Short-term Impact of Income on Mortality: Evidence from South Korea's Public Pension Programs[*]

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Abstract

We examine the short-term impact of pension income receipt on older adults' mortality by exploiting the pension disbursement date falling on the 25th of every month in South Korea. Using the national death registry data, we document that the mortality rate decreases by two percent in the week of the disbursement date compared to the prior week. The effects are larger i) among those with lower educational attainment or without spouses, ii) when individuals are required to wait for a longer period before the next disbursement, and iii) during the summer/winter season with greater demands for air conditioning/heating.

Keywords: income effect, liquidity constraints, public pension, mortality, older adults

JEL classification: H55, I18

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1. Introduction

A large literature has documented positive income and health gradients across various settings (e.g., Deaton, 2003). Under the standard framework of the life-cycle/permanent income hypothesis with liquidity constraints (PIH-LC), an increase in income can alleviate liquidity constraints, thereby improving health via various channels (e.g., more healthcare utilization, better nutrition, and increased mental well-being). To identify the causal effects of income on health, previous studies utilized exogenous variations in income, such as the German reunification, lottery wins, and unconditional cash transfer experiments (Frijters et al., 2005; Evans and Garthwaite, 2014; Cesarini et al., 2016; Haushofer and Shapiro, 2016; Kangas et al., 2019), and found mixed evidence, ranging from null to positive impacts.

Unlike unexpected and isolated income shocks, the primary sources of regular household income streams are salary and pension benefits for the working-age population and older adults, respectively. Therefore, it is important to understand how the receipt of regular income sources affects individuals' health. Previous studies, such as Evans and Moore (2012), and Andersson et al. (2015), demonstrated that in the US and Sweden, mortality increases immediately after the receipt of a social security payment or a paycheck, which is inconsistent with the predictions of the PIH-LC.

In this study, we revisit this question by examining the short-term impact of monthly receipts of public pension benefit on mortality in South Korea (hereafter, Korea). We argue that the Korean context provides a unique opportunity to better understand how the mortality rate changes within the monthly billing cycle due to the following reasons. First, the poverty rate of older adults in Korea is the highest among OECD countries. Korea has experienced rapid population aging over the last few decades, and social insurance and welfare programs have slowly expanded (Ahn et al., 2021; Koh and Yang, 2021). This has resulted in acute old-age poverty problems in Korea.[1] As the health impacts of income can be greater among low-income groups under the classical health production theory (Grossman, 1972), the positive impact of income receipts on the health of older adults in Korea could be larger than those in Western countries with stronger income support.

[1] For example, Panel A of Figure A1 shows that Korea's elderly poverty rate, defined as the share of households of older adults aged above 65 earning below half of the national median income, is the highest among OECD countries. Panel B indicates that, compared with other countries, the Korean government has provided relatively weaker social insurance programs for older adults, measured by pension spending as a percentage of the Gross Domestic Product (GDP).

Second, as a possible explanation behind the seemingly counterintuitive results that income receipts raise mortality in the US and Sweden (Evans and Moore 2012; Andersson et al., 2015), other studies have shown that an increase in income increases substance use and related accidents (Phillips et al., 1999; Samet, 2001; Riddell and Riddell, 2006; Dobkin and Puller, 2007; Bruckner et al., 2011; Gross and Tobacman, 2014). However, we argue that the negative health impact of income receipt due to risky health behaviors is likely to be minimal in Korea. Substance use has not been as serious a public health threat in Korea, as it has been in the US or European countries. For example, as of 2019, the number of substance-related deaths per 100,000 in Korea was 12.2, whereas the corresponding rate was 45.3 in the US.[2] Hence, the positive health impact of income receipt is more likely to outweigh the negative impact in Korea.

This study capitalized on public pension benefits being disbursed on the 25th day of each month, and many individuals aged 65 and over receiving these benefits. Using individual-level mortality data, we documented evidence of the positive short-term impact of income receipt on health. We found that older adults' mortality rate decreases by two percent in the first week of disbursement (i.e., over the first seven days from the benefit receipt) compared to the prior week. The estimate was statistically significant at the one percent level. The impact on mortality continues to decrease (1.6 percent) in the following week and reverts to zero until they receive the next disbursement.

Two possible mechanisms were investigated in this study. First, relaxed liquidity constraints can be a leading mechanism through which pension income gain reduces the mortality rate, given the prevalent poverty problem among older adults in Korea. Our heterogeneity analyses indicate that the beneficial impact on health is greater among older adults who are likely to face more binding liquidity constraints. Specifically, we found a larger mortality reduction among older adults with lower educational attainments or without spouses. Additionally, we observed a larger impact of pension benefit receipt when recipients have to wait longer for the next disbursement, or during the summer or winter season when air-conditioning or heating are in higher demand. Consistent with this finding, we noted that, as evidenced in the monthly cycle of mortality, older adults' consumption spending increases during the week of pension benefit disbursement and decreases in the following weeks. Second, a rise in the mortality rate due to risky behaviors in Korea is less likely to play a significant

[2] To define substance-abuse related deaths, we follow Phillips et al. (1999).

role. Our analysis of the causes of death presents little evidence that pension income receipt increases the likelihood of deaths due to substance abuse.

Lastly, we investigated the relationship between the mortality rate and macroeconomic conditions, measured by the regional unemployment rate and GDP. Previous studies have suggested that the adverse short-term impact of income can be a potential channel of the procyclical mortality trend over the business cycle (Evans and Moore, 2012; Andersson et al., 2015). We find little evidence of the procyclical relationship between macroeconomic conditions and mortality rates in Korea. This finding suggests that the positive short-term mortality impact of income receipt we document in the baseline analysis could explain cross-country heterogeneity in the mortality trends over business cycles.

Our study contributes to the literature by providing novel evidence on the short-term impact of regular income receipts on health. We shed new light on the beneficial role of income in health within the monthly billing cycle, which has been under-emphasized by previous studies, such as Evans and Moore (2012) and Andersson et al. (2015). In fact, several studies in the US context present evidence suggesting the positive impact of income on health within the billing cycle among older adults or low-income households. For example, Gross et al. (2021) showed that the receipt of a monthly Social Security check immediately increased the prescription drug consumption of low-income Medicare Part D enrollees. Cotti et al. (2020) found that emergency room visits increased (decreased) immediately before (after) receiving SNAP benefits (formerly Food Stamp). Combined with these findings, our analyses of potential mechanisms imply that recipients' degree of liquidity constraints may play an important role in determining the overall impact of income on health within the billing cycle. In addition, our analyses on the relationship between mortality rate and macroeconomic conditions provide additional evidence that short-term mortality trends within the billing cycle could be a possible mechanism for understanding how mortality rates vary over the business cycle.

The remainder of this paper is organized as follows. Section 2 describes the policy background and pension payout schedule. Sections 3 and 4 present the data and the empirical strategy, respectively. Section 5 presents the main results of this study. Section 6 concludes.

2. Background

Korea operates a social security system called the National Pension (NP). It provides income insurance against i) old age, ii) death of a spouse, and iii) work-limiting disability. Employers and employees each contribute 4.5 percent of the monthly wages. Self-employed individuals

contribute 9 percent of their monthly income.[3] After contributing for at least 10 years, individuals can claim monthly NP benefits, computed based on the so-called average indexed monthly earnings, when they reach the pension claiming age. It was set at 60 until 2012 but has since been raised by 2.4 months per year to 65. As of September 2021, the average monthly NP (old-age) benefit amount was KRW 454,273 (US$ 381.9).[4] In addition, since 2008, the government has operated another income support program, called the Basic Pension (BP), for the older adult population aged 65 and over with household income below the 70th percentile of the distribution. Eligible individuals receive up to KRW 300,000 (US$ 252.2).[5] According to national representative panel data from the Korea Welfare Panel Study, over 95 percent of households with individuals aged 65 and over receive public pension benefits.

Prior to May 2012, NP benefits were disbursed on the last day of the month. Since May 2012, the disbursement date has been changed to the 25th day of the month to better accommodate beneficiaries' spending needs, as most utility and tax bill payment deadlines (e.g., gas and water bills, residence and property taxes, etc.) in Korea are due by the end of the month. Consequently, since June 2009, the disbursement date of the BP program has also changed from the last day to the 25th of the month.[6] As a result, all public pension programs has disbursed pension benefits to their beneficiaries on the 25th of every month since May 2012. We used this recurring monthly pension benefit payout date to investigate the short-term impact of income receipts on mortality for older adults aged 65 and over. It is noteworthy that the payment is delivered one day prior to the disbursement date if it falls on a weekend or a public holiday. For example, if the 25th day of the month falls on a Saturday, the payment is delivered on Friday, unless Friday is a public holiday.

3. Data

For the empirical analysis, we used individual-level data of registered death records from Statistics Korea's Causes of Death Statistics (CODS), a census of all deaths in Korea. The CODS data provide detailed information on the exact date and cause of an individual's death

[3] Those working in specific sectors (e.g., public administration, police force, and teachers and university professors) are subject to different pension programs, but their pension benefit disbursement dates are identical to that of the NP program.

[4] The average NP benefit amounts for dependents (survivors) and disabled workers are KRW 254,620 (US$ 214.1) KRW 454,666 (US$ 382.3), respectively. As of 2021, old-age, survivor, and disability beneficiaries account for 83.5 percent, 15.3 percent, and 1.2 percent of the NP program, respectively. (National Pension Service, 2021).

[5] As of 2021, the value of monthly equivalent income (a function of labor income, other incomes, and household assets) must be below KRW 1.69 million (US$1,412) for single households and KRW 2.74 million (US$2,290) for married households to be eligible for the BP benefits.

[6] The previous disbursement date of the BP program before June 2009 was also the last day of each month.

along with socio-demographic details such as age, sex, marital status, educational attainment, place of residence, etc. Although it does not provide information on whether deceased individuals were pensioners, most of the older adult population (over 95 percent) are public pension beneficiaries. Thus, we argue that our empirical results represent the effects of pension benefits.

We used the CODS data from May 2012 to December 2019 for the following reasons. First, since May 2012, the disbursement date of different public pension programs has been standardized to fall on the 25th of every month. As this study investigates how mortality rates evolve before and after the disbursement date, it is difficult to cleanly identify the effect of a receipt of pension benefits with multiple disbursement dates in the same month without knowing the decedent's pension program enrollment details. Second, we did not consider the data collected after 2019 due to the COVID-19 pandemic. There has been a large increase in the mortality rate, especially among older adults, and local and central governments have provided cash transfers to provide temporary income support to households (Kim et al., 2021). In addition, we restricted the data to those deceased at 65 years or older because the eligible age for the BP program is 65 or older. This age restriction also helps remove the potential influence of monthly wage payments made on the 25th because this age group is relatively less likely to engage in gainful employment.

Table A1 summarizes the statistics of all deaths and older adult deaths. The CODS data included 2,140,031 deaths from May 2012 to December 2019. The average number of deaths per day was 764. The total number of deaths among older adults aged 65 and over was 1,602,037, and the average number of older adult deaths per day was 572. The average age at the time of death was 73.2 and 80.8 among the entire population and older adults, respectively. Males accounted for 55 percent of all deaths, whereas older individuals accounted for 49 percent. 45–46 percent of the individuals who died were married. The average number of years of education among all the deceased individuals and older deceased individuals aged 65 and over was 7.47 years and 6.30 years, respectively.

Our primary dependent variable was the logarithm value of daily mortality counts using the exact date of death. To understand potential mechanisms through which receipts of pension benefits affect mortality, we also calculated the logarithm values of daily mortality counts by cause and socio-demographic characteristics. Over 50 categories of causes of death are represented in the CODS data, including i) cancer, ii) heart disease, iii) cerebrovascular disease, iv) pneumonia, v) diabetes, vi) chronic lower respiratory diseases, vii) hypertensive diseases,

viii) Alzheimer's disease, ix) Suicide, and x) Septicemia. Table A2 reports the distribution of the frequent causes of death in our sample.

4. Empirical Strategy

To examine the short-term relationship between receipts of public pension benefits and older adults' mortality, we first constructed a synthetic calendar to account for differences in the number of days across calendar months and the occurrence of public holidays and weekends, following Stephens (2003) and Evans and Moore (2011). A synthetic day (*d*) is defined relative to the pension benefit disbursement date. For example, the value 0 refers to the day of the pension benefit payout, and -1 refers to the day before the payment. As the 25th of a certain month could be the weekend or a public holiday, a synthetic day with a value of 0 could be the 24th or could even fall before the 24th. Each synthetic month begins 14 days prior to the pension payout date and ends 14 days before the next payment date. As a result, a synthetic month can be 28–34 days long, depending on the disbursement date and number of days in the calendar month. Thus, the value of *d* can range from -14 to 20. We constructed a synthetic year that included 12 synthetic months, from January to December.

We then investigated how the mortality rate changes within the ±14-day window of the benefit disbursement date by estimating the following regression equation:

$$ln\left(Y_{dmy}\right) = \alpha + \sum_{w=-2\,(w\neq -1)}^{1} I\left[Payweek_{dmy} = w\right]\beta_w + \sum_{j=2}^{31} I\left[Day_{dmy} = j\right]\delta_j$$

$$+ \sum_{k=1}^{6} I\left[Weekday_{dmy} = k\right]\gamma_k + \sum_{l=1}^{M} I\left[Special_{dmy} = l\right]\varphi_l + \mu_m + \vartheta_y + \varepsilon_{dmy}\,, \qquad (1)$$

where $ln\left(Y_{dmy}\right)$ is the logarithm value of mortality count for synthetic day *d* in synthetic month *m* and synthetic year *y*, $Payweek_{dmy}$ denotes a synthetic week. It assumes the values -2, -1, 0, and 1 if the date of death falls on i) 8–14 days before, ii) 1–7 days before, iii) within 7 days of, and iv) 8–14 days after the pension benefit disbursement date, respectively.[7] We included Day_{dmy}, which represents the calendar day of the month, to control for the within-month mortality cycle. $Weekday_{dmy}$ represents the day of the week (the omitted category is Saturday). $Special_{dmy}$ denotes various public holidays (e.g., New Year's Day, Independence

[7] The results are robust in estimating the effect of the last *Payweek* (by assigning the value of 2), which is 15-20 days after the pension disbursement date, using the mortality count data of the entire period (i.e., outside the 14-day window).

Day, Mid-Autumn Festival, Christmas, etc.) across the calendar year. μ_m and ϑ_y denote synthetic month- and year-fixed effects, respectively. ε_{dmy} is an error term. The coefficients of interest are β_w, which capture the changes in the weekly mortality rate in week *w* compared to that in the week -1 (i.e., 1–7 days before the disbursement date). For statistical inference, we calculated the standard errors clustered at the synthetic year and month levels.

5. Short-term Effects of Pension Income Receipts on Older Adults' Mortality

5.1. Main Result

Figure 1 demonstrates estimated changes in the daily mortality rate compared to those 14 days prior to the pension income disbursement date after controlling for calendar day, day-of-week, public holiday, synthetic month, and synthetic year fixed effects. For statistical inference, we calculated the standard errors clustered at the synthetic year-month level. It shows that older adults' daily mortality rate begins to decrease a few days prior to the disbursement date, although the estimates are statistically insignificant. This might reflect individuals' anticipation of collecting pension income.[8] Upon receiving the monthly pension income, older adults' mortality rate further decreases for almost a week, and the estimates are statistically significant at the five percent level. Subsequently, the mortality impact diminishes and becomes statistically insignificant.

We then summarize short-term impact on mortality of receipts of pension benefits using equation (1), with the reference period being 1–7 days before collecting pension benefit. Column (1) of Table 1 indicates that the mortality rate decreases by 2.2 percent in the week of the disbursement date, which is statistically significant at the one percent level. In the following week, the mortality rate was still significantly lower by 1.6 percent compared to the week before disbursement. The estimate was statistically significant at the five percent level. The estimated mortality rate change during the week 8–14 days prior to the disbursement date was close to zero and statistically insignificant. The results imply that older adults' mortality rate decreases immediately after the receipt of pension benefits, with a positive impact on health lasting for two weeks within the monthly billing cycle.

[8] One possible pathway through which individuals' anticipation affects their mortality is peace of mind or mental health improvements. To indirectly examine this pathway, we analyzed how daily suicide rates evolve within the billing cycle after controlling for fixed effects for calendar days, days of the week, public holidays, synthetic months, and synthetic years. Figure A2 provides similar patterns to those of the aggregate mortality rate, although several estimates are not statistically significant at the 5 percent level.

We conducted the following checks to examine the sensitivity of our baseline results under the alternative specifications in the other columns. In column (2), we replaced calendar day fixed effects with calendar week fixed effects. We added calendar month and year fixed effects in column (3), and included additional data for deaths occurring during the 29th to 34th synthetic days in the sample to estimate the impact on mortality during the second week after the pension benefit receipt in column (4). Lastly, in column (5), we incorporated the mortality data of older adults aged 60–64 years into the sample as the NP benefit-claiming age was set at 60 for those who were born before 1952. The results indicate that our baseline findings are robust under alternative specifications: the mortality rate drops immediately after the pension income receipt and then reverts to its average during the week prior to the disbursement date.

To further strengthen the causal interpretation of our baseline findings, we conducted the following falsification checks. First, we estimated the false effects of pension income receipts on mortality before the introduction of the NP. As the individual-level COD data is available from 1983 and NP benefits for dependents (survivors) and disabled workers have started since 1989, we restrict the sample to the years between 1983 and 1988. We then estimated the short-term mortality impact of fictitious pension income receipts on the 25th of each month using equation (1). Column (6) of Table 1 indicates that all estimates are statistically insignificant.

Second, we conducted Fisher's permutation test by randomly assigning synthetic weeks and re-estimating the short-term mortality impacts of fictitious pension income receipts 1,000 times. Figure 2 shows the distributions of the estimated effects of fictitious pension income receipts in the week of the pension income receipts, one week after the receipts, and two weeks prior to the receipts in panels A, B, and C, respectively. The vertical lines represent the corresponding baseline estimates reported in column (1) of Table 1. At the bottom of each figure, we calculated the share of estimates of fictitious pension income receipts, whose magnitudes are lower than those of the baseline analysis. Panels A and B indicate the baseline estimates of the impact of pension income receipts on mortality in the week of the disbursement, and the following week, which is clearly located outside of the distributions. These results imply that randomly generated fictitious pension income receipts cannot replicate our baseline findings. However, Panel C shows that the baseline estimate of the impact of pension income receipts on mortality two weeks prior to the disbursement date is placed within the distribution of the effects of fictitious pension income receipts. The share of false estimates whose values are smaller than the baseline estimate is 29.1 percent. This finding implies that the null impact of pension income receipts on mortality in the two weeks prior to the disbursement date in the

baseline analysis can be replicated by randomly assigning fictitious pension income receipts. In summary, the permutation test results provide further evidence that our baseline analysis is likely to capture the true relationship between mortality and pension income receipts.

Comparison with the previous studies

Unlike previous studies in the US and Sweden documenting the rise in mortality following a pension or salary receipt (Evans and Moore, 2012; Andersson et al., 2015), our results indicate that pension income receipts are associated with reductions in mortality.

As a possible explanation to reconcile these discrepancies, we argue that the marginal impact of income on health could vary according to the underlying income levels of recipients. Korea has experienced rapid population aging over the last few decades, and social insurance and welfare programs have gradually expanded (Ahn et al., 2021; Koh and Yang, 2021). For example, Panel A of Figure A1 shows that the poverty rate, defined as the share of households of older adults aged above 65 years, earning below half of the national median income, has been the highest among the OECD countries. However, Panel B indicates that, in comparison to other countries, the Korean government has provided relatively weaker social insurance programs for older adults, measured by pension spending as a percentage of GDP. As the impact of income on health is greater among low-income groups under the classical health production theory (Grossman, 1972), the impact of income receipts on the health of older adults in Korea might be higher than those in Western countries.[9] To further examine this conjecture, we conducted two additional analyses: i) we examined whether the impact on mortality is higher for those with greater liquidity constraints or experiencing a tighter constraint via heterogeneity analyses in Subsection 5.2; and ii) we studied whether pension income receipts relax liquidity binding by investigating how consumption spending changes around the disbursement date in Subsection 5.3.

Another possible explanation is heterogeneity in the research context. As a possible explanation for the seemingly counterintuitive results that income receipts raise mortality in the US and Sweden (Evans and Moore 2012; Andersson et al., 2015), the authors cited other studies showing that an increase in income increases substance use and related accidents (Philips et al., 1999; Samet, 2001; Riddell and Riddell, 2006; Dobkin and Puller, 2007;

[9] If we focus on low-income families, we also find consistent evidence from the US that can support the positive short-term relationship between income and health. For example, Gross et al. (2021) show that the receipt of a monthly Social Security check immediately increases low-income Medicare Part D enrollees' prescription drug consumption. Cotti et al. (2020) find that emergency room visits increase (decrease) immediately before (after) receiving SNAP benefits (formerly, Food Stamp).

Bruckner et al., 2011; Gross and Tobacuman, 2014). However, we argue that the negative impact of income on health due to an increase in risky health behaviors is likely to be minimal in Korea. Substance use has not been as serious a public health threat in Korea, as it has been in the US or other European countries. For example, as of 2019, the number of substance-related deaths per 100,000 in Korea was 12.2, whereas the corresponding rate was 45.3 in the US. Hence, the positive impact of income receipts on health is more likely to dominate the negative impact, if any, in Korea. To further test this conjecture, we estimated the short-term impact on mortality based on the causes of death in Subsection 5.4.

5.2. Heterogeneity Analyses

By individual characteristics

First, we analyzed whether the impact of mortality is greater among older adults with more binding liquidity constraints. The receipt of pension income may have reduced the mortality rate in the short run by temporarily relaxing liquidity constraints (Stephens, 2003). As older adults with lower educational attainment (high school diploma and below) are more likely to experience liquidity constraints than those with higher educational attainment (above high school diploma), we compared the impact on mortality based on the decedent's education level.[10]

Table 2 presents the heterogeneous impact of a receipt of pension benefit on mortality based on educational attainment. Column (1) shows that the estimated short-term effect of pension income on mortality among older adults with lower educational attainment is greater than the baseline estimate. Compared to the mortality rate one week prior to the disbursement date, older adults' mortality rate reduces in the week of and one week after the receipt of the pension benefits by 2.5 and 1.7 percent, respectively. The estimates are statistically significant at the one percent and five percent levels. The estimate for the impact on mortality two weeks prior to the disbursement date is small in magnitude and statistically insignificant as in the baseline analysis. However, column (2) presents that the short-term impact of pension income on mortality is negligible in magnitude and statistically insignificant among older adults with higher educational attainment. The results provide consistent evidence with the conjecture that

[10] The CODS data provides information on a decedent's employment (and occupation) status. However, this information at the time of the older adult's death may not be a good proxy of liquidity constraints because many low-income older adult workers engage in temporary employment with a small pay. This feature prevents us from cleanly isolating low-income older adult workers from high-income ones.

relaxed liquidity constraints might have played a role in explaining how the pension income receipts reduce older adults' mortality within a short period of time.

We also considered marital status to be a complementary proxy for liquidity constraints. Marital status is positively correlated with higher socioeconomic status, and a spouse can provide informal income insurance within the household (Lundberg, 1985). Thus, single individuals may experience tighter liquidity constraints than married individuals do. Columns (3) and (4) of Table 2 indicate that the impact on mortality is greater among unmarried individuals than married individuals, providing evidence consistent with our conjecture.

By length and seasonal timing of the billing cycle

We also examined the heterogeneous effects by the duration and seasonal timing of the billing cycle. First, the length of the billing cycle can differ across months, although the amount of monthly pension benefits is fixed within a year. For example, as February is shorter than the other months, the pension benefit in March will generally be disbursed two to three days earlier than that in April from the prior payment. This implies that individuals experiencing a longer waiting period before the next month's pension income may be subject to tighter liquidity constraints. The waiting period was measured by calculating the length of the billing cycle of the previous month. Then, the sample was split into two groups with waiting periods of 28–30 days and 31–34 days. Columns (1) and (2) of Table 3 show that the estimated impact on mortality is greater when older adults experience a longer billing cycle from the previous month, providing evidence consistent with our conjecture.

Second, we examined the heterogeneous impact of pension income receipts on mortality based on the season. Older adults are more susceptible to extreme weather conditions as they cannot easily adjust to temperature changes (Anderson and Bell, 2009). In Korea, the difference between the highest (around 40℃ or 104℉) and lowest (around -20℃ or -4℉) temperatures within a year often ranges from 50–60℃ (122–140℉) (Korea Meteorological Administration, 2021). Consequently, the impact of pension income receipts on health could vary by season if the increase in income via pension benefits affects energy consumption (e.g., heating and air conditioning). We estimated the impact of pension income on mortality in summer (June–August), winter (December–February), and other seasons in Table 3. Columns (3) and (4) show that the mortality rate reduces in the week of collecting pension income and the following week only during the summer and winter seasons. The estimates are greater in magnitude than those in the baseline analysis and are statistically significant at the five percent level. However, column (5) shows little evidence that older adult mortality rate decreases after

receiving pension income during the spring or autumn seasons. The estimates are small in magnitude and statistically insignificant. These results imply that pension income might play a fundamental role in improving the health of older adults when there is a greater demand for air conditioning and heating. This evidence is consistent with the results reported in Table 2, illustrating that relaxed liquidity constraints are a probable explanation for the positive impact of pension income receipts on health.[11]

Heterogeneity analysis by age

As shown in Table A3, we conducted additional heterogeneity analyses. First, we examined whether the impact on mortality varied across different age groups. As the underlying health status generally deteriorates as individuals age, the impact of pension income on health could be heterogeneous by age. We considered three age groups: 65–75 years, 76–85 years, and above 85 years in columns (1), (2), and (3), respectively. The results indicate that older adults' mortality rates generally decline in the week of and one week after the pension income disbursement date regardless of age. The mortality rates drop immediately after receiving a pension payout by 1.9 percent, 2.1 percent, and 2.3 percent relative to those in the prior week among older adults aged 65–75 years, 76–85 years, and above 85 years, respectively. The estimates were statistically significant at the 10 percent, five percent, and 10 percent levels, respectively, for each age group. In the following week, the mortality rates were still lower than those in the week before the disbursement date by 1.2 percent, 1.5 percent and 1.9 percent for older adults aged 65–75 years, 76–85 years, and older than 85 years, respectively. Only the latter two estimates were statistically significant at the 10 percent and five percent levels, respectively. Regardless of the age group, we did not find any statistically significant impact two weeks prior to the disbursement date. In summary, we found that the short-term impact of pension income receipts on mortality is greater as individuals age.[12]

5.3. Short-term Effects of Pension Income Receipt on Card Spending

[11] The results are in line with the previous studies showing that cheaper energy prices or heating subsidies improves health (including mortality) among low-income households (Crossley and Zilio, 2018; Chirakijja et al., 2021).

[12] In addition to the heterogeneity by age, we estimate the heterogeneous mortality impact by sex. We find relatively larger and more persistent impacts among females. This difference is likely to reflect the fact that female decedents are significantly older, less-educated, and less likely to be married than male ones.

The PIH-LC framework predicts that a pension payout can reduce the mortality rate in the short run by relaxing the liquidity constraint. We investigated this implication by demonstrating how older adults' consumption spending changes around the disbursement date of pension income. To do so, we used proprietary transaction data from the largest credit card company in Korea with a market share of 22 percent.[13]

One limitation of this dataset is that it only provides information on daily total credit and debit card expenditure in Seoul from January 2017 onward, and on cardholders' age only in the 10-year interval (e.g., 60–69 years).[14] In contrast, our baseline analysis represents mortality trends of older adults aged 65 years or older, regardless of their residence, during 2012–2019. To address this limitation, we first examined whether the short-term impact of pension income receipts on the mortality of Seoul residents aged 60 years or older from 2017 to 2019 are similar to those of the baseline analysis. Figure A3 shows that changes in the daily mortality rate had a short-term trend similar to that of the baseline sample. The mortality rate begins to decrease a few days prior to the disbursement date, although the estimates are statistically insignificant, which might reflect individuals' anticipation of pension income receipts. Upon receiving the monthly pension income, older adults' mortality rate further decreases for almost a week and gradually rebounds to the level it was 14 days prior to the disbursement date.

We then estimated the short-term impact on card spending after the pension income disbursement date using data comprising of the card transactions of Seoul residents aged 60 and above in Figure 3. Panel A shows that the logarithm value of card spending slightly increases after the disbursement date and reverts to the pre-disbursement level, whereas all estimates are statistically insignificant. Panel B shows that card spending on groceries or food begins to increase a few days before the disbursement date and continues to increase over the next several days. It then reverts to its pre-disbursement level. These results imply that improved nutrition might be one possible pathway through which pension income receipts decreased the mortality rate. Panel C indicates that card spending on healthcare decreases before the disbursement date and smoothly reverts to the average card spending level as it approaches the disbursement date. We also found similar patterns of healthcare utilization using data on administrative healthcare claims from the National Health Insurance Service in

[13] Stephens (2003) demonstrated that older adults' consumption spending sharply increased immediately after the receipt of a Social Security paycheck in the US using the Consumer Expenditure Survey data. Korean household spending survey data do not provide information on daily consumption spending. The card transaction data access is given through the Seoul Metropolitan City Government's Big Data Campus office.
[14] The card transaction data do not provide information on household income.

Figure A4. These results are inconsistent with the findings of the previous studies in the US. One possible explanation is that older adults might intertemporally substitute their healthcare spending over the billing cycle without deteriorating their health because the Korean government administers a universal health insurance program with a more extensive coverage for older adults.

5.4. Short-term Morality Impact based on Causes of Death

We studied the impact of pension income receipts on mortality based on causes of death. Table 4 shows that impact on mortality after receiving pension income is heterogeneous by cause of death, whereas it does not indicate any statistically significant impact two weeks prior to the disbursement date regardless of the cause. Column (1) focuses on deaths related to substance abuse. We applied the definition used by Phillips et al. (1999) to ensure consistency with the terminology used in previous studies. This indicates that mortality due to substance abuse decreases in the week of and one week after receiving a pension payout by 15.3 percent and 12.5 percent, respectively, which are both statistically significant at the five percent level. This implies that in our setting, an increase in income translates to lower mortality via a reduction in substance use. These results are contrary to those of previous studies that reported that pension income receipts increased deaths due to substance abuse (Evan and Moore, 2012; Andersson et al., 2015). One possible explanation to reconcile the difference between our study results and those of previous studies is that additional income via receipts of pension benefits enabled substance users to pursue medical assistance.

Second, we examined how mortality due to external causes, such as vehicular accidents and other external causes, varies within the billing cycle as relaxed liquidity constraints could increase individuals' economic activities, thereby increasing mortality risk (Evans and Moore, 2012).[15] Column (2) shows that mortality due to vehicular accidents increases in the week of and one week after the receipt of pension income by 16.4 and 10.9 percent, respectively, and are statistically significant at the five percent and 10 percent levels. The results are similar to those of previous studies (Evan and Moore, 2012; Andersson et al., 2015), which provide supplementary evidence that pension income receipts reduced liquidity constraints. However, column (3) presents little evidence that pension income receipts increases mortality due to other external causes.

[15] Other external causes include falls, accidental drowning and submersion, exposure to smoke, fire and flames, and accidental poisoning by and exposure to noxious substances.

Third, in columns (4)–(6), we presented the effects of pension receipts on the logarithm values of mortality counts due to cancer, diabetes, and lower respiratory diseases. As these are chronic health conditions, it is difficult to interpret the estimation results as a short-term impact of income on the incidence of these causes. Instead, the results capture the short-term impact on health among those with the aforementioned underlying health conditions. Column (4) shows that the mortality rate among those with cancer immediately decreases in the week of and one week after the receipt of the pension income by 3.1 percent 2.6 percent, respectively. The estimates are statistically significant at the five percent level. Columns (5) and (6) show little evidence that pension income receipts are associated with mortality rates among individuals with diabetes and lower respiratory diseases.

Fourth, to further examine the relationship between pension payouts and mortality due to the incidence of health conditions, we estimated the short-term effects of pension income disbursement on mortality due to acute health conditions, such as heart disease, cerebrovascular disease, pneumonia, and hypertensive disease. Columns (7) and (8) document little evidence of a relationship between pension income payouts and mortality due to health and cerebrovascular diseases. However, columns (9) and (10) indicate that mortality due to pneumonia or hypertensive disease decreases immediately after the receipt of pension income. The mortality rate due to pneumonia decreased by 4.1 percent in the week of pension income disbursement, which is statistically significant at the five percent level. The mortality rate due to hypertensive disease decreased by six and 8.2 percent, respectively, in the week of and one week after receiving a pension payout. The estimates were statistically significant at the 10 percent and five percent levels.

Finally, to conduct an additional falsification test, we investigated how mortality due to Alzheimer's disease evolves within the billing cycle. Individuals with Alzheimer's may have trouble understanding the monthly payment cycle of their pension income due to their mental illness. This implies that the mortality rate due to Alzheimer's disease would not differ before and after the disbursement date if our baseline estimate captured the true relationship between the mortality rate and the receipt of pension income. Consistent with this conjecture, column (11) demonstrates that mortality due to Alzheimer's does not have a statistically significant relationship with pension income receipts.

5.5. Relationship between the Business Cycle and Mortality

Since Ruhm's (2000) seminal work on procyclical mortality observed in the US, much research has been conducted to understand the sources of the seemingly puzzling patterns of the data. Previous studies, such as Evans and Moore (2011) and Andersson et al. (2015), argue that the procyclical relationship between mortality and income within the billing cycle could be a potential mechanism that explains the procyclical relationship between mortality and income over the business cycle.

In this subsection, we extrapolated this argument to the context of this study. We did not find evidence of a procyclical relationship between mortality and income over the billing cycle. If the relationship between mortality rate and income within the billing cycle can be a pathway for the relationship between mortality rate and income over the business cycle, as suggested by previous studies, we conjectured that we might not find evidence of procyclical relationships between mortality and income over the business cycle in Korea. In fact, Lee and Kim (2017) document that the mortality rate had a counter-cyclical relationship with the business cycle in Korea during 2002–2012. To further test whether a similar relationship is observed during our baseline sample period, we estimated the relationship between mortality rate, unemployment rate, and GDP during 2012–2019. For details on the econometric specification, see Appendix A.

Table 5 shows that the relationship between macroeconomic conditions and mortality rate are not pro-cyclical. Panel A indicates that the estimated relationship between province-level unemployment rate and mortality rate are small in magnitude and statistically insignificant. As an alternative measure for macroeconomic conditions, we used the logarithm value of province-level GDP. Panel B presents that the estimated relationships between the logarithm value of GDP and mortality rates are small in magnitude and statistically insignificant. This finding, combined with the previous studies (Evans and Moore, 2011; Andersson et al., 2015), implies that a short-term mortality impact of income can be an important pathway through which macroeconomic conditions are related with the mortality rate.

6. Conclusion

We examined how the receipt of public pension benefits affects older adults' mortality rate within the monthly billing cycle by exploiting that the disbursement date of public pension benefits falls on the 25th of every month in Korea. Using the national death registry data, we documented that the receipt of public pension income has a positive short-term impact on

health. The mortality rate decreased by two percent in the week of the disbursement date compared to the prior week. Although smaller, the mortality impact (1.6 percent) remained statistically significant in the following week. To study possible mechanisms, we found evidence that pension income receipts improved health via relaxed liquidity constraints: i) the impact on health is greater among older adults with tighter liquidity constraints (measured by educational attainment levels or marital status) or when they experience tighter credit constraints (e.g., waiting longer for the next disbursement or during the summer/winter season with greater demands for air conditioning/heating), and ii) older adults' card spending for foods and groceries immediately increases after the disbursement date. As an additional mechanism, we showed that the unintended morality consequences of income gain, such as substance-related death, do not occur. Given the prevalence of poverty among older adults in Korea, this study provides novel evidence of the positive short-term health impact of pension income receipts in a country with more serious older adult poverty issues.

We acknowledge the limitations of this study. Our study focused only on the mortality impact of public pension income among older adults. We did not include information on individual paydays of the public and private sectors. Due to the large variations that exist across workplaces, we could not assess the impact of regular wage income on mortality.

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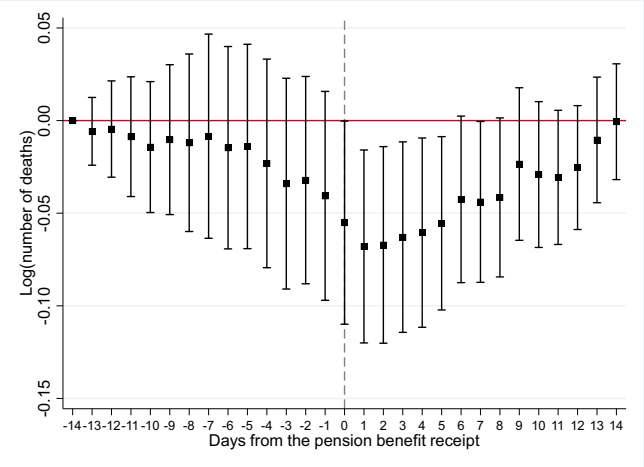
Figures and Tables

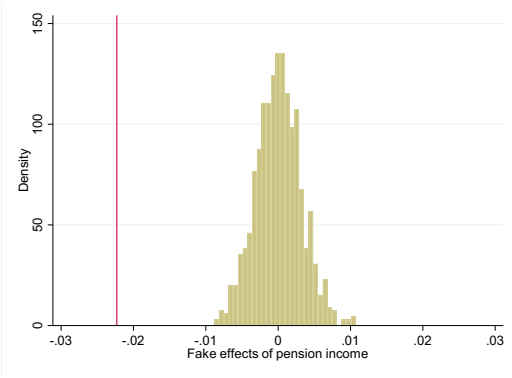
Figure 1. Short-term Daily Mortality Impact of Pension Receipt



Data source: The Korean Causes of Death Statistics data, May 2012–December 2019
Notes: We restricted the sample to those aged 65 or older. We also restricted the sample to +/- 14 synthetic days from the pension disbursement date. We plotted the estimated changes in the logarithm value of daily mortality counts over the billing cycle after controlling for calendar day, public holiday, day-of-week, synthetic month, and synthetic year fixed effects. The black squares represent the estimated changes in mortality compared to 14 days prior to the pension income disbursement date. Standard errors were clustered at the synthetic month and year levels. Caps indicate 95 percent confidence intervals.

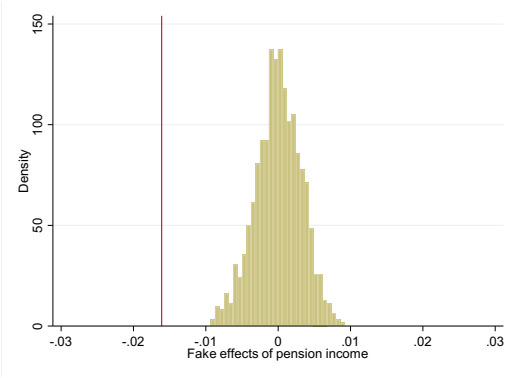
Figure 2. Distribution of Estimates of Fictitious Pension Income Receipt

A. In the week of pension income disbursement date



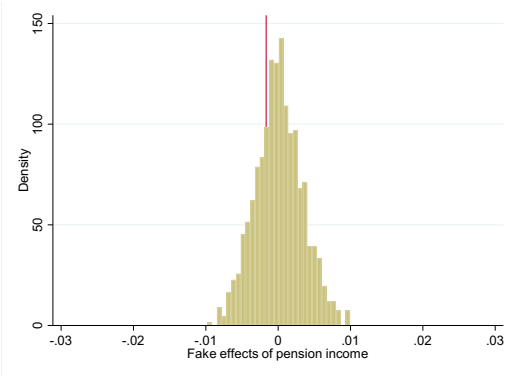
Pr(fictitious effects ≤ -0.0223)=0.000

B. One week after pension income disbursement date



Pr(fictitious effects ≤ -0.0161)=0.000

C. Two weeks prior to pension income disbursement date

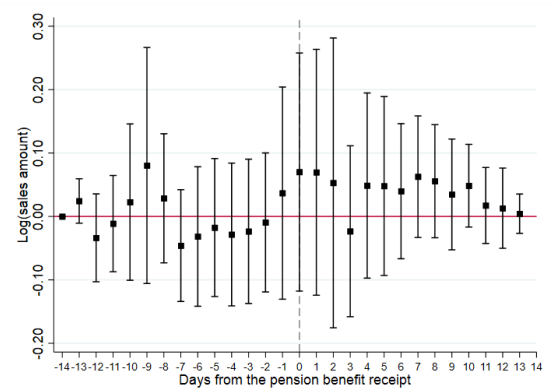


Pr(fictitious effects ≤ -0.00166)=0.291

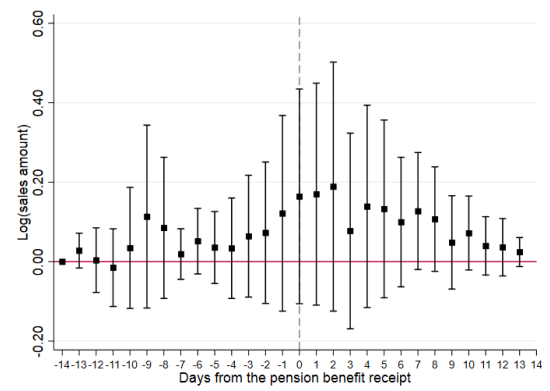
Data source: The Korean Causes of Death Statistics, May 2012–December 2019
Notes: We restricted the sample to those aged 65 or older. We also restricted the sample to +/-14 synthetic days from the pension disbursement date. We estimated changes in the logarithm value of morality counts compared to those in the week prior to the pension benefit receipt. For the control variables, we included day-of-week, public holiday, synthetic year and synthetic month fixed effects. In Panels A to C, we plotted the distributions of fake effects of pension income receipt on the mortality rate in the week of pension income disbursement date, one week after the receipt, and two weeks prior to the receipt, respectively. The vertical lines indicate the baseline estimates of the short-term mortality impacts of pension income receipt.

Figure 3. Short-term Card Spending Impact of Pension Receipt

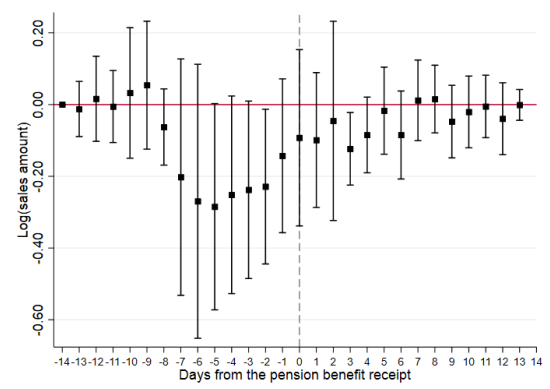
A. Total card spending



B. Card spending for groceries or food



C. Card spending for medical treatment



Data source: Offline card transaction data in Seoul from Shinhan Card, January 2017–December 2019
Notes: We restricted the sample to those aged 60 or older. We also restricted the sample to +/-14 synthetic days from the pension disbursement date. We plotted the estimated changes in the logarithm value of total card spending (Panel A), spending on food or groceries (Panel B), and care spending for healthcare (Panel C) over the billing cycle after controlling for calendar day, public holiday, day-of-week, synthetic month, and synthetic year fixed effects. Standard errors were clustered at the synthetic month and year levels. Caps indicate 95% confidence intervals.

Table 1. Short-term Mortality Impact of Pension Receipt

	(1)	(2)	(3)	(4)	(5)	(6)
Payweek(-2)	-0.00158	-0.00377	0.00265	-0.00192	-0.00010	0.00344
	(0.00886)	(0.00550)	(0.0113)	(0.00925)	(0.00877)	(0.0170)
Payweek(0)	-0.0219***	-0.0119**	-0.0192***	-0.0209**	-0.0218***	0.0149
	(0.00685)	(0.00501)	(0.00693)	(0.00796)	(0.00638)	(0.0152)
Payweek(1)	-0.0159**	-0.00929	-0.0131*	-0.0138	-0.0160**	0.00812
	(0.00672)	(0.00575)	(0.00735)	(0.0101)	(0.0065)	(0.0123)
Payweek(2)				0.00654		
				(0.0160)		
Observations	2,627	2,627	2,627	2,769	2,627	2,080
R-squared	0.731	0.730	0.748	0.729	0.739	0.813
Periods	2012–2019	2012–2019	2012–2019	2012–2019	2012–2019	1983-1988
Calendar day FE	Y		Y	Y	Y	Y
Calendar week FE		Y				
Calendar month FE			Y			
Calendar year FE			Y			
Add 60-64 years					Y	

Data source: The Korean Causes of Death Statistics, May 2012–December 2019 for columns (1) to (5) and January 1983–December 1988 for column (6).

Notes: We restricted the sample to those aged 65 or older. In columns (1) to (3), we restricted the sample to +/-14 synthetic days from the pension disbursement date. Column (4) includes the entire sample and estimates the effects of the last pay-week on mortality. We estimated the change in the logarithm value of morality counts compared to that in the week prior to the pension benefit receipt. For the control variables, we included day-of-week, public holiday, synthetic year and synthetic month fixed effects. We calculated the standard errors clustered at the synthetic year and monthly levels. *** p<0.01, ** p<0.05, * p<0.1.

Table 2. Short-term Mortality Impact of Pension Receipt
by Education Attainment Level and Marital Status

Characteristics:	Education attainments		Marital Status	
Groups:	HS graduate and below	Above HS	Married	Not married
	(1)	(2)	(3)	(4)
Payweek(-2)	-0.00356	-0.0200	0.00389	-0.00536
	(0.00922)	(0.0219)	(0.0112)	(0.00988)
Payweek(0)	-0.0254***	-0.00420	-0.0189**	-0.0248***
	(0.00687)	(0.0210)	(0.00892)	(0.00849)
Payweek(1)	-0.0168**	0.00468	-0.00861	-0.0216**
	(0.00660)	(0.0213)	(0.00928)	(0.00888)
Observations	2,627	2,627	2,627	2,627
R-squared	0.647	0.622	0.589	0.683

Data source: The Korean Causes of Death Statistics, May 2012–December 2019

Notes: HS denotes high (secondary) school. We restricted the sample to those aged 65 or older. We also restricted the sample to +/-14 synthetic days from the pension disbursement date. We estimated the change in the logarithm value of morality counts compared to that in the week prior to the pension benefit receipt. For the control variables, we included day-of-week, public holiday, synthetic year and synthetic month fixed effects. We calculated the standard errors clustered at the synthetic year and monthly levels. *** p<0.01, ** p<0.05, * p<0.1

Table 3. Short-term Mortality Impact of Pension Receipt
By the Length of Billing Cycle and Season

Categories:	Length of billing cycle		Season		
Groups:	28–30 days	31–34 days	Summer	Winter	Spring/Autumn
	(1)	(2)	(3)	(4)	(5)
Payweek(-2)	0.00433	-0.0239	-0.0119	0.0200	-0.0111
	(0.0131)	(0.0146)	(0.0225)	(0.0213)	(0.0115)
Payweek(0)	-0.0234**	-0.0277**	-0.0361**	-0.0305**	-0.0145
	(0.00883)	(0.0128)	(0.0137)	(0.0134)	(0.0119)
Payweek(1)	-0.0109	-0.0245*	-0.0287***	-0.0286**	-0.0107
	(0.00738)	(0.0127)	(0.00924)	(0.0104)	(0.00907)
Observations	1,358	1,269	695	601	1,331
R-squared	0.721	0.772	0.722	0.636	0.663

Data source: The Korean Causes of Death Statistics, May 2012–December 2019

Notes: We restricted the sample to those aged 65 or older. We also restricted the sample to +/-14 synthetic days from the pension disbursement date. We estimated the change in the logarithm value of morality counts compared to that in the week prior to the pension benefit receipt. For the control variables, we included day-of-week, public holiday, synthetic year and synthetic month fixed effects. We calculated the standard errors clustered at the synthetic year and monthly levels. *** p<0.01, ** p<0.05, * p<0.1

Table 4. Short-term Mortality Impact of Pension Receipt
by Cause of Death

Cause of death:	Substance abuse	External causes		Chronic condition			Acute condition				Alzheimer's disease
Specific cause:		Transport accidents	Other external causes	Any cancer	Diabetes	Lower respiratory diseases	Any heart disease	Cerebro-vascular diseases	Pneumonia	Hypertensive diseases	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Payweek(-2)	-0.012	-0.009	-0.047	0.003	0.023	-0.005	-0.033	0.017	-0.031	0.0007	0.061
	(0.072)	(0.062)	(0.066)	(0.012)	(0.033)	(0.039)	(0.020)	(0.017)	(0.029)	(0.048)	(0.038)
Payweek(0)	-0.153**	0.164**	-0.077	-0.031**	0.027	-0.001	-0.012	-0.032	-0.041**	-0.060*	0.003
	(0.066)	(0.064)	(0.066)	(0.012)	(0.031)	(0.030)	(0.014)	(0.021)	(0.020)	(0.033)	(0.032)
Payweek(1)	-0.125**	0.109*	-0.030	-0.026**	0.003	-0.030	-0.023	-0.019	-0.022	-0.082**	0.020
	(0.051)	(0.062)	(0.058)	(0.012)	(0.030)	(0.033)	(0.018)	(0.018)	(0.020)	(0.035)	(0.033)
Observations	2,603	2,620	2,595	2,627	2,627	2,627	2,627	2,627	2,627	2,627	2,627
R-squared	0.082	0.124	0.087	0.301	0.294	0.227	0.543	0.352	0.769	0.198	0.396
Mean daily death	5.0	6.2	4.8	146.7	22.1	17.8	64.1	54.0	41.9	13.8	13.5

Data source: The Korean Causes of Death Statistics, May 2012–December 2019

Notes: We restricted the sample to those aged 65 or older. We also restricted the sample to +/-14 synthetic days from the pension disbursement date. We estimated the change in the logarithm value of morality counts compared to that in the week prior to the pension benefit receipt. For the control variables, we included day-of-week, public holiday, synthetic year and synthetic month fixed effects. We calculated the standard errors clustered at the synthetic year and monthly levels. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Associations between Macroeconomic Conditions and Mortality Rate

Age groups:	25 years or older	25-64 years	65 years or older
	(1)	(2)	(3)
A. Measure for macroeconomic condition: unemployment rate			
Unemployment rate	0.014	0.014	-0.008
	(0.034)	(0.034)	(0.005)
Observations	128	128	128
R-squared	0.996	0.996	0.999
B. Measure for macroeconomic condition: log(GDP)			
Log(GDP)	-0.161	-0.161	-0.137
	(0.436)	(0.436)	(0.096)
Observations	128	128	128
R-squared	0.996	0.996	0.999

Data source: The Korean Causes of Death Statistics, 2012–2019

Notes: We calculated heteroskedasticity-robust standard errors. *** p<0.01, ** p<0.05, * p<0.1

Appendix

A. Econometric Specification for the Relationship between the Business Cycle and Mortality

To estimate the relationship between macroeconomic conditions and mortality, we considered the following regression specification, commonly used in the literature, using 2012–2019 CODS data:

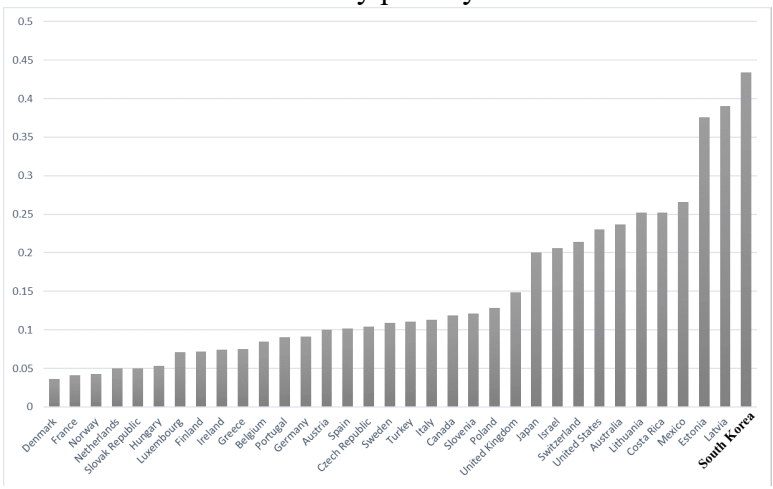
$$log(mortality)_{i,t} = \alpha UNEMP_{i,t} + \lambda_i + \mu_t + X'_{i,t}\gamma + \epsilon_{i,t}, \qquad (A.2)$$

where i and t indicate the province and calendar years, respectively. $log(mortality)_{i,t}$ represents the logarithm value of the total number of deaths in province i and year t among individuals aged 25 years or older. As the mortality impacts can differ between the working-age population and older adults, we also considered the logarithm value of the total number of deaths among individuals aged 25–64 years and 65 years or older. We used these age groups to maintain consistency with the analysis in Section 5.1. However, using mortality rates among individuals aged 19 years or older and 19–64 years yielded similar results. $UNEMP_{i,t}$ represents the annual unemployment rate among the working-age population aged 19–64 years in province i and year t. λ_i and μ_t indicate province and year fixed effects, respectively, to account for province-specific and year-specific heterogeneity in mortality rate. $X_{i,t}$ includes the time-varying characteristics of provinces, such as the average age of residents, the average years of education, the share of females, and province-specific time trends. $\epsilon_{i,t}$ indicates an error term. We ran a regression using the total population in province i and year t as analytical weights. We used data from the Population Projection of Korea and the Economically Active Population Survey to calculate the province-level unemployment rate and the aforementioned province-specific characteristics, respectively. α is the parameter of interest that captures the associations between macroeconomic conditions and mortality rate. For statistical inference, we calculated the standard errors clustered at the province-level.

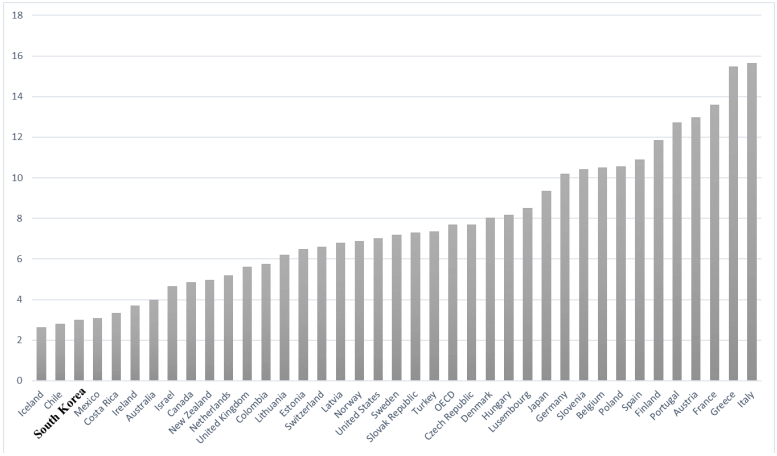
B. Supplementary Figures and Tables

Figure A1. Older Adults' Poverty Rate and Public Pension Spending for Older Adults among OECD Countries

A. Elderly poverty rate



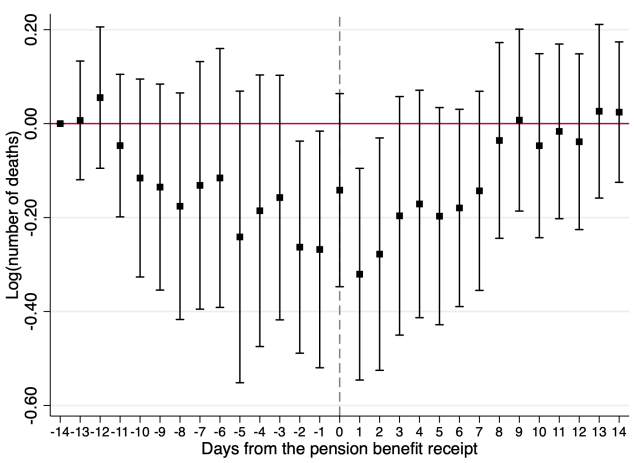
B. Old-age and survivor pension spending as a percentage of GDP



Data source: OECD (2022), Poverty rate (indicator). doi: 10.1787/0fe1315d-en (Accessed on 12 January 2022) for panel A and Pension spending (indicator). doi: 10.1787/a041f4ef-en (Accessed on 28 March 2022) for panel B.

Notes: The poverty rate is the ratio of the number of people (aged 66 and above) whose income falls below the poverty line (half of the median household income of the total population). Pension spending is defined as all cash expenditures (including lump-sum payments) on old-age and survivors pensions.

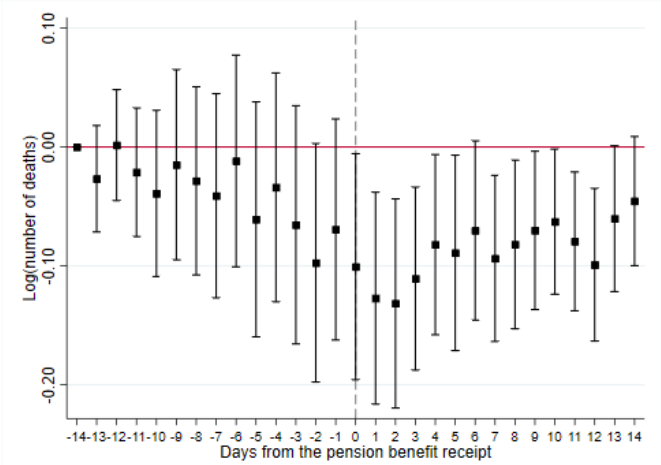
Figure A2. The Average Logarithm Value of Daily Suicide Counts over the Pension Billing Cycle



Data source: The Korean Causes of Death Statistics data, May 2012–December 2019
Notes: We restricted the sample to those aged 65 or older. We also restricted the sample to +/-14 synthetic days from the pension disbursement date. We plotted the estimated changes in the logarithm value of daily mortality counts over the billing cycle after controlling for calendar day, public holiday, day-of-week, synthetic month, and synthetic year fixed effects. Black squares represent the estimated changes in mortality compared to 14 days prior to the pension income disbursement date. Standard errors were clustered at the synthetic month and year levels. Caps indicate 95% confidence intervals.

Figure A3. The Average Logarithm Value of Daily Mortality Counts over the Pension Billing Cycle

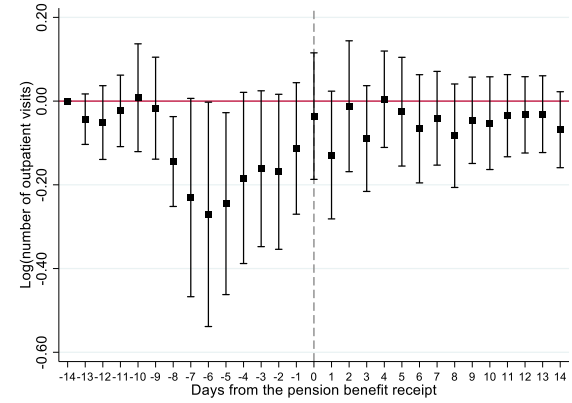
Among Seoul Residents during 2017-2019



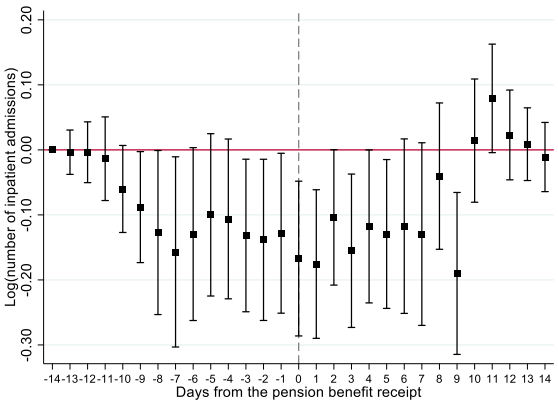
Data source: The Korean Causes of Death Statistics data, January 2017–December 2019
Notes: We restricted the sample to Seoul residents aged 65 or older. We also restricted the sample to +/-14 synthetic days from the pension disbursement date. We plotted the estimated changes in the logarithm value of daily mortality counts over the billing cycle after controlling for calendar day, public holiday, day-of-week, synthetic month, and synthetic year fixed effects. Black squares represent the estimated changes in mortality compared to 14 days prior to the pension income disbursement date. Standard errors were clustered at the synthetic month and year levels. Caps indicate 95% confidence intervals.

Figure A4. Short-term Healthcare Utilization Impact of Pension Receipt

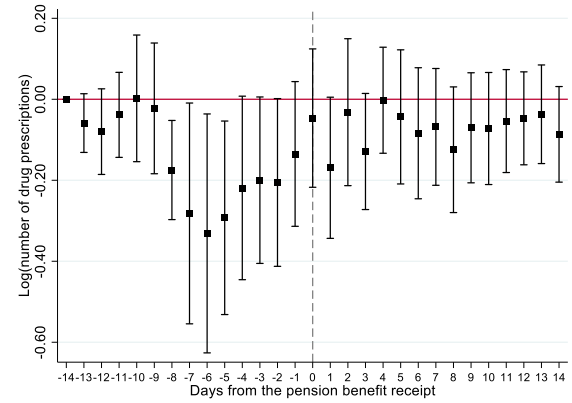
A. Outpatient visits



B. Inpatient admissions



C. Drug prescriptions



Data source: Administrative healthcare claims data from the Korean National Health Insurance Service, May 2012–December 2019

Notes: We restricted the sample to those aged 65 or older. We also restricted the sample to +/-14 synthetic days from the pension disbursement date. We plotted the estimated changes in the logarithm value of outpatient visits (Panel A), inpatient admissions (Panel B), and drug prescriptions (Panel C) over the billing cycle after controlling for calendar day, public holiday, day-of-week, synthetic month, and synthetic year fixed effects. Standard errors were clustered at the synthetic month and year levels. Caps indicate 95% confidence intervals.

Table A1. Summary Statistics

	All (1)	65 and over (2)
Death		
Total number of deaths	2,140,031	1,602,037
Number of daily deaths	764	572
Characteristics		
Age of Death	73.2	80.8
Share of male	0.55	0.49
Share of married	0.46	0.45
Share of non-employed	74.4	81.6
Schooling year	7.47	6.30

Data source: The Korean Causes of Death Statistics, May 2012–December 2019

Table A2. Distribution of the Frequent Causes of Deaths among the Elderly

Cause of death	Proportion (%)
Cancer	25.68
Heart diseases	11.23
Cerebrovascular diseases	9.43
Pneumonia	7.35
Diabetes mellitus	3.85
Chronic lower respiratory diseases	3.10
Hypertensive diseases	2.43
Alzheimer's disease	2.38
Suicide	1.75
Septicaemia	1.45
All others	31.35
Total	100.0

Data source: The Korean Causes of Death Statistics, May 2012–December 2019
Note: We restricted the sample to those aged 65 or older.

Table A3. Short-term Mortality Impact of Pension Receipt by Age

Groups:	65-75 years	76-85 years	Older than 85 years
	(1)	(2)	(3)
Payweek(-2)	0.0193	-0.00679	-0.0113
	(0.0125)	(0.0105)	(0.0107)
Payweek(0)	-0.0191*	-0.0212**	-0.0225*
	(0.00997)	(0.00890)	(0.0119)
Payweek(1)	-0.0118	-0.0147*	-0.0191**
	(0.0116)	(0.00837)	(0.00957)
Observations	2,627	2,627	2,627
R-squared	0.376	0.654	0.788

Data source: The Korean Causes of Death Statistics, May 2012–December 2019

Notes: We restricted the sample to those aged 65 or older. We also restricted the sample to +/-14 synthetic days from the pension disbursement date. We estimated the change in the logarithm value of morality counts compared to that in the week prior to the pension benefit receipt. For the control variables, we included day-of-week, public holiday, synthetic year and synthetic month fixed effects. We calculated the standard errors clustered at the synthetic year and monthly levels. *** p<0.01, ** p<0.05, * p<0.1.