

Changing Relationship between Unemployment and Mortality in South Korea: 1989-2012¹

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Abstract

This study provides the first evidence on the effect of business cycle on health in South Korea that is comparable to the growing international literature. Mortality changes in South Korea were generally pro-cyclical between 1989 and 2012, as suggested by other studies. For the period between 2001 and 2012, however, a strong positive relationship between unemployment and mortality emerges. The positive effect of unemployment on mortality in recent years is strongly revealed only for individuals with low educational attainment. Cancers and diseases of the digestive system played particularly important roles in changing the direction of the effect of unemployment on mortality. We hypothesize that positive income effects of economic prosperity became strong enough to dominate negative influences of booms during the 2000s. We provide evidence suggesting that the extended protection of the National Health Insurance during the 2000s was one of the contributing factors. This study suggests that the relationship between business cycle and health may differ across times and places, depending on institutional and environmental factors that are related to the relative strength of positive and negative influences of economic booms.

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1. Introduction

Growing evidence suggests that mortality rates decline during economic downturns. A number of studies find that changes in various health outcomes in the U.S. are counter-cyclical (Ruhm 2000, 2004, 2007; Dehejia and Lleras-Muney 2004; Miller et al. 2009). Similar relationships between health and economic fluctuations are observed in other countries, too (Neumayer 2004; Tapia Granados 2005; Gerdtham and Ruhm 2006; Lin 2009). The deterioration in health in times of low unemployment has largely been attributed to behavioral changes of individuals in response to increased opportunity cost of time (e.g. decrease in physical exercise and increase in smoking) and negative external effects (e.g. rise of pollution and decline in the quality of health care) generated by economic booms (Ruhm 2000, 2003; Miller et al. 2009; Stevens et al. 2011).

Even with the voluminous literature on the topic, it is not entirely clear whether the pro-cyclical change in mortality is a general phenomenon or is peculiar to particular times and countries. It was recently revealed that the relationship between elderly mortality and unemployment turned to positive after mid 1990s (McInerney and Jennifer Mellor 2012; Ruhm 2013). The effect of business cycle on health might differ across countries depending on social, economic, political, and institutional characteristics. Evidence from additional countries and comparisons across times can deepen our understanding of the subject.

In this study, we contribute to the existing literature by providing the first evidence on the effect of business cycle on health in South Korea that is comparable to the widely-cited studies based on U.S. and European data. More specifically, we estimate how the unemployment rates affect the all-cause and cause-specific mortality rates from 1989 to 2012 applying the widely-used fixed effect model with region-specific time trend to the province-level data. We also investigate how the relationship between unemployment and mortality changed across times. We will suggest below that mortality changes in South Korea were generally pro-cyclical, as suggested by other studies, if the entire period or the period prior to 2001 is concerned. For the period between 2001 and 2012, however, a strong positive relationship between unemployment and mortality emerges.

Finally, we attempt to explain why the direction of influences of business cycle on health changed. We hypothesize that the favorable income effects of economic booms became strong enough to dominate the negative influences during the 2000s. We suggest that a series of government policies that extended the coverage of the National Health Insurance

for low-income people during the 2000s is one of possible factors that made the change. As medical treatments for serious diseases became more affordable for low-income individuals, earning changes became increasingly important in determining the medical utilization during the 2000s. Consistent with the hypothesis, the change in the relationship between unemployment and mortality between the 1990s and the 2000s is larger for the diseases with a greater increase in the medical expenditure per patient between 2000 and 2011.

2. Previous Studies

In his pioneering research on the subject, Ruhm (2000) finds that mortality is negatively related to state-level unemployment rate in the United States from 1972 to 1991. The results of estimating a state fixed effect model suggest that a one percentage point increase in unemployment rate is associated with 0.54% decline in the crude death rates. The negative effect of unemployment on mortality is more strongly revealed for younger adults aged 20 to 44, and for several causes of death including traffic accident, homicide, cardiovascular diseases, respiratory diseases, and liver diseases.

Subsequent studies conducted based upon US data provide similar results, confirming the negative relationship between unemployment and health. Utilizing the National Health Interview Survey for the period 1972 to 1981, Ruhm (2003) reports that changes in a variety of health measures are counter-cyclical. Dehejia and Lleras-Muney (2004) find that babies conceived in times of high unemployment rate have better health outcomes at birth, which is attributable both to selection and to improvements in health behavior during recessions. Ruhm (2007) finds that an a one percentage point increase in unemployment rate leads to 0.75% decline in the rate of mortality caused by coronary heart diseases. A replication of the original analysis of Ruhm (2000) using US state-level data extended to 2004 provides a similar result (Miller et al. 2009).

Pro-cyclical changes in mortality have been found in other countries and cross-country comparisons, too. Neumayer (2004) reports that mortality rates for all age groups as well as specific age groups were lower in recession based on German state-level data from 1980 to 2000. Tapia Granados (2005) finds that unemployment has negative effect on mortality rates of the Spanish provinces from 1980 to 1997. Based upon analyzing OECD cross-country data from 1960 to 1997, Gerdtham and Ruhm (2006) provide that a rise of unemployment by one percentage point results in a fall in crude death rate by 0.4%.

A primary explanation for the pro-cyclical changes in mortality is behavioral changes of individuals in response to increased opportunity cost of time during economic booms. In support of this hypothesis, a number of studies find that during economic booms tobacco consumptions and obesity increase whereas physical exercise and the number of physician visits decreases (Ruhm 2000, 2005; Xu and Kaestner 2010). Another possible mechanism is negative external effects of economic booms, such as accidents, pollution, and tighter labor market. The result of Miller et al. (2009) that cyclical deaths are concentrated outside of typical working ages highlights the importance of business cycle externalities. Stevens et al. (2011) suggest that cyclical fluctuations in the mortality rate in the U.S. are largely driven by fluctuations in the quality of health care.²

Even with the growing body of research on the topic, it still remains less clear whether the pro-cyclical change in mortality is a general phenomenon or is peculiar to particular times or countries. Existing evidence as to mortality has largely been drawn from the United States and European nations from the early 1970s to the early 1990s.³ A recent study by Melissa McInerney and Jennifer Mellor (2012) finds that elderly mortality is countercyclical during the period from 1994 to 2008. The study also discovers from the Medicare Current Beneficiary Survey that during recession seniors report worse mental health and are no more likely to engage in healthier behaviors. Ruhm (2013) reports that total mortality in the U.S. has shifted over the 1976-2009 period from strongly procyclical to being essentially unrelated to macroeconomic conditions. These results suggest that the relationship between unemployment and health might change across times.

Similarly, the effect of business cycle on health could differ across countries depending on social, economic, political, and institutional characteristics. Even among relatively homogenous rich OECD countries, some minor disparities across nations emerge. For example, Gerdtham and Ruhm (2006) suggest that the negative relationship between unemployment and health is more strongly present in the nations with weaker social insurance programs.

The relationship between business cycle and health in individual countries outside

² This study finds that cyclicity of mortality among the elderly is especially strong for deaths occurring in nursing homes, and demonstrates that staffing in nursing facilities moves countercyclically.

³ Fishback et al. (2007) report that mortality rates in the 114 US cities were negatively related to unemployment rates during the 1930s.

Europe and North America is much less studied. Based on country-level data from eight Asia-Pacific nations from 1976 to 2003, Lin (2009) finds that unemployment rate is negatively and significantly correlated with mortality. Lee and Kim (2011), published in Korean, provide the first evidence that the mortality rates in South Korea are negatively related to unemployment rate, using province-level data. Results of analyzing age- and cause-specific mortality rates suggest that the link between the unemployment rate and health might be mediated by both external effects and behavioral changes produced by business.

Our study provides the first evidence on the relationship between business cycle and health South Korea that is comparable to the major works of its kind in terms of the methods, and one of rare studies on the issue based on data from an Asian country.⁴ To our knowledge, this is one of very few attempts to offer not only the evidence on changing relationship between unemployment and mortality but also explanations for the change.

3. Data and Methods

In this paper we investigate the causal relationship between unemployment rates and mortality. Following Ruhm (2000), we set the basic specification as the following:

$$(1) \quad H_{jt} = X_{jt}\beta + E_{jt}\gamma + \alpha_t + R_j + RT_jt + \varepsilon_{jt}$$

H denotes the natural logarithm of the mortality rate in region j and time t , E unemployment rates and X supplementary regressors. Both time effects (α_t) and time-invariant regional effects (R_j) are included in order to control the fixed effects. To control the time trend that varies across the regions we also added the region-specific trend term, RT_jt . Occasionally, we report regression results in which region-specific trends are not included for comparison. Additional regressors consist of the percentage of the population according to three age categories [1) less than 5, 2) between 5-29, 3) 65 or over] and three educational categories [among the population aged 30 or more: 1) with less than a high school degree, 2)

⁴ This paper is distinct from the previous work (published in Korean) by one of the authors (Lee and Kim 2011) in several major aspects. First, province-specific time trend is controlled and all standard errors are adjusted for clustering in this paper, as in other major works of its kind on other countries (e.g. Ruhm 2000). Second, we extend the period under study from the period 1991-2009 to the years from 1989 to 2012. Finally, we investigate how the relationship between the unemployment rate and health changed over time and explain why the cyclicity of mortality changed utilizing addition data drawn from the National Health Insurance.

with some college education, 3) with a college degree or more]. Observations are weighted by the population for the corresponding region and year. Sometimes we employ alternative dependent variables of interest. We report clustered robust standard errors because our specification is two-way panel data model. Stock and Watson (2008) show conventional robust errors are inconsistent for the variance matrix in panel data model, while clustered errors yield the consistent estimator for it.

We have obtained most data required for computing the mortality and unemployment rates from *Korea Statistical Information Service* by *Statistics Korea* (KOSTAT)⁵. Sources of the data are as follows: The total or age-specific death data come from the *Current Population Survey* and the cause-specific death data were from the *Cause of Death Statistics*. Both data were originally collated from information recorded in death registration records. The population for each year was obtained from the *Population Projection of Korea* and unemployment rates from the *Economically-active Population Survey*. The variables regarding age-specific and cause-specific death and education that were unobtainable from the Korea Statistical Information Service data were generated using the micro data from the 1991-2011 *Cause of Death Statistics* and the 2% micro samples of the 1990-2010 censuses. The micro data from the *Cause of Death Statistics* are accessible in every year, whereas the micro data on census are only available every 5 year. Educational variables are interpolated or extrapolated for the years in which the census was not conducted. Since the regional unemployment rates are obtainable only for the years from 1989 and the micro data from the *Cause of Death Statistics* are available from 1991, the range of analyses varies from 1989 or 1991 to 2011 or 2012, depending on the purpose of analysis.

The medical expenses and the number of patients for each disease were drawn from the 2000-2011 National Health Insurance Statistical Year Book provided by the National Health Insurance Service and the Health Insurance Review & Assessment Service.⁶ The province-level cancer incidence data for each type of cancer in 2002-2010 were obtained from the Annual Report of Cancer Statistics.

4. Unemployment and Mortality in South Korea

⁵ The URL of *Korea Statistical Information Service*: <http://www.kosis.kr>

⁶ These sources provide the total medical care cost, the cost paid by the insurer, and the number of patients for 298 diseases.

Firstly we focus on the effects of unemployment on mortality. Table 1 shows that the relationship between unemployment and mortality in the entire period 1989-2012 is negative, as found in the majority of previous studies, but regression coefficient is marginally insignificant (p-value = 0.120). If we shorten the period of interest to 1991-2009, the effect of unemployment on mortality becomes significant, confirming the result of Lee and Kim (2011). The result for the extended period, however, demonstrates the pro-cyclical connection between recession and mortality that has been repeatedly confirmed by previous is relatively weak in South Korea.

We investigate if the effect of unemployment on mortality changed over time, by conducting the regression for every 10-year interval from 1989 to 2012. Figure 1 presents the regression coefficient on unemployment for each beginning year of the 10-year span. The regression coefficient gradually increased over the 1990s and then sharply rose in the early 2000s. This suggests the relationship between unemployment and mortality radically differ between the first and second half of the 24 years under investigation.

Motivated by the changing pattern of cyclicity of mortality change, we conduct regression analysis separately for each of the two sub-periods, 1989-2001 and 2002-2012. The regression results (Columns 3 and 4) show that mortality change turned from pro-cyclical to counter-cyclical between the latter periods. In 1989-2001 unemployment *decreased* mortality but its effect was statistically insignificant, whereas unemployment significantly *increased* mortality in 2002-2012.⁷

Table 2 shows varying effects of unemployment on the mortality among different gender and age groups. First, the effect of unemployment is stronger for females than for males. Considering the relatively low female labor force participation rate in Korea (49.9% in 2012), the result implies that the changing effect may not have directly come from the changes in individuals' labor-market conditions. Secondly, if age-specific mortality is concerned, the effect of business cycle is insignificant for persons aged 20-44 as a whole; and the sign of coefficient is negative for the females and positive for males. Lastly, the effect of unemployment is generally strong for the population aged 65 or older, although it marginally misses statistical significance for older males. In addition to that, the regression coefficient is relatively large for females aged 45 to 64. These results imply that recent Korea has similar

⁷ We also examine the relationship between the natural logarithm of unemployment rates and the log of mortality rates (Appendix Table 1). The results are robust to the alternative specifications.

pattern to the United States since the mid-1990s: for example, McInerney and Mellor (2012) find counter-cyclical pattern of mortality among the elderly people in the United States.

Mortality data do not provide personal wealth of the deceased. Educational attainment of the dead, however, provides indirect evidence as to whether the poor have been more affected by business cycle, since less educated people tend to be poorer. Table 3 presents different effects of unemployment by educational attainment. In identifying varying effects by educational attainment, the age effect should be taken into consideration because older people tend to be less educated. We limit the sample to the population aged 45 and older to control the age effect at least partially. The result reported in Table 3 clearly shows that the effect of unemployment is strongly revealed only for individuals with high school education or less. The result remains unchanged if males and females are considered separately.

Examination of the effects of unemployment on the cause-specific mortality may help us with identifying what explains the turn around. Table 4 shows the relationship between unemployment and cause-specific mortality in two sub-periods. Causes of death are divided according to the *Korean Standard Classification of Diseases* (KCD), which is comparable to the 10th revision of the *International Classification of Diseases* (ICD-10). The results reported in Table 4 show that cancer and diseases of digestive system played particularly important roles in changing the direction of the effect of unemployment on mortality. Only the cancer-caused mortality changed from significantly counter-cyclical in 1989-2001 to significantly pro-cyclical in 2002-2012. In the case of diseases of digestive system, the effect of unemployment was insignificant in the first half of the period under study, and became significantly positive in the second half.⁸

5. Explaining the Counter-Cyclical Mortality in Recent Years

Economic prosperity per se, even if temporary, could be beneficial for health. For example, increased earnings would allow sick persons to receive better medical treatments. In

⁸ It appears that counter-cyclical changes in cancer mortality between 2002 and 2010 were produced largely by fluctuations in case fatality, not by changes in the number of cancer patients. The unemployment had no significant effect on the number of cancer patients, and its coefficient is negative if region-specific time trend is not included (Column 1 of Appendix Table 2). Although the effect of the unemployment rate on the cancer case fatality marginally misses statistical significance (Column 2 of Appendix Table 2), it is apparent it is the more important contributing factor of the pro-cyclical cancer mortality. Thanks to the Cancer Registration Data, cancer is the only disease category for which the accurate number of patients can be calculated. Thus, this exercise is limited to cancers.

this sense, the pro-cyclical mortality might imply that adverse influences of economic booms (such as more work-related stress, less healthy behaviors, and deteriorated quality of health care) dominate positive effects (such as decline in unemployment and rise in earnings).

Thus, a possible explanation for the turnaround in the relationship between unemployment and mortality is that the potential positive effects of prosperous business conditions became strong enough to dominate the negative influences of economic booms over the 2000s. The result of the preceding section suggests that the “income effect” of economic prosperity became particularly powerful for lower-class persons (Table 3) and cancer patients (Table 4).

Did South Korea experience any changes between the 1990s and 2000s that would strengthen the income effect of business cycle on health? A possible candidate is a series of policy reforms in the 2000s that extended the protection of National Health Insurance to low-income individuals. In 2000, for example, the government began to subsidize out-of-pocket (OOP) payment that exceeds a certain amount, and reduced the ceiling in 2004, 2007, and 2009.⁹ In 2005, the government radically extended the insurance coverage for serious diseases, including major cancers, requiring huge medical expenses. Recent studies show that these policy measures contributed to substantial increase in medical utilizations of low-income people in Korea (Lee, Yun, and Hong 2013; Lee et al. 2013).

Prior to 2000, many of low-income people with serious diseases, such as cancers, perhaps could not afford to receive high-quality medical services because of the prohibitively high OOP expenses. Under the circumstance, modest fluctuations in earnings would not affect the medical utilizations of poorer persons. However, as the insurance coverage and government subsidy for expensive medical treatments increased during the 2000s, individuals who can pay the upper limit of OOP payments (for example, 3 million won or about 2800 dollars per six month in 2004 and 2 million won in 2007) have better access to medical services. Since the ceiling of out-of-pocket payment still remains a considerable burden for low-income people, it is likely that changes in earnings became increasingly important in

⁹ In January 2000, the government started the program subsidizing 50% of the out-of-pocket (OOP) expenses that exceed 120 million Won (about 1,150 US dollars) for one month. The policy became increasingly generous over time: it began to cover 100% of the OOP costs exceeding 300 million Won for 6 months in July 2004, and reduced the ceiling to 200 million Won for 6 months in January 2007. In 2009, the upper limit of OOP payments was further reduced in a manner to favor low-income individuals: a yearly limit of 400, 300, and 200 million Won for, respectively, the upper 20%, the next 30%, and the bottom 50% families.

determining the medical utilization during the 2000s. This might explain why the rates of deaths (especially among low-income people and those caused by cancers) turned strongly counter-cyclical in the 2000s.

If this hypothesis were true, we expect that the change in the relationship between the unemployment and the mortality rates should be more strongly revealed for deaths caused by diseases that require a greater amount of medical expenses. We can also anticipate that the turnaround in the effect of unemployment should be more pronounced for the diseases for which the increase in the medical expenditure per patient (especially the benefits paid by the National Health Insurance) is greater during the 2000s.

Our strategy for identifying whether or not the change has come from diseases associated with a rapid rise in medical expenditure starts with the regression model below:

$$(2) H_{ijt} = E_{jt}\gamma_{i0} + I_t \times (X_{jt}\beta_{i1} + R_{1ij} + RT_{1ijt}) + (1 - I_t) \times (E_{jt}\gamma_{i2} + X_{jt}\beta_{i2} + R_{2ij} + RT_{2ijt}) + \alpha_{it} + \varepsilon_{jt}$$

The above specification is a modification of the Chow test (Chow 1960). This regression model is basically the same with our basic specification. I_t is the dummy variable that identifies the former period (say 1991-2001) and subscript 0, 1 and 2 denote the entire period, the former and the latter period (say 2002-2011). Subscript i stands for the type of disease. With the above setting, the parameter γ_{i0} means the effect of unemployment on death from disease i in the former period and γ_{i2} indicates the *change* of the effect from the former to the latter period, because $\gamma_{i0} + \gamma_{i2}$ should be effect of unemployment in the latter period. By checking an estimate $\hat{\gamma}_{i2}$ we know both the degree of changes and its significance level.

The National Health Insurance Statistical Yearbooks provide data on the number of patients and medical expenses for 298 disease categories. Using micro data on the Cause of Death Statistics, we constructed extensive cause-specific mortality data for the period 1991-2011 so that the causes of death match the disease classifications of the medical utilization data. For each cause-specific mortality, we estimate $\hat{\gamma}_{i2}$ and then regress $\hat{\gamma}_{i2}$ on the variables pertaining to medical utilization, i.e.,

$$(3) \hat{\gamma}_{i2} = X_i\beta + u_i$$

where X_i denotes medical utilization such as the treatment amount (the total medical care cost), change in the treatment amount or the patient payments per individual patient.

Table 5 presents the regression results. The changes in the effect of unemployment tend to be larger for diseases with a large amount of expenditure per patient (Column 1). The amount of expenditure, if the number of patients is controlled, is also positively related to the changes in the effect of business cycle (Column 2). Consistent with the hypothesis, furthermore, the increase in the medical expenditure per patient between 2000 and 2011 is positively related with the change in the relationship between unemployment and mortality between the 1990s and the 2000s (Columns 3 and 4). Finally, changing effects of unemployment are not significantly related to change in the out-of-pocket payments (Columns 5 and 6).¹⁰ These results lead us to speculate that the changes in the relationship between business cycle and health were at least partly produced by the government policies that extended the coverage of the National Health Insurance.

Advances in medical technology might be another factor that can strengthen the positive income effects of economic booms. If a certain type of disease cannot be cured with available medical treatments, an increase in income would not matter much in determining the mortality caused by the disease. Innovations in medicine can increase the magnitude of income effect by allowing money buy health. Indeed, it appears that there were substantial advances in medical technology during the last two decades that might affect the diseases of our interest such as cancers and digestive diseases for which the effects of business cycle changed.

However, the medical technology hypothesis is not matched well with the results given in this paper. First, if advances in medical technology tend to produce more expensive, new methods rather than to lower the costs of the existing methods, the hypothesis is consistent with the result that the change in business cycle effect is positively related with the amount of expenditure per patient (Table 5).¹¹ However, since newly developed, more expensive treatments would be less likely to be covered by public health insurance than more

¹⁰ All results are robust to the alternative time periods.

¹¹ A similar explanation is suggested for why total mortality has shifted over time from strongly procyclical to being practically unrelated to business cycles in the United States. Ruhm (2013) finds that strong countercyclical patterns of cancer mortality and some external sources of death have emerged over time. He conjectures that the changing effect of macroeconomic condition on cancer mortality may be partly attributed to the rise of sophisticated (and expensive) treatments of cancers in recent years that probably increased protective effect of financial resources.

conventional, cheaper methods, it is likely that advances in medical technology would increase the out-of-pocket expenses more than the insurance benefits. Thus, the medical technology hypothesis cannot explain well why the changing effect of unemployment is unrelated with the change in out-of-pocket expenditure (Columns 5 and 6 of Table 5). Nor is it consistent with the result that the turnaround in the effect of unemployment is observed only among poorer (less-educated) individuals (Table 3).

An alternative hypothesis is that the negative (direct or indirect) influences of economic booms on health became weaker during the 2000s. Increased hours of work, less healthy behaviors (such as smoking and drinking) and more serious pollution are major potential mediating factors by which economic booms can adversely affect health. If changes in these factors become less pro-cyclical, or if the link between these factors and health becomes weaker, the negative effects of economic booms on health would diminish. It is beyond the scope of this paper to investigate rigorously if Korea experienced such changes during the last two decades.¹² However, labor-market and environmental changes do not seem to be the major factors that changed relationship between unemployment and mortality. This study suggests that the changes in the effect of unemployment are more strongly revealed among the elderly (Table 2) and for deaths caused by cancers (Table 4). It is unlikely that changes in hours of work and the quality of environment would have particularly strong impact on the health of older persons and cancer patients.

6. Conclusions

Growing evidence suggests that mortality rates decline during economic downturns. However, it is not entirely clear whether the pro-cyclical change in mortality is a general phenomenon or is peculiar to particular times and nations. This study contributes to the existing literature by providing the first evidence regarding the effect of business cycle on health in South Korea that is comparable to the widely-cited studies based on U.S. and European data. More specifically, we estimate how the unemployment rates affect the all-cause and cause-specific mortality rates from 1989 to 2012, applying the fixed effect model

¹² Some circumstantial evidence suggests there were improvements in work and environmental conditions. The hours of work substantially declined in Korea, from 47.6 hours per week in 1999 to 41.1 hours in 2012, thanks in part to the enactment of the five-day-week law in 2002. Smoking is prohibited in increasing number of buildings and public places; and various types of pollution are more tightly monitored and regulated than before.

with region-specific time trend to the Korean province-level data. We also investigate how and why the relationship between unemployment and mortality changed across times in Korea.

Mortality changes in South Korea were generally procyclical between 1989 and 2012, as suggested by other studies. For the period between 2001 and 2012, however, a strong positive relationship between unemployment and mortality emerges. The positive effect of unemployment on mortality in recent years is strongly revealed only for individuals with low educational attainment. Cancers and diseases of the digestive system played particularly important roles in changing the direction of the effect of unemployment on mortality.

We attempt to explain why the direction of influences of business cycle on health changed. We hypothesize that the favorable income effects of economic booms became strong enough to dominate the negative influences of business expansion in the 2000s. We then suggest that a series of government policies that extended the coverage of the National Health Insurance for low-income people during the 2000s is one of the possible factors that made the change. As medical treatments for serious diseases became more affordable for low-income individuals, earning changes became increasingly important in determining the medical utilization during the 2000s. Consistent with the hypothesis, the change in the relationship between unemployment and mortality between the 1990s and the 2000s is larger for the diseases with a greater increase in the medical expenditure per patient between 2000 and 2011; and changing effects of unemployment is unrelated with the change in the out-of-pocket payments. Alternative hypotheses (e.g., advances in medical technology and changes in labor-market and environmental conditions) are not matched well with the available evidence.

This study suggests that the relationship between short-term changes in business conditions and health may differ across times and places, depending on the relative strength of positive and negative influences of economic booms. Although further investigations are called for, public health policy seems to be a major determinant of the association between economic conditions and health, at least in the case of South Korea over the last 25 years. Advances in medical technology and changes in labor-market conditions are potentially important factors that can change the balance between the favorable and adverse effects of economic booms. Additional evidence from more heterogeneous times and places will be helpful for understanding how and why the effects of business cycle on health change across

times and places.

References

- Chay, Kenneth, and Michael Greenstone (2003): "The Impact of Air Pollution on Infant Mortality: Evidence from Geographic Variation in Pollution Shocks Induced by a Recession," *Quarterly Journal of Economics* 118, 1121-1167.
- Chow, Gregory C. (1960): "Tests of Equality between Sets of Coefficients in Two Linear Regressions," *Econometrica* 28(3): 591-605.
- Gerdtham, Ulf-G, and Christopher J. Ruhm (2006): "Deaths Rise in Good Economic Times: Evidence from the OECD," *Economics and Human Biology* 4, 298-316.
- Fishback, Price, Michael Haines, and Shawn Kantor (2007): "Birth, Deaths, and New Deal Relief during the Great Depression," *Review of Economic Studies* 89(1), 1-14.
- Fontenla, Matias, Fidel Gonzalez, and Troy Quast (2011): "Are Recessions Good for Everyone's Health? The Association between Mortality and the Business Cycle by Race/Ethnicity in the US," *Applied Economics Letters* 18, 207-212.
- Lee, Chulhee, and Tae Hoon Kim (2011): "Are Recessions Good for Your Health? Unemployment and Mortality Rates in South Korea, 1991~2009," *Economic Analysis* 17(3): 131-182. (in Korean)
- Lee, Chulhee, Youngho Yun, and Junglim Hong (2013): "The Effects of the Expansion of the National Health Insurance Coverage in 2005 on Medical Utilization and Health Outcomes," Working Paper, Seoul National University.
- Lee, Chulhee, Sok Chul Hong, Jungmin Lee, and Youngho Yun (2013): "The Effects of the Ceiling of Out-Of-Pocket Expenditure on Medical Utilization and Health Outcomes," Report submitted to National Health Insurance Corporation.
- Lin, Shin-Jong (2009): "Economic Fluctuations and Health Outcome: A Panel Analysis of Asia-Pacific Countries," *Applied Economics* 41, 519-530.
- McInerney, Melissa, and Jennifer M. Mellor (2012): "Recessions and Seniors' Health, Health Behaviors, and Health Care Use: Analysis of the Medicare Current Beneficiary Survey," *Journal of Health Economics* 31, 744-751.
- Miller, Douglas, M. Page, A. Stevens, and M Filipksi (2009): "Why Are Recessions Good for Your Health?" *American Economic Review Papers and Proceedings* 99, 122-127.
- Neumayer, Eric (2004): "Recessions Lower (Some) Mortality Rates: Evidence from Germany," *Social Science and Medicine* 58, 1037-1047.
- Rajeev Dehejia, and Adriana Lleras-Muney (2004): "Booms, Busts, and Babies' Health," *Quarterly Journal of Economics* 119(3), 1091-1130.

Ruhm, Christopher J. (2000): "Are Recessions Good for Your Health?" *Quarterly Journal of Economics* 115, 617-650.

Ruhm, Christopher J. (2003): "Good Times Make You Sick," *Journal of Health Economics* 22, 637-658.

Ruhm, Christopher J. (2005): "Healthy Living in Hard Times," *Journal of Health Economics* 24, 341-363.

Ruhm, Christopher J. (2007): "A Healthy Economy Can Break Your Heart," *Demography* 44, 829-848.

Ruhm, Christopher J. (2013): "Recessions, Healthy No More?" NBER Working Paper No. 19287.

Stevens, Ann Huff, Douglas L. Miller, Marianne E. Page, and Mateusz Filipowski (2011): "The Best of Times, The Worst of Times: Understanding Pro-Cyclical Mortality," National Bureau of Economic Research Working Paper No. 17657.

Stock, James H. and Mark W. Watson (2008): "Heteroskedasticity-Robust Standard Errors for Fixed Effects Panel Data Regression," *Econometrica* 76(1): 155-174.

Stuckler, D., C. Meissner, P. Fishback, S. Basu, and M. McKee (2011): "Banking Crisis and Mortality during the Great Depression: Evidence from Urban Populations, 1929-1937," *Journal of Epidemiology and Community Health* (March 2011).

Sullivan, Daniel, and Till von Wachter (2009): "Job Displacement and Mortality: An Analysis using Administrative Data," *Quarterly Journal of Economics* 124(3), 1265-1306.

Tapia Granados, José A. (2005): "Recessions and Mortality in Spain, 1980-1997," *European Journal of Population* 21, 393-422.

Xu, Xin, and Robert Kaestner (2010): "The Business Cycle and Health Behaviors," NBER Working Paper No. 15737.

Table 1
Effects of Unemployment on Mortality

Model	(1) 1989-2012	(2) 1991-2009	(3) 1989-2001	(4) 2002-2012
No region-specific trends	-0.0127 (0.0077)	-0.0116* (0.0059)	-0.0011 (0.0038)	0.0106* (0.0054)
With region-specific trends	-0.0045 (0.0033)	-0.0037** (0.0016)	-0.0044 (0.0026)	0.0116*** (0.0029)

Note: The dependent variable is the natural logarithm of the total mortality rate per 100,000 persons. All models include the shares of the population belonging to each three age categories and three education categories. Year and regional dummy variables are also controlled for. Clustered robust standard errors are in parentheses. Observations are weighted by the square root of the total population for the region and year.

* Statistical significance for 0.10 level.

** Statistical significance for 0.05 level.

*** Statistical significance for 0.01 level.

Table 2
Effects of Unemployment on Age-Specific Mortality

Age Group	(1) All		(2) Male		(3) Female	
	1989- 2001	2002- 2012	1989- 2001	2002- 2012	1989- 2001	2002- 2012
All	-0.0044 (0.0026)	0.0116*** (0.0029)	-0.0044 (0.0031)	0.0097* (0.0046)	-0.0040 (0.0028)	0.0128*** (0.0041)
≤4 year olds	0.0214 (0.0181)	0.0066 (0.0685)	0.0319 (0.0202)	-0.0865 (0.0910)	0.0133 (0.0229)	0.0888* (0.0480)
5-19 year olds	-0.0112 (0.0143)	0.0268 (0.0446)	-0.0293* (0.0149)	0.0321 (0.0575)	0.0291 (0.0281)	0.0212 (0.0662)
20-44 year olds	-0.0025 (0.0053)	0.0095 (0.0143)	-0.0025 (0.0059)	0.0310* (0.0158)	-0.0012 (0.0075)	-0.0301 (0.0333)
45-64 year olds	-0.0046 (0.0031)	0.0148 (0.0089)	-0.0065 (0.0040)	0.0094 (0.0098)	0.0017 (0.0036)	0.0277* (0.0144)
≥65 year olds	-0.0011 (0.0034)	0.0095*** (0.0035)	0.0011 (0.0038)	0.0083 (0.0073)	-0.0042 (0.0042)	0.0097* (0.0055)

Note: Age and education variables are those of each sex. Observations are weighted by the square root of the population of each group for the region and year. See Table 1.

* Statistical significance for 0.10 level.

** Statistical significance for 0.05 level.

*** Statistical significance for 0.01 level.

Table 3
Effects of Unemployment on Mortality by Educational Attainment

	(1) All, ≥ 45 year olds		(2) High school graduates or less, ≥ 45 year olds		(3) College graduates or more, ≥ 45 year olds	
	1991-2001	2002-2011	1991-2001	2002-2011	1991-2001	2002-2011
All	-0.0018 (0.0023)	0.0140*** (0.0023)	-0.0056 (0.0068)	0.0157*** (0.0036)	0.0027 (0.0087)	0.0198 (0.0162)
Male	-0.0021 (0.0023)	0.0101* (0.0048)	-0.0093 (0.0075)	0.0132** (0.0059)	-0.0013 (0.0098)	0.0138 (0.0167)
Female	-0.0014 (0.0035)	0.0170*** (0.0056)	-0.0065 (0.0061)	0.0169** (0.0062)	0.0720* (0.0374)	0.0820 (0.0676)

Note: Observations are weighted by the square root of the population of each group for the region and year. See Table 1.

* Statistical significance for 0.10 level.

** Statistical significance for 0.05 level.

*** Statistical significance for 0.01 level.

Table 4
Effects of Unemployment on Cause-Specific Mortality in 1989-2001 and 2002-2012

Disease Category	1989-2001	2002-2012
Certain infectious and parasitic diseases	0.0145 (0.0169)	-0.0751* (0.0370)
Cancers	-0.0108** (0.0044)	0.0211*** (0.0066)
Endocrine, nutritional and metabolic diseases	-0.0016 (0.0128)	-0.0094 (0.0357)
Diseases of the nervous system	0.0170 (0.0360)	-0.0406* (0.0219)
Diseases of the circulatory system	-0.0010 (0.0076)	0.0205 (0.0160)
Diseases of the respiratory system	-0.0158 (0.0138)	0.0006 (0.0518)
Diseases of the digestive system	0.0052 (0.0116)	0.0485* (0.0253)
Diseases of the genitourinary system	-0.0403* (0.0227)	0.0329 (0.0522)
Vehicle and traffic injuries	-0.0098 (0.0121)	-0.0353 (0.0276)
Falls	-0.0699*** (0.0197)	-0.0455 (0.0780)
Drowning	-0.0455 (0.0331)	-0.0066 (0.0708)
Fire, flames or hot objects	-0.0113 (0.0557)	-0.0813 (0.1860)
Poisoning	0.0963 (0.0729)	-0.0411 (0.1487)
Suicide	-0.0192 (0.0242)	0.0123 (0.0200)
Assault	0.0536 (0.0346)	0.1163 (0.0872)
Other external causes	0.0072 (0.0229)	0.0395 (0.0619)

Note: See Table 1.

* Statistical significance for 0.10 level.

** Statistical significance for 0.05 level.

*** Statistical significance for 0.01 level.

Table 5

The Correlation between Medical Utilization and the Changing Effect of Unemployment

	The treatment amount, 2011		Change in the treatment amount, 2000-2011		Change in the patient payments, 2000-2011	
	(1)	(2)	(3)	(4)	(5)	(6)
Expenditure per patient	8.1178** (2.8201)		10.4313** (4.2798)		-41.6397 (45.2960)	
Expenditure		0.0539** (0.0247)		0.0652** (0.0294)		0.1611 (0.1142)
Number of patients		-0.0128* (0.0067)		-0.0272** (0.0127)		-0.0265* (0.0146)

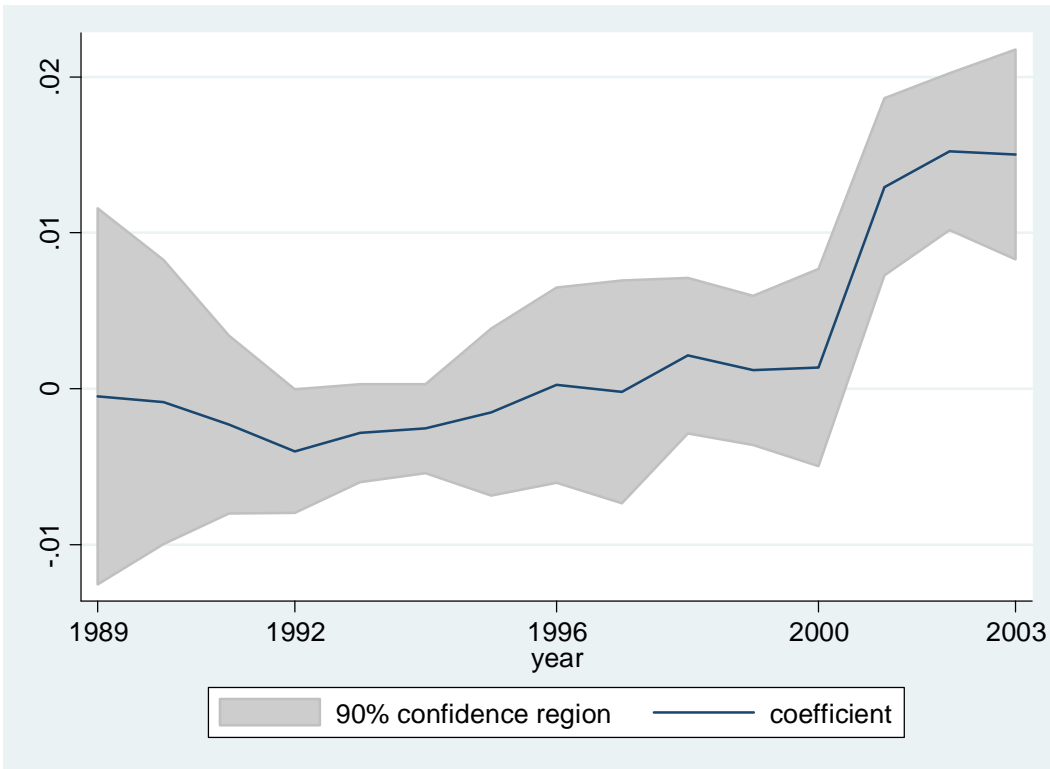
Note: The dependent variable is the degree of changes in the regression coefficients on log unemployment rates from 1991-2001 to 2002-2011, i.e., $\gamma_2 = \gamma_{02-11} - \gamma_{91-01}$. Explanatory variables are medical utilization in won by each disease (1 billion won), the number of patients (1 million people) and medical utilization per patient (1 million won). Observations are weighted by the square root of the number of 2011 deaths by each disease.

* Statistical significance for 0.10 level.

** Statistical significance for 0.05 level.

*** Statistical significance for 0.01 level.

Figure 1
The Rolling Regression Result for the Effects of Unemployment on Mortality in 1989-2012



Note: Rolling regressions have been run for every 10 year. The x-axis numbers refer to the beginning year of each regression. The blue line indicates regression coefficients of unemployment rates. See Table 1.

Appendix Table 1
Effects of Unemployment on Mortality: Alternative Specifications

	1989-2012	1991-2009	1989-2001	2002-2012
Log of unemployment rate, no region-specific trends	-0.0254 (0.0307)	-0.0325 (0.0257)	0.0076 (0.0083)	0.0243* (0.0122)
Log of unemployment rate, with region-specific trends	0.0051 (0.0131)	0.0055 (0.0085)	-0.0049 (0.0086)	0.0224** (0.0102)

Note: See Table 1.

*** Statistical significance for 0.10 level.

*** Statistical significance for 0.05 level.

*** Statistical significance for 0.01 level.

Appendix Table 2
Effects of Unemployment on Cancer Mortality and Cancer Incidence in 2002-2010

	Cancer incidence	Case fatality from cancer	Cancer mortality
No region- specific trends	-0.0010 (0.0098)	0.0186 (0.0135)	0.0197** (0.0077)
With region- specific trends	0.0011 (0.0151)	0.0266 (0.0179)	0.0282*** (0.0081)

Note: The dependent variable is the natural logarithm of the mortality rate or the cancer incidence rate per 100,000 population. All models include the shares of the population belonging to each three age categories and three education categories. Year and regional dummy variables are also controlled for. Clustered robust standard errors are in parentheses. Observations are weighted by the square root of the total population for the region and year.

* Statistical significance for 0.10 level.

** Statistical significance for 0.05 level.

*** Statistical significance for 0.01 level.