Are Recessions Good for Your Health?

Evidence from Norway

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Preface

First of all, I would like to thank to my supervisor, Jon Hernes Fiva for his great help throughout the work of this thesis. He helped me from choosing a topic to the last day before the submission. He gave ma relevant source of references and technical examples, which were very valuable to develop my analysis. Furthermore, he helped me many times to reach the relevant data from the local governments. Without his help, I could not find such as interesting topic for myself and develop the analysis up to this level. In addition, this thesis has been developed also with a great help from Bærum municipality. I would like to send special thank to Mr. Pedro Ardila at the development section in Bærum municipality. His comments and advice were very valuable to develop the analysis in more detail. Furthermore, I am also grateful for providing me detailed data from Bærum municipality.

The analysis in this thesis is mainly dependent on the rich data from *Norwegian Social Science Data Service* (NSD), *Statistics Norway* and *Organization for Economic Co-operation and Development* (OECD). I am grateful for their rich data as well as their kind help to guide me to correct data archive.

I am grateful to all of my families to support my studying in the course of my master at University of Oslo. Particularly, my mother gave ma a lot of encouragements from Japan. Finally, I would like to thank my husband, Bagher, for his full support during my studying. Particularly, for this thesis, his contribution to polish my text was substantial. Without his warm support, I could not finish my studying.

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Summary

This study is motivated by the finding provided by Ruhm in the Unites States. He found that the mortality rate increases by 0.5% when the unemployment rate decreases by 1%. This finding surprised many researchers because they previously hypothesized that people are healthier during the economic upturns. Based on Ruhm's interesting finding, some researchers suggest that traffic accident may be a dominant reason for that. According to these findings, in this study, attempt is made to investigate whether the total mortality rate increases when the unemployment rate decreases in Norway and, if so, whether traffic accident is a dominant reason for that.

We disentangle these questions by using panel data across the Norwegian counties observed from 1977 to 1998. The panel data allow us to examine the impact of the unemployment rate on the total mortality rate as well as the rate of traffic victims as holding constant the regional characteristics and time trend. For this empirical analysis, we mainly apply *Ordinary Least Squares* (OLS) regression model by using STATA.

We found that the total mortality rate for senior individuals (over age 67) increases when the unemployment rate decreases in Norway. On the other hand, the total mortality rate for children and working-age individuals (age from 0 to 15 and age from 16 to 66, respectively) is not influenced by the unemployment rate. Furthermore, we also found that traffic accident is not a dominant reason for this finding among senior individuals. Instead, traffic accident is one of the factors which can increase the total mortality rate for senior individuals with small magnitude when the unemployment rate decreases in Norway.

Contents

1 Introduction

In a series of papers, Christopher J. Ruhm has shown that the economic cycle is one of the factors which influence the mortality rate in the United States. (Ruhm, 2000, 2002, 2003). He found that 1 % decrease in the unemployment rate is associated with 0.5 % increase in the mortality rate in the United States. This finding surprised many researchers because previously they used to hypothesize that health would be improved when the unemployment rate decreases. However, this negative association between the unemployment rate and the mortality rate is found also in different other countries (e.g. Gerdtham and Ruhm, 2002, Neumayer, 2004) Neumayer found similar association in Germany by using data from Germany states over the period from 1980 to 2000 (2004). In addition, this procyclical relationship between the mortality rate and the unemployment rate is also found across 23 OECD countries, using the unemployment rate as proxy for the macroeconomic condition (Gerdtham and Ruhm, 2002).

However, the mechanism of this association is not still clear. Many analyses have been done to address the reasons for this finding (e.g. Gerdtham and Johannesson, 2005, Miller et al., 2009). Ruhm himself discusses that this correlation seems to be driven mainly by increase in traffic accidents and bad habits such as smoking and drinking, and also lack of enough exercises when the unemployment rate decreases (Ruhm, 2000, 2002). Miller et al. developed Ruhm's analysis further to investigate the mechanism of higher mortality rate when the unemployment rate decreases in the United States by categorizing the mortality rate based on the causes of death such as traffic accident and cardiovascular disease. They concluded that traffic accidents are strongly associated with the fluctuation of total mortality rate due to the fluctuation of the unemployment rate among the working-age adults. (Miller et al., 2009). On the other hand, an association between the unemployment rate and mortality related to health behaviors were not found. It implies that unhealthy habits such as smoking and drinking are not dominant reasons of higher rate of total mortality when the unemployment rate decreases. Based on this analysis, traffic accidents is a potential candidate to explain that the total mortality rate increase when the unemployment rate decreases.

An exception is, however, found in Sweden by Gerdtham and Johannesson using individual level data and some alternative business cycle indicators (e.g. the share of advanced notifications of job loss in population, change in GDP and industry capacity utilization rate) in addition to the unemployment rate (Gerdtham and Johannesson, 2005). In their study, a procyclical relationship between the unemployment rate and the total mortality rate was not found, while the industry capacity utilization, the industry confidence indicator and change in GDP showed a procyclical relationship with the total mortality rate. According to the analyses by Gerdtham and Ruhm (2002) and by Gerdtham and Johannesson (2005), it has been documented that fluctuation of the total mortality rate as a response to the change of macroeconomic condition is smaller in the countries with relatively strong social insurance system, comparing to those with relatively less spending on social insurance system. These findings show that the association between the mortality rate and economic cycle is sensitive to the choice of the country to be investigated and proxy of macroeconomic condition. This thesis looks to Norway to investigate the relationship between the economic cycle and the mortality. Norway is, like Sweden, a country with a strong social insurance system. Hence, it can be useful to contrast the result from Norway with those from Sweden.

A detailed analysis about the association between the total mortality rate and the unemployment rate has not been previously addressed by using Norwegian data, to the best of my knowledge. Therefore, this analysis is performed to provide an answer whether the negative association between the total mortality rate and the unemployment rate exists in Norway and if so, whether traffic accident is the key factor of this mechanism. This analysis is based on panel data across the Norwegian counties observed from 1977 to 1998. An advantage of this panel data approach is that we can estimate the association between the unemployment rate and the total mortality rate at county level holding constant the regional characteristics and time trend which can influence the total mortality rate. Through this study, empirical analysis is performed by STATA.

The choice of traffic accident for this analysis is motivated by the study of Miller et al. (2009). They show that decrease in the mortality rate in recession is strongly associated with the traffic accidents. In their research, attempt is made to separate health changes resulting from changes in an individual's own job and health behaviors, and health changes that are related to "externalities" with the macroeconomic condition. The externalities in this context are the potential factors which deteriorate the health when the unemployment rate decreases. To disentangle this issue, they extend the Ruhm's research by disaggregating the total mortality rate based on the cause of death. The results show that the coefficient of the mortality rate by motor vehicle accidents is largest. In addition, by categorizing the age of samples, they find that motor vehicle accident has dominant contribution to the fluctuation of mortality particularly among working-age adults from age 30 to 65. Together with the fact that the estimated coefficients on motor vehicle accidents are similarly large across all other age groups, they point that the traffic accidents is one of the dominant factor which deteriorates the health when the unemployment rate decreases. On the other hand, Miller et al. also note that cardiovascular mortality, which stands for the one-third of the total mortality, may explain best for the death caused by the work-related stress as well as unhealthy habits or other time allocation choices. Therefore, an advantage of focusing on the traffic accidents is that it can isolate the deteriorated health due to the externality of booming economy from other types of deteriorate health due to the change of individual's own job and health behavior. Based on this finding, we focus on the data of traffic accidents for the second step of this analysis.

One of the main findings in this study is that the total mortality rate for young and working-age individuals does not increase when the unemployment rate decreases in Norway. In fact, we found that there is no relation between the unemployment rate and the total mortality rate for individuals who are in these age ranges. On the other hand, we found that the total mortality rate for senior individuals increases when the unemployment rate decreases. It means that Ruhm's finding in the United States is valid only among senior individuals in Norway. Another main finding in this study is that traffic accident is not a dominant factor which can increase the total mortality rate for senior individuals when the unemployment rate decreases. Instead, we found that traffic accident is one of the factors for this association. Our result suggests that, therefore, this association for senior individuals is driven by the other factors.

The rest of the thesis is organized as follows. In chapter 2, we discuss the institutional setting in Norway with some comparisons to the United States. The comparison of institutional setting can help to understand the possible impact of social insurance system on the total mortality rate in Norway. In chapter 3, the data such as the total mortality rate and the unemployment rate as well as other socioeconomic factors, which are used in the estimation, are introduced and explained. Based on these data, in chapter 4, the estimation method is given. As taking the advantage of detailed data of the total mortality rate and the unemployment rate in Norway, we extend the investigation of Ruhm's study in Norway by separating the population based on three age groups to investigate if procyclical relationship between the total mortality rate and the unemployment rate can be found across different age groups. The same estimation methods are applied in the estimation where the traffic accident is used instead of the total mortality rate. The corresponding results and discussions to the estimations in chapter 4 are given in chapter 5. In addition, the extended estimations of chapter 4 are addressed in chapter 6 as the sensitivity analysis. The specification test and causality problem between the total mortality rate and the unemployment rate as well as between the rate of traffic victims and the unemployment rate are addressed. The data about the traffic accidents according to the types of transportations are also used in the sensitivity analysis.

1.1 Why might a booming economy be bad for your health?

Many researchers have hypothesized that health will deteriorate in recessions rather than in a booming economy (e.g. Brenner and Mooney, 1983, Junankar, 1991). The reason for this hypothesis is that many health problems could possibly happen for many individuals in the recession period. For example, psychosocial stress increases, happiness and general well-being decreases, and consumption of health products such as vehicle safety drops due to lower income for many individuals in the recession period. Junankar showed in his study that there is positive association between the unemployment and the mortality (1991). However, at least three main reasons have been given why health might be worse instead of better during the economic booming (Gerdtham and Ruhm, 2002, Ruhm, 2003). First reason is the decrease in non-market leisure time during the economic booming. As a result of the intensive workloads during the economic upturns, individuals increase their bad habits such as smoking and drinking, while they decrease their exercise due to the lack of non-market leisure time (Ruhm, 2002).[1] Second reason is longer-working time during the economic upturns. During the temporal economic improvement, health is one of the inputs for increasing the production of goods and services. The physical intensive work and less sleeping time due to the extended working hours have negative impact on the health (Sokejima and Kagamimori, 1998). Third reason is the negative effect of temporary increase in income on the health. When economy is booming, the income of labors can increases because of higher production and selling. It is pointed out that negative effects of temporary increase in income are more likely observed in already wealthy countries (Gerdtham and Ruhm, 2002). It is found that individuals drive more, when they have temporary increase of income, and may even more tend to do so after consuming alcohol (Evans and Graham, 1988, Freeman, 1999, Ruhm, 1995). They found that this tendency of individuals results in increase of the traffic accidents when income increases temporary. On the other hand, they also note that the permanent increase of income has

1 In addition, it is pointed out that the usage of drug also increases in some countries.

positive effect on the health because individuals tend to spend more for the investing in safety products such as a safe automobile or living place to a better one. These findings show that the temporary increase in income may be more likely to be spent on social activities such as going to restaurants and bars rather than for the investment in safety products. For example, senior adults' vehicle mortalities increase when income increases temporary in the United States because they can finance to have hard liquor at restaurants and bars instead of having beer at home (Ruhm, 1995). These hypotheses as well as the finding by Miller et al. (2009) motivate our focus on the traffic accident to investigate whether it can increase the total mortality rate during the economic upturns in Norway. However, it must be noted that these examples may be less relevant for Norway due to the lower unemployment rate and higher average income as well as unemployment benefit from the Norwegian government. In addition, the drunk driving is not common in Norway (Christophersen et al., 2001). Therefore, focusing on traffic accident in this study may contribute to provide evidence from Norway for these hypotheses.

2 Institutional setting

Based on the studies mentioned in the previous chapter, the fluctuation of the total mortality rate as a response to the change of macroeconomic condition may be smaller in the countries with relatively high spending on social insurance system than in the countries with relatively less spending on it. As it is well known, Norway has strong social insurance system which is financed by the central government. Therefore, our hypothesis in this study is that the association between the total mortality rate and the unemployment rate which Ruhm found in the United States may not be found in Norway. To examine this hypothesis, it is important to acknowledge how strong the actual social insurance system is in Norway. Therefore, an insight to the Norwegian social insurance system is given to investigate which types of the Norwegian social insurance systems may influence the association between the total mortality rate and the unemployment rate. It helps to understand how the total mortality rate may react when the unemployment rate decreases in Norway. For example, these knowledge help to investigate the relevance of three main reasons discussed in chapter 1.2 about why the total mortality rate might increase when the unemployment rate decreases in Norway. Furthermore, a comparison for the strength of the social insurance system is also made between Norway and the United States, because we examine the validity of Ruhm's finding in Norway.

2.1 Insight to the Norwegian social insurance system

The public social insurance system in Norway is called the Norwegian National Insurance Scheme (folketrygden). This national insurance scheme is mandatory for all inhabitants in Norway. The coverage includes health service benefits, lump sum grants for birth and adoptions, old-age pensions, disability pensions, benefits for surviving spouse, orphan's pensions, unemployment benefits, single mother or father benefits, funeral grants, basic and auxiliary benefits, medical and occupational rehabilitation, and grants to former family cares. As is listed, the Norwegian National Insurance Scheme offers wide range of financial supports based on the residents' situation. In this study, our focus is analyzing the relation between the total mortality rate and the unemployment rate. Thus, the focus is made on the social insurance system related to employment status in Norway. This is because the governmental supports for the unemployment can form the impact of the unemployment rate on the total mortality rate in Norway in different way than the United States. For example, being unemployed may be no longer fear factor for individuals in Norway due to the strong social backup by unemployment benefit. In addition, the financial support such as disability benefit and sickness benefit for individuals who are not able to work due to the physical conditions could support their health conditions better, and thus, lower the total mortality rate in Norway than in the United States. These financial supports can make the health conditions including mortality less sensitive to the change of employment status. This is because, thanks to the social insurance system in Norway, individuals do not need to change their life style and/or their health behaviors when their employment status changes. Therefore, the Norwegian social insurance system can mitigate any types of impacts of macroeconomic conditions on Norwegian residents' health. We explain those social insurance benefits which can have highest impact on our study in more details in the following subsections.

Unemployment benefit

The individulas can receive support from the Norwegian National Insurance Scheme according to their employment status if they have earned certain amount during last or last three years. The contribution for the Norwegian National Insurance Scheme is made by deducting from people's income as tax. The employer is responsible for making their employee a member of the insurance scheme and for making sure that the Norwegian tax authorities receive the contribution of their employees. This insurance covers the unemployment period if the requirement is fulfilled. For the case of being laid off as well as unpaid leave and period with no or few work, the Norwegian National Insurance Scheme can also cover this period if the requirement has been met.

Disability benefit

Disability benefit is called disability pension and in principle in a permanent benefit in Norway. It is granted if there is a clear evidence of no prospects of an improvement in earning ability. It is, for most cases, calculated in the same way as the old-age pension. The recipients of this disability benefit will have automatically their old-age pension when they reach age of 67.

Sickness benefit

Sickness benefit is a compensation for loss of income from employment in the event of occupational disability due to illness and injury. The conditions to be entitled for the sickness benefit are the doctor's certificate as well as at least four weeks work. The basis for calculating the sickness benefit is mainly the amount of income earned in the first four weeks prior to the first day of the sickness leave, translated into annual income. In the case of partial disabilities, correspoinding to the degree of disabilities, it may cover from 20% to 100% of the income the person used to earn before the disability.

As it was listed above, financial supports by the Norwegian government particularly those related to the unemployment, disability and sickness benefits can influence the mechanism of the higher total mortality rate when the unemployemnt rate decreases. Strong social backups could mitigate the job related stress as well as the threat of losing job. It suggests, thus, that individuals may not change their behaviors according to the employment status. For example, the decrease in income by losing job can not be necessary a reason of stopping bad habits when the unemployemnt rate increases in Norway. Thus, some of the discussed reasons why the total mortality rate may increase when the unemployment rate decreases may not be relevant to the case of Norway.

2.2 The strength of the Norwegian social insurance system

One of the possible methods of measuring the strength of the social insurance system is using the country's average public social expenditure as a percentage of GDP. The public social expenditure is used in former studies to compare the strength of social insurance system across countries (e.g. Gerdtham and Ruhm, 2006). It is pointed out that the public social expenditure has the advantage of being well measured and closely tied to programmatic asistance related to the social insurance. Therefore, we also focus on the public social expenditure to investigate the strength of the Norwegian social insurance system. Data are available from *OECD social expenditure database* since 1980. Because we are examining the validity of Ruhm's finding in Norway, the data from the United States as well as average data from OECD countries are also added.

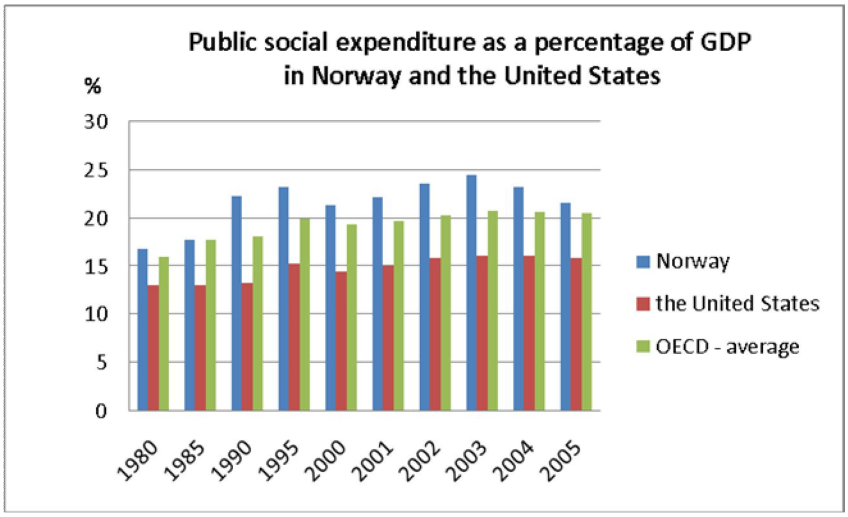

Figure 2-1. Public social expenditure as a percentage of GDP for Norway, the United States and the average within OECD countries. Data are from 1980 to 2005.

Figure 2-1 shows the share of public social expenditure relative to GDP in Norway and the United States as well as the average share of the public social expenditure within OECD countries from 1980 to 2005. It shows that Norway has higher public social expenditure than the United States during this period. The mean share of the public social expenditure over observed years is 21.6% in Norway, while it is 14.8% in the United States. In addition, the share of public social expenditure as a percentage of GDP in Norway has been above the average within OECD countries. It means that Norway has stronger social insurance system than many other developed countries including the United States.

In addition, we introduce gross replacement rate as an alternative method to measure the strength of the social insurance system. Gross replacement rate is the proportion of expected income from work which is maintained for somebody unemployed and related welfare benefits. It means that, if a country has higher gross replacement rate, it shows that this country has stronger social backup for being unemployed. Data are available from OECD *social data* for uneven years from 1961 to 2007. We used the data from 1977 to 1999 which cover the period of this study. In these data, gross replacement rate includes the unemployment and related welfare benefits such as social assistance, family benefits, housing benefits, employment-conditional benefits and lone-parent benefits. For the detailed description of data, see chapter 8 in OECD (1994) and Martin (1996).

The advantage of gross replacement rate is that it can reflect the social insurance system, particularly those related to unemployment. In other words, it can illustrate how strong actual social backup is for being unemployed in Norway, comparing to the United States. Thus, gross replacement rate can be even more precise method to understand the possible impact of Norwegian social insurance system on the association between the unemployment rate and the total mortality rate in Norway.

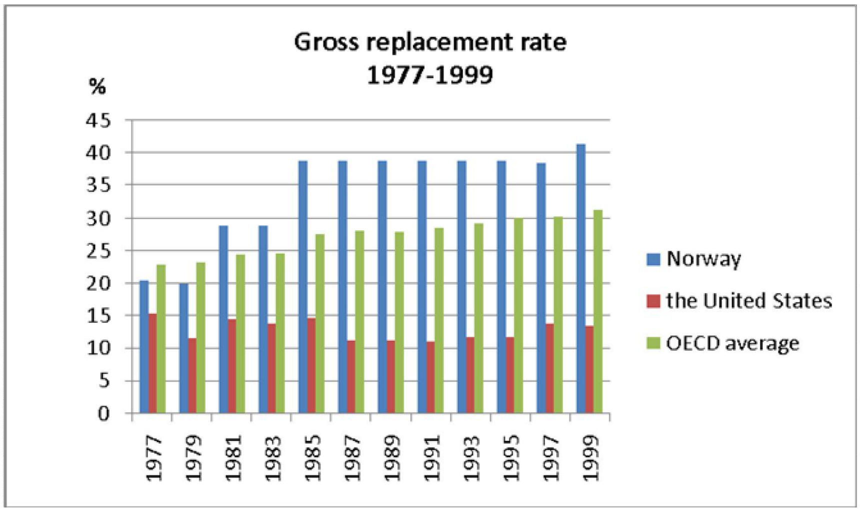

Figure 2-2. Gross replacement rate for Norway, the United States and the average within OECD countries. Data are from 1977 to 1999..

Figure 2-2 shows the gross replacement rate in Norway and the Unites States as well as the average within OECD countries from 1977 to 1999. Figure 2-2 shows that Norway has generally high gross replacement rate than the United States and also other developed countries. Even though Norway has lower gross replacement rate than the average within OECD from 1977 to 1979, we assume that Norway has generally higher gross replacement rate than other OECD countries because the rate in Norway becomes substantially higher after 1985. Furthermore, by comparing figures 2-1 and 2-2, we can realize that Norwegian social insurance system becomes even stronger in terms of unemployment social backups. This is because gross replacement rate is nearly three times higher in Norway than in the Unites States after 1985, as in figure 2-2.

Overall, therefore, figures 2-1 and 2-2 support our hypothesis that Norway has stronger social insurance system, particularly related to unemployment, than the United States, and thus, may not have a same association between the total mortality rate and the unemployment rate as Ruhm found in the United States.

3 Data

3.1 Context of data

In our study, we will mainly rely on the data from *Norwegian Social Science Data Services* (NSD) and partly on the data from Statistics Norway. Data include the total mortality rate, the unemployment rate, the rate of traffic victims and after-tax income as well as socioeconomic factors such as ethnic background, marital status and education level. Because numbers of municipalities and counties have been changed over time, we use number of municipalities and counties in 1990 as the fixed number for all years used in this study. Therefore, there are 448 municipalities which are categorized into 19 counties. We will utilize a panel data set of counties observed from 1977 to 1998[2]. Since observations from each municipality are few, especially in rural areas, we aggregate the observations at each county level instead of the municipality level. In addition, each county has responsibility for roads and infrastructures which are important factors for the traffic accidents, making it more interesting to study at county level. Another advantage of focusing on county level is that the unemployment rate at county level forms natural labor market better than the unemployment rate at municipality level according to Askilden et al. (2005). They discussed that the unemployment rate at municipality level does not reflect the actual labor market due to high mobility of labors across municipalities, while labors are less mobile across counties. Thus, the unemployment rate at county level is better proxy for the actual labor market.

The data of total mortality are available based on gender and age. In chapter 4, we use the data which covers the number of death from all causes for both genders as the total mortality rate. These data are available for each age and cover the range from 0 to over 100 years old. The population of each age is also available from 1977 to 1998[3]. The populations

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[2] Due to the shortage of socioeconomic data such as ethnic background and education level, the estimation including these data are performed from 1980 to 1998.

[3] The population based on each age is not available in 1989. Instead, we use the data constructed by Norwegian

are measured at the end of the year until 1986. However, they are measured at the first day of the next year after 1986. This means that in this study, the data after 1986 are considered as the data of a year before. The same procedure is applied for the data of ethnic background and marital status. In addition, we categorize total mortality as well as ethnic background and education level into three age groups. They are 0-15 years old (age group 1), 16-66 years old (age group 2) and over 67 years old (age group 3). By aggregating the total mortality and population for each age group at county level, we calculate the total mortality rate for each age group. However, as is noted, the data of population based on each age are not available in 1989, and therefore, we use the data constructed by Norwegian local governments instead. Because available data for 1989 are already grouped based on different age groups, age of 66 can not be categorized into age group 2, but into age group 3 in this study. It means that age of 66 belongs to age group3 only in 1989, while it belongs to age group2 in other years. However, we found that this inconsistency in data does not bias the coefficient of our interest (i.e. the unemployment rate) and, thus, decided to use the data from 1977 to 1998 including 1989 for all the estimation in this study.[4]

The reason why we categorize the total mortality rate into three age groups is that we can investigate whether the association between the total mortality rate and the unemployment rate has different pattern across the different age groups. In many of the analyses about the association between the mortality rate and the unemployment rate, the focus is made only among the working-age or prime working-age adults. For example, in the study performed by

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local governments for 1989.

[4]To investigate whether this inconsistency in data bias the coefficient of our interest (i.e. the unemployment rate), we regressed the mortality rate on the unemployment rate using the data from 1977 to 1998 both including and excluding 1989. Based on theses results, we performed t-test over these two populations including and excluding 1989. It shows that there are statistically no differences in coefficients of the unemployment rate over these populations. According to the result of t-test, we concluded that including the data of 1989 does not bias the coefficient of our interest.

Ruhm, he used the data restricted to the individuals who are in the range from 30 to 65 years old, employed males and have relatively homogeneous types of occupations as well as the access to medical cares (Ruhm, 2003). The reason of this restriction is that, by doing so, it is possible to avoid the causality problem such that health problems influence the employment status. For example, a person could be unemployed because he/she needs to stay at hospital due to his/her health condition. In addition, more importantly, individuals who are in the range from 30 to 65 years old and particularly male are more sensitive to the change of macroeconomic conditions. Thus, the focus in many studies has been made only on the working-age or prime working-age adults because this age group can illustrate the impact of the unemployment rate on the mortality rate better than the other age groups, as well as the advantage of addressing causality problems. However, procyclical relationship between the mortality rate and macroeconomic conditions is also found among elderly in some studies (Miller et al., 2009, Gerdtham and Johannesson, 2005[5]). One reason discussed is that macroeconomic conditions are general risk for majorities no matter if they are in the labor force or not (Gerdtham and Johannesson, 2005). On the other hand, others discussed that the reason for elderly to be unhealthier during the economic upturns may differ from the reason for individuals of prime-working age (Miller et al., 2009). These analyses show that there are some questions remained to be further investigated for the association between the mortality rate and the unemployment rate not only among working-age but also across other different age groups. Therefore, we use the data categorized into three age groups to investigate if the association between the total mortality rate and the unemployment rate are same across different age groups in Norway.

In Norway, the usual National Insurance Scheme retirement age is 67 with some exceptions. The maximum limit of these exceptions is 70 years old for most positions. In

[5] In their study, the cyclical relationship between the mortality rate and economic cycle is found only among male elderly.

addition, most of the members of Norwegian Public Service Pension Fund are entitled to contractual pension after reaching age of 62. Therefore, individuals can more or less choose the time of retirement within the range from 62 to 70 years old. However, in this study, we consider a fixed retirement age is 67 years old in Norway. Therefore, we consider age group of 16-66 years old as working-age group. Similarly, we consider the age groups of 0-15 years old and over 67 years old as children and senior adults group, respectively.

In chapter 4, the unemployment rate at county level is used as the proxy of macroeconomic condition in Norway. The annual average number of unemployed individuals at each county is available from NSD for both sexes. In these data, an individual is recognized as unemployed if he/she does not have position with salary and has been registered as a job seeker at Norwegian employment bureau (Arbeidskontoret). They are counted as unemployed in the county they live. In addition, data of population which covers the range from 16 to 66 years old are available. The data are measured at the end of each year. By using these data, we calculate the unemployment rate at county level.

Socioeconomic factors such as ethnic background, marital status and education level are used as control variables in the estimations in chapter 4. Data of ethnic background and marital status are extracted from NSD while data of education level are from Statistics Norway. For the data of ethnic background, the numbers of immigrants are used. They are categorized into the areas such as Europe, Arica, Asia, America and Oceania. By using these data and data of population, the population share of these ethnic backgrounds are calculated. For the data of marital status, the numbers of individuals who are single are used. They are categorized based on the type of being single such as never married, widow/widower, divorced and separated. Similarly, by using these data and data of population, the population share of these marital statuses are calculated. For the data of education level, the numbers of individuals based on the education level are used. The education levels are categorized into lower secondary school, upper secondary school, higher education less than 4 years and higher education over 4 years and none/unknowns. Again, together with the data of population, we calculate the population share of these education levels. Note that these data of ethnic background and education level are categorized into three age groups similar to the case of the total mortality rate. However, the data of the marital status are not categorized into these age groups because they are not available based on each age. All these data are available from 1980 to 1998.

Furthermore, the income variable is also included partly in the estimation in chapter 4. For the data of income, the average income of population at each county is used. The average income of population at each county is measured by average after-tax income of married couples[6] without children. The data are available from Statistics Norway from 1993 to 2000. In this study, we use part of these data which cover from 1993 to 1998. The after-tax income includes wages and salaries, net entrepreneurial income, property income, various pension and social security benefits.

Data for traffic accident are available from 1977 to 1998[7]. Data are categorized into two cases such as injury and death. In addition, the numbers of traffic victims according to the types of transportations that victims were using when the accidents occurred are available. Data for the cases that pedestrians are involved into the traffic accidents are separated. The specified types of transportations in these data are automobile, motorcycle, moped, cycle, ski[8] and others. These data include not only dead victims but also injured victims, since the observations of dead victims are very few in each county (see figure 3-4 in next section). In

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[6] Married couple in this context includes also registered partnerships.

[7] At Norwegian Social Science Data Services, data after 1994 have less information of traffic victims according to gender, age, the types of transportations and etc. Instead, these data from 1994 to 1998 are provided by Statistics Norway.

[8] It includes the sliding as well.

Norway, individuals over 16 years old are allowed to take a license and drive mopeds and motorcycle. However, the rate of traffic victims caused by moped and motorcycle are calculated based on the total population for the sake of convenience to compare the results across different transportations. Similarly, the whole population is used for the rate of traffic victims caused by automobile where individuals are allowed to take a license and drive after 18 years old. The rates of traffic victims caused by other types of transportations including pedestrians are also calculated based on the whole population.

3.2 Characteristics of data

In this section, we observe the characteristics of data to see, for example, how the data fluctuate over time and if the data have any regional characteristics. Figure 3-1 shows the fluctuation of the total mortality rate and the unemployment rate from 1977 to 1998 in Norway. The variables are scaled such that 0 is the average total mortality rate and the unemployment rate over the period of this study. To further ease the interpretation, the variables are also divided by the corresponding standard error in each year. The fluctuations in the following figures in this chapter are also generated with the same method. In addition, to further ease the interpreting in following figures as well as results in chapter 5, the mean value and standard deviation for each data during the period of this study is presented in appendix (1).

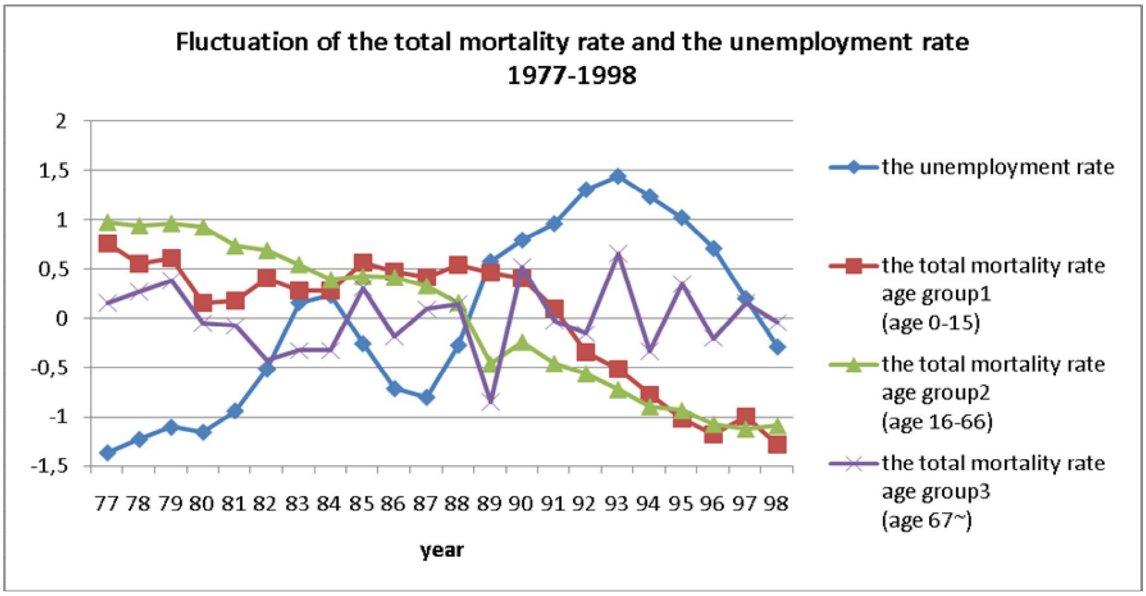

Figure 3-1. Fluctuation of the total mortality rate and the unemployment rate from 1977 to 1998.

As is apparent from figure 3-1, the unemployment rate fluctuates more than the total mortality rates for age groups 1 and 2. On the other hand, the mortality rate for age group 3 fluctuates more than the unemployment rate. However, the magnitude for the fluctuation of the unemployment rate is larger than any of the total mortality rates for all age groups. The unemployment rate fluctuates within the range from -1.5 to 1.5, while the total mortality rate fluctuates within the rage from -1 to 1for all age groups.

The unemployment rate increases constantly until 1993 despite of a big fall after 1984, and decreases after 1993. On the other hand, the total mortality rate for age groups 1 and 2 decreases constantly in the period from 1977 to 1998. The total mortality rate for age group 3 has large fluctuation, however, keeps more or less same rate over the period of this study. Any correlation can not be observed between the unemployment rate and the total mortality rate for all age groups in figure 3-1. The econometric analyses are needed to examine the actual correlation between the total mortality rate and the unemployment rate.

Figures 3-2 and 3-3 show the mean unemployment rate and total mortality rate from 1977 to 1998 at each county, respectively. In addition, in these figures, the standard deviations of the mean unemployment rate and total mortality rate for each age group at each county are added for the ease of further interpretation.

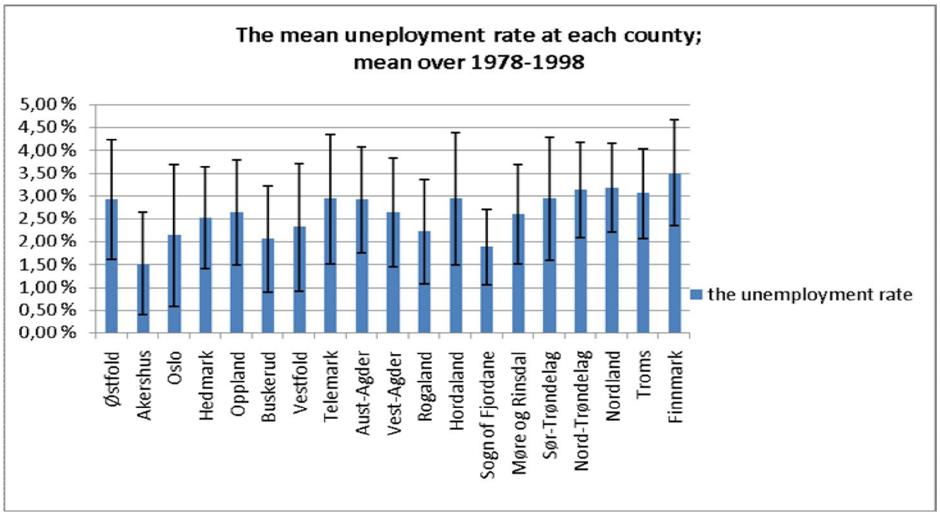

Figure 3-2. The mean unemployment rate with standard deviation at each county from 1977 to 1998.

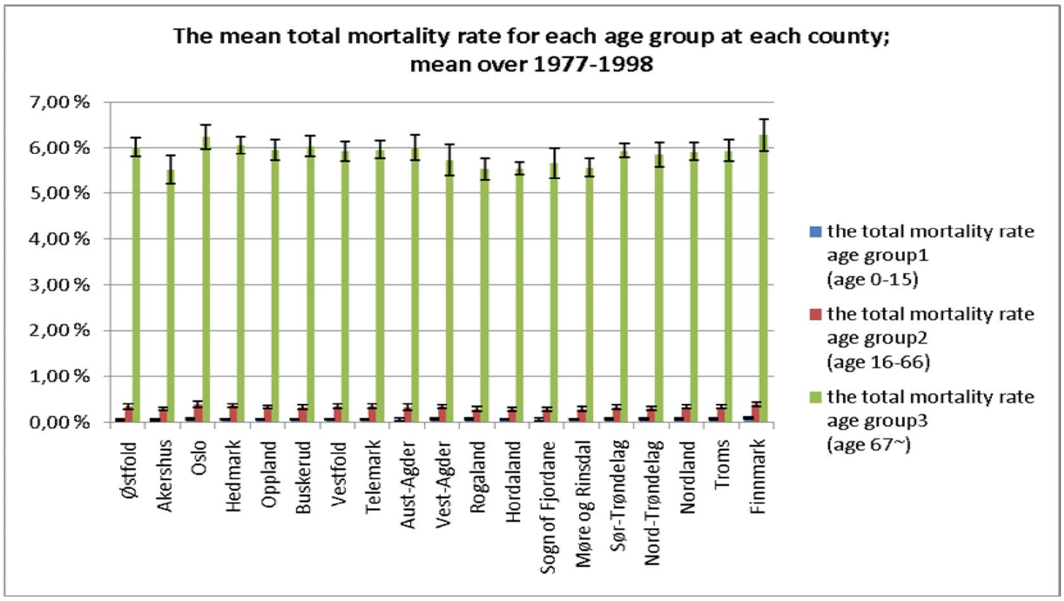

Figure 3-3. The mean total mortality rate with standard deviation for each age group at each county. Data are from 1977 to 1998.

It seems no substantial differences are observed in the mortality rate across counties, while relatively more differences can be observed in the unemployment rate. In the more urban areas such as Akershus and Oslo, the mean unemployment rate is near half of its value in the more rural areas such as Nordland, Troms and Finnmark. Therefore, figure 3-2 suggests that the unemployment rate is lower in the urban area than rural area in Norway._However, figure 3-2 does not show the association between the total mortality rate and the unemployment rate across counties. Therefore, further econometrics analysis is needed to investigate if there is any association.

About the socioeconomic factors such as ethnic background, marital status and education level, we found that the rate of immigrants, singles and individuals with higher education increase in the period from 1977 to 1998 in Norway. In addition, based on the mean value at each county, we found immigrants and educated individuals with higher education tend to cluster in urban area than in rural area. On the other hand, we could not found any substantial differences in distribution of singles across all counties.

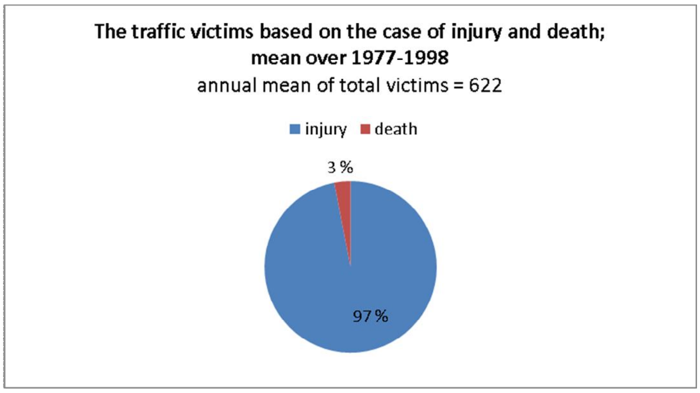

Figure 3-4. The proportion of the traffic victims based on the case of injury and death. The mean number of the traffic victims from 1977 to 1998.

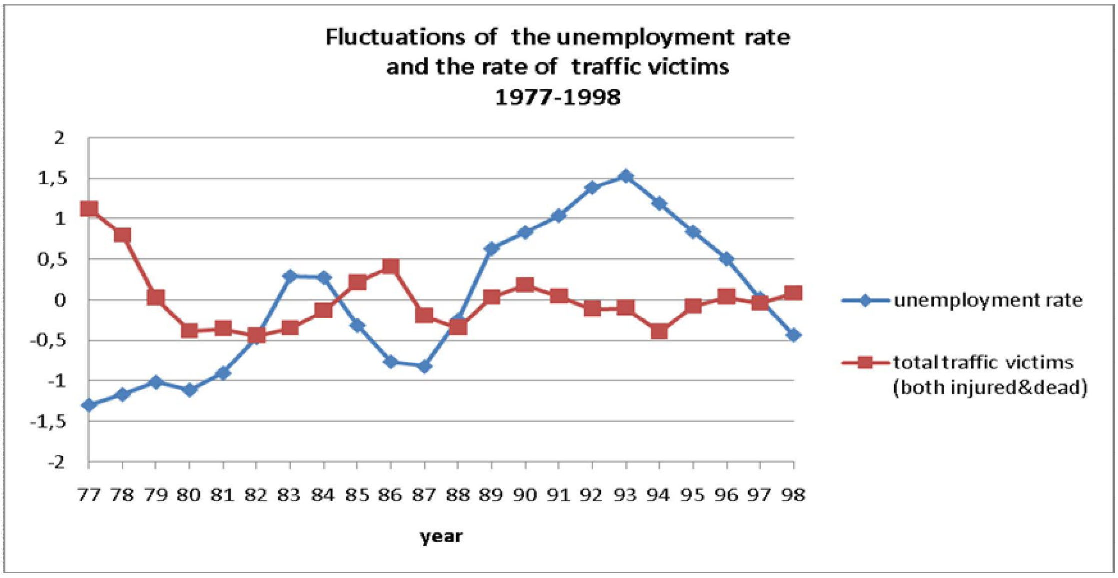

Figure 3-5. Fluctuation of the unemployment rate and the rate of traffic victims from 1977 to 1998.

Figure 3-4 shows the proportion of injured and dead traffic victims. As it is obvious, majority of the traffic victims are injured. Observations of dead traffic victims are very small.

Figure 3-5 shows the fluctuation of the unemployment rate and the rate of total traffic victims in Norway. The total traffic victims include both cases of injury and death. Comparing figure 3-1, where the total mortality rate is used instead of the rate of traffic victims, with figure 3-5 it seems that more obvious negative association exists between the unemployment rate and the rate of traffic victims from 1977 to 1998. Since the observations of dead traffic victims are very small, the fluctuation of total traffic victims may be driven mainly by injured traffic victims.

Figure 3-6 shows the proportion of traffic victims based on the type of transportations. Figures 3-7, 3-8 and 3-9 show the fluctuation of traffic victims based on the types of transportations over time.

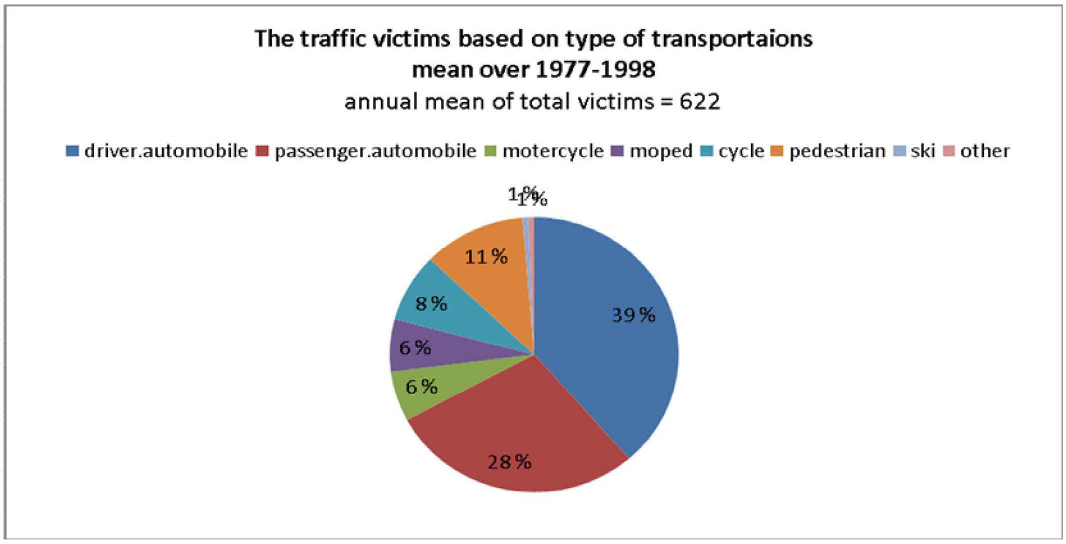

Figure 3-6. The proportion of the traffic victims based on type of transportations. The mean number of traffic victims from 1977 to 1998.

Figure 3-6 shows that more than 60 percent of the traffic victims are either injured or killed as the driver or passenger of automobiles. Interestingly, second largest victims are the pedestrians. After pedestrians, cycle, motorcycle and moped drivers follow with almost similar proportion.

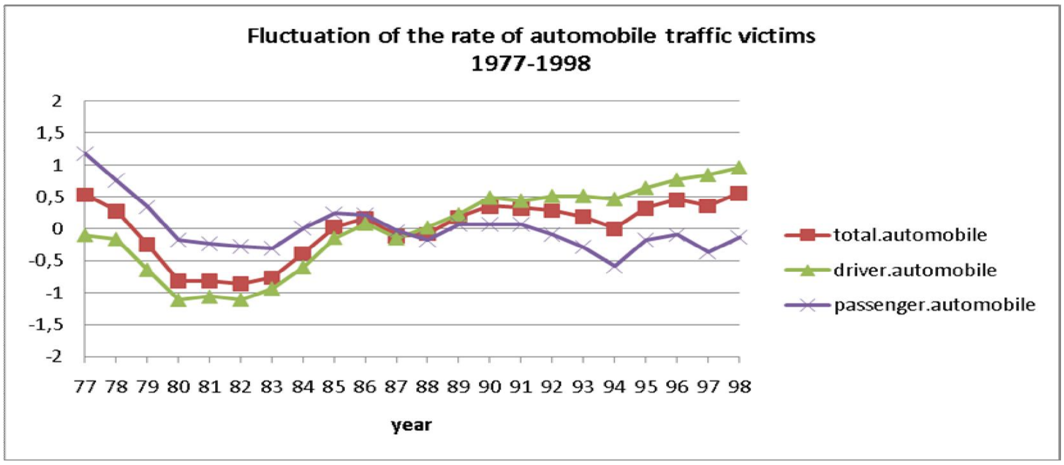

Figure 3-7. Fluctuation of the rate of automobile traffic victims from 1977 to 1998.

Figure 3-7 shows the fluctuation of the rate of automobile victims over time from 1977 to 1998. The fluctuations of total and driver automobile victims are very similar. This shows that the fluctuation of the rate of automobile victims is mainly driven by dead or injured automobile drivers rather than passengers. This finding suggests that any correlation between the unemployment rate and the rate of automobile victims may be dependent on the impact of the unemployment rate on the automobile drivers.

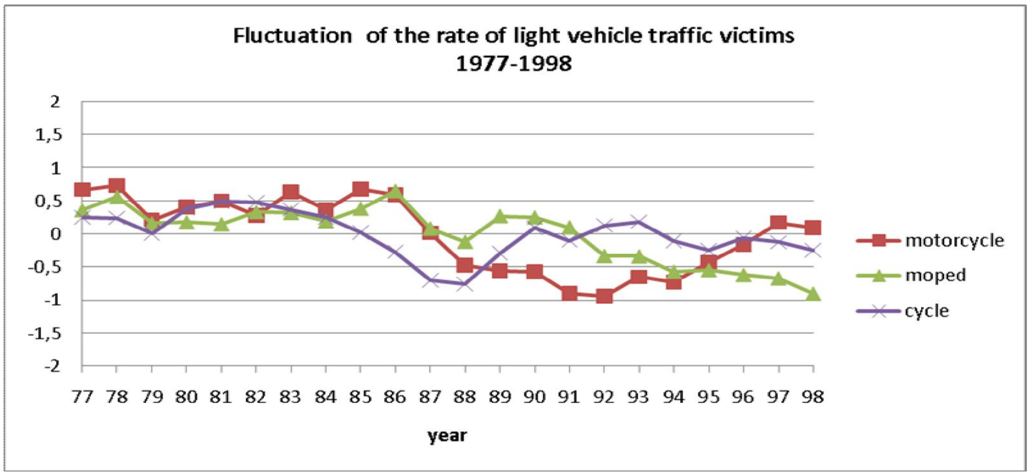

Figure 3-8. Fluctuation of the rate of traffic victims injured or killed by motorcycle, moped and cycle from 1977 to 1998.

Figure 3-8 shows the fluctuation of the rate of traffic victims either injured or dead during riding the motorcycle, moped or cycle. The fluctuation of these traffic victims seems to have similar pattern even though the size of the fluctuation differs. However, we can not judge any similarities within these traffic victims only by looking at figure 3-8 without any empirical evidence.

Figure 3-9 shows the fluctuation of the rate of pedestrian, skiing and other victims involved into traffic accidents. The rates of pedestrian and skiing victims decrease during the observed years without any substantial fluctuation, while victims of others (e.g. drivers of tractor etc) have been remained on the same level with some slight fluctuations.

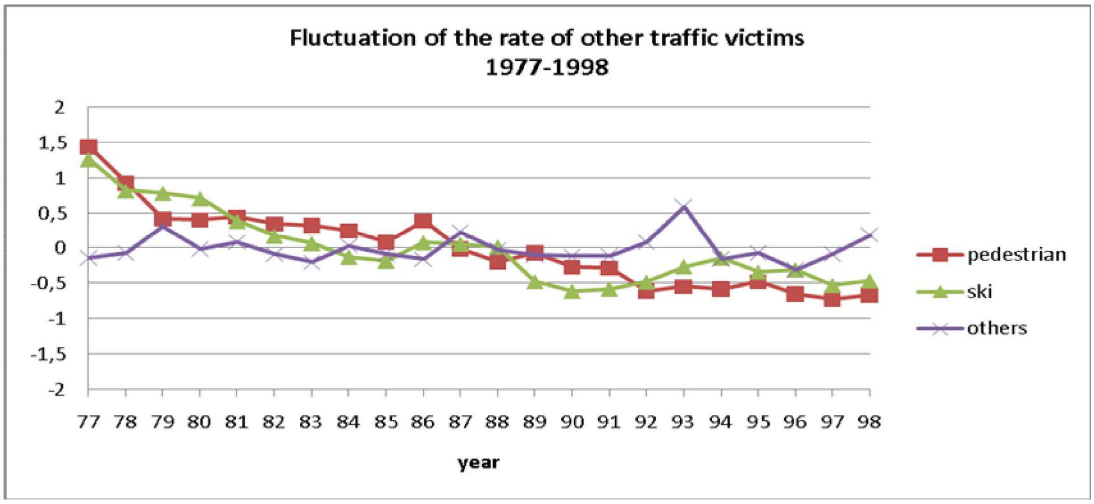

Figure 3-9. Fluctuation of the rate of traffic victims who are injured or killed pedestrian and users of ski and other transportations from 1977 to 1998.

By looking at figures 3-7 and figure 3-8, it seems that the rates of automobile and motorcycle victims have some negative correlations with the unemployment rate. For other types of traffic victims, it is difficult to realize any correlation with the unemployment rate only by looking at figures.

Figure 3-10 shows fluctuation of the rate of total traffic victims across counties.

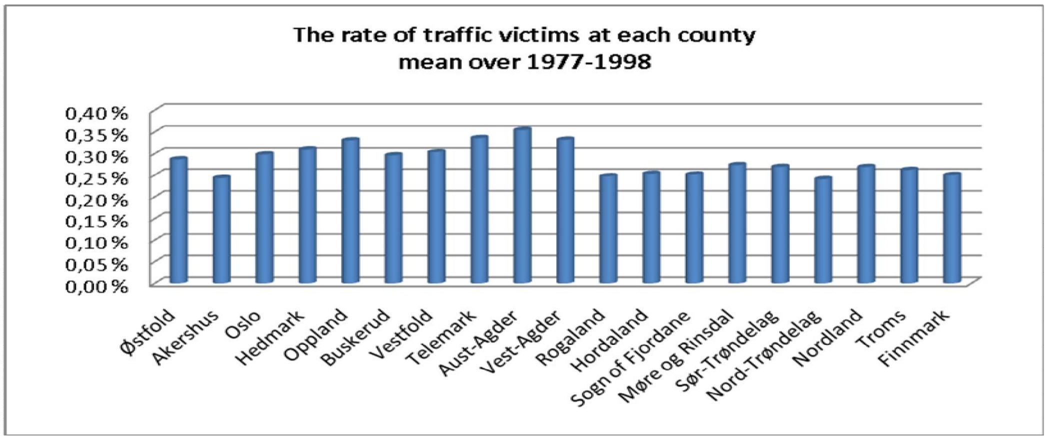

Figure 3-10. The mean rate of traffic victims at each county from 1977 to 1998.

The rate of total traffic victims in figure 3-10 does not show big differences across counties. The smallest rate of traffic victims is in Nord-Trøndelag which is 0.24%. On the other hand, the highest rate of traffic victims is in Aust-Agder which is 0.35%. Therefore, to find any differences in fluctuation of the rate of traffic victims across counties, a detailed empirical estimation is needed which we address in sensitivity analysis in chapter 6.

Figure 3-11 extends figure 3-10 by separating the rate of traffic victims according to the type of transportations. In all counties, the first and second highest rate of traffic victims is automobile drivers and passengers, respectively. The third highest rate of traffic victims is pedestrians in all counties except Østfold, Hedmark and Vest-Agder.

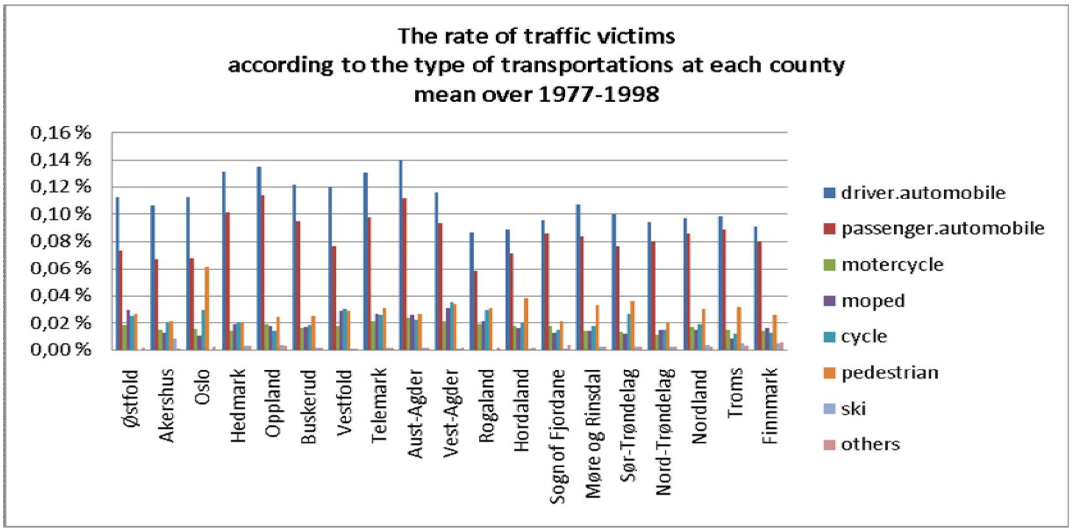

Figure 3-11. The mean rate of traffic victims according to the type of transportations from 1977 to 1998.

In Oslo, the rate of traffic victims of pedestrian is substantially higher than other counties. This may be because of the higher population density, comparing to other counties. In some counties located in Northern part of Norway such as Nordland, Troms and Finnmark, the rate of traffic victims of skiing is higher than counties in other parts of Norway. This shows the impact of weather condition in these areas on the traffic victims. However, regression analysis is needed to disentangle what mechanisms drive the variation across counties and over time.

4 Econometrics methods and estimations

We investigate whether Ruhm's fnding in the United States is also valid in Norway and whether the traffic accident increases the total mortality rate when the unemployment rate decreases. The dependent variables in our study are the total mortality rate and the rate of traffic victims.

To estimate the relation between the unemployment rate and the total mortality rate as well as the rate of traffic victims, we start with the following *Ordinary Least Squares* (OLS) regression model:

$$Y = \alpha + \beta_1 unemployrate_{ct} + \lambda_t + \gamma_c + \varepsilon_{cit} \qquad (4.1)$$

where Y is the total mortality rate and the rate of traffic victims.

The total mortality rate is, $Y = Y_{ct}^{iM} = mortalityrate_{ct}^{i} = \dfrac{mortality_{ct}^{i}}{population_{ct}^{i}}$,

and the rate of traffic victims is, $Y = Y_{ct}^{T} = \dfrac{traffic.victims_{ct}}{population_{ct}}$.

i denotes three different age groups which cover the ranges from 0 to 15 years old (age group 1), from 16 to 66 years old (age group 2), and over 67 years old (age group 3). c denotes the county and t denotes the year. $mortality_{ct}^{i}$ is the number of observed deaths for age group i at county c in year t. $population_{ct}^{i}$ is the population of age group i at county c in year t. $unemployrate$ is the unemployment rate at each county measured by dividing the number of unemployed individuals registered as a job seeker at county c in year t by population at county c in year t. λ_t is the time fixed-effect and γ_c is the county fixed-effect. ε is the residual.

OLS estimation gives unbiased and consistent estimator provided that the following assumptions are met (Greene, 2008).

1. Linearity ; $E(Y|unemployrate_{ct}, \lambda_t, \gamma_c) = \alpha + \beta_1 unemployrate_{ct} + \lambda_t + \gamma_c$

2. No perfect multicollinearity; regressors are non-singular

3. Regressors are exogenous; $\text{var}\, E(\varepsilon_{ct}^i | unemployrate_{ct}, \lambda_t, \gamma_c) = 0$

4. Homoscedasticity; $\text{cov}\, E(\varepsilon_{ct}^i \varepsilon_{dt}^j) \begin{cases} = \sigma^2 I & \text{where } c = d, \text{and } i = j. \\ = 0 & \text{otherwise.} \end{cases}$

   No autocorrelation; $\text{cov}\, E(\varepsilon_{ct}^i \varepsilon_{ct}^i) = 0$ where $\forall i \neq s$

5. Regressors can be both constant and variable.

6. Residual is normal distributed; $\varepsilon \sim N(0, \sigma^2 I)$

If the third condition is violated, the result of OLS will be biased. The first statement in the forth condition shows an assumption of constant variance within the same age group at the same county in the same year. The second statement shows that there is no correlation in error terms across different years, even within the same age group at the same county. If one of the statement in the forth condition is violated, the estimator will be no more efficient.

The time fixed-effect, λ_t, absorbs the influence of all omitted variables differ from year to year but are constant across counties. In other words, it captures the different characteristics of each year which influence the dependent variables (i.e. Y^M and Y^T), and are invariant across all counties. For example, the improvement of medical technology over time has impact on both Y^M and Y^T. As time goes by, the improved medical technology can reduce both of them. However, this improved medical technology must be available commonly across all counties in Norway to be addressed by λ_t. On the other hand, the county fixed-effect, γ_c, absorbs the influence of all omitted variables differ from county to county but are constant across all years used in this study. In other words, it captures the different characteristics of each county which influence our dependent variables, and are invariant across all years. For example, in some counties, they may have generally better access to medical and health facilities. These factors can lower the total mortality rate, Y^M, in these counties. On the other hand, in some counties, it may snow or rain more than other counties. In such counties, traffic accident can occur more often because snow and rain can make the road slippery and make the view of drivers worse. Therefore, these factors can increase the rate of traffic victims, Y^T. However, these types of regional characteristics, particularly climate, do not change across different years.

As it is discussed, these time-fixed and county-fixed characteristics influence Y^M and Y^T. However, we want to estimate β_1, the effect of the unemployment rate on both Y^M and Y^T, respectively, holding constant these time-fixed and county-fixed characteristics. By including time and county fixed-effect, λ_t and γ_c, in the estimation, we can estimate β_1 isolated from these time-fixed and county-fixed characteristics. Therefore, in the following estimation, we will stick to including both time and county fixed-effect.

In addition, to investigate if the different age generations within each age group have different impacts on Y^M and Y^T, we develop equation (4.1) by adding age distributions of each age group.

$$Y = \alpha + \beta_1 unemployrate_{ct} + \rho Z_{ct}^i + \lambda_t + \gamma_c + \varepsilon_{ct}^i \quad (4.2)$$

where Z_{ct}^i is a vector of age distribution variables within age group i at county c in year t, and ρ is a matrix of coefficients for Z_{ct}^i.

A possibility remains that some factors which were not included in the estimation up to this stage have some correlations with both Y^M and Y^T, and the unemployment rate. If there is any, this omitted variable is included in error term. Therefore, the third condition of OLS will be violated when there are any omitted variables related to both dependent variables and the unemployment rate. It means that $\operatorname{var} E(\varepsilon^i_{ct} | unemployrate_{ct}, Z^i_{ct}, \lambda_t, \gamma_c) \neq 0$. In this case, each estimated impact of the unemployment rate on Y^M and Y^T, β_1 is biased.

In many studies for the association between the health problems and the macroeconomic condition, there are some factors which are generally included in their analyses. Based on the former studies, we consider the share of the population at each county according to ethnic background, marital status and education level for factors which are correlated to both dependent variables and the unemployment rate. For an excellent discussion about variation in health outcomes across socioeconomic groups, see Cutler et al. (2006).

It has been documented by some researchers that the individuals with foreign ethnic backgrounds have more health problems than native residents (Cutler et al. 2006). For example, in United Kingdom, it was found that a black person live on average 7.4 years shorter than a white person (Junankar, 1991). There may be some differences in the average income level between immigrants and natives. A native person may have higher income than foreigners. Since he/she can purchase better medical products and/or safe products such as safer automobiles, the native person may be also healthier than foreigners. Thus, the share of population according to ethnic background can influence both Y^M and Y^T.

Many researchers have also discussed the correlation between marital status and health problems. International evidences are provided by Culter et al. (2006), Gerdtham and Johannesson (2002), and Junankar (1991), while the evidence from Norway is provided by

Fiva et al. (2009). They showed that married individuals are healthier. However, the mechanism can be a mutual correlation where the married individuals tend to be healthier or healthy individuals tend to get married. Thus, the share of population related to marital status can influence Y^M. In addition, it can also influence Y^T, since married individuals, particularly those with children, may drive more careful than singles.

Furthermore, the education level in the population can also influence both Y^M and Y^T. This is because some findings show that individuals with higher education have better understanding and productivity in producing health, and thus they can avoid many types of health problems (Culter et al., 2006, Fiva et al., 2009, Gerdtham and Johannesson, 2002, Smith, 1999).

Based on these discussions, therefore, these variables are potentially important determinants of both Y^M and Y^T. In addition, it must be emphasized again that these variables could be also potentially correlated to the unemployment rate causing an omitted variable problem. Different ethnic background may face the difficulty in job market. In addition, married individuals tend to have a job or employed individuals tend to get married. Furthermore, certainly, the education level could explain a lot about the one's employment status. As it is discussed, therefore, these control variables can be correlated to not only Y^M and Y^T, but also to the unemployment rate.

Based on these discussions, population characteristics related to ethnic background, marital status and education level could be omitted variables in equations (4.1) and (4.2) which bias the estimation of the unemployment rate. Therefore, extended analysis are needed to avoid the omitted variables problem and to provide the unbiased OLS estimator. We add these three variables to equation (4.2) as control variables.

$$Y_{ct}^{i} = \alpha + \beta_1 unemployrate_{ct} + \rho Z_{ct}^{i} + \delta_1 X_{1ct}^{i} + \delta_2 X_{2ct} + \delta_3 X_{3ct}^{i} + \lambda_t + \gamma_c + \varepsilon_{ct}^{i} \quad (4.3)$$

where X_n (n = 1,2,3) is a vector of each control variables and δ_n(n = 1,2,3) is a matrix of coefficients for each control variable. X_1 denotes the share of population according to ethnic background where we consider six ethnic groups. X_2 denotes the share of population based on the marital status where we do not follow the defined three age groups, but the age range over 15 years old due to the limited available data. X_3 is the share of population based on the education level. For age group 1, we include the share of population according to education level where the population covers the range over 16 years old. For age groups 2 and 3, the education level is constructed based on the population which covers the range from 16 to 66 years old and over 67 years old, respectively. These control variables may be correlated with both dependent variables and the unemployment rate, which can give rise to omitted in equations (4.1) and (4.2),

$$\text{var}\, E(\varepsilon_{ct}^{i}\{X_1, X_2, X_3\} | unemployrate_{ct}, Z_{ct}^{i}, \lambda_t, \gamma_c) \neq 0$$

if $\text{cov}\, E(unemploymentrate_{ct}, X) \neq 0$.

However, in equation (4.3),

$$\text{var}\, E(\varepsilon_{ct}^{i} | unemployrate_{ct}, X_1, X_2, X_{3,}, Z_{ct}^{i}, \lambda_t, \gamma_c) = 0 .$$

In other words, the omitted variable in equations (4.1) and (4.2), X_1, X_2 and X_3, are no longer included in error term in equation (4.3). Thus, the third condition of OLS will hold in equation (4.3). In this case, OLS gives unbiased estimator of the unemployment rate. Note also that we assume control variables as well as age distribution variables and time and county fixed-effect are not correlated to the error term. It means that $\text{var}\, E(\varepsilon_{ct}^{i} | X, Z_{ct}^{i}, \lambda_t, \gamma_c) = 0$. The exogeneity of these variables means that they are not correlated to any other factors which are determinants of both Y^M and Y^T, and included in error term, ε_{ct}^{i}.

Furthermore, note that even if these control variables are not correlated to the unemployment rate but the dependent variables (i.e. Y^M and Y^T), it still improves the results.

$$\operatorname{cov} E(Y, X) \neq 0$$

$$\operatorname{cov} E(unemploymentrate_{ct}, X) = 0$$

The reason is that including the important determinants of dependent variable reduces the variance of error term so that our estimation will be more efficient with smaller standard errors.

In the sensitivity analysis in chapter 6, we also investigate if the nonlinear specification is suitable for this study[9] by adding the squared unemployment rate to equation (4.3).The reason we focus on equation (4.3) is that it provides the most reliable result of the association between the unemployment rate and, Y^M and Y^T, respectively. This is because, as it is discussed, including control variables reduces the chance of omitted variable. In addition, even if there are no omitted variables, it ca still improve the efficiency of estimation. Therefore, we focus on the equation (4.3) to examine if the nonlinear specification is suitable for this study.

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[9] We also examined the lagged unemployment rate. However, none of the coefficients showed to be significant. In addition, lagged unemployment rate is less relevant to our hypothesis that traffic accidents increase the total mortality rate in Norway when the unemployment rate decreases. This is because impact of lagged unemployment rate on the health problems usually reflects the chronic health problems due to the lower unemployment rate rather than acute health problems. However, the traffic victim is one of the main source of acute deaths. Therefore, based on our hypothesis as well as the non-significant results, it suggests that including the lagged unemployment rate in the estimation is not sufficient. Based on these reasons, the lagged unemployment rate is omitted from the discussion.

Using a linear specification for the regression when actual regression function is nonlinear can bias the results, since a variable which reflects the nonlinear aspect will be omitted variable (Stock and Watson, 2007). For example, if the actual regression function in this study is nonlinear, excluding the squared unemployment rate can cause omitted variable bias. By including the squared unemployment rate in the regression, we can examine if the true population is linear or nonlinear from the coefficient of the squared unemployment rate:

$$Y = \alpha + \beta_1 unemployrate_{ct} + \beta_2 unemployrate^2{}_{ct} + \rho Z^i_{ct} + \delta_1 X^i_{1ct} + \delta_2 X_{2ct} + \delta_3 X^i_{3ct} + \lambda_t + \gamma_c + \varepsilon^i_{ct} \quad (4.4).$$

5 Results and discussions

5.1 Validity of Ruhm's finding in Norway

Estimated values for the coefficients in equations (4.1) to (4.3) are presented in tables 5-1 to 5-3 for age groups 1 to 3, respectively. The dependent variable in all tables is the total mortality rate. In each table, result of equation (4.1) is presented in specification (1), result of equation (4.2) is presented in specification (2), and result of equation (4.3) is presented in specifications (3) and (4). The difference between specifications (3) and (4) is how we categorize ethnic background and marital status variables. In specification (3), ethnic background variables are categorized into two such as immigrants and natives. The total immigrants include all immigrants in Norway no matter where they come from. Similarly, marital status variables are categorized into two such as all types of singles and married individuals. The all types of singles include all singles in Norway no matter what king of singles they are. On the other hand, in specification (4), both ethnic background and marital status variables are categorized into more detailed than in specification (3). Ethnic background variables are categorized into six groups as Europe, Africa, Asia, America, Oceania, and natives. By doing so, we can observe how different background of immigrants possibly influences the total mortality rate. Similarly, marital status variables are categorized into five groups as never married, widow/widower, divorced, separated and married individuals. By doing so, we can observe how singles' marital status possibly influences the total mortality rate.

Table 5-1. Result of OLS estimation for the relation between the unemployment rate and the total mortality rate in age group 1 (young population form age 0 to 15).

	(1)	(2)	(3)	(4)
Unemployrate	-.002 (.002)	-.003 (.002)	-.002 (.002)	-.002 (.002)
Z; age distribution (age of 0-6 =ref)				
age7-15		-.003*** (.0006)	-.002** (.001)	-.002* (.001)
X1; ethnic background (natives=ref)				
Totalimmigrants			.002 (.002)	
Europe				-.008 (.005)
Africa				.004 (.013)
Asia				.004 (.003)
America				.005 (.011)
Oceania				-.078 (.178)
X_2; marital status (married=ref)				
Total.singles			.002 (.002)	
Never.married				.002 (.002)
Widow/Widower				.005 (.007)
Divorced				.0006 (.004)
Separated				-.019 (.014)
X_3; education level (low.sec=ref)				
Upper.sec			-.0003 (.001)	.0001 (.001)
Higher.edu(≤4years)			.0006 (.003)	-.0004 (.004)
Higher.edu(>4years)			-.007 (.005)	-.009 (.007)
Unknown / None.edu			.006 (.005)	.008 (.006)
observations	418	418	361	361
Adjusted-R^2	0.543	0.564	0.586	0.589

The unemployment rate and the dependent variable as well as other variables included in each specification are scaled within the range from 0.0 to 1.0. The specification (1) and (2) include the data from 1977 to 1998. The specification (3) and (4) include the data from 1980 to 1998. The time and county fixed-effects are included, but not reported. Standard errors in parentheses.
**p<0.1, **p<0.05, ***p<0.01*

Table 5-2. Result of OLS estimation for the relation between the unemployment rate and the total mortality rate in age group 2 (working –age population from age 16 to 66).

	(1)	(2)	(3)	(4)
Unemployrate	-.007** (.003)	-.0006 (.003)	.0007 (.003)	.005 (.003)
Z; age distribution (age of 16-25 = ref)				
age26-35		-.002 (.002)	.006 (.004)	-.003 (.004)
age36-45		.003 (.004)	.011** (.005)	.001 (.006)
age46-55		-.002 (.004)	.001 (.005)	-.009 (.005)
age56-66		.01*** (.002)	.012*** (.003)	.003 (.003)
X_1; ethnic background (natives=ref)				
Totalimmigrants			-.001 (.006)	
Europe				-.017 (.012)
Africa				.017 (.028)
Asia				.003 (.007)
America				.033 (.020)
Oceania				-.086 (.392)
X_2; marital status (married=ref)				
Total.singles			.005** (.002)	
Never.married				.0006 (.003)
Widow/Widower				.059*** (.009)
Divorced				-.003 (.006)
Separated				.0005 (.020)
X_3; education level (low.sec=ref)				
Upper.sec			.0007 (.001)	-.0002 (.001)
Higher.edu(≤4years)			-.004 (.005)	.007 (.005)
Higher.edu(>4years)			-.006 (.007)	.022** (.009)
Unknown / None.edu			-.006 (.009)	-.005 (.012)
observations	418	418	361	361
Adjusted- R^2	0.878	0.892	0.888	0.903

The unemployment rate and the dependent variable as well as other variables included in each specification are scaled within the range from 0.0 to 1.0. The specification (1) and (2) include the data from 1977 to 1998. The specification (3) and (4) include the data from 1980 to 1998. The time and county fixed-effects are included, but not reported. Standard errors in parentheses.
**p<0.1, **p<0.05, ***p<0.01*

Table 5-3. Result of OLS estimation for the relation between the unemployment rate and the total mortality rate in age group 3 (senior population over age 67).

	(1)	(2)	(3)	(4)
Unemployrate	-.100*** (.031)	-.095*** (.029)	-.122*** (.032)	-.08** (.034)
Z; age distribution (age of 67-70 = ref)				
age71-75		-.007 (.026)	.002 (.026)	.033 (.028)
age76-80		-.013 (.023)	.005 (.029)	.026 (.030)
age81-		.103*** (.022)	.067** (.026)	.089*** (.028)
X_1; ethnic background (natives=ref)				
Totalimmigrants			.252** (.122)	
Europe				-.036 (.310)
Africa				-5.37 (5.81)
Asia				-.384 (.982)
America				.198 (.1637)
Oceania				-6.38 (5.55)
X_2; marital status (married=ref)				
Total.singles			-.009 (.030)	
Never.married				.071 (.040)
Widow/Widower				.275** (.111)
Divorced				-.370*** (.078)
Separated				-.037 (.183)
X_3; education level (low.sec=ref)				
Upper.sec			.004 (.0265)	.027 (.0283)
Higher.edu(≤4years)			-.027 (.063)	.264*** (.088)
Higher.edu(>4years)			-.242* (.130)	-.574*** (.150)
Unknown / None.edu			.363** (.152)	.693*** (.204)
observations	418	418	361	361
Adjusted-R^2	0.542	0.589	0.643	0.667

The unemployment rate and the dependent variable as well as other variables included in each specification are scaled within the range from 0.0 to 1.0. The specification (1) and (2) include the data from 1977 to 1998. The specification (3) and (4) include the data from 1980 to 1998. The time and county fixed-effects are included, but not reported. Standard errors in parentheses. **p<0.1, **p<0.05, ***p<0.01*

The most reliable results are presented in specification (4) by including detailed control variables. As it was discussed in chapter 4, including control variables reduces the chance of the omitted variable bias. In addition, it can still improve the efficiency of estimations even if there are no omitted variables. Therefore, in this chapter, we mostly focus on the result of specification (4). The results of specification (4) in tables 5-1 and 5-2 show no statistically significant association between the total mortality rate and the unemployment rate for age groups 1 and 2. On the other hand, the specification (4) in table 5-3 shows that there is association between the unemployment rate and the total mortality rate for age group 3. For this age group, the coefficient of the unemployment rate is negative and significant within 95% confidence interval. Result shows that the coefficient of the unemployment rate for age group 3 is -0.08. It means that when the unemployment rate decreases by 1%, the mortality rate for age group 3 increases by approximately 0.08%. This corresponds to about one quarter of a standard deviation increase in the total mortality rate for age group 3 (see table A in appendix (1)). In addition, it allows us to calculate expected increase in the number of death for age group 3. According to table A, we found that approximately 238 more senior individuals die when the unemployment rate decreases by 1%, and it corresponds to about 0.76% of the mean population for this age group. Based on the 95% confidence interval of the coefficient for the unemployment rate, similarly, we also calculate the expected maximum and minimum increase in the number of death for age group 3. We found that maximum increase in the number of death is 422 and minimum increase is 29. These numbers are corresponding to about 1.4% and 0.1% of the mean population for age group 3, respectively. These findings show that increase in the number of death for age group 3, when the unemployment rate decreases by 1%, varies from 0.1% to 1.4% of the total population for this age group. This fraction of the increase in the number of death seems to be small.

As it is discussed previously, there are some factors which generally are important determinants of the total mortality rate. For example, marital status, education level and ethnic background are suggested by some researchers. However, the unemployment rate does not seem to be a major determinant of the total mortality rate. Instead, it is more plausible that the unemployment rate is one of the factors which can influence the total mortality rate. Based on this point, one quarter increase of a standard deviation in the total mortality rate for age group 3, when the unemployment rate decreases by 1%, seems to be small, but plausible value. In addition, as it is found, increase in the number of death for age group 3 in terms of total population seems to be also small. This result shows that, therefore, the unemployment rate has a statistically significant effect on the total mortality rate for age group 3, however, the magnitude of the effect is not very big.

To see our regression results differently, we plot the data of all counties for all years in three scatters plots showing each age group. Y axis in figures 5-1, 5-2 and 5-3 shows the total mortality rate and X axis shows the unemployment rate.

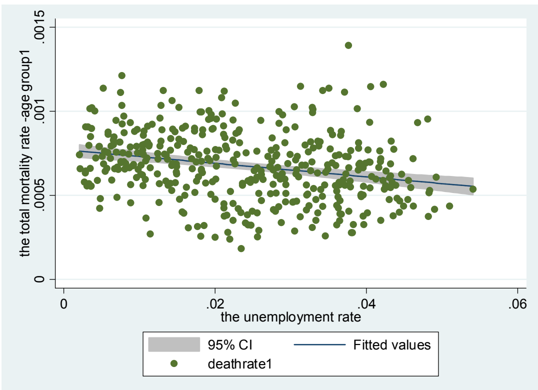

Figure 5-1. The association between the unemployment rate and the total mortality rate for age group 1 (from age 0 to 15). Data are from 1977 to 1998.

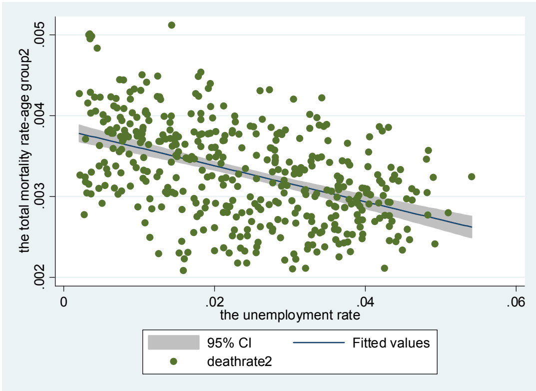

Figure 5-2. The association between the unemployment rate and the total mortality rate for age group 2 (from age 16 to 66). Data are from 1977 to 1998.

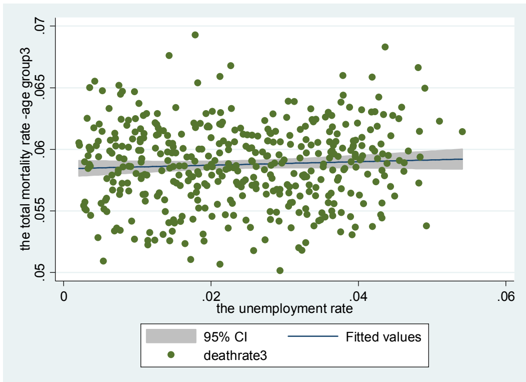

Figure 5-3. The association between the unemployment rate and the total mortality rate for age group 3 (over age 67). Data are from 1977 to 1998.

Figure 5-1 shows the slight negative association between the unemployment rate and the total mortality rate for age group 1. The result of empirical analysis in tables 5-1 also shows that this association is negative, but it is not statistically significant. Similarly the negative association between the unemployment rate and the total mortality rate for age group 2 is seen in figure 5-2. This negative association seems to be stronger in age group 2 than in age group 1. However, the result of empirical analysis by specification (4) in tables 5-2 shows that this association is not statistically significant and positive. It shows that specification in figure 5-2 is likely suffering from omitted variable bias and, therefore, it need to include time and county fixed effects as well as other control variables. Figure 5-3 shows more or less flat, but relatively positive association between the unemployment rate and the total mortality rate for age group 3. However, the result of empirical analysis in table 5-3 shows that this association is negative and significant and has small magnitude. Therefore, specification in figure 5-3 also seems to suffer from the omitted variable bias. As it is seen in figure 5-3, the impact of the unemployment rate on the total mortality rate for age group 3 is small because the slope is close to be flat.

These results show that Ruhm's finding in the United States is not valid among young and working-age population (age groups 1 and 2) in Norway. On the other hand, Ruhm's finding in the United States is valid among senior population (age group 3).[10] It means that the unemployment rate does not influence the total mortality rate for young and working-age individuals, while it does for senior individuals with small magnitude.

As it was stated in chapters 1 and 2, our hypothesis is that the association between the total mortality rate and the unemployment rate, similar to what Ruhm found in the United States, may not be found in Norway because of the strong Norwegian social insurance system. Together with the results, our hypothesis suggests that one possible reason why this association does not exist for young and working-age population is the strong Norwegian social insurance system. As it was discussed, strong social backup for being unemployed in Norway may mitigate the impact of the unemployment on one's mortality for young and working-age populations. However, to investigate this in more detail, further analysis is needed. On the other hand, what we found for senior population is very interesting because the unemployment rate has an impact on the individuals who are already retired from labor

[10] Interestingly, when we apply the same estimations only for ten largest municipalities in Norway (i.e. Bergen, Bærum, Drammen, Fredrikstad, Kristiansand, Oslo, Stavanger, Sandnes, Trondheim, and Tromsø), the association between the total mortality rate and the unemployment rate is not found for all age groups.

market. According to this result, one my suspect that it may be because of omitted variable. However, we include time and county fixed effects as well as control variables to avoid omitted variables. Therefore, the possibility that omitted variable problem arises in the estimation for age group 3 must have been lowered. Therefore, the association between the total mortality rate and the unemployment rate among senior population seems to be driven by other factors which we did not consider in this study.

Note that, overall, none of the coefficients of the ethnic background variables are significant for all age groups in specification (4). It suggests that the ethnic background is not an important determinant of the total mortality rate for all age groups in Norway. In addition, some of the coefficients of marital status and education level variables are significant for age groups 2 and 3 in specification (4), but not for age group 1. It shows that marital status and education level are determinants of the total mortality rate for age groups 2 and 3, but not for age group 1. Age distribution variables show that the increase in the rate of older generation increases the total mortality rate, comparing to the case of increase in the rate of youngest generation, for age groups 2 and 3. However, for age group 1, the increase in the rate of younger generation increases the total mortality rate for this age group, comparing to the case of increase in the rate of older generation.

Many researchers have discussed that the income of a person has also significant impact on his/her mortality (Gerdtham and Johannesson, 2002, Smith, 1999, Wilkinson, 1996). Having higher income reduces one's mortality risk, since individuals with higher income can afford buying better medical care, for example. In addition, it was found that the income inequality in a society also increases the mortality. For example, Wilkinson (1996) found that Sweden and Norway where inequality in income is relatively less than other countries have mean life expectancy 2 or 3 years higher than the United States, United Kingdom and West Germany. These discussions show that income is one of the important determinants of the total mortality rate. Therefore, we also considered including income as a control variable in this estimation. However, due to the limited available data of income, the estimation and result as well as discussion where income is included are excluded from our main discussions and are presented in appendix (2).[11]

Furthermore, a possibility remains that the OLS requirements may have been violated in the estimations up to this stage. In that case, it means that OLS is not the best suitable method for this analysis. For example, the causal relationship between the mortality rate and the unemployment rate has been pointed out by some researchers (Gerdtham and Johannesson, 2005, Ruhm, 2003, Smith, 1999). They discussed that the health condition, which the mortality rate may serve as a proxy for, may influence the employment status. For example, staying hospital due to the deteriorated health makes individuals unemployed. When the dependent variable has impact on a regressor, the OLS estimation will be biased and inconsistent because the third condition of OLS requirements will be violated. In this study, it means that the estimated coefficient of the unemployment rate is biased and inconsistent. Since our focus is to estimate the unbiased impact of the unemployment rate on the total mortality rate, this causality problem must be investigated. We address the causality problem in the sensitivity analysis in chapter 6.

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[11] We add the income to equation (4.3) and compare the results estimated by including and excluding income. As it is noted in chapter 3.1, the data of income is available only from 1993 to 1998 for this study. Therefore, the results excluding income are also provided by estimating the period from 1993 to 1998 for the ease of comparison. The results are reported in appendix (2) together with the detailed interpretation. Based on the results estimated by the available data of income, we conclude that the income is not an important determinant of the total mortality rate for all age groups in Norway, and thus, it does not need to be included in the estimation.

5.2 Does the traffic accident increase the total mortality rate when the economy is booming in Norway?

Estimated values for the coefficients in equations (4.1) to (4.3) are presented in tables 5-4 to 5-6 for each type of traffic victims such as total, injury and death, respectively. The dependent variable in these tables is the rate of traffic victims. In each table, result of equation (4.1) is presented in specification (1), result of equation (4.2) is presented in specification (2), and result of equation (4.3) is presented in specifications (3) and (4). The difference between specifications (3) and (4) is how ethnic background and marital status variables are categorized, as it is explained in the previous section.

Similar to the previous section, the most reliable results are presented in specification (4) by including detailed control variables. Therefore, in this chapter, we also mostly focus on the result of specification (4). The result of the specification (4), in tables 5-4 to 5-6, show that the coefficients of the unemployment rate for both the total and injured traffic victims are negative and significant. For the rate of dead traffic victims, there is also a negative relationship, but it is not statistically significant at conventional levels (p=0.11).

These results show that the rate of total and injured traffic victims increases when the unemployment rate decreases in Norway. The coefficient of the unemployment rate is -0.009 for the rate of total traffic victims. It means that, when the unemployment rate decreases by 1%, the rate of total traffic victims increases by approximately 0.009%. This corresponds to about one fifth of a standard deviation increase in the rate of total traffic victims. On the other hand, the coefficient of the unemployment rate for the rate of injured traffic victims shows that the rate of injured traffic victims increases by approximately 0.008% when the unemployment rate decreases by 1%. It corresponds to about 0.18 of a standard deviation increase in the rate of injured traffic victims. These point estimates show relatively small magnitude of effect of the unemployment rate on the rate of total and injured traffic victims.

Table 5-4. Result of OLS estimation for the relation between the unemployment rate and the rate of total traffic victims.

	(1)	(2)	(3)	(4)
Unemployrate	-.007** (.004)	-.008** (.0041)	-.011** (.004)	-.009** (.005)
Z; age distribution (age of 0-6 = ref)				
age7-15		-.010 (.008)	-.030** (.013)	-.030** (.015)
age16-25		-.008 (.007)	-.023* (.012)	-.021 (.014)
age26-35		.007 (.011)	-.030 (.018)	-.022 (.020)
age36-45		.022** (.009)	-.001 (.014)	.015 (.017)
age46-55		.016* (.009)	.0009 (.014)	.004 (.016)
age56-66		-.005 (.008)	-.033** (.014)	-.030* (.016)
age67-70		.002 (.015)	-.026 (.019)	-.030 (.022)
age71-75		.015 (.016)	-.003 (.021)	-.012 (.022)
age76-80		-.016 (.017)	-.021 (.022)	-.034 (.023)
age81-		.023 (.015)	.011 (.025)	-.008 (.026)
X_1; ethnic background (natives=ref)				
Totalimmigrant			-.00008 (.007)	
Europe				.007 (.017)
Africa				.046 (.048)
Asia				-.016 (.012)
America				.040 (.029)
Oceania				-.670 (.664)
X_2; marital status (married=ref)				
Total.singles			-.011** (.005)	
Never.married				-.019*** (.006)
Widow/Widower				.005 (.020)
Divorced				.010 (.010)
Separated				-.037 (.028)
X_3; education level (low.sec=ref)				
Upper.sec			-.0008 (.003)	-.0004 (.003)
Higher.edu(≤4years)			.008 (.007)	.003 (.009)
Higher.edu(>4years)			-.004 (.013)	.003 (.016)
Unknown / None.edu			.010 (.012)	.006 (.016)
observations	418	418	361	361
Adjusted-R^2	0.691	0.708	0.699	0.702

The unemployment rate and the dependent variable as well as other variables included in each specification are scaled within the range from 0.0 to 1.0. The specification (1) and (2) include the data from 1977 to 1998. The specification (3) and (4) include the data from 1980 to 1998. The time and county fixed-effects are included, but not reported. Standard errors in parentheses. **p<0.1, **p<0.05, ***p<0.01*

Table 5-5. Result of OLS estimation for the relation between the unemployment rate and the rate of injured traffic victims.

	(1)	(2)	(3)	(4)
Unemployrate	-.006* (.003)	-.008* (.004)	-.010** (.004)	-.008* (.005)
Z; age distribution (age of 0-6 = ref)				
age7-15		-.009 (.008)	-.031** (.014)	-.032** (.015)
age16-25		-.008 (.007)	-.024** (.012)	-.022 (.014)
age26-35		.008 (.011)	-.030* (.018)	-.022 (.020)
age36-45		.022** (.009)	.001 (.014)	.016 (.016)
age46-55		.016* (.009)	.001 (.014)	.005 (.016)
age56-66		-.004 (.008)	-.034** (.014)	-.031** (.015)
age67-70		.002 (.014)	-.030 (.019)	-.030 (.021)
age71-75		.017 (.016)	-.001 (.021)	-.012 (.022)
age76-80		-.014 (.017)	-.017 (.022)	-.030 (.023)
age81-		.022 (.0148)	.011 (.024)	-.010 (.026)
X_1; ethnic background (natives=ref)				
Totalimmigrants			.00001 (.007)	
Europe				.010 (.017)
Africa				.042 (.046)
Asia				-.016 (.012)
America				.043 (.028)
Oceania				-.712 (.651)
X_2; marital status (married=ref)				
Total.singles			-.013** (.005)	
Never.married				-.020*** (.006)
Widow/Widower				.007 (.019)
Divorced				.009 (.010)
Separated				-.041 (.027)
X_3; education level (low.sec=ref)				
Upper.sec			-.001 (.003)	-.0009 (.003)
Higher.edu(≤4years)			.008 (.007)	.004 (.009)
Higher.edu(>4years)			-.006 (.012)	.002 (.016)
Unknown / None.edu			.009 (.012)	.005 (.016)
observations	418	418	361	361
Adjusted-R^2	0.682	0.699	0.695	0.699

The unemployment rate and the dependent variable as well as other variables included in each specification are scaled within the range from 0.0 to 1.0. The specification (1) and (2) include the data from 1977 to 1998. The specification (3) and (4) include the data from 1980 to 1998. The time and county fixed-effects are included, but not reported. Standard errors in parentheses. **p<0.1, **p<0.05, ***p<0.01*

Table 5-6. Result of OLS estimation for the relation between the unemployment rate and the rate of dead traffic victims.

	(1)	(2)	(3)	(4)
Unemployrate	-.0008** (.0004)	-.0007 (.0005)	-.0006 (.0005)	-.0009 (.0006)
Z; age distribution (age of 0-6 = ref)				
age7-15		-.0007 (.0009)	.001 (.002)	.002 (.002)
age16-25		.00004 (.0008)	.0008 (.001)	.001 (.002)
age26-35		-.0008 (.001)	.00006 (.002)	-.0002 (.002)
age36-45		-.0003 (.001)	-.00005 (.002)	-.0009 (.002)
age46-55		-.00006 (.001)	-.0003 (.002)	-.001 (.002)
age56-66		-.0007 (.0009)	.001 (.002)	.002 (.002)
age67-70		.0003 (.002)	.003 (.002)	.004* (.003)
age71-75		-.002 (.002)	-.001 (.003)	.0002 (.003)
age76-80		-.003 (.002)	-.004 (.003)	-.003 (.003)
age81-		.0007 (.002)	.0002 (.003)	.002 (.003)
X_1; ethnic background (natives=ref)				
Totalimmigrants			-.00009 (.0008)	
Europe				-.003 (.002)
Africa				.004 (.006)
Asia				.0005 (.001)
America				-.003 (.004)
Oceania				.042 (.081)
X_2; marital status (married=ref)				
Total.singles			.001* (.0006)	
Never.married				.002** (.0007)
Widow/Widower				-.002 (.002)
Divorced				.0006 (.001)
Separated				.004 (.003)
X_3; education level (low.sec=ref)				
Upper.sec			.0002 (.0003)	.0005 (.0003)
Higher.edu(≤4years)			-.0008 (.0009)	-.0004 (.001)
Higher.edu(>4years)			.002 (.002)	.0006 (.002)
Unknown / None.edu			.0002 (.001)	.002 (.002)
observations	418	418	361	361
Adjusted-R^2	0.541	0.539	0.508	0.507

The unemployment rate and the dependent variable as well as other variables included in each specification are scaled within the range from 0.0 to 1.0. The specification (1) and (2) include the data from 1977 to 1998. The specification (3) and (4) include the data from 1980 to 1998. The time and county fixed-effects are included, but not reported. Standard errors in parentheses.
**p<0.1, **p<0.05, ***p<0.01*

The coefficient of the unemployment rate for the rate of dead traffic victims is not significant. However, it is close to be statistically significant and, thus, shows that potentially there is a negative association between the unemployment rate and the rate of dead traffic victims. It shows that the rate of dead traffic victims increases by 0.0009% when the unemployment rate decreases by 1%. It corresponds to about one quarter of a standard deviation increase in the rate of dead traffic victims. This point estimate also show relatively small magnitude of effect of the unemployment rate on the rate of dead traffic victims.

To see the regression results differently, we plot the data of all counties for all years in three scatters plots each showing a type of traffic victims. Y axis in figures 5-4, 5-5 and 5-6 shows the rate of traffic victims and X axis shows the unemployment rate. The association between the unemployment rate and the rate of injured traffic victims in figure 5-5 seems to be very similar to the case of dead traffic victims in figure 5-6. On the other hand, empirical analyses show that the association in figures 5-4 and 5-5 are statistically significant, while the association in figure 5-6 is not. However, the association in figure 5-6 is close to be significant and it looks similar to the case of injured traffic victims which is significant. Based on these points, therefore, it seems that there is a potentially association between the unemployment and the rate of dead traffic victims. In other words, on average, the unemployment rate has an effect on the rate of dead traffic victims even though the coefficient is not significant.

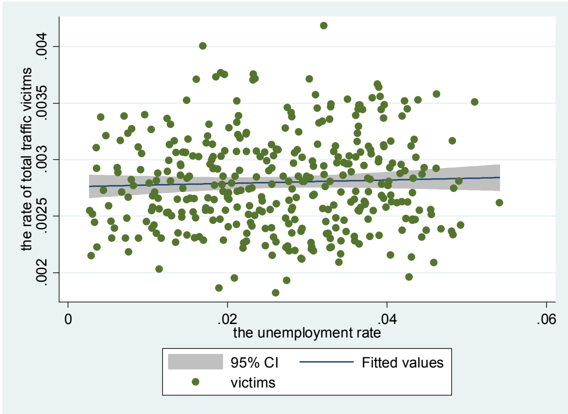

Figure 5-4. The association between the unemployment rate and the rate of total traffic victims. Data are from 1977 to 1998.

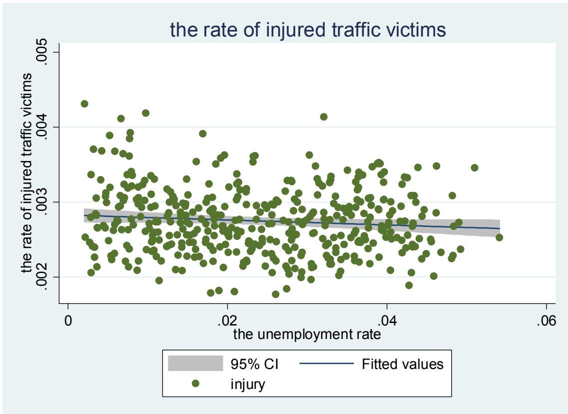

Figure 5-5. The association between the unemployment rate and the rate of injured traffic victims. Data are from 1977 to 1998.

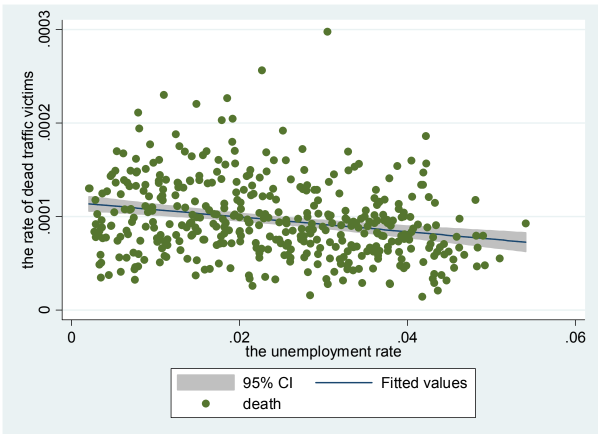

Figure 5-6. The association between the unemployment rate and the rate of dead traffic victims. Data are from 1977 to 1998.

Our attempt is to investigate whether the traffic accident increases the total mortality rate when the unemployment rate decreases in Norway. Therefore, we need to investigate to what extent on average traffic accidents can increase the total mortality rate for all age groups. To do so, we compare the expected increase in the number of traffic death, when the unemployment rate decreases by 1%, with expected increase in the number of death in total for all age groups. In other words, we compare the expected increase in a standard deviation for mean number of traffic death with the expected increase in a standard deviation for mean number of death in total for all age groups. By using the results in tables 5-1 to 5-3 and 5-6 as well as table A,[12] we found that on average 207 more people die in total for all age groups when the unemployment rate decreases by 1%. On the other hand, on average 33 more people die in traffic accidents when the unemployment rate decreases by 1%. It shows that traffic death explains approximately 16% of the increase of the death in total for all age groups in Norway. Similar to previous section, by using the 95% confidence interval of the coefficient for the unemployment rate, we also calculate the expected maximum and minimum increase in the number of traffic death when the unemployment rate decreases by 1%. We found that maximum increase of traffic death is 75 and minimum increase of traffic death is 7. These numbers are corresponding to about 36% and 4% of the increase of death in total, respectively. These findings show that traffic accident explains the increase of death in total for all age groups within the range from 4% to 36%. Even if the actual increase in the number of traffic death takes the maximum value, which is 75, it explains only 36% of the increase of the total mortality rate across all age groups in Norway. This is not so large value that we can consider the traffic accident as a dominant factor which increases the total mortality rate in Norway. Therefore, we conclude that the traffic accident can be one of factors which drive the association between the total mortality rate for all age groups and the unemployment rate, but

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[12] Based on the results by specification (4) in tables 5-1 to 5-3, we calculate the expected extra death for each age group, when the unemployment rate decreases by 1%, and sum them up.

it is not a dominant factor for this.

However, we are not still sure if the traffic accident can be a factor which explains why the total mortality rate for age group 3 increases when the unemployment rate decreases, according to our finding in the previous section. Note that number of traffic death is not categorized into three age groups. Therefore, we do not know how many share young and senior individuals actually have among the traffic death. It means that, even though we found that the traffic accident is a factor which increases the total mortality rate for all age groups, it does not mean that traffic accident is a factor also for the increase in the total mortality rate for age group 3. If only a few of the dead traffic victims are those who belong to age group 3, for example, increase in the traffic accidents does not have much impact on the total mortality rate for age group 3.

To investigate to what extent on average the traffic accident can possibly increase the total mortality rate for age group 3, we consider expected maximum increase of traffic death. As it is discussed, expected maximum increase of traffic death is 75, when the unemployment rate decreases by 1%. We do not know how many of these dead traffic victims are those who belong to age group 3. However, we assume that all of 75 dead traffic victims are over 67 years old and belong to age group 3. Recall that we found that on average 238 more senior individuals die when the unemployment rate decreases by 1%. In that case, it means that 75 senior individuals die in traffic accidents out of 238 senior individuals who die in total. This result suggests that at maximum the traffic accident can explain about 32% of the increase in the total death for age group 3. However, as it is noted, we do not know how many of 75 dead traffic victims belong to age group 3. Our assumption that all of 75 dead traffic victims belong to age group 3 is indeed unrealistic. As it is documented in some studies, the traffic accidents usually occur among young individuals more often than among senior individuals (Miller et al., 2009, Ruhm, 1995). In fact, in Norway, near 80% of the traffic victims are those who belong to age group 2 in this study, see figure 5-7. On the other hand, senior individuals who are over 65 year old are on average only 10% of the total traffic victims. Therefore, our assumption that all expected traffic deaths happen among senior individuals is unrealistic.[13]

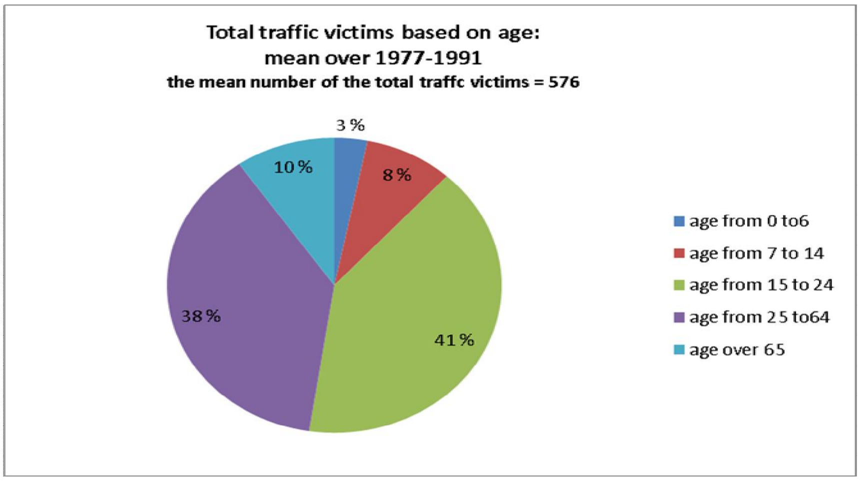

Figure 5-7. Total traffic victims based on age in the period from 1977 to 1991. Total traffic victims include both injured and dead victims. Data are provided from NSD.

We recall that expected average and minimum numbers of dead traffic victims are 33 and 7, respectively. Similar to the case of maximum increase of traffic death, we assume that all of these expected traffic death are those who belong to age group 3. In that case, it suggests that the traffic accident can explain about 13% and 3% of total death for age group 3, respectively. These results show that the traffic accident can explain the increase of the total death for age group 3 within the range from 3% to 32%. However, again, note that our assumption that all traffic deaths are among senior individuals is unrealistic and, thus, the value calculated must be larger than its actual value. If we assume that 10% of the expected

[13] Figure 5-7 covers shorter period than the period which we cover in this study. However, there is a substantially big difference between young adults population (age from 15 to 64) and senior adults population (age over 65) in terms of the share in traffic victims. Therefore, we assume that traffic accident occur more often among the young adults than senior adults in Norway also in the period from 1977 to 1998.

increase in dead traffic victims are senior individuals according to figure 5-7, it suggest that traffic accident can explain the increase of the total death for senior individuals only within the range from 0.3% to 3.2%. Therefore, the actual range which traffic accident can explain for the increase of the total death for age group 3 must be low. It shows that traffic accident explains only few portion of the increase in the total mortality rate for age group 3. Thus, we conclude that the traffic accident is a factor which can influence the total mortality rate for age group 3 when the unemployment rate decreases, but not a dominant factor. The major mechanism which can explain why the total mortality rate for age group 3 increases when the unemployment rate decreases, is still unclear to us.

Overall, these results show that the traffic accident increases when the unemployment rate decreases. The potential mechanism for this can be that, as we hypothesized, social activities increase due to the temporary increase of income and, thus, they increase the usage of transportation. More usage of transportations can, consequently, result in more traffic accidents and, thus, increase the injured and dead traffic victims. Further analyses are needed to investigate the potential mechanism for this in more details.

Note that, overall, none of the coefficients for the ethnic background and education level variables are significant for all types of traffic victims in specification (4). It suggests that the ethnic background and education level are not important determinants of the rate of traffic victims. On the other hand, some of the coefficients for the marital status variables are significant. It suggests that marital status is a determinant of the rate of all types of traffic victims. In addition, some of the age distribution variables are significant for all types of traffic victims but with different sign. It shows that some age generations have impact on the rate of each type of traffic victims but differently.

Similar to the previous section, a possibility remains that the OLS requirements may have been violated in the estimations up to this stage. For example, traffic accidents may keep individuals unemployed due to the injury. In this case, dependent variable has an impact on the regression and, thus, makes the OLS estimation biased and inconsistent. We address this causality problem also between the traffic accident and the unemployment rate in the sensitivity analysis in chapter 6.

6 Sensitivity analysis

6.1 Specification test for nonlinearity

As it was discussed in chapter 4, using the linear specification, when the actual population is nonlinear, can bias the coefficient of our interest (i.e. the unemployment rate). We examine whether nonlinear specification is suitable for this study by adding the squared unemployment to equation (4.3). If the coefficient of the squared unemployment rate is significant, it shows that the nonlinear specification is better than linear, and if not, verse vice. Estimated values for the coefficients in equation (4.3), which are corresponding to specification (4) in chapter 5, are presented in tables 6-1 and 6-2, for the total mortality rate and the rate of traffic victims, respectively.

Table 6-1. Result for specification test of nonlinearity in specification (4). The relation between the unemployment rate and the total mortality rate for each age group. (1980-1998)

	Age group1 (age 0-15)	Age group2 (age 16-66)	Age group3 (age 67-)
Unemployrate	.002 (.005)	.016** (.008)	-.128 (.080)
Unemployrate^2	-.068 (.076)	-.163 (.106)	.786 (1.13)
observations	361	361	361
Adjusted-R^2	0.588	0.903	0.666

The unemployment rate and the dependent variable as well as other variables included are scaled within the range from 0.0 to 1.0. Age distribution variables and control variables as well as time and county fixed-effects are included, but not reported. Standard errors in parentheses.
**p<0.1, **p<0.05, ***p<0.01*

Table 6-1 shows that none of the coefficients of the squared unemployment rate are significant for all age groups. It shows that linear specification fits better for the association between the unemployment rate and the total mortality rate for all age groups. In addition, based on figures 5-1, 5-2 and 5-3, we can realize also visually that the association between the unemployment rate and the total mortality rate seems to be linear for all age groups. Therefore, we conclude that the results of the linear specification presented in tables 5-1 to 5-3 for each age group do not suffer from the omitted variables bias due to using the wrong specification.

Table 6-2. Result for specification test of nonlinearity in specification (4). The relation between the unemployment rate and the rate of each type of traffic victims such as total, injured and dead victims. (1980-1998)

	Total victims	Injured victims	Dead victims
Unemployrate	-.023** (.011)	-.022** (.011)	-.002 (.001)
Unemployrate^2	.214 (.149)	.205 (.147)	.0092 (.018)
observations	361	361	361
Adjusted-R^2	0.703	0.700	0.506

The unemployment rate and the dependent variable as well as other variables included are scaled within the range from 0.0 to 1.0. Age distribution variables and control variables as well as time and county fixed-effects are included, but not reported. Standard errors in parentheses.
**p<0.1, **p<0.05, ***p<0.01*

Table 6-2 shows that none of the coefficients of the squared unemployment rate are significant for all types of traffic victims. Similar to the case of the total mortality rate, it shows that the association between the unemployment rate and the rate of traffic victims fits better with the linear specification. In addition, based on figures 5-4 to 5-6, we can realize also visually that the association between the unemployment rate and the rate of traffic victims seems to be linear for all types of victims. Therefore, we conclude that the results of the linear specification presented in tables 5-4 to 5-6 for each type of traffic victims do not suffer from the omitted variable bias dues to using the wrong specification.

6.2 Extended estimation for "Does the traffic accident increase the total mortality rate when the economy is booing in Norway?"

We develop our study by separating the rate of traffic victims according to the type of transportations.[14] Specified transportations are automobile, motorcycle, moped, cycle, ski and other. Pedestrians who are involved into traffic accidents are also added in addition to other specified transportations. In addition, automobile traffic victims are separated by drivers and passengers. Note that the rate of traffic victims according to type of transportations includes both injured and dead victims. Furthermore, the traffic victims according to transportations are categorized by the specified transportation which victims were using when accidents occurred, but not by the transportation which injured or killed victims.

To estimate the association between the unemployment rate and the rate of traffic victims according to each type of transportations, we also address the specification test of nonlinearity presented by equation (4.4), similar to the previous section. However, based on the result of the nonlinear specification, we found that none of the coefficients of the squared unemployment rate are significant. It means that the association between the unemployment rate and the rate of traffic victims according to the transportations fits better with linear specification. Therefore, table 6-3 presents the estimated value for the coefficients in equation (4.3), which is corresponding to specification (4) in chapter 5, for each type of traffic victims according to transportations.

[14] I also examine the impact of the expenditures based on different purposes at each county on the rate of traffic victims. For the detailed description about estimation method and results including expenditure, see appendix (3). However, based on the estimation results and our concern about the endogenous problem for the expenditure variable, we conclude to exclude the estimation with expenditure variable from our discussion.

Table 6-3. Result of OLS estimation for the relation between the unemployment rate and rate of traffic victims according to the type of transportations in specification (4). (1980-1998)

	Automobile								
	total	driver	pass	motcycl	moped	cycle	pedestr	Ski	others
Unemployrate	-.007* (.004)	-.003 (.002)	-.004* (.002)	.0007 (.0008)	-.001* (.0008)	.0003 (.0008)	-.0005 (.0008)	-.0003 (.0002)	-.0006** (.0003)
Z; age distribution (age of 0-6 = ref)									
age7-15	-.015 (.013)	-.006 (.007)	-.008 (.007)	-.003 (.003)	-.005* (.003)	-.003 (.003)	-.003 (.003)	-.001 (.0009)	-.0006 (.0009)
age16-25	-.011 (.011)	-.002 (.006)	-.009 (.007)	.0007 (.002)	-.004* (.002)	-.003 (.002)	-.003 (.002)	-.001* (.0008)	-.0003 (.0009)
age26-35	-.002 (.017)	.002 (.009)	-.004 (.010)	-.005 (.004)	-.006* (.004)	-.003 (.004)	-.004 (.004)	-.002* (.001)	-.001 (.001)
age36-45	.020 (.014)	.016** (.008)	.004 (.008)	-.005 (.003)	.002 (.003)	.003 (.003)	-.002 (.003)	-.001 (.001)	-.002 (.001)
age46-55	.012 (.013)	.011 (.007)	.001 (.008)	-.004 (.003)	.002 (.003)	.0001 (.003)	-.003 (.003)	-.001 (.0009)	-.002** (.001)
age56-66	-.015 (.013)	-.005 (.007)	-.010 (.008)	-.002 (.003)	-.005* (.003)	-.003 (.003)	-.003 (.003)	-.002** (.0009)	-.0007 (.001)
age67-70	-.007 (.018)	-.0009 (.010)	-.006 (.011)	-.009** (.004)	-.005 (.004)	-.0004 (.004)	-.001 (.004)	-.002* (.001)	-.0009 (.001)
age71-75	.011 (.019)	.007 (.010)	.005 (.011)	-.006 (.004)	-.009** (.004)	-.0007 (.004)	-.006 (.004)	-.003** (.001)	.001 (.001)
age76-80	-.008 (.019)	-.003 (.011)	-.005 (.011)	-.003 (.004)	-.008** (.004)	-.008* (.004)	-.006 (.004)	-.0004 (.001)	.0005 (.001)
age81-	-.002 (.022)	-.004 (.012)	.003 (.013)	-.0004 (.005)	-.002 (.004)	-.001 (.005)	-.002 (.005)	.002 (.002)	-.002 (.002)
X_1; ethnic background (natives=ref)									
Europe	.005 (.014)	.009 (.008)	-.005 (.008)	.002 (.003)	.003 (.003)	-.002 (.003)	.002 (.003)	-.001 (.0009)	-.001 (.001)
Africa	.030 (.040)	.019 (.021)	.010 (.024)	-.001 (.009)	.004 (.008)	.024*** (.008)	-.006 (.009)	-.004 (.003)	.0005 (.003)
Asia	-.015 (.010)	-.008 (.006)	-.007 (.006)	.0005 (.002)	-.002 (.002)	-.0006 (.002)	-.0008 (.002)	.0004 (.0007)	.0007 (.0008)
America	.041* (.024)	.031** (.013)	.010 (.014)	-.008 (.005)	.004 (.005)	.006 (.005)	-.005 (.005)	-.0007 (.002)	.002 (.002)
Oceania	-.402 (.554)	-.175 (.304)	-.227 (.330)	.112 (.120)	-.29** (.114)	-.059 (.117)	-.039 (.118)	.014 (.038)	-.004 (.042)
X_2; marital status (married=ref)									
Never.married	-.013** (.005)	-.008*** (.003)	-.004 (.003)	-.001 (.001)	-.003*** (.001)	-.00007 (.001)	-.0002 (.001)	-.0007* (.0004)	-.0003 (.0004)
Widow/ Widower	-.007 (.016)	-.0004 (.009)	-.007 (.010)	.008** (.004)	.002 (.003)	-.002 (.003)	.008** (.003)	-.0008 (.001)	-.004*** (.001)
Divorced	.012 (.009)	.011** (.005)	.001 (.005)	-.002 (.002)	-.001 (.002)	.0004 (.002)	.0005 (.002)	-.0006 (.0006)	.0006 (.0006)
Separated	-.024 (.023)	-.016 (.013)	-.008 (.014)	-.006 (.005)	-.011** (.005)	-.003 (.005)	.004 (.005)	-.0004 (.002)	.003 (.002)
X_3; education level (low.sec=ref)									
Upper.sec	-.0003 (.002)	.0006 (.001)	-.0009 (.001)	.0007 (.0005)	-.00009 (.0005)	-.0005 (.0005)	-.0005 (.0005)	-.0003** (.0002)	.0006*** (.0002)
Higher.edu (≤4years)	.004 (.007)	.0007 (.004)	.003 (.004)	.003 (.002)	-.003** (.002)	-.001 (.002)	.002 (.002)	-.0003 (.0005)	-.0007 (.0006)
Higher.edu (>4years)	-.002 (.013)	.003 (.007)	-.004 (.008)	.002 (.003)	.005** (.003)	-.002 (.003)	-.002 (.003)	.0005 (.001)	.0003 (.001)
Unknown/ None.edu	.002 (.013)	-.002 (.007)	.003 (.008)	.006** (.003)	-.0006 (.003)	-.001 (.003)	-.0003 (.003)	.0005 (.001)	.0006 (.001)
observations	361	361	361	361	361	361	361	361	361
Adjusted-R^2	0.749	0.831	0.615	0.537	0.784	0.764	0.859	0.578	0.405

The unemployment rate and the dependent variable as well as other variables included are scaled within the range from 0.0 to 1.0. Time and county fixed-effects are included, but not reported. Standard errors in parentheses. **p<0.1, **p<0.05, ***p<0.01*

Table 6-3 shows that the coefficient of the unemployment rate are negative and significant for the rate of total and passenger automobile victims as well as the rate of moped and other traffic victims. It means that the rate of traffic victims injured or killed by these transportations increases when the unemployment rate decreases. In previous chapter, we found that traffic victims who are injured or killed in traffic accidents increases when the unemployment rate decreases. Thus, result in table 6-3 suggests that the increase of the traffic victims in such period is driven mainly by the automobile, moped and other types of transportations.

This finding may contribute to the further analysis why the traffic accident increases when the economy improves. For example, recall that some researcher hypothesized that social activities such as going to restaurants and bars can increase, when the unemployment rate decreases, because of the temporary increases in income and, thus, it can result in increase of the traffic accidents. The increase in the rate of automobile and moped traffic victims can be a support for their hypothesis. This is because these transportations, particularly moped, are usually for private usage. On the other hand, increase in the rate of other traffic victims may suggest that increase in the traffic accident may be also because of the increase of business activities. We do not know the detail components of the transportations categorized into "others" in this study. However, these transportations are likely for the business usage rather than for private. The increase in production of goods and services during the economic upturns can increase the traffic accidents because these goods and services must be transported between producers and consumers. However, to investigate why traffic accident increases when the economy improves, further analysis is needed.

6.3 Causality problem

As it is noted in chapter 5, there may be causality problem between health problems and the unemployment rate. Deteriorated health may keep individuals away from labor market. When the dependent variable has some impact on a regressor, the OLS estimation will be biased and inconsistent. In this study, we want to estimate the unbiased impact of the unemployment rate on the total mortality rate and the rate of traffic victims, respectively. Therefore, it is necessary to investigate if the total mortality rate as well as the rate of traffic victims has any impact on the unemployment rate. In other studies, this causality problem is addressed as restricting the age from 33 to 55 and controlling the initial health (Gerdtham and Johannesson, 2005, Ruhm, 2003). By doing so, they make the health condition more or less homogeneous among population they investigated. However, in this study, our estimation is based on the share of total populations where we can not control the initial health condition The data used in this analysis for the unemployment rate count a person as an unemployed if he/she is eligible to work and looking for a job. Therefore, data of unemployed individuals used in this study may have already made the health among population more or less homogenous. This is because a person who is willing to work and is registered as a job seeker must have few health problems. However, there is still a possibility that the estimations in chapter 4 suffer from an endogeneity problem. For example, the individuals with better initial health may have better job opportunity. In United Kingdom, it is found that changes in wealth are correlated with the initial health (Smith, 1999). Based on this discussion, we hypothesize that the majority of the unemployed individuals in the data we used may have relatively weaker health condition than those who are already in the labor market. In other words, their weaker health may have influenced their job opportunities and keep them unemployed. Thus, the possibility of endogeneity problem still remains. We investigate this endogeneity problem by using *Two Stage Least Square* (2SLS) estimation.

In this chapter, the dependent variables are the total mortality rate and the rate of traffic victims. This is because we need to address the causality problems for the estimations in both chapter 5.1 and 5.2. Therefore, methods and estimations presented in this chapter, particularly those related to the requirement of instrument variables, must be valid for both the total mortality rate and the rate of traffic victims. Similar to the previous sensitivity analyses, we focus on specification (4) to investigate this causality problem because results we mainly rely on in chapter 5 were also specification (4).

To address the causality problem, we use the 2SLS estimation where we need to have at least one instrument variable for the unemployment rate. The first stage in 2SLS estimation is

$$unemployrate_{ct} = \omega_t + \tau_1 Instr_{ct} + \theta Z^i_{ct} + \upsilon Controlls^i_{ct} + \lambda_t + \gamma_c + \eta^i_{ct}$$

with assumptions

$$E(\eta_{ct}, \eta_{ds}) \begin{cases} = \sigma^2 I & \text{where } t = s \text{ and } c = d \\ = 0 & \text{otherwise} \end{cases}$$

i denotes three different age groups which cover the ranges from 0 to 15 years old (age group 1), from 16 to 66 years old (age group 2), and over 67 years old (age group 3). c denotes the county and t denotes the year. $Control^i_{ct}$ denotes the socioeconomic factors included also in chapter 4 and υ is a matrix of coefficients for each control variable. λ_t and γ_c indicates the time and county fixed-effect, respectively. $Instr_{ct}$ is the instrument variable for the unemployment rate and τ_1 is the coefficient for instrument variable. Similarly Z^i_{ct} is the vector of the age distribution in each age group, and θ is a matrix of coefficients for age distribution variables. From the first stage of 2SLS, we can get predicted $unemployrate_{ct}$, $\hat{unemplyrate}_{ct}$. Then second step of 2SLS is to regress Y on

$\hat{unemplyrate}_{ct}$. That is,

$$Y = \alpha + \beta_1 \, \hat{unemployrate}_{ct} + \rho Z^i_{ct} + \delta Controls^i_{ct} + \lambda_t + \gamma_c + \varepsilon^i_{ct}$$

Note Y is the total mortality rate and the rate of traffic victims. Note also that Z^i_{ct}, $Controls^i_{ct}$, λ_t and γ_c are again included in second stage of 2SLS, since they are not excluded instrument. This is because our assumption is that none of these variables are correlated to error term. If one of them is correlated to error term, we need to find another instrument variables and instrument this variable as well as the unemployment rate.

The choice of valid instrument is essential. The important requirements of the instrument variable for the unemployment rate in 2SLS are

$$\begin{cases} 1. \quad \text{cov}(\varepsilon^i_{ct}, Instr_{ct}) = 0 : \text{Exogeneity} \\ 2. \quad \text{cov}(unemployrate_{ct}, Instr_{ct}) \neq 0 \ : \text{Relevance} \end{cases}$$

Otherwise, 2SLS will be failed to give a consistent and efficient estimator. First requirement means that the instrument variable should not be correlated with dependent variable and any omitted variable included in ε^i_{ct}. Second requirement means that $Instr_{ct}$ must be correlated with the unemployment rate. The lagged unemployment rate can possibly have impact on the current unemployment rate. In addition, to refer previous year for estimating the current year is a frequently used method in macroeconomics analysis. Therefore, I hypothesize that the lagged unemployment rate can fulfill the requirements of valid instrument for the unemployment rate.

To be more precise, we can also address the weak instrument test. Even if the instrument fulfills the requirement of valid instrument, poor sufficiency for the second requirement of valid instrument may fail the 2SLS. If the chosen instrument is not actually correlated or weakly correlated with the endogenous variable which needs to be instrument, 2SLS does not give a consistent result any more. To precede the weak instrument test, we regress the first stage of 2SLS and check the F statistic. If the F statistic is bigger than 10, it assures that the chosen instrument has strong correlation with endogenous variable. (Greene, 2008, Stock and Stock, 2007) It implies that the second requirement of instrument variable is assured. Tables 6-4 and 6-5 show the results from the first stage of 2SLS for the total mortality rate and the rate of traffic victims, respectively.

Based on the requirements of instrument variable, we found that the lagged unemployment rate is a good candidate of valid instrument. In this analysis, we hypothesize that the fluctuation of the total mortality rate according to the unemployment rate are driven by acute death such as traffic accident. However, effect of the lagged unemployment rate on the total mortality rate more likely reflects chronic death including disease. Therefore, our assumption is that, lagged unemployment rate is not correlated to the total mortality rate. We also assume that the lagged unemployment rate should not be correlated to the rate of traffic victims because traffic victim is a source of acute death.

Table 6-4. Results of weak instrument test for each age group. The dependent variable is the unemployment rate. The first stage of 2SLS estimation for specification (4) where *Instrument = lagged unemployment rate*. (1980-1998).

	Age group1 (age of 0 -15)	Age group2 (age of 16 -66)	Age group3 (age of 67-)
$Unemployrate_{t-1}$	.712*** (.042)	.635*** (.043)	.680*** (.044)
Observations	361	361	361
F-statistics	161.9	168.6	162.7
Adjusted	0.958	0.962	0.960

Dependent variable as well as other variables included are scaled within the range from 0.0 to 1.0. Age distribution variables and control variables as well as time and county fixed-effects are included, but not reported. Standard errors in parentheses.
**p<0.1, **p<0.05, ***p<0.01*

Table 6-5. Results of weak instrument test for each type of traffic victims. The dependent variable is the unemployment rate. The first stage of 2SLS estimation for specification (4) where *Instrument = lagged unemployment rate*. (1980-1998).

	Total traffic victims	Injured traffic victims	Dead traffic victims
$Unemployrate_{t-1}$	.61*** (.047)	.61*** (.047)	.61*** (.047)
observations	361	361	361
F-statistics	152.9	152.9	152.9
Adjusted	0.962	0.962	0.962

Dependent variable as well as other variables included are scaled within the range from 0.0 to 1.0. Age distribution variables and control variables as well as time and county fixed-effects are included, but not reported. Standard errors in parentheses.
**p<0.1, **p<0.05, ***p<0.01*

The F statistics in tables 6-4 and 6-5 are much bigger than 10. Therefore, we confirm that the lagged unemployment rate has strong correlation with the unemployment rate and fulfill the second requirement of instrument variable.

Tables 6-5 and 6-6 show the results of 2SLS for the total mortality rate and the rate of traffic victims by using the lagged unemployment rate as an instrument variable for the unemployment rate.

The comparison of results between tables 5-1 to 5-3, where OLS estimation is applied, and table 6-6, where 2SLS is applied, shows that the coefficients of the unemployment rate in tables 5-1 to 5-3 have remained significant also in table 6-6. However, the value of coefficient and standard error for the unemployment rate differs between OLS and 2SLS. Note that the focus of comparison is made on the coefficient of the unemployment rate because the main reason of applying 2SLS estimation is to investigate whether the unemployment rate is endogenous. Similarly, by comparing tables 5-4 to 5-6 with table 6-7, we found that the value of coefficient and standard error for the unemployment rate differs between OLS and 2SLS also for the rate of traffic victims. In addition, significant coefficients of the unemployment rate in tables 5-4 to 5-6 turn to be insignificant in table 6-7.

However, 2SLS estimates seem to be imprecise. This is because many of the coefficients of the unemployment rate are close to zero and statistically insignificant. In addition OLS estimate is within 95% confidence interval of 2SLS estimate.[15] Note that the Adjusted-R^2 from OLS can not be compared to the Adjusted-R^2 from 2SLS, since they are from different estimation.

Therefore, we conclude to rely on the result of OLS estimation in tables 5-1 to 5-6.

[15] In both tables 6-6 and 6-7, we examine if OLS fits better than 2SLS by Hausman test (Greene, 2008). Result of Hausman test suggests that OLS is better specification for both the relation between the unemployment rate and the total mortality rate as well as the relation between the unemployment rate and the rate of traffic victims.

Table 6-6. Result of 2SLS estimation, where *Instrument = lagged unemployment rate*, for the relation between the unemployment rate and the total mortality rate for age groups 1, 2 and 3, respectively.

	Age group 1 (age 0-15)	Age group 2 (age 16-66)	Age group 3 (age 67-)
Unemployrate	-.0007 (.003)	.001 (.005)	-.104** (.052)
Z; age distribution, (age of 0-6=ref), (age of 16-25=ref), (age of 67-70=ref), respectively			
age7-15, age26-35, age71-75	-.002 (.001)	-.001 (.004)	.034 (.028)
age36-45, age76-80		.003 (.006)	.026 (.030)
age46-55, age81-		-.006 (.006)	.084*** (.029)
age56-66		.004 (.004)	
X_1; ethnic background (natives=ref)			
Europe	-.008 (.005)	-.016 (.012)	-.063 (.312)
Africa	.003 (.013)	.016 (.028)	-4.53 (5.95)
Asia	.004 (.003)	.003 (.007)	-.276 (.996)
America	.005 (.011)	.035* (.020)	.217 (.166)
Oceania	-.063 (.179)	-.083 (.393)	-5.57 (5.67)
X_2; marital status (married=ref)			
Never.married	.003 (.002)	.001 (.003)	.065 (.041)
Widow/Widower	.006 (.007)	.056*** (.010)	.258** (.114)
Divorced	.0005 (.004)	-.002 (.006)	-.359*** (.080)
Separated	-.019 (.014)	.004 (.021)	-.024 (.184)
X_3; education level (low.sec=ref)			
Upper.sec	.0001 (.001)	-.0005 (.001)	.0278 (.028)
Higher.edu(≤4years)	-.0003 (.004)	.006 (.005)	.266*** (.088)
Higher.edu(>4years)	-.009 (.007)	.021** (.009)	-.589*** (.152)
Unknown / None.edu	.009 (.006)	-.008 (.012)	.684*** (.205)
observations	361	361	361
Adjusted-R^2	0.589	0.902	0.666

The unemployment rate and the dependent variable as well as other variables included are scaled within the range from 0.0 to 1.0. The time and county fixed-effects are included, but not reported. Standard errors in parentheses. **p<0.1, **p<0.05, ***p<0.01*

Table 6-7. Result of 2SLS estimation, where *Instrument = lagged unemployment rate*, for the relation between the unemployment rate and the rate of traffic victims such as total, injured and dead victims.

	The rate of total traffic victims	The rate of injured traffic victims	The rate of dead traffic victims
Unemployrate	.0008 (.0077)	.002 (.008)	-.001 (.0009)
Z; age distribution (age of 0-6 = ref)			
age7-15	-.028* (.015)	-.030** (.014)	.002 (.0018)
age16-25	-.015 (.014)	-.017 (.014)	.001 (.002)
age26-35	-.021 (.021)	-.021 (.020)	-.0001 (.002)
age36-45	.019 (.017)	.020 (.016)	-.001 (.002)
age46-55	.004 (.016)	.005 (.016)	-.001 (.002)
age56-66	-.024 (.016)	-.026 (.016)	.001 (.002)
age67-70	-.023 (.022)	-.028 (.021)	.004* (.003)
age71-75	-.018 (.023)	-.019 (.022)	.0003 (.003)
age76-80	-.032 (.023)	-.028 (.022)	-.003 (.003)
age81-	-.007 (.026)	-.010 (.026)	.002 (.003)
X_1; ethnic background (natives=ref)			
Europe	.006 (.017)	.009 (.017)	-.003 (.002)
Africa	.046 (.048)	.042 (.047)	.004 (.006)
Asia	-.016 (.012)	-.017 (.012)	.0005 (.001)
America	.039 (.029)	.042 (.029)	-.003 (.004)
Oceania	-.617 (.670)	-.658 (.658)	.041 (.081)
X_2; marital status (married=ref)			
Never.married	-.020*** (.006)	-.022*** (.006)	.002** (.0008)
Widow/Widower	.018 (..021)	.021 (.021)	-.002 (.003)
Divorced	.011 (.010)	.010 (.010)	.0005 (.001)
Separated	-.045 (.028)	-.050* (.028)	.005 (.003)
X_3; education level (low.sec=ref)			
Upper.sec	.0001 (.003)	-.0002 (.003)	.0005 (.0003)
Higher.edu(≤4years)	.003 (.009)	.004 (.009)	-.0004 (.001)
Higher.edu(>4years)	.010 (.016)	.010 (.016)	.0004 (.002)
Unknown / None.edu	.014 (.017)	.012 (.016)	.002 (.002)
observations	361	361	361
Adjusted-R^2	0.697	0.694	0.507

The unemployment rate and the dependent variable as well as other variables included are scaled within the range from 0.0 to 1.0. The time and county fixed-effects are included, but not reported. Standard errors in parentheses. **p<0.1, **p<0.05, ***p<0.01*

7 Conclusions and remarks

The main attempts of this study are to find whether the total mortality rate increases when the unemployment rate decreases in Norway and if so, whether the traffic accident is the dominant reason for this increase. We found that the total mortality rate increases among the senior population (age group 3) when the unemployment rate decreases. However, we did not find this association among young and working-age populations (age groups 1 and 2).

Furthermore, we found that both injured and dead traffic victims increase when the unemployment rate decreases in Norway, even though the magnitude of the increases are relatively small. Our result shows that traffic death can explain at maximum 32% of the increase in the total death for senior population when the unemployment rate decreases by 1%. However, this result is conditional to an optimistic assumption that all of the expected increases in dead traffic victims are those who are senior. It means that, in reality, the portion that traffic accident can explain about the increase in the total death for senior population must be lower than 32%. Therefore, we conclude that the traffic accident can be one of the factors which increase the total mortality rate for senior population when the unemployment rate decreases in Norway, but it is not a dominant factor for this increase. These results suggest that association between the mortality rate and unemployment rate for senior individuals is driven mainly by the other factors than traffic accidents. Therefore, the factor which actually drives this association for senior individuals in Norway is still unclear and is left for future analysis. In addition, our results do not tell why the traffic accident increases in economic upturns. Therefore, investigating the potential mechanism for this in more detail may be also interesting topic for future analysis.

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Source of Data

Norwegian Social Science Data Service

Statistics Norway

Organization for Economic Co-operation and Development

Appendix

Appendix 1.

Summary statistics

Table A. Summary statistics for dependent and independent variables as well as the number of total death for each age group and traffic victims.

	Mean	**Standard deviation**
The number of death and traffic victims		
Number of death (age group 1)	30.43	16.29
Number of death (age group 2)	457.70	240.90
Number of death (age group 3)	1828.55	951.21
Number of total traffic victims	616.36	291.91
Number of injured traffic victims	597.84	288.37
Number of dead traffic victims	51.44	155.59
Population		
Population (age group 1)	47414.52	22463.21
Population (age group 2)	144922.4	73194.56
Population (age group 2)	31234.42	15733.14
Total population	223571.3	109176.2
Dependent variables		
Total mortality rate (age group 1)	.0006755	.0002054
Total mortality rate (age group 2)	.0032942	.0006009
Total mortality rate (age group 3)	.0587673	.0032653
Rate of total traffic victims	.0028462	.0004555
Rate of injured traffic victims	.0027496	.0004436
Rate of dead traffic victims	.0000966	.0000413
Rate of total automobile victims	.0019402	.0003872
Rate of automobile driver victims	.0010951	.0002541
Rate of automobile passenger victims	.0008451	.0001972
Rate of motorcycle traffic victims	.0001671	.0000635
Rate of moped traffic victims	.0001833	.0000885
Rate of cycle traffic victims	.0002147	.0000832
Rate of pedestrian traffic victims	.000298	.0001228
Rate of ski traffic victims	.0000214	.0000245
Rate of other traffic victims	.0000211	.0000181
Proxy of macroeconomic condition		
Unemployment rate	.0238781	.0126511
Socioeconomic factors **Ethnic background**		
Rate of natives (age group 1)	.9731377	.0230462
Rate of total immigrants (age group 1)	.0268623	.0230462
Rate of natives (age group 2)	.9707261	.0196825
Rate of total immigrants (age group 2)	.0292739	.0196825
Rate of natives (age group 3)	.992533	.0064458

Rate of total immigrants (age group 3)	.007467	.0064458
Rate of immigrants from Europe (age group 1)	.0143541	.0078322
Rate of immigrants from Africa (age group 1)	.0015088	.0031191
Rate of immigrants from Asia (age group 1)	.0081277	.0123547
Rate of immigrants from America (age group 1)	.0026369	.0022822
Rate of immigrants from Oceania (age group 1)	.0000734	.0000696
Rate of immigrants from Europe (age group 2)	.0184076	.0100929
Rate of immigrants from Africa (age group 2)	.0013613	.0020962
Rate of immigrants from Asia (age group 2)	.0059186	.0066211
Rate of immigrants from America (age group 2)	.0033795	.0031135
Rate of immigrants from Oceania (age group 2)	.0001658	.0001022
Rate of immigrants from Europe (age group 3)	.0033858	.0023102
Rate of immigrants from Africa (age group 3)	.0000252	.0000591
Rate of immigrants from Asia (age group 3)	.0003203	.0005159
Rate of immigrants from America (age group 3)	.003654	.0055247
Rate of immigrants from Oceania (age group 3)	.000023	.0000358
Marital status		
Rate of married	.5288355	.0546955
Rate of all types of singles	.4711645	.0546955
Rate of never married	.3226046	.042358
Rate of widow/widower	.0822588	.0084792
Rate of divorced	.0513598	.0197511
Rate of separated	.0150647	.0035993
Education level		
Rate of lower secondary	.4275978	.0690651
Rate of upper secondary	.4192201	.0370983
Rate of higher education (≤4 years)	.111381	.032634
Rate of higher education (>4 years)	.026554	.0137977
Rate of unknown/none education	.0152464	.0071895
Rate of lower secondary (age group 2)	.3845755	.067864
Rate of upper secondary (age group 2)	.4433598	.0374301
Rate of higher education (≤4 years) (age group 2)	.1266964	.0363485
Rate of higher education (>4 years) (age group 2)	.0291777	.0147699
Rate of unknown/none education (age group 2)	.0161906	.0080962
Rate of lower secondary (age group 3)	.6232586	.0900127
Rate of upper secondary (age group 3)	.3091829	.0633419
Rate of higher education (≤4 years) (age group 3)	.0420147	.0183837
Rate of higher education (>4 years) (age group 3)	.0145099	.0108344
Rate of unknown/none education (age group 3)	.0110338	.005309

N=361. The variables are scaled within the range from 0.0 to 1.0.
Age groups 1 to 3 are for the ranges from age 0 to 15, from age 16 to 66 and over age 67, respectively.
Since our main discussion is based on the specification (4) where the data are from 1980 to 1998, the mean and standard error for each variable is given within the period from 1980 to 1998 for the ease of interpretation.

Appendix 2.

Result of OLS estimation to investigate if income variable is relevant to this model.

Table B. Result of OLS estimation in specification (4) where income is included in (1) and excluded in (2) for each age group. (1993-1998)

	Age group1 (age 0-15)		Age group2 (age 16-66)		Age group3 (age 67-)	
	(1)	(2)	(1)	(2)	(1)	(2)
Unemployrate	-.001 (.006)	-.002 (.006)	.003 (.009)	.003 (.009)	.088 (.096)	.078 (.096)
Income	.0005 (.0006)		.0005 (.0008)		.012 (.009)	
Z; age distribution, (age of 0-6=ref), (age of 16-25=ref), (age of 67-70=ref), respectively						
age7-15, age26-35, age71-75	.0003 (.005)	-.0001 (.005)	-.017 (.018)	-.019 (.017)	.007 (.079)	.004 (.080)
age36-45, age76-80			-.047** (.020)	-.049** (.020)	.009 (.112)	.020 (.112)
age46-55, age81-			-.015 (.026)	-.022 (.023)	-.132 (.116)	-.147 (.117)
age56-66			.016 (.028)	.011 (.026)		
X_1; ethnic background (natives=ref)						
Europe	-.002 (.011)	-.0004 (.011)	-.0008 (.034)	-.002 (.034)	-.763 (.908)	-.520 (.897)
Africa	.004 (.036)	-.001 (.036)	.031 (.092)	.022 (.091)	-13.0 (12.0)	-15.3 (12.0)
Asia	.015* (.009)	.016* (.009)	-.020 (.035)	-.019 (.035)	3.19 (2.37)	2.43 (2.32)
America	-.009 (.024)	-.006 (.024)	-.006 (.079)	.013 (.073)	-1.76 (1.36)	-1.76 (1.37)
Oceania	-.075 (.470)	-.065 (.469)	-.196 (.801)	-.200 (.798)	-24.8* (14.5)	-26.2* (14.5)
X_2; marital status (married=ref)						
Never.married	.006 (.010)	.008 (.010)	.016 (.024)	.014 (.023)	.008 (.196)	.053 (.194)
Widow/Widower	-.010 (.024)	-.007 (.024)	.061* (.036)	.066* (.034)	.014 (.413)	-.007 (.416)
Divorced	.005 (.021)	.006 (.021)	-.002 (.034)	-.004 (.034)	.295 (.325)	.234 (.324)
Separated	.017 (.042)	.017 (.042)	-.029 (.056)	-.028 (.056)	.377 (.537)	.371 (.541)
X_3; education level (low.sec=ref)						
Upper.sec	-.00007 (.008)	-.002 (.007)	-.012 (.012)	-.011 (.025)	-.002 (.114)	.003 (.115)
Higher.edu(≤4years)	.002 (.020)	.002 (.020)	-.022 (.027)	-.021 (.026)	.573 (.267)	.597** (.269)
Higher.edu(>4years)	-.002 (.025)	.0009 (.024)	.003 (.030)	.003 (.030)	-1.12 (.531)	-1.03* (.531)
Unknown / None.edu	.031 (.023)	.030 (.023)	.004 (.034)	.006 (.034)	-.453 (.608)	-.505 (.611)
observations	114	114	114	114	114	114
Adjusted-R^2	0.416	0.417	0.817	0.819	0.749	0.746

The unemployment rate and the dependent variable as well as other variables included are scaled within the range from 0.0 to 1.0. Time and county fixed-effects are included, but not reported. Standard errors in parentheses. **p<0.1, **p<0.05, ***p<0.01*

The results including income in Table B show that none of the coefficients of income are significant for all age groups. It suggests that income is not an important determinant of the mortality rate among all age groups for the estimated period from 1993 to 1998. However, note that the coefficient of the unemployment rate is also insignificant for all age groups in the results both including and excluding income. The coefficient of the unemployment rate was insignificant for age groups 1 and 2 in tables 5-1 and 5-2 where the period was from 1977 to 1998. On the other hand, the coefficient of the unemployment rate was significant for age group 3 in table 5-3 where the period was also from 1977 to 1998. The significant coefficient of the unemployment rate for age group 3 in the period from 1977 to 1998 turns out to be insignificant in the shorter period from 1993 to 1998. It means that the significance of the unemployment rate disappears due to the shortage of the estimated period. Therefore, it suggests that insignificant effect of income on the mortality rate in table B may be also due to the shortage of the estimated period. In other words, the income may show the significant effect on the mortality rate when we extend the period of the estimation. However, based on the results estimated by the available data of income, we conclude that the income is not an important determinant of the mortality rate for all age groups in Norway. Therefore, we do not need to include the income in the estimation.

Appendix 3.

Estimation with spending variables

Our main interest is the expenditure on transports and infrastructures, since higher expenditure on transports and infrastructures could reduce the traffic victims. Therefore we examine if the expenditure related to transports and infrastructures at each county has impact on the rate of traffic victims. Data of expenditure based on purpose at each county are available from NSD. Detailed description about the data of expenditure, see Fiva et al. (2010).

For the estimation of traffic accidents where the dependent variable is the rate of traffic victims, Y_{ct}^{T}, I extend the estimation including the spending variables related to transports and infrastructures at each county.

$$Y_{ct}^{T} = \alpha + \beta_1 unemploymentrate_{ct} + \rho Z_{ct} + \delta X_{ct} + \eta transport_{ct} + \lambda_t + \gamma_c + \varepsilon_{ct} \qquad (5)$$

transport is a spending variables related to transports and infrastructure at each county, while η is the vector of coefficients for this spending variables. X is a vector of control variables and δ is a matrix of coefficients. Other notations stay same as in chapter 4.

According to the result in tables C and D, all the coefficients of this spending variable are insignificant except for the victims of cycle. However we conclude that this spending variable does not have significant impact on the traffic victims, and thus, including this expenditure variable does not improve this study. In addition, this spending variable can be potentially endogenous, since expenditure at each county may be correlated to other factors. Therefore, it is also not obvious if we should control for this variable in the estimation. It implies that the result by including this variable in OLS may not be also reliable. Due to this concern and no evidence of significant impact of transport expenditure on the rate of traffic victims, the analysis including expenditure variable related to transports and infrastructures are excluded from both results and discussions.

Table C. Result of OLS estimation in specifications (3) and (4) for the relation between the unemployment rate and the rate of traffic victims such as total, injured and dead victims, where spending variable is included. (1980-1998)

	Total victims		Injured victims		Dead victims	
	(1)	(2)	(1)	(2)	(1)	(2)
Unemployrate	-.010** (.004)	-.009** (.005)	-.010** (.004)	-.008* (.005)	-.0005 (.0005)	-.0008 (.0005)
Transport	.00002 (.00006)	.0000003 (.00006)	.00002 (.00006)	-.0000003 (.00006)	-.000001 (.000008)	.0000006 (.000008)
Z; age distribution (age of 0-6 = ref)						
age7-15	-.030** (.014)	-.030* (.015)	-.031** (.013)	-.031** (.015)	.001 (.001)	.002 (.002)
age16-25	-.023* (.012)	-.021 (.014)	-.024** (.012)	-.022 (.014)	.0008 (.001)	.001 (.002)
age26-35	-.030 (.018)	-.022 (.020)	-.030* (.018)	-.022 (.020)	.00006 (.002)	-.0001 (.003)
age36-45	-.001 (.014)	.015 (.017)	-.001 (.014)	.016 (.016)	-.00004 (.002)	-.0009 (.002)
age46-55	.0006 (.015)	.004 (.015)	.0009 (.014)	.005 (.015)	-.0002 (.002)	-.001 (.002)
age56-66	-.033** (.014)	-.029* (.016)	-.034** (.014)	-.031** (.015)	.001 (.002)	.001 (.002)
age67-70	-.027 (.020)	-.026 (.022)	-.030 (.019)	-.030 (.021)	.003 (.002)	.004* (.003)
age71-75	-.037 (.021)	-.011 (.022)	-.001 (.021)	-.012 (.022)	-.001 (.003)	.0001 (.003)
age76-80	-.022 (.022)	-.034 (.023)	-.018 (.022)	-.030 (.023)	-.004 (.003)	-.003 (.003)
age81-	.010 (.025)	-.008 (.026)	.010 (.024)	-.010 (.026)	.0002 (.003)	.002 (.003)
X_1; ethnic background (natives=ref)						
Totalimmigrants	-.0005 (.007)		-.0004 (.007)		-.00006 (.0008)	
Europe		.007 (.017)		.010 (.017)		-.003 (.002)
Africa		.046 (.048)		.042 (.047)		.004 (.006)
Asia		-.015 (.012)		-.0164 (.012)		.0005 (.001)
America		.040 (.029)		.043 (.029)		-.003 (.004)
Oceania		-.671 (.667)		-.712 (.653)		.041 (.082)
X_2; marital status (married=ref)						
Total.singles	-.011** (.005)		-.012** (.005)		.001* (.0006)	
Never.married		-.019*** (.006)		-.020*** (.006)		.002** (.0007)
Widow/Widower		.005 (.020)		.007 (.019)		-.002 (.002)
Divorced		.009 (.010)		.009 (.010)		.0005 (.001)
Separated		-.036 (.027)		-.041 (.027)		.004 (.003)
X_3; education level (low.sec=ref)						
Upper.sec	-.0008 (.003)	-.0004 (.003)	-.001 (.002)	-.0008 (.003)	.0002 (.0003)	.0004 (.0003)
Higher.edu(≤4years)	.007 (.008)	.003 (.008)	.008 (.007)	.003 (.009)	-.0007 (.0009)	-.0004 (.001)
Higher.edu(>4years)	-.004 (.012)	.003 (.016)	-.005 (.012)	.002 (.016)	.002 (.001)	.0006 (.002)
Unknown / None.edu	.010 (.012)	.006 (.016)	.010 (.012)	.005 (.016)	.0001 (.001)	.002 (.002)
observations	361	361	361	361	361	361
Adjusted-R^2	0.699	0.701	0.694	0.698	0.507	0.506

The unemployment rate and the dependent variable as well as control variables included are scaled within the range from 0.0 to 1.0. Time and county fixed-effects are included, but not reported. Standard errors in parentheses. **p<0.1, **p<0.05, ***p<0.01*

Table D. Result of OLS estimation in specification (4) for the relation between the unemployment rate and the rate of traffic victims according to the type of transportations where a spending variable is included. (1980-1998)

	Automobile								
	total	driver	pass	motcycl	moped	Cycle	pedestr	Ski	others
Unemployrate	-.007*	-.003	-.004*	.0006	-.001*	.0002	-.0005	-.0003	-.0006**
	(.004)	(.002)	(.002)	(.0008)	(.0008)	(.0008)	(.0008)	(.0003)	(.0003)
Transport	.00002	.002	.000005	-.000004	.000005	-.00002*	-.000003	-.0000004	.0000008
	(.00005)	(.00003)	(.00003)	(.00001)	(.00001)	(.00001)	(.00001)	(.000003)	(.000004)
Z; age distribution (age of 0-6 = ref)									
age7-15	-.015	-.006	-.008	-.003	-.005**	-.003	-.003	-.001	-.0006
	(.013)	(.007)	(.007)	(.003)	(.003)	(.003)	(.003)	(.0009)	(.0009)
age16-25	-.011	-.003	-.009	.0007	-.004*	-.002	-.003	-.001*	-.0003
	(.012)	(.006)	(.007)	(.002)	(.002)	(.002)	(.002)	(.0008)	(.0009)
age26-35	-.002	.002	-.004	-.005	-.006*	-.003	-.004	-.002*	-.001
	(.017)	(.009)	(.010)	(.004)	(.004)	(.004)	(.004)	(.001)	(.001)
age36-45	.020	.016**	.004	-.005	.002	.004	-.002	-.001	-.002
	(.014)	(.008)	(.008)	(.003)	(.003)	(.003)	(.003)	(.001)	(.001)
age46-55	.012	.011	.0009	-.004	.002	.0005	-.003	-.001	-.002**
	(.013)	(.007)	(.008)	(.003)	(.003)	(.003)	(.003)	(.0009)	(.001)
age56-66	-.015	-.005	-.010	-.002	-.005*	-.003	-.003	-.002**	-.0007
	(.013)	(.007)	(.008)	(.003)	(.003)	(.003)	(.003)	(.0009)	(.0009)
age67-70	-.007	-.001	-.006	-.010**	-.006	.00004	-.001	-.002	-.0009
	(.018)	(.010)	(.011)	(.004)	(.004)	(.004)	(.004)	(.001)	(.001)
age71-75	.012	.007	.005	-.006	-.009**	-.0009	-.006	-.003**	.001
	(.019)	(.010)	(.011)	(.004)	(.004)	(.004)	(.004)	(.001)	(.001)
age76-80	-.009	-.004	-.006	-.003	-.008**	-.007	-.006	-.0003	.0005
	(.012)	(.011)	(.012)	(.004)	(.004)	(.004)	(.004)	(.001)	(.001)
age81-	-.002	-.005	.002	-.0003	-.002	-.0009	-.002	.001	-.002
	(.022)	(.012)	(.013)	(.005)	(.004)	(.005)	(.005)	(.002)	(.002)
X_1; ethnic background (natives=ref)									
Europe	.004	.009	-.005	.002	.003	-.002	.002	-.0009	-.001
	(.014)	(.008)	(.009)	(.003)	(.003)	(.003)	(.003)	(.0009)	(.001)
Africa	.030	.020	.010	-.002	.004	.024***	-.007	-.004	.0005
	(.040)	(.022)	(.024)	(.009)	(.008)	(.008)	(.009)	(.003)	(.003)
Asia	-.015	-.008	-.007	.0006	-.002	-.0002	-.0007	.0004	.0007
	(.010)	(.006)	(.006)	(.002)	(.002)	(.002)	(.002)	(.0007)	(.0007)
America	.040	.031	.010	-.008	.004	.007	-.005	-.0007	.002
	(.024)	(.013)	(.014)	(.005)	(.005)	(.005)	(.005)	(.002)	(.002)
Oceania	-.419	-.188	-.230	.115	-.294**	-.045	-.037	.014	-.005
	(.556)	(.306)	(.331)	(.120)	(.115)	(.117)	(.119)	(.039)	(.042)
X_2; marital status (married=ref)									
Never. married	-.013**	-.008***	-.004	-.001	-.003***	-.0003	-.0002	-.0007*	-.0002
	(.005)	(.003)	(.003)	(.001)	(.001)	(.001)	(.001)	(.0004)	(.0004)
Widow/ Widower	-.007	-.0003	-.007	.008**	.002	-.002	.008**	-.0007	-.004***
	(.016)	(.009)	(.010)	(.004)	(.003)	(.003)	(.003)	(.001)	(.001)
Divorced	.012	.011**	.001	-.002	-.001	.0007	.0006	-.0006	.0006
	(.009)	(.005)	(.005)	(.002)	(.002)	(.002)	(.002)	(.0006)	(.0006)
Separated	-.022	-.015	-.008	-.006	-.011**	-.004	.003	-.0004	.003
	(.023)	(.013)	(.014)	(.005)	(.005)	(.005)	(.005)	(.002)	(.002)
X_3; education level (low.sec=ref)									
Upper.sec	-.0004	.0005	-.0009	.0007	-.0001	-.0004	-.0004	-.0003**	.0005***
	(.002)	(.001)	(.001)	(.0005)	(.0005)	(.0004)	(.0004)	(.0001)	(.0002)
Higher.edu (≤4years)	.004	.0007	.003	.003	-.003**	-.001	.002	-.0002	-.0006
	(.007)	(.004)	(.004)	(.002)	(.001)	(.002)	(.002)	(.0005)	(.0005)
Higher.edu (>4years)	-.002	.002	-.004	.002	.005*	-.001	-.001	.0004	.0002
	(.013)	(.007)	(.008)	(.003)	(.003)	(.003)	(.003)	(.0009)	(.0009)
Unknown/ None.edu	.002	-.0008	.003	.006**	-.0003	-.002	-.0004	.0004	.0006
	(.013)	(.007)	(.008)	(.003)	(.003)	(.003)	(.003)	(.0009)	(.001)
observation	361	361	361	361	361	361	361	361	361
Adjusted-R^2	0.748	0.831	0.614	0.536	0.784	0.766	0.858	0.577	0.403

The unemployment rate and the dependent variable as well as control variables included are scaled within the range from 0.0 to 1.0. Time and county fixed-effects are included, but not reported. Standard errors in parentheses. **p<0.1, **p<0.05, ***p<0.01*