LUND UNIVERSITY
School of Economics and Management

Are recessions still healthy?

- *Empirical evidence regarding the relationship between mortality and macroeconomic conditions*

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Abstract

The relationship between macroeconomic conditions and mortality has previously been established to be procyclical, which means that mortality has decreased during recessions and vice versa. This has been shown for various settings. However, more recent findings suggests that the procyclicality between mortality and macroeconomic conditions have undergone a secular shift from being procyclical to being unrelated to each other in the U.S.. Using a dataset with aggregated data for 16 OECD-countries during the period 1980-2019, I find that there still is a procyclical relationship between mortality and macroeconomic conditions, with a 1 percentage point increase in national unemployment rate suggesting a decrease of total mortality with around 0.6 percent for the whole period. When examining the data with a more flexible sample strategy, a similar pattern as Ruhm (2015) found can be observed, suggesting that the magnitude of the procyclicality might be fading out also for other countries although not in the same pace as in the U.S.. Two potential explanations for the secular shift that are presented by Ruhm (2015) are revisited with the conclusion being that less macroeconomic volatility does not appear to be a reasonable explanation, but the increase of mortality caused by accidental poisonings may be an explanation for the U.S. but not for the rest of the sample.

Keywords: Health; Mortality; Macroeconomic conditions; Recessions; Business cycles

1. Introduction

There is research within economics and other related fields that examines the relationship between health outcomes and the business cycle in the economy, which started off with Harvey Brenner´s (1973, 1975, 1979) seminar work using aggregated time-series data. His results implied that health outcomes improved in financially good times as he found that mortality, infant mortality as well as mortality stemming from cardiovascular diseases and other causes, decreased when the economy strengthened. These studies were later critiqued because of econometric flaws, and correcting the flaws led to mixed results regarding the relationship between the business cycle and mortality. A few decades later, Ruhm (2000) published a seminal paper examining the effect of weakened economic conditions on mortality using aggregate state-level panel data and a fixed effect-approach. Since Brenner´s paper was published, a common belief was that health outcomes including mortality is usually thought to worsen during economic bad times such as a recession, but Ruhm (2000) found that the opposite was true for his sample that included data from the United States between the years 1972-1991 — mortality declined during recessions and increased when the economy was strengthened which implied that although recessions were bad for the economy they were good from a health perspective.

Following his paper, several follow ups have been published. For example, Gerdtham & Ruhm (2006) used the same model and empirical approach but instead of only looking at the United States a wider range of countries was examined with 23 OECD-countries between the years 1960-1997 included in the sample. The results were remarkably similar to those found by Ruhm (2000). They showed a negative effect on mortality when unemployment increases, which suggested that the external validity of Rhum's (2000) results were stable and that the pro-cyclical behavior of mortality and unemployment data was well established also for a wider range of countries and years.

Ruhm (2015) later published another paper examining the same phenomenon but for a longer period, including the years 1976-2010 for the United States, which meant that the sample ran 20 years longer than his first sample. Interestingly, his estimates showed that for the period that came after his first paper, 1991-2010, the results did not suggest that mortality declined during recessions in a statistically significant way. Ruhm (2015) concluded that the pro-cyclical pattern previously shown seemed to have disappeared for more recent years. That raises some

questions. Does the result presented by Ruhm (2015) hold for other settings as well, and if it does, what could explain it?

The aims of this paper are twofold. Firstly, the effect of macroeconomic conditions on mortality will be examined using the same methodology as Ruhm (2015). Secondly, given that the results are similar to those presented by Ruhm (2015), I will evaluate whether the possible suggestions for the secular shift in procyclicality presented by Ruhm (2015) also hold for my data. In order to do that, a sample of 16 OECD countries with data ranging from 1980 to 2019 is used, which allows for examining whether the same type of procyclical pattern between mortality and unemployment that Ruhm (2000) and Gerdtham & Ruhm (2006) showed can be found using data including later years, or if the pattern for the later years has changed and will be more in line with the results shown by Ruhm (2015) suggesting that there is no procyclical pattern any more. I will also extend the baseline regressions and examine if the effect of macroeconomic conditions differs for different types of death causes, which is also done by Gerdtham & Ruhm (2016). Examining heterogeneity in mortality allows us to see whether there are differences in more recent years in the causes of death that could help us explain possible changes in the procyclicality between macroeconomic conditions and mortality.

Using unemployment as a proxy for macroeconomic conditions, I find a statistically significant effect of unemployment on mortality for the whole period (1980- 2019) and also in both periods when the sample is divided in two time frames, one for earlier years (1980-1999) and one for later years (2000-2019). Using the exact same years as Ruhm (2015) does for his latest period, 1991-2010, the estimates suggest that there is a statistically significant effect of unemployment on mortality also for that period. The results for the earlier years are in line with what Ruhm (2000, 2015) and Gerdtham & Ruhm (2006) find for periods before 2000, but the results for the later periods are different from the result that Ruhm (2015) found for the United States. This result is not sensitive for whether the U.S. is included or excluded from the sample. This could either imply that there is no secular shift in the procyclicality at all as was suggested by Ruhm (2015), or at least that there is no procyclicality in other western economies such as those included in this sample which would suggest that the external validity for Ruhms (2015) results could be considered to be quite low. However, when examining the estimates graphically which allows for more flexible sample strategies there is a slightly decreasing magnitude of the estimates for more recent years which could suggest that Ruhm (2015) was touching upon

something even though the estimates for the recent years stay negative and statistically significant for this sample.

When examining the heterogeneity regarding mortality I find a procyclical relationship between cardiovascular diseases and unemployment but no strong relationship between macroeconomic conditions and cancer mortality. For suicide and accidental poisoning the results are partially countercyclical but usually not statistically significant. I also revisit both the potential explanations that were suggested by Ruhm (2015), which was the ”great moderation” and accidental poisonings. I find that the decreased macroeconomic volatility during a period from the 80´s to the mid 00´s, which is the definition of the great moderation, is very similar for the U.S. and the rest of the countries in my sample. Since the estimates for more recent years still are negative and statistically significant, I rule out the great moderation as a possible explanation for Ruhms (2015) secular shift. For accidental poisoning I find that the patterns for the U.S. are very different, with an extreme increase in the U.S. in more recent years, which possibly could affect the procyclicality in the U.S. but not in other western countries. All the results presented here will be discussed further later in the essay.

The essay will continue as follows. In the next section, an overview of previous relevant literature will be presented. The following part will describe the data and sample in general, its sources and some descriptive statistics will also be presented. The next section will discuss the methodology and the empirical approach that is used and the results from the estimates will be presented after that. The potential explanation presented by Ruhm (2015) will be revisited and in the last section a conclusion will be presented.

2. Background

2.1 Previous literature

Business cycles and mortality was for long studied as separate fields, but the relationship between them has been studied at least since the 1970´s when Brenner (1973, 1975, 1979) used time-series data and showed that mortality of several different causes and also admissions to mental hospitals, with death causes including cardiovascular diseases, homicide and suicide among others, had a countercyclical effect in relation to macroeconomic conditions, i.e. health outcomes improved in good times. However, the robustness of the results were later discussed due to technical and econometric flaws (for example by Gravelle et al. (1981)). When these

corrections were made and the same procedure as Brenner used took place again, the results were mixed as shown in several settings, for example by Forbes and McGregor (1984) and McAvinchey (1988).

Ruhm´s seminal paper (2000) used data from 1972-1991 in the United States, and using panel techniques like fixed-effects regressions he found the opposite results of Brenner. Ruhm found that there was a statistically significant procyclical relationship between macroeconomic conditions and unemployment, suggesting that a one percentage point increase in unemployment would decrease total mortality by 0.5 percent. Since this result was the opposite of Brenners and perhaps because it was opposite to what made sense intuitively for many, several studies have since followed Ruhm and used fixed-effects regressions in various settings, using different periods and different countries and found results that supported the procyclical finding. These studies have both used micro and macro data, that is both individual and aggregated data, and the countries and years included have varied.

Most of these studies include data from one specific country and use a similar methodology as Ruhm (2000). For instance, Neumayer (2004) also found a procyclical relationship in Germany using data from 1980-2000. Granados (2005) found similar results for both total mortality and various cases of mortality when using Spanish data ranging from 1980-1997, and Buchmueller et al. (2007) shows that the same baseline results hold in a French setting as they performed their analysis using French data from 1982-2002. Similar results have also been found outside of Europe. For example, Lin (2009) found the same procyclical relationship (which also included infant mortality) in Asia-Pacific countries for the years 1976-2003. Gonzalez and Quast (2011) find a procyclical pattern for total mortality but various results for different causes of mortality in Mexico during 1993-2004. Using data for some middle-aged groups in Canada, Ariizumi and Schirle (2012) also find a procyclical relationship. The same procyclical behavior between the variables has also been found in the U.S. during more severe economic crises than a ”normal” recession (Ruhm, 2016). A few studies have looked at Sweden. They have shown that the results for 20-64 year old’s during the period 1993 to 2007 give the same procyclical relationship as the previous mentioned papers when examining aggregated data (van den Berg et al, 2017) but that the procyclical pattern is not found for both men and women when using individual level data for 40´000 individuals and using various measurements of macroeconomic conditions (Gerdtham & Johannesson, 2005). Also for Sweden, Gerdtham et al (2020) uses different measurements and micro data from 20-44 year old males during the period 1983-2000

and using various measurements of macroeconomic conditions, they find positive estimates that are not statistically significant.

There are also some contributions that include several countries in their sample to examine if the results hold not only within a country but also across several countries. For example, Gerdtham and Ruhm (2006) uses data from 23 OECD-countries covering the period 1960–1997. They also find a procyclical relationship suggesting that a 1 percentage point increase in unemployment would increase the overall mortality rate by -0.004, or 0.4 percent, (compared to Ruhm´s (2000) 0.5 percent). van Gool and Pearson (2014) also use a set of OECD countries, more precisely 24 OECD-countries between the years 1997-2011. They also find a procyclical relationship but with a smaller magnitude and they find that some risky behaviors such as drinking and smoking declined somewhat, although the estimates were not always statistically significant. Toffolutti and Suhrcke (2014) used a sample with 23 EU-countries during the period 2003-2010 and also found procyclical results. It is however worth noting that the latter two studies, van Gool & Pearson (2014) and Toffolutti & Suhrcke (2014), used relatively short time frames compared to other studies.

With quite few exceptions, the procyclical relationship between unemployment and mortality has been well established for various countries and settings. However, Ruhm (2015) then published another paper with interesting results, this time with U.S. data during the period 1976-2010 which meant that the final year of the sample ended almost 20 years later than in his first paper. He found a similar procyclical relationship in the period 1976-1995 with an estimate of -0.0043, but when using the same estimation techniques for the period 1991-2010 he got a positive but statistically insignificant estimate of 0.001 suggesting a secular shift from procyclicality to a non-procyclical relationship for more recent years.

There are some other papers suggesting that including more recent years in the sample and thus changing the time period of analysis alters and might reduce the significance of the procyclicality. For example, Stevens et al. (2015) uses data from 1978-2006 and when the period 1978-1991 is used they find a procyclical relationship, but when the period is extended to 2006 the coefficient decreases from -0.0040 to -0.0019. McInerney and Mellor (2012) examine the population that are 65 years old or older with data from 1976-2008 and find a similar pattern. When using the period 1976-1991 they get an estimate of decreased mortality by -0.0027, but when examining the period 1994-2008 the estimate is positive instead. Tekin et

al (2018) also finds weaker estimates than Ruhm (2000) when changing the time frame and using data from the period 1990-2014. To the best of my knowledge, no one has yet examined the relationship between mortality and macroeconomic conditions for even more recent years which will be done in this essay.

2.2 Mechanisms behind procyclicality of mortality and unemployment

Although there are several studies that examine the relationship between unemployment and mortality and although most of them find a procyclical relationship between the two, there are very few that can explain what causes a procyclical relationship (or what causes the procyclical relationship first found to become smaller in magnitude or to disappear completely as has been found in some more recent papers).

Ruhm (2000) presents some reasons for why an economic upturn could decrease health. The first reason has to do with lifestyle changes since lower unemployment caused by the economic boom increases the opportunity cost of health-promoting activities that take up time such as engaging in physical exercise and to make appointments and go to preventive care visits. The increasing number of working hours could also increase exposure to hazardous working conditions, industrial pollution, physical exertion and job-related stress in general which all could be assumed to have negative health effects. An increase of accidents and motor vehicle fatalities could also be expected. The final potential mechanism that Ruhm (2000) mentions is that migration caused by the economic upturn can reduce general health by crowding and importing diseases. Similar suggestions can be found in other papers, for example in Gerdtham & Ruhm (2006).

The first reason mentioned by Ruhm (2000) suggests that behavior related to health changes with altered macroeconomic conditions. Changes in health behaviors due to macroeconomic changes have been found in several studies, for example in Ásgeirsdóttir et al. (2014) where health behavior changed during and after a recession. Although health behavior could change, the suggestion that individual's behavior and time use affect the procyclicality has also been criticized. With the aim to explain why there might be a secular shift in the procyclicality in more recent years, Stevens et al (2015) argues that the four suggestions by Ruhm (2000) for why there would be a procyclicality does not hold when studying the data closer. They claim that the pro-cyclical mortality in the United States is not driven by changes in individuals' own time use associated with their own employment changes. Instead, they find evidence that

alternative mechanisms are at work, including cyclical variation in the quality of health care. According to Stevens et al. (2015) and Goodman (2006) the mechanism behind this could be that when working hours in the economy rises due to an economic upturn (i.e. when unemployment decreases), fewer low-skilled workers who usually work with direct care within the health care sector find other work which in turn leads to both lower quality and quantity in health care. This affects the elderly and those that live in nursing homes mostly, which is also those that are in the age group with the highest mortality rates in general. It is worth noting that this study focuses on the U.S. and the U.S. labor market and health care system.

Since Ruhm (2015) finds that for more recent years (1991-2010) the procyclicality in the U.S. has undergone a secular shift compared to his previous results with positive but not statistically significant estimates on mortality for unemployment, does that mean that health is less related to macroeconomic conditions these days? Ruhm (2015) offers two suggestions as to what could explain the secular shift. One is that because of the ”great moderation” (the fact that macroeconomic volatility in general was reduced from the 80´s until the early 00´s), procyclicality probably also declined. His second theory relates to the increase of mortality because of accidental poisonings (drug overdoses), which has increased a lot in the U.S. in recent years and has a countercyclical relationship to macroeconomic conditions which in turn could affect the overall result. There is an increasing amount of literature that has found interesting results regarding mortality in general, mostly focusing on the U.S.. Case & Deaton (2015) concludes that over time mortality had a negative trend overall, but since the turn of the century mortality has decreased in Europe but in the U.S. mortality and morbidity has increased (especially for white non-hispanics). This could have several explanations, but one is the ongoing ”opioid epidemic” in the U.S.. Drug mortality is now the leading cause of injury deaths in the United States, exceeding the number of motor vehicle fatalities since 2009 (Ruhm, 2019). Hollingsworth et al (2017) has also found that mortality related to drug overdoses and emergency department visits related to opioids and other drugs increases with unemployment and they conclude that opioids are the driving factor for the total drug death rate as well. It is not clear if this affects the procyclicality between unemployment and mortality, but it suggests that mental health aspects are important and maybe more important now than before. Both the ”great moderation” and the trend change in mortality in the U.S. and their possible connection with the procyclicality between macroeconomic conditions and mortality will be examined further in section 6.

3. Data and descriptive statistics

The empirical analysis in this paper is done based on aggregated panel data including variables from 16 OECD-countries between the years 1980 and 2019. The countries that are included are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Norway, Sweden, the Netherlands, Spain, Switzerland, United Kingdom and the United States. This means that all countries included are considered to be advanced, western, economies which therefore are considered to be homogenous and more comparable to each other. Using many similar countries instead of observations of only one country increases the number of observations and it makes it possible to examine whether the results are generalizable between countries in the same way that Gerdtham & Ruhm (2006) does. Since one of the main purposes of the analysis is to examine whether Rhum's (2015) findings for his latest period, that the pro-cyclicality between business cycles and mortality is fading out in the U.S., also holds in other settings I wanted to use as recent data as possible. With that said, I decided against including the years 2020 and 2021 because of the COVID-19 pandemic which would probably affect both the business cycle and mortality in a way which would make the results less comparable to previous studies. The starting year of 1980 is similar to what Ruhm (2015) uses (1976) and given the final year being 2019 it allows me to split the panel into two equally long time frames with 20 years included in both samples. Using a 20-year window is ideal according to Ruhm (2015) because a shorter window, for example 5-10 years, would generate less precise estimates. Including 15 years would give more precise estimates but they would still lack sufficient precision in determining whether what is observed is real or reflects statistical noise (Ruhm, 2015). It is also preferable since Ruhm (2000, 2015) also uses 20-year long windows which makes the results more relatable to each other.

The data that is used comes from publicly available and reliable data sources. As a proxy for the business cycle the national annual unemployment rate is used, which is standard in the literature, and the data mainly comes from the World Bank (2022). For some countries and years, for example Germany, the Netherlands and Italy, there were some years with no observations. In these cases data from the Bureau of Labor Statistics (2022) was used which is one of the sources Gerdtham & Ruhm (2006) uses in their analysis as well. The definition of unemployment is the same regardless of the source, which is the annual percentage of the total labor force that is currently without a job.

Total mortality is the dependent variable and the data source is also the World Bank (2022). The unit of the estimates are ”Death rate per 100,000 population, crude rate”. To examine heterogeneous effects among the death causes, data provided by OECD (2022) is used with the unit being the amount per 100´000 people. The data on specific death causes provided are quite broad in terms of available variables. I use similar causes that are used in previous papers, which means that two of the most common causes of death in the western world, cancer and cardiovascular diseases, are included as well as some variables that also are of interest such as suicide and accidental poisoning. Cardiovascular diseases could in fact be several types of diseases, and here two causes are added together (called ”cardiovascular disease” and ”ischaemic heart diseases”) to form the variable ”CVD". As a robustness check, control variables are added to the baseline equation. The data comes from the World bank (2022) and the variables are GDP per capita, the share of the population that are male, the share of the population that are 65 years old or older, the unemployment spending as a share of GDP and ”working age”. To be able to generate a weighting variable I use data for each country's population, and the data was collected from the World Bank (2022).

The variables used and their summary statistics are displayed in Table 1 which is found below. Worth noting is that the number of observations that are included for the variables that regard various death causes and some of the control variables are not the same amount as for the mortality and unemployment variables. This is because there is a lack of data for certain countries and years for certain variables. However, for the baseline equations there are no missing observations.

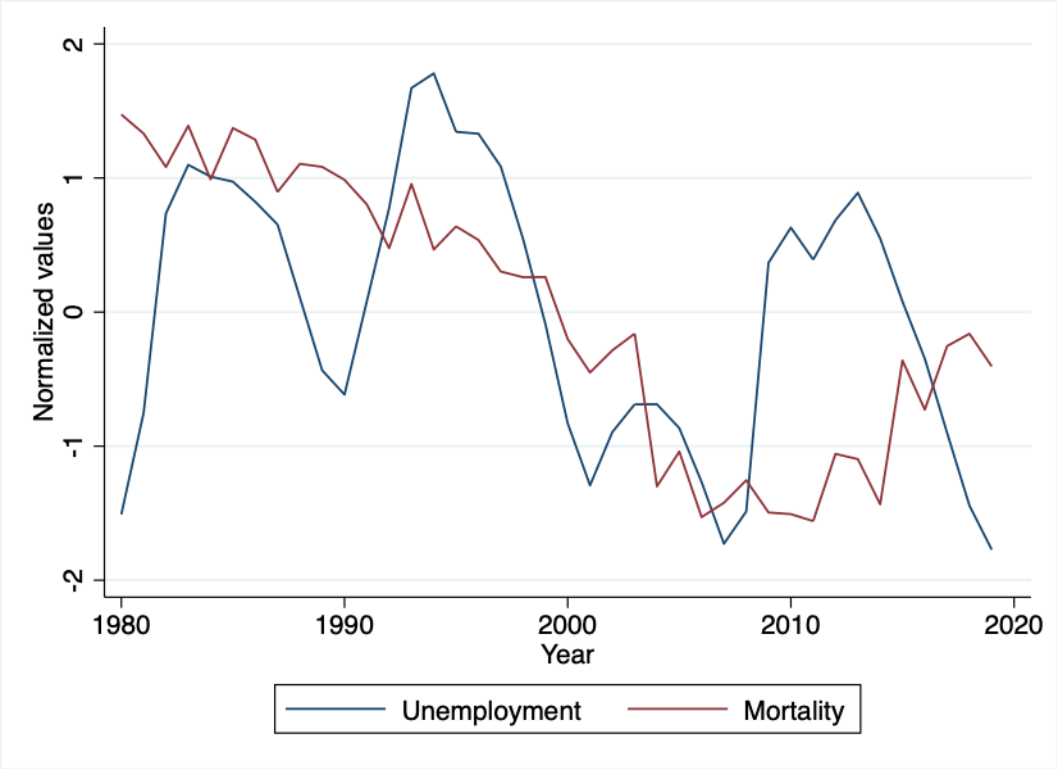
Table 1. *Summary statistics*

Variable	Obs	Mean	Std. Dev.	Min	Max
Mortality, total	640	929.87	133.77	630	1230
Unemployment	640	7.46	3.92	0.2	26.09
Cancer	600	231.55	30.73	167.1	304.9
Suicide	599	14.15	5.77	5.2	31.7
CVD	600	248.18	92.56	95.5	511.3
External causes	600	54.12	15.02	29.9	95
Accidental poisoning	600	2.88	3.11	0.2	19.9
Male	629	49.09	0.53	47.3	50.4
65 +	640	15.50	2.53	9.40	23.06
Unemployment spending	598	1.43	0.98	0	4.643
Working age	640	66.36	1.56	61.82	69.48
GDP per capita	640	30209.29	14314.81	6958.78	72033.95

Average mortality rate is 930 people per 100 000 people and the average unemployment rate in the sample is about 7.5%. When it comes to the causes of death, which will be examined further in the following section, one can conclude that cancer and cardiovascular diseases indeed are very common causes of death with 232 and 248 people per 100 000 respectively, from these causes from the total 930. The amounts of suicide and accidental poisonings are fortunately much lower but still interesting to examine further.

To get a clearer overview of the relationship between mortality and unemployment the relationship between the two variables is illustrated in Figure 1. To be able to make a graphical comparison, the two variables go through some alteration following the same procedure as similar papers such as Ruhm (2000, 2015) and Gerdtham & Ruhm (2006). First, weights are calculated as the square root of the country's population so that a larger country has a larger impact. Second, the variables are multiplied with the weights which gives observations from a country with a higher population larger weight than observations from countries with fewer observations. As a final procedure, the variables are normalized and detrended so that the relationship can be illustrated effectively, with the mean being zero for both variables.

Figure 1. *Unemployment and total mortality (normalized and detrended)*



The trends for the variables differs somewhat from each other. The unemployment seems to reach peak during the mid 80's, the mid 90's and during the late 00´s to early 10´s, possibly as a consequence of the economic crises during the time. There are of course also some periods with negative trends and over the whole period there does not seem to be a systematic pattern of increasing or decreasing unemployment rates. For the mortality the trend is slightly different. Although it is not linear, it seems like there is a downward facing trend with the highest mortality rates in the beginning of the period and lowest values around 2010, when something happens and it rises again (even though the new ”peak” in 2019 is below 0 and therefore below the average level.) When it comes to procyclicality between the variables one could argue for there being what looks like procyclicality in the mid 90´s and early 10´s, but graphically the relationship is not as visually clear as for the similar figures in Ruhm (2000) and Gerdtham & Ruhm (2006). It is interesting that the mortality seems to increase in the last five years of the sample since that is something that has been observed in the U.S. for recent years (Case & Deaton, 2015). It is also interesting that the unemployment goes in the reverse direction for recent years. Since this figure does not provide any estimates and since confounding factors may have an impact on the results, further analysis needs to be done.

4. Empirical approach

The empirical approach that is used in this essay is the same as in the previous studies mentioned, such as Ruhm (2000, 2015) and Gerdtham & Ruhm (2006). A fixed effects (FE) model is therefore used to examine the relationship between unemployment and mortality. A FE-model is used to be able to control for, in this case, country-specific and time-specific characteristics which would not be captured by using only a naive binary regression of unemployment on mortality rates. Also, the interaction between time and country is used to be able to control for country specific time trends. The baseline equations look like follows;

$$M_{c,t} = \alpha_t + \beta_c + \beta_c * T + \gamma U_{c,t} + \delta X_{c,t} + \varepsilon_{c,t}$$

where the subscripts c represents the country and t represents the year. ”M” represents mortality, total or for a specific cause depending on where it is used. What follows the mortality is the fixed effects elements. The first term, α_t, accounts for year-specific aspects that have the same impact on mortality for all countries at that time. The following term, β_c, accounts for country-specific aspects that are unique to each country and that are assumed to be fixed over time. After that comes $\beta_c * T$ which is the interaction between time and the country-specific aspects which accounts for year-specific aspects within the country specific variable. ”U” represents the unemployment rate which makes γ the variable that we are interested in. Depending on specification, control variables relating to characteristics of a country's population can be included and then they are represented by $\delta X_{c,t}$, where X is a row vector with variables. Finally there is an error term, $\varepsilon_{c,t}$.

Weights are used as mentioned in the data section, where the square root of each country's population determines the countries impact on the result in the sense that a larger country as the United States has a larger impact than a smaller country like Norway, and it also helps to overcome issues related to heteroscedasticity. This is also done by Ruhm (2000) and Gerdtham & Ruhm (2006). When heterogeneity in causes of death is examined, the same model is used but instead of logged mortality as dependent variable the natural logarithm of a specific cause of death is used instead. As one of the robustness checks, control variables are added to the baseline equation. Standard errors are clustered on the country level in all regressions.

5. Results

To examine the impact of the unemployment rate on mortality the equations described in the previous section were estimated and the results will be presented in this section both in tables including estimates and graphically.

5.1 Baseline

In Table 2 the estimates of the baseline equation are presented. The equations include the three types of fixed effects presented in the previous section, year-specific fixed effects, country-specific fixed effects and country-specific trends, which is in line with previous papers. In the first (1) and third (3) column the baseline equation is estimated for two 20-year windows, the first one including the years 1980-1999 and the one presented in column (3) for the years 2000-2019. In column two (2) the same equation is estimated for the period 1991-2010 which is an equally long period and the same period as Ruhm (2015) uses as his latest sample with his most recent data. In the last column, column (4), the equation is estimated using all years in the sample (1980-2019).

Table 2. *Baseline results.*

	(1) 1980-1999	(2) 1991-2010	(3) 2000-2019	(4) 1980-2019
Unemployment	-0.00268**	-0.00533***	-0.00374**	-0.00577**
	(0.00110)	(0.00129)	(0.00131)	(0.00219)
N	320	320	320	640
R^2	0.828	0.896	0.870	0.832
Year fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Country specific time trends	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

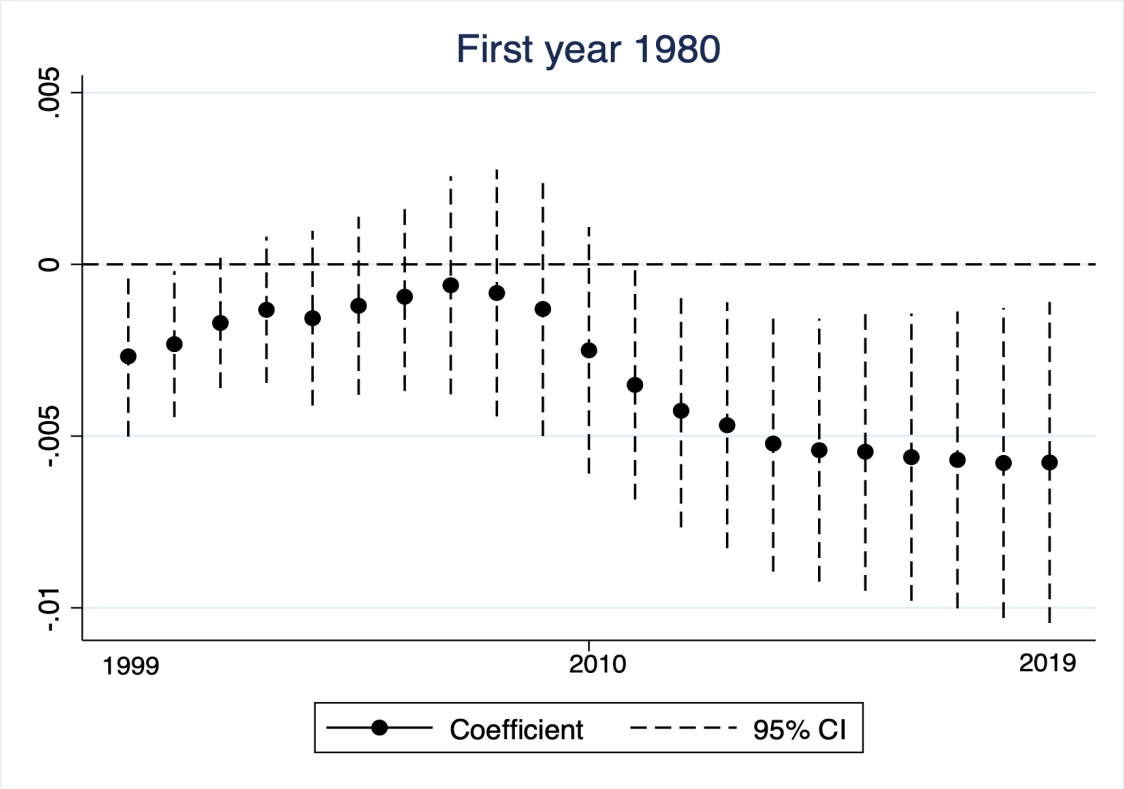
The estimates show a statistically significant negative effect of unemployment on total mortality per 100´000 population for all columns, with coefficients ranging between -0.003 and -0.006. For the whole period the estimate is strongest at about -0.006, which is relatively strong. This suggests that a 1 percentage point increase in unemployment is expected to decrease total mortality by around 0.6 percent. The estimates for the earliest and latest period are a bit smaller in magnitude at about -0.003, with the later period having a slightly higher coefficient than the

early period although the difference is quite small. For the mid-period, shown in column (2), the coefficient is slightly higher than in the previous and following period. These results are interesting for two reasons. Firstly, they are very similar to those in similar studies, for example did Ruhm (2000) get an estimate of -0.005 as well, Gerdtham and Ruhm (2006) got a baseline estimate of -0.004 and Ruhm (2015) also got a baseline estimate of -0.004 for his early period. Secondly, these results are interesting since they seem to contradict that there has been a secular shift towards less procyclicality when using these time frames, which is what Ruhm (2015) found for the United States in his latest period (the same period as I have in column (2)).

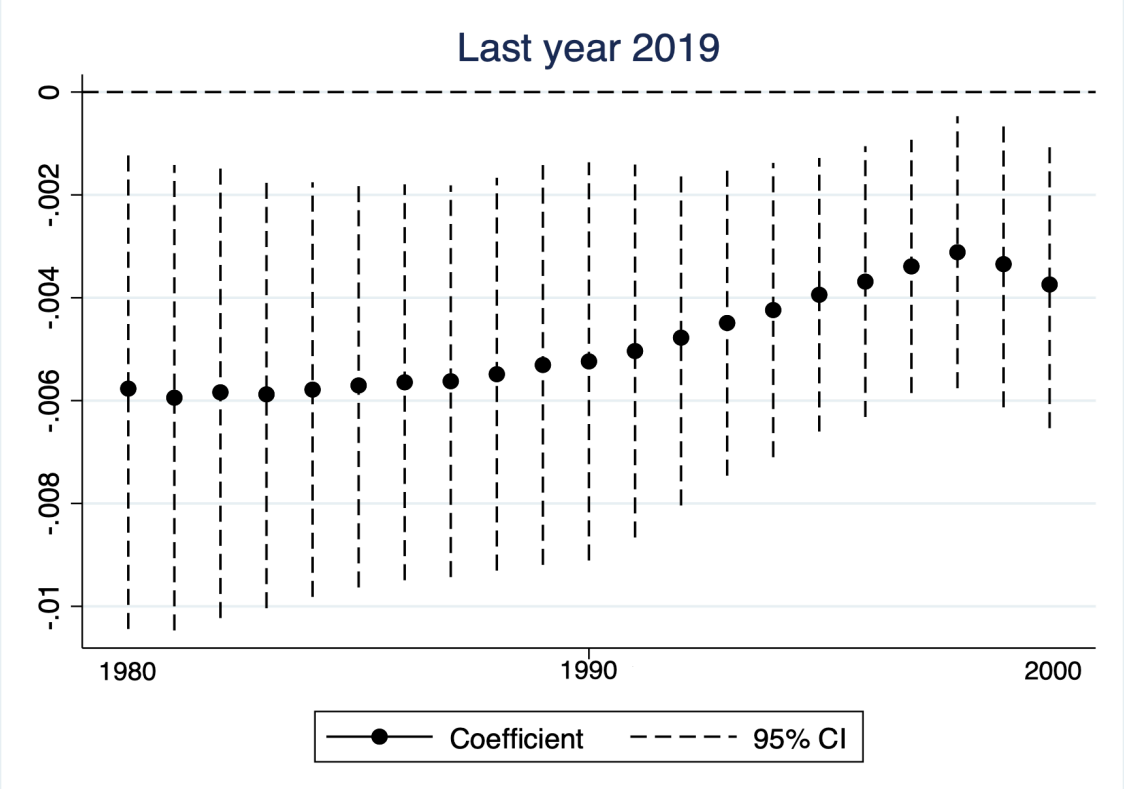
Apart from the table, the results can also be illustrated graphically. This also allows for many different sample strategies regarding the time frame to be represented in an effective way to examine the pattern of procyclicality over time which can be considered to be a form of robustness check as well. In Figure 2, the same equation as was estimated in Table 1 is estimated again using various time frames with the coefficients for each year being plotted graphically. The dot represents the actual estimate, and the dotted lines represents the standard errors on the 95% confidence interval. Figure 2 has three different panels representing three different estimation strategies. In Panel (2a), each estimate has different length with the starting year always being 1980 but the end year changes from 1999 to 2019 (thus the sample containing the fewest years still covers 20 years, Ruhm´s preferred time frame, and the longest with most years contains all 40 years). In Panel (2b) the same approach is taken but instead of having the same start year and different end year, the end year is always 2019 with the starting year changing. That means that the first estimate represents the most number of years included, 1980-2019, while the number of years included becomes fewer and fewer until the last estimate which includes the years 2000-2019. In the third panel, Panel (2c), a so-called rolling window of 20 years is used which means that each point represents a different period containing a 20-year long time frame (i.e. the first observation represents the years 1980-1999, the second 1981-2000 and the last one 2000-2019). Panel (2c) is the one with the preferred estimation strategy since all samples include the preferred 20-year window, but Panel (2a) and Panel (2b) offer insights as well.

Figure 2. *Graphical illustrations of the baseline estimates.*

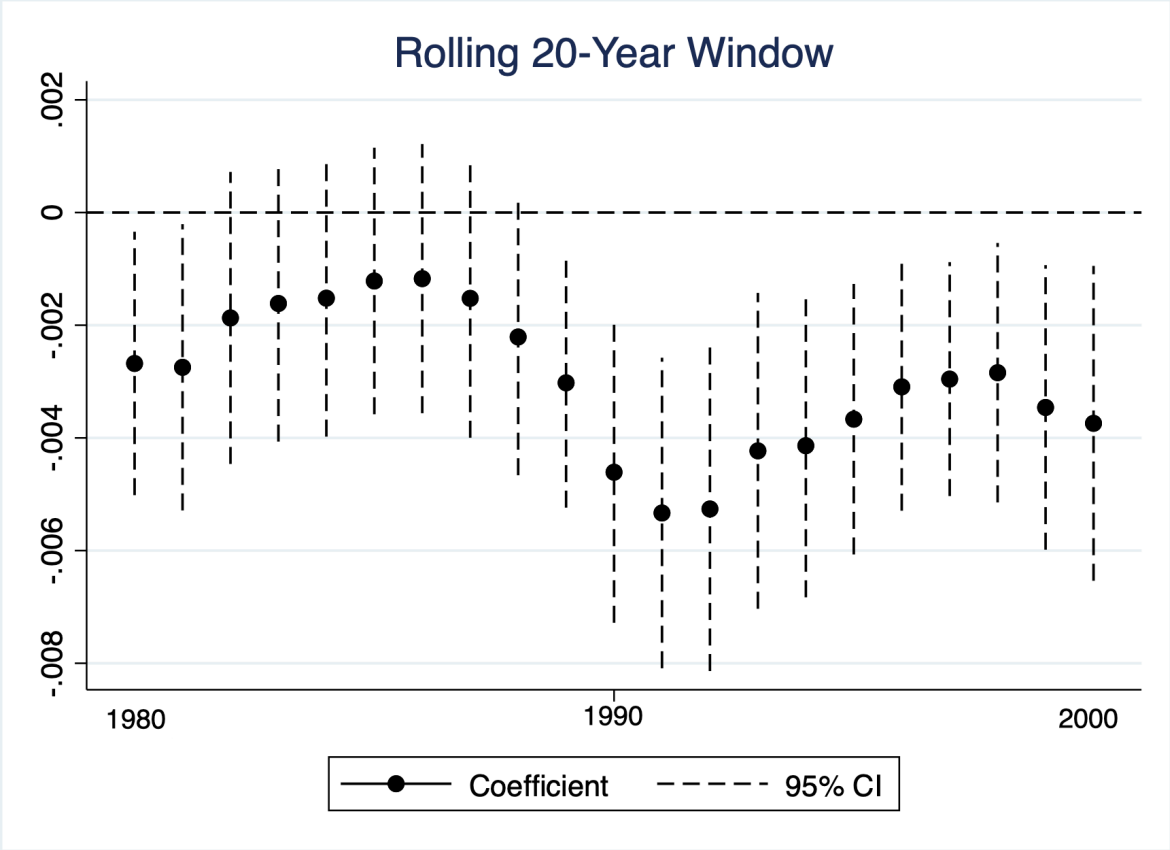
Panel 2A: First year 1980. Last year as described in the graph



Panel 2B: Last year 2019, first year as described in the graph.



Panel 2C: Rolling window, 20 years. Starting year as described in the graph



The panels in Figure 2 partly support the results of the estimates in Table 1, although there are some exceptions. In Panel (2b), where the starting year differs but the end year always is 2019, all estimates are negative and statistically significant with the magnitude ranging between about -0.006 and -0.003 as in Table 1. However, when Panel (2a) and Panel (2c) are considered, it is worth noting that although all estimates in both panels are negative there are some estimates that are not statistically significant (i.e. when the standard errors with 95% confidence intervals are not completely below zero). The areas within the panels where this takes place are about the same and come from the period that covers years during the mid 80's.

Ruhm (2015) has similar panels for his sample and the pattern in what is equivalent to my Panel (2c) have both similarities and differences. What is most different is that for the first windows in his panel the estimates are almost identical and statistically significant for several years whereas for my sample there are some of the estimates in the first half that are statistically insignificant, although they are still negative, before becoming statistically significant again. A similarity is that the years that are statistically insignificant in my panel are the years with a start year during the mid-80´s and that is the period in which Ruhms estimates start to decrease

in magnitude. Towards the end of his panel the estimates become statistically insignificant whereas for my sample the estimates stay statistically significant although one could say that the estimates have less magnitude for the later period which would be similar to Ruhm (2015). These results suggest that although all the estimates are negative, the years included in the sample can affect the magnitude of the results although for the most recent years all estimates are statistically significant.

5.2. Various causes of death

To examine whether there is heterogeneity in the causes of mortality, four various causes similar to those examined by Ruhm (2015) and Gerdtham & Ruhm (2006) are examined separately. Cancer and cardiovascular diseases are among the most common causes of death in the western world, and accidental poisoning and suicide are included because they could be assumed to be connected to mental health issues and could therefore be interesting to examine further. The same setup as in the baseline equation is used except for using the specific cause of death instead of overall mortality. The results are presented in Table 3. The columns in Table 3 represent the same 20-year long windows as in the previous table.

Table 3. *Various causes of death*

	(1) 1980-1999	(2) 1991-2010	(3) 2000-2019
Cardiovascular diseases	0.00275	-0.00553***	-0.00715**
	(0.00270)	(0.00150)	(0.00318)
Cancer	0.00114	-0.00111	-0.000478
	(0.00120)	(0.000933)	(0.000588)
Accidental poisoning	-0.0142	-0.00275	-0.000608
	(0.0105)	(0.0133)	(0.0103)
Suicide	0.00520	0.00222	-0.0000822
	(0.00537)	(0.00344)	(0.00269)
N	310	318	290
R^2	0.909	0.979	0.979
Year fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
Country specific time trends	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

As mentioned in the data section, a general difference compared to the baseline estimates is that there are some observations missing for some years because of data availability. For some countries the final years of data that is available for specific causes is 2017 or 2018 instead of 2019, and for others there are just some years where for some reason no observations are reported. Since most of the countries provide data for almost all years it is not assumed that the lack of data for some certain years should cause any major problems.

For CVD, the cardiovascular diseases, there is a positive but statistically insignificant estimate for the first period as seen in column (1), but negative and statistically significant estimates with coefficients ranging between -0.005 and -0.007 for the later periods as seen in column (2) and (3). Ruhm (2015) gets estimates that are negative and statistically significant for both his periods and the same goes for Gerdtham & Ruhm (2006) and Ruhm (2000) with estimates ranging from -0.003 to -0.005. This differs from my own estimates, which show a positive coefficient for the first period but then negative and statistically significant estimates for the later periods. Ruhm (2015) gets an estimate of -0.004 in his late period and the corresponding period of my estimates, displayed in column (2) in Table 2, shows an estimate of -0.005. The results are almost identical. This implies that there is a procyclical relationship between unemployment and mortality caused by cardiovascular diseases which is as strong, if not slightly stronger, as the overall mortality. For cancer the coefficient goes from being positive to negative when going from the early to the later periods, but since all estimates are statistically insignificant it suggests that there are no strong connections between unemployment and cancer mortality. Ruhm (2000, 2015) and Gerdtham & Ruhm (2006) all get positive but statistically insignificant estimates, except for the latest period in Ruhm (2015) where the estimate is statistically significant. What might explain this is that cancer is different from the other causes of death included in this table in the sense that the effect of unemployment might not have as direct of an impact on mortality of cancer as the other causes since it usually takes time to develop the cancer to a harmful state.

When it comes to accidental poisoning the coefficients are all negative and decrease in magnitude when comparing the earliest to the later periods. However, all estimates are statistically insignificant. This cause of mortality was also tested by Ruhm (2015) and he found a negative and statistically insignificant coefficient for his early period and then a positive estimate for the latest period which was only statistically significant at the 10%-level. Also for suicides all estimates are statistically insignificant for my sample. The coefficients for the first

two periods are positive but the one for the latest period is negative, although with a very low coefficient at -0.0008. Previous papers have mostly found positive but statistically insignificant estimates but Ruhm (2015) found positive and statistically significant for his latest period which differs from my estimate and which suggests that the number of suicides increases when unemployment rises. This could mean that the impact of mental health related mortality of unemployment differs between the samples or that simply that no such conclusions can be drawn because of the statistically insignificance of the estimates in this sample.

5.3. Robustness checks

To examine the robustness of the baseline estimates some procedures are taken. As usual, the time frames are the same 20-year windows as seen before and the equation is the same as before as well. What is different is that in the first row, ”Without U.S.”, the sample is not the 16-country sample but rather the 16-country sample from before but with the U.S. excluded. This is done since we already know what the result for the U.S. looks like with a secular shift in the procyclicality as shown by Ruhm (2015), at least up until 2010 when his sample ended. In the second row the same 16-country sample as in the baseline equation is used (i.e. U.S. is included again) but here some control variables are added to the equation. The numbers of observations differ slightly between the rows because of data availability for some of the control variables. To make it easier to relate the estimates here to the baseline estimates in Table 1, the coefficients are included here again. The results are presented in Table 4 below.

Table 4. *Robustness checks.*

	(1) 1980-1999	(2) 1991-2010	(3) 2010-2019	(4) 1980-2019
Baseline	*-0.00268***	*-0.00533****	*0.00374***	*-0.00577***
	(0.00110)	*(0.00129)*	*(0.00131)*	*(0.00219)*
Without U.S.	-0.00204*	-0.00513***	-0.00318***	-0.00580**
	(0.00108)	(0.00122)	(0.000986)	(0.00229)
	N=300	N=300	N=300	N=600
	R^2: 0.84	R^2: 0.89	R^2: 0.89	R^2: 0.88
With controls	-0.00336**	-0.00476***	-0.00267**	-0.00548***
	(0.00136)	(0.00119)	(0.00108)	(0.00142)
	N=297	N=320	N=295	N=592
	R^2: 0.83	R^2: 0.91	R^2: 0.89	R^2: 0.88

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

When removing the U.S. from the sample the estimates remain very similar to those in Table 1 where the U.S. is included. What is worth mentioning is that for the first period, displayed in column (1), the coefficient goes from being statistically significant on the 5%-level to only being so on the 10%-level without the U.S. at a coefficient of -0.0020 compared to -0.0027. It is also noticeable how the rest of the estimates are almost identical to those where the U.S. is included and that they all stay statistically significant.

For the estimates with the full sample and control variables included, there are no big changes from the baseline either. Here the coefficient is slightly higher at -0.0034 compared to 0.0027 in the baseline and also statistically significant. In the second column (2), both estimates could be rounded to 0.005. For the third (3) and fourth (4) column, the baseline estimates are slightly higher than those with controls with -0.0037 and -0.0058 compared to -0.0027 and -0.0055 respectively.

6. Possible explanations

As mentioned briefly in previous sections, Ruhm (2015) suggests two possible explanations for why his results suggested a secular shift in the procyclicality of mortality and macroeconomic conditions defined as unemployment. There is no evidence presented in this essay that suggests that procyclicality has undergone a significant secular shift during more recent years for the western countries included in the sample used, in the sense that the estimates are negative and statistically significant for all estimated periods which differs from what Ruhm (2015) found for the U.S.. With that said, the graphical illustrations in Figure 2 (c) suggests that the magnitude of the estimates decreases for more recent years, which could be interpreted as a similarity to what Ruhm (2015) found for the U.S.. The question still remains as to why there could be what seems to be a decrease in procyclicality in the U.S., especially since the same pattern does not seem to be found for other western countries to the same extent. The offered explanations by Ruhm (2015) for why the secular shift in procyclicality are ”the great moderation” and the drastic increase of mortality caused by accidental poisonings (drug overdoses). Using aggregated data for both the U.S. and the rest of the countries in the sample these explanations will be revisited in this section.

6.1. ”The great moderation”

One possible explanation mentioned by Ruhm (2015) is the phenomenon called ”the great moderation”, which is a period from the mid 80´s to the beginning of the 21st century according to Ruhm (2016), and more precisely to 2007 according to Hakkio (2013), characterized by reduced macroeconomic volatility which meant a more stable and predictable economic development compared to previous (and subsequent) periods. Ruhm (2015) suggests that this decrease in the macroeconomic volatility also has an impact on the procyclicality examined since a drastic change in the variable representing the macroeconomic conditions, unemployment, would affect the overall results of procyclicality as well since the role of unemployment as a proxy for macroeconomic conditions might have changed as well. To examine whether this could be a valid explanation one must first establish that there has been a ”great moderation” for both the U.S. and the other countries in the first place. This can be examined in several ways since macroeconomic volatility could be measured by evaluating different macroeconomic aspects. We have previously looked at unemployment as a proxy for macroeconomic conditions (Figure 1), and here we will also look closer at the change in GDP growth and inflation. Hakkio (2013) and Ruhm (2015, 2016) were mostly interested in the United States, but here both the US and the other countries included in the sample used here are included in order to compare the patterns. The changes in GDP growth are illustrated in Figure 3 and the inflation over time is illustrated in Figure 4. The period called ”great moderation” is highlighted in a gray color.

Figure 3. *Percentage change in total GDP growth compared to previous year.*

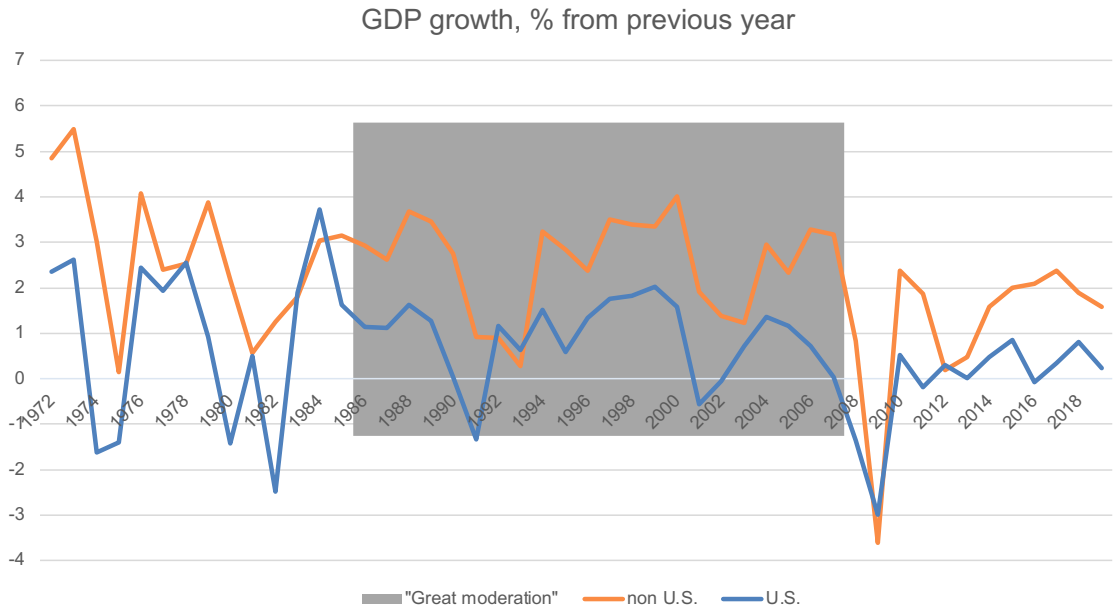
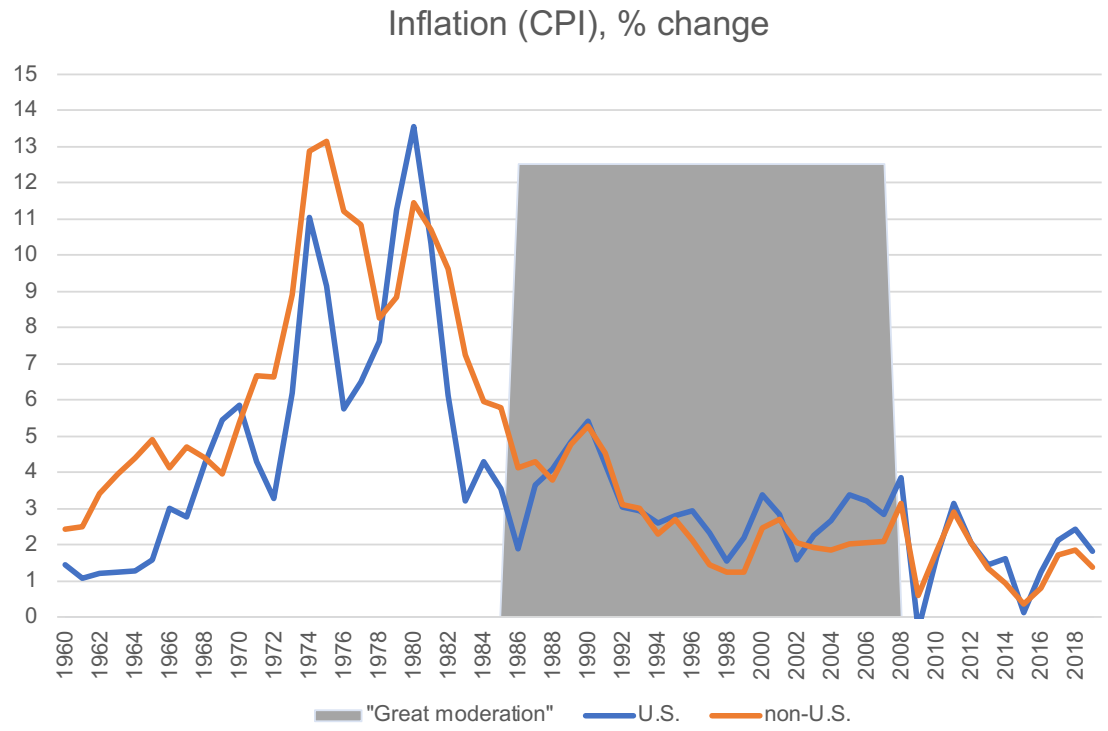


Figure 4. *Percentage change in inflation, measured as CPI, compared to previous year.*



Looking at unemployment rates, as in Figure 1, there is no obvious specific trend that could be captured during the period of the great moderation (although that line includes all countries in the sample and it is also normalized and detrended). When examining the other variables, the

inflation and change in GDP growth, it is a bit clearer that the period preceding the great moderation has a bit more volatility with a slightly higher maximum and minimum value for both the U.S. and the rest of the sample than during the great moderation. The most striking difference, worthy of the name ”great moderation”, is seen in the change in inflation rates as illustrated in Figure 4. During the highlighted period it is clear that the volatility decreased drastically, and that the general inflation rate was lower than in the previous period. The reason for why the macroeconomic indicators were stabilized could be endogenous but also come from policies, for example fiscal and monetary policies.

When examining Figure 3 and 4, it is also worth noting that the general pattern in both changes of GDP growth and inflation are very similar for both the U.S. and the rest of the sample, which might not be that surprising since it a homogenous group of western economies that are open and all well integrated in the world economy. This also suggests that the same type of ”great moderation” is not a phenomenon exclusive to the U.S., but rather a phenomenon that holds for the rest of the western economy as well, including the countries in my sample. Since I get a negative coefficient for my baseline equations in all time periods, including the later one that include more recent years, and including the one with the exact same years that Ruhm (2015) uses, Ruhms (2015) suggestion that the great moderation could be a reason for the procyclicality in the U.S. to decline does not appear to be a likely explanation. If the great moderation would be an important factor for the secular shift in procyclicality as he presents it then it would have to have an effect for other comparable countries such as those in my sample as well (but it does not). Even though there are other proxies that can be used for macroeconomic volatility, the fact that unemployment levels might have been affected by the great moderation (or the policies enabling more macroeconomic stability) does not seem to be able to explain the secular shift in procyclicality in the U.S. presented Ruhm (2015).

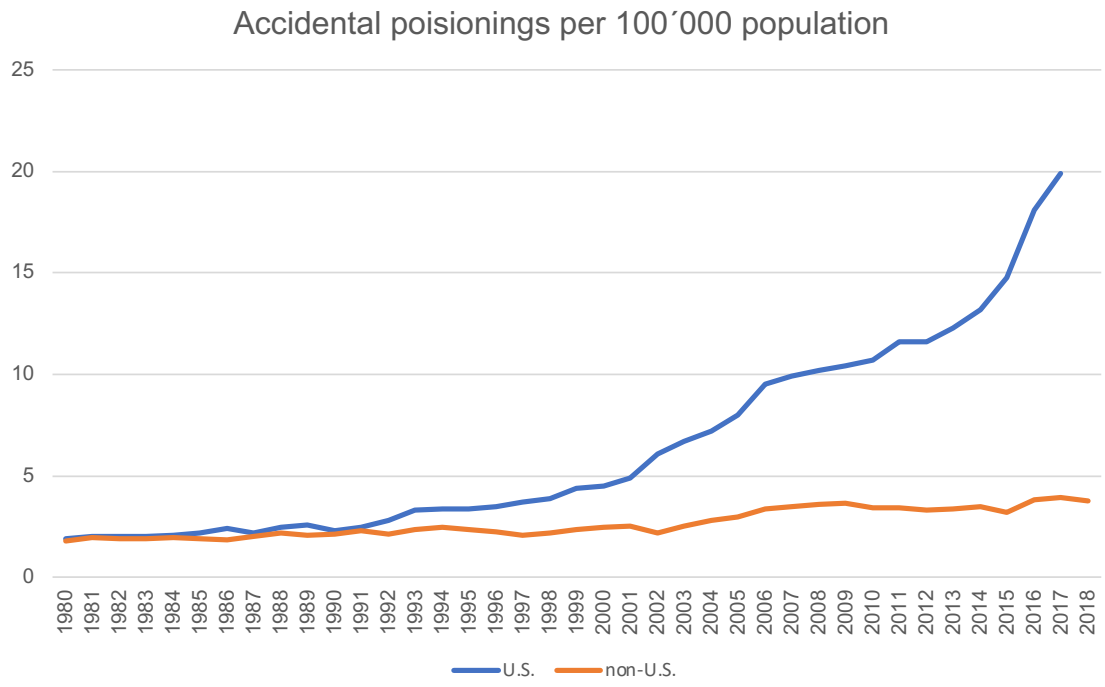
6.2. Accidental poisoning

The other possible explanation that Ruhm (2015) presents is that a recent change in the mortality variable has occurred which in turn causes the procyclical relationship with unemployment to change. As mentioned in section 2, it has been established that the mortality is increasing on average in the U.S. and that a driver of that phenomenon is because of an increased amount of accidental poisoning (drug overdoses) following what is called ”the opioid epidemic” or ”the opioid crisis”. The phenomenon began in the 90´s when a large increase of prescribing opioids took place. Since then there has been drastic increases in mortality caused

by both opioids such as heroin and synthetic opioids such as fentanyl. Between 1999 and 2019, nearly 500´000 people died from accidental poisoning (overdose) involving any opioid, including prescription and illicit opioids (CDC, 2021).

In Figure 5 the number of deaths from accidental poisonings per 100´000 persons are illustrated graphically with the blue line representing the U.S. and the orange line representing all other 15 countries in the sample. As expected based on the previous literature and Ruhms (2015) suggestion, the blue line representing the U.S. shows a dramatic increase in recent years. There is a big difference between the U.S. and the rest of the sample however, with similar rates of accidental poisoning in the 80´s and 90´s but with trend for the U.S. taking a completely different direction than the other countries after the turn of the century with a mortality rate stemming from accidental poisoning that are about five times as high as the other countries.

Figure 5. *Accidental poisonings per 100´000 population.*



As noted in section 5.2 where various causes of mortality were examined in more detail, the coefficient for accidental poisoning is not statistically significant for either of the periods in this sample. Ruhm (2015) however found a positive and statistically significant relationship between unemployment and accidental poisoning, suggesting that deaths from accidental poisoning increases when unemployment rises in the U.S.. In light of the results presented here,

both in the estimates in section 5.2 and in Figure 5, it is worth noting that there is a big difference in the number of accidental poisonings which makes Ruhms (2015) suggestion that the increase of deaths in accidental poisonings could explain the secular shift he sees more valid, and the difference could partly explain why there is no such secular shift in my sample.

It is however worth noting a few caveats with this suggested explanation. Firstly, as mentioned in section 5.2, the level of statistical significance for the mortality caused by accidental poisoning is on the 10%-level and not on the 5%-level. Secondly, although there has been a rapid increase of the deaths from accidental poisonings in the U.S. during recent years, the actual amount is still very low compared to some of the most common causes of mortality such as cancer and cardiovascular diseases. A final point is that although there may be a relationship between unemployment and mental health which in turn could affect the number of accidental poisonings, there could also be other, perhaps country-specific, factors related to the accidental poisoning that could be drivers which could be availability of drugs, the health care system, social benefits etc.

7. Conclusions

Although there are a few exceptions, I conclude that there is a large empirical literature that establishes that there is a procyclical relationship between unemployment and mortality for various settings even though very few offer any explanations for why there could be a procyclical relationship or for why the relationship would have changed. In contrast to Ruhm (2015) I find no evidence for a secular shift in the procyclicality between unemployment and mortality when extending the sample to include more countries and more recent years as is shown when estimating the same model but for a longer period. These estimates seem to be robust and hold when controls are added to the equation and when the U.S. is excluded from the analysis. However, the panels in Figure 2 suggest that changing the considered time frame could impact the robustness of the results, and although the estimates in my sample still are negative and statistically significant for more recent years, one could argue that the magnitude seem to decrease which would be in line with what Ruhm (2015) found in a larger scale for the U.S..

When examining heterogeneity in the mortality variable I find results that are both similar and somewhat different from previous papers with the estimates for suicide and accidental poisoning not being statistically significant, for example. The two suggestions provided by

Ruhm (2015) for why he finds a secular shift in the procyclicality are revisited. The conclusion is that the ”great moderation” probably not is a valid explanation for why Ruhm (2015) finds a secular shift in procyclicality since both the U.S. and the rest of the sample has almost identical trends when it comes to macroeconomic volatility for all years, yet the estimates for the more recent period differs. The drastic increase of mortality caused by accidental poisoning, the other suggested explanation by Ruhm (2015), is also considered and I conclude that it may be a partial explanation for the U.S. but not for a wider set of countries since the trends differ very much between the U.S. and the rest of the sample. Further research could focus on not only if there is a procyclicality between unemployment and mortality, but also why the phenomenon occurs and (perhaps) changes.

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