0.09	0.09
	(0.06)	(0.06)	(0.06)	(0.10)	(0.10)	(0.10)	(0.06)	(0.06)	(0.07)	(0.17)	(0.17)	(0.16)	(0.07)	(0.07)	(0.08)
Dependent variable	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound
N	622	622	622	622	622	622	622	622	622	622	622	622	622	622	622

Panel B –All crises

	DALYs			DALYs cardiovascular diseases			DALYs neoplasm			DALYs infectious/parasitic diseases			DALYS depression		
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Crisis	0.56	0.51	0.44	0.97	1.03*	0.94	0.24	0.19	0.16	1.26	0.97	0.69	0.16	0.08	0.13
	(0.30)	(0.26)	(0.22)	(0.48)	(0.47)	(0.46)	(0.23)	(0.23)	(0.24)	(0.94)	(0.95)	(0.88)	(0.21)	(0.21)	(0.22)
Unemployment	-0.25***	-0.26***	-0.26***	-0.44***	-0.45***	-0.44***	-0.23***	-0.25***	-0.26***	-0.50**	-0.51**	-0.45**	0.07	0.09	0.09
	(0.06)	(0.06)	(0.06)	(0.09)	(0.10)	(0.10)	(0.06)	(0.06)	(0.07)	(0.17)	(0.17)	(0.16)	(0.08)	(0.08)	(0.08)
Dependent variable	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound
N	622	622	622	622	622	622	622	622	622	622	622	622	622	622	622

Panel C –Severe crises

	DALYs			DALYs cardiovascular diseases			DALYs neoplasm			DALYs infectious/parasitic diseases			DALYS depression		
	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)
Severe crisis	0.55	0.48	0.44	1.03	1.05	1.00	-0.00	0.05	0.07	0.37	0.11	0.01	-0.18	-0.29	-0.17
	(0.40)	(0.37)	(0.29)	(0.65)	(0.66)	(0.65)	(0.29)	(0.28)	(0.32)	(1.00)	(1.01)	(0.90)	(0.29)	(0.30)	(0.33)
Unemployment	-0.25***	-0.26***	-0.27***	-0.45***	-0.46***	-0.45***	-0.23***	-0.24***	-0.26***	-0.49**	-0.49**	-0.44*	0.08	0.09	0.09
	(0.06)	(0.06)	(0.06)	(0.10)	(0.10)	(0.10)	(0.06)	(0.06)	(0.07)	(0.17)	(0.17)	(0.16)	(0.07)	(0.07)	(0.08)
Dependent variable	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound
N	622	622	622	622	622	622	622	622	622	622	622	622	622	622	622

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(DALYs)*100. The DALYs in turn are measured as new cases of a particular disease category times the years with full health lost due to the disease per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. All regressions include a constant, share of females in population, country-specific time trends and country and year fixed effects. The data is weighted by the square root of the average population in each country during the period 1992–2014 All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Table A13

Countries with public healthcare spending below and above the median

Below the median		Above the median	
Bulgaria	4.34 %	Austria	7.37 %
Cyprus	2.71 %	Belgium	6.81 %
Estonia	4.66 %	Croatia	6.46 %
Greece	5.78 %	Czechia	7.17 %
Hungary	5.26 %	Denmark	7.52 %
Latvia	3.79 %	Finland	6.80 %
Lithuania	5.34 %	France	7.46 %
Luxembourg	4.51 %	Germany	6.54 %
Malta	5.14 %	Ireland	6.34 %
Netherlands	6.14 %	Italy	6.48 %
Poland	4.15 %	Portugal	6.61 %
Romania	3.40 %	Slovenia	6.49 %
Slovakia	6.06 %	Sweden	6.50 %
Spain	5.66 %	United Kingdom	6.19 %

Countries in the group below the median have average public healthcare spending as a share of GDP below the EU median during the period 1992–2014. Countries in the group above the median have average public healthcare spending as a share of GDP above the EU median during the period 1992–2014. Percentages are each country's average public health care spending as a share of GDP during the same period.

Table A14

Cause-specific mortality split on high and low public healthcare spending

Panel A – All crises

	Cardiovascular mortality			Neoplasm mortality			Infectious and parasitic disease mortality			Suicide mortality			Traffic accident mortality		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Crisis	1.43**	0.94	0.77	0.44	-0.32	0.62	-0.47	10.57	-4.06	0.39	1.01	-3.88	0.76	0.43	3.03
	(0.51)	(0.61)	(0.60)	(0.36)	(0.30)	(0.73)	(3.99)	(6.62)	(3.54)	(1.10)	(1.50)	(1.91)	(1.29)	(2.41)	(1.57)
Unemployment	-0.12	-0.14	-0.05	-0.03	-0.11	0.01	-0.87	-0.11	-1.49*	0.22	-0.17	0.42	-1.43***	-0.99	-1.74***
	(0.14)	(0.16)	(0.22)	(0.10)	(0.19)	(0.08)	(0.65)	(1.36)	(0.55)	(0.22)	(0.36)	(0.20)	(0.32)	(1.07)	(0.37)
Health care spending	All	High	Low	All	High	Low	All	High	Low	All	High	Low	All	High	Low
N	612	263	258	612	263	258	570	243	238	610	263	256	607	262	255

Panel B – Severe crises

	Cardiovascular mortality			Neoplasm mortality			Infectious and parasitic disease mortality			Suicide mortality			Traffic accident mortality		
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Severe crisis	1.67**	0.84	-0.57	0.52	-0.07	1.03	-1.52	7.76	-9.64	1.10	1.90	-4.78	0.52	-0.09	2.60
	(0.60)	(0.63)	(0.97)	(0.45)	(0.45)	(0.99)	(4.96)	(6.93)	(5.05)	(1.21)	(1.53)	(2.26)	(1.80)	(2.35)	(3.01)
Unemployment	-0.14	-0.15	-0.03	-0.04	-0.11	-0.01	-0.84	-0.13	-1.31	0.20	-0.20	0.47*	-1.43***	-0.99	-1.76***
	(0.15)	(0.16)	(0.23)	(0.09)	(0.19)	(0.08)	(0.64)	(1.35)	(0.61)	(0.21)	(0.34)	(0.20)	(0.33)	(1.07)	(0.37)
Health care spending	All	High	Low	All	High	Low	All	High	Low	All	High	Low	All	High	Low
N	612	263	258	612	263	258	570	243	238	610	263	256	607	262	255

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ The dependent variable in all regressions is ln(Mortality rate)*100. The mortality rate in turn is measured as total deaths due to a particular disease category per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. High healthcare spending regressions include countries where the country average for 1992–2014 is above the EU median. Low healthcare spending regressions include countries where the country average for 1992–2014 is below the EU median. All crises are all crises included in ECB dataset. Severe crises are *systemic* crises included in the ECB dataset. All regressions include a constant, share of females in population, country-specific time trends and country and year fixed effects. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.

Figure A3

Cause-specific mortality
Distribution of coefficients when excluding one country at a time

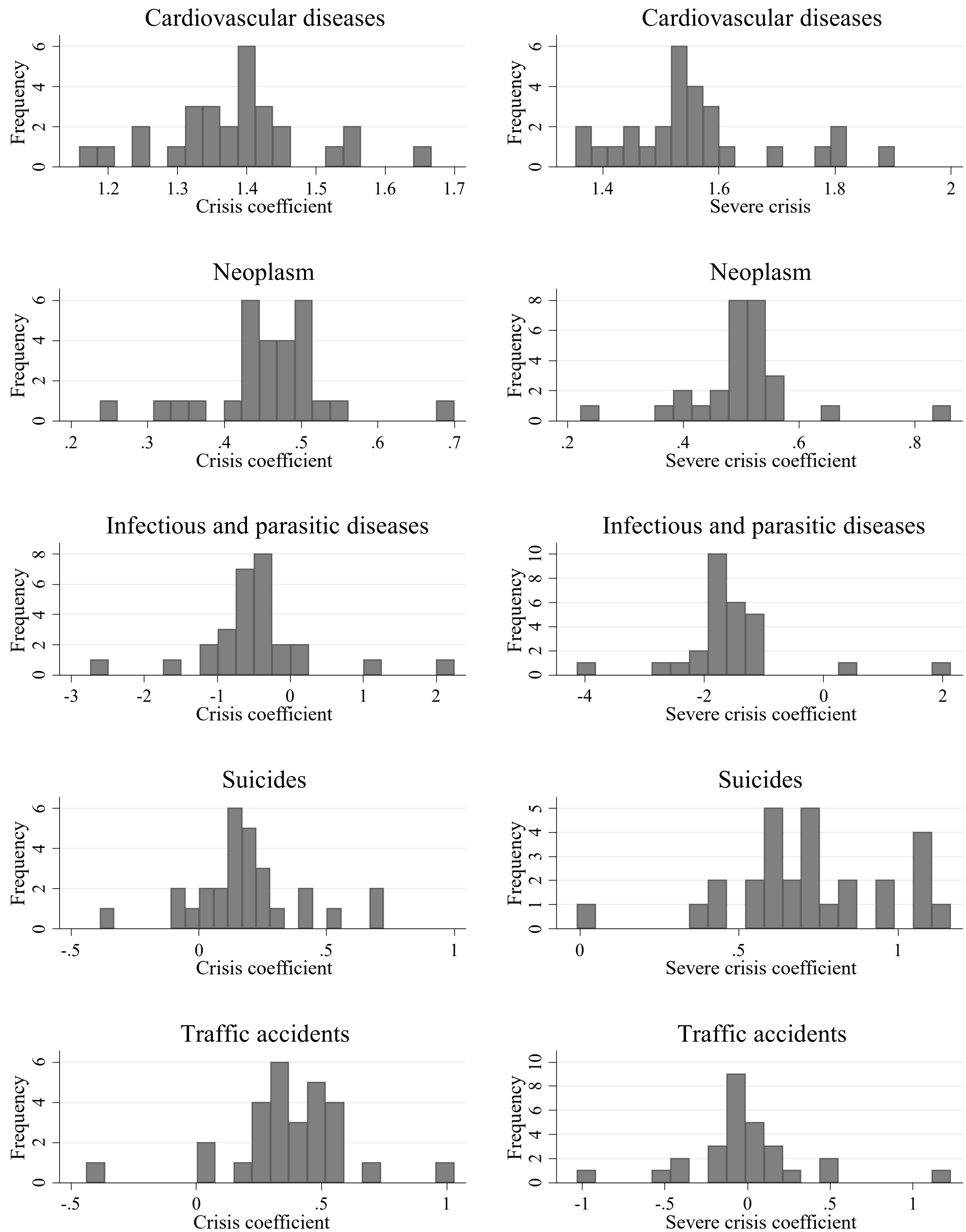


Figure A3. Coefficients on the crisis dummy variables from regressions when excluding one country at a time. The crisis coefficient is the coefficient on the dummy representing all crises included in ECB dataset. The severe crisis coefficient is the coefficient on the dummy representing all systemic crises included in the ECB dataset. The dependent variable in all regressions is ln(Incidence)*100. The incidence in turn is measured as new cases of a particular disease category per 100,000 people.

Table A15

All-cause mortality with lags

	ln(All-cause mortality)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crisis	1.29**	1.22**	1.34**	1.34**	1.15*	1.00*	1.07*	1.23**
	(0.42)	(0.42)	(0.41)	(0.42)	(0.45)	(0.45)	(0.42)	(0.44)
Unemployment	-0.31***	-0.27*	-0.32**	-0.31***	-0.28***	-0.23***	-0.19**	-0.20*
	(0.08)	(0.11)	(0.09)	(0.08)	(0.07)	(0.06)	(0.06)	(0.08)
Share of females in population	678	688	641	594	481	394	428	521
	(381)	(402)	(408)	(396)	(394)	(358)	(321)	(325)
1-period lag		-0.06						
		(0.09)						
2-period lag			-0.01					
			(0.06)					
3-period lag				0.04				
				(0.06)				
4-period lag					0.11			
					(0.08)			
5-period lag						0.18*		
						(0.09)		
6-period lag							0.16	
							(0.10)	
7-period lag								0.05
								(0.11)
Constant	1565***	1572***	1581***	1564***	1521***	1457***	1430***	1459***
	(56)	(56)	(53)	(53)	(56)	(59)	(70)	(87)
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country and year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	573	568	564	555	545	537	527	517

Cluster-robust standard errors in parentheses. Significance stars interpreted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable in all regressions is ln(All-cause mortality)*100. All-cause mortality in turn is measured as total deaths per 100,000 people. Unemployment is measured as all persons over 14 without work, and who also were either available for work or seeking work, as a share of the working age population. Lags are unemployment from earlier periods, with the 1-period lag being unemployment last period, the 2-period lag the unemployment 2 periods ago and so on. Crises are all crises included in ECB dataset. The data is weighted by the square root of the average population in each country during the period 1992–2014. All coefficients are interpreted as percentage change of the dependent variable in response to a one-unit change in the independent variable.