Short-term Mortality Impact of Public Pension Programs: Evidence from South Korea[1]

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Abstract

We examine the short-term impact of pension income receipt on mortality within the monthly payment cycle. Using the national death registry data of South Korea, we document that the mortality rate decreases by 1.2–1.4 percent in the week of the disbursement date. The mortality-reducing effects are larger for causes of death that could have been avoided through timely and effective healthcare interventions and among those with lower educational attainment. We provide suggestive evidence of greater mortality-reducing effects from a smaller but more frequent disbursement than from a monthly disbursement.

Keywords: public pension, mortality, older adults, card spending, healthcare utilization

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1. Introduction

Many governments operate direct cash transfers to improve their citizens' welfare by providing income insurance as a consumption smoothing mechanism, often on a monthly basis. While the life-cycle/permanent income hypothesis (LCPIH) predicts smooth spending responses within the payment cycle, Stephens (2003) documents evidence of non-smooth spending response to regular income receipt: pension beneficiaries increase spending immediately after receiving a monthly US Social Security payment check and gradually decrease spending until the next payment. This result suggests potential short-term impacts on other major life outcomes via uneven allocations of economic resources within the payment cycle. Previous studies such as Dobkin and Puller (2007), Evans and Moore (2012), and Andersson et al. (2015) demonstrate that hospital admissions and mortality related to substance abuse and accidents increased immediately after the receipt of a public cash transfer or a paycheck.

In this paper, we revisit the literature by investigating the mortality impact of monthly receipt of public pension benefits among older adults in South Korea (hereafter, Korea).[5] For the empirical analysis, we leverage the fact that public pension benefits have been disbursed on the 25th day of each month since May 2012. We argue that the Korean context provides a unique opportunity to better understand the mortality consequences of pension income receipt within the monthly payment cycle.

First, Korea's poverty rate (43.2%) of older adults is the highest among OECD countries as shown in Panel A of Figure A1. It has experienced rapid population aging over the last few decades, while Panel B of Figure A1 suggests that social insurance and welfare programs have not been able to keep up with the demographic change (Ahn et al., 2021; Koh and Yang, 2021). This has resulted in acute old-age poverty problems and forced older adults in Korea to continue to engage in the labor market and temporary work for subsistence needs (Panels C and D of Figure A1). These stylized facts suggest that Korean older adults could be more "liquidity-sensitive" and thus they are more likely to forgo necessary spending and health

[5] We acknowledge that several studies on the causal effects of income on health have exploited exogenous variations in income (e.g., German reunification, lottery wins, and unconditional cash transfer experiments) and documented mixed evidence (Frijters et al., 2005; Evans and Garthwaite, 2014; Cesarini et al., 2016; Haushofer and Shapiro, 2016; Kangas et al., 2019; Kim and Koh, 2021). However, unlike unexpected and isolated income shocks, the primary sources of regular household income for the working-age population and older adults are salary and pension benefits, respectively. Therefore, it is important to examine how the receipt of regular income sources affects individuals' health to better understand welfare consequences of income gains.

care (Gross et al., 2022).[6] As the impact of income on health is greater among low-income groups under the classical health production theory (Grossman, 1972), the positive health impact of income receipt among Korean older adults may be larger compared to other developed countries.

Second, the negative health impact of income receipt due to risky health behaviors could be small in Korea. Previous studies have documented healthcare utilization and mortality due to substance abuse as an important channel through which pension or welfare benefit receipt worsens beneficiaries' health (Dobkin and Puller, 2007; Evans and Moore, 2012; and Andersson et al., 2015). However, substance abuse has not been considered a serious 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.[7] This suggests that the negative health impact of income receipt can be small in Korea.

We first examine older adults' card spending and healthcare utilization responses to pension income receipt within the monthly payment cycle. Consistent with the existing literature (Stephens, 2003; Gross et al., 2022), we show that card spending and healthcare utilization, measured by the number of inpatient admissions, outpatient visits and drug prescriptions, increase immediately after the receipt of pension income, using proprietary card transaction data and administrative healthcare claims data.

Then, we document evidence of the positive short-term impact of income receipt on health using individual-level mortality data between May 2012 and December 2019. We find that older adults' mortality rate decreases by 1.2–1.4 percent in the first week of disbursement (i.e., over the first seven days from the benefit receipt) compared to the prior week. The mortality impact becomes weaker but still negative in the following week. Then it reverts to zero until they receive the next disbursement. The analysis by cause of death indicates that the mortality-reducing effect of pension income receipt is larger on deaths caused by potentially treatable conditions through timely and effective healthcare interventions and acute and chronic conditions. We find little evidence that pension income receipt raises the likelihood of deaths due to substance abuse. We also find a larger decrease in the mortality after the pension

[6] Previous studies have also suggested potential mechanisms for the positive health impact of income within the billing cycle among older adults or low-income households even in the same setting as the previous studies. For example, Gross et al. (2022) show that the receipt of a monthly Social Security check immediately increases prescription drug spending among low-income Medicare beneficiaries.
[7] We follow Evans and Moore (2011) to define substance-abuse related deaths.

income receipt among older adults with lower educational attainment who depend more on pension income for post-retirement spending needs.

The immediate spending responses to pension income receipt can also be explained by behavioral factors such as short-run impatience and financial planning failure other than liquidity constraints (Shapiro, 2005; Campbell, 2006). This conjecture suggests that beneficiaries' spending could have over-responded to the income receipt beyond the point where there is no additional health benefit. As such, there has been a debate about whether smaller but more frequent disbursements could be a more effective budget-neutral policy alternative (Shapiro, 2005; Puller and Dobkin, 2007). To test this hypothesis in our setting, we compare the effect of pension income when different pension benefits were disbursed on two different days of the month (before May 2012) instead of on the identical date of the month (May 2012 onward). We find suggestive evidence that the mortality-reducing effect of pension income receipt becomes larger when it was disbursed on two different days of the month, supporting the advantage of frequent disbursements.

Our study contributes to the literature by providing novel evidence on the short-term health impact of regular income receipt. First, we shed new light on the beneficial role of pension income for health, while previous studies show evidence of the adverse health impact. In addition to direct (but small) welfare loss due to non-smooth spending responses (Cochrane, 1989; Shapiro, 2005), previous studies document evidence implying that the welfare loss can be exacerbated because income receipt increases hospital admissions and mortality related to substance abuse and accidents (Riddell and Riddell, 2006; Dobkin and Puller, 2007; Evans and Moore, 2012; Andersson et al., 2015).[8] However, our findings indicate that the mortality impact of pension income receipt can be heterogeneous by underlying contexts. Thus, the short-term health consequence of income receipt may not always lead to a larger welfare loss.

Second, our study contributes to the literature by providing new suggestive evidence on health impacts of smaller but more frequent disbursements. The previous studies such as Shapiro (2005) and Dobkin and Puller (2007) argue that smaller but frequent disbursements can improve welfare by reducing unnecessary drug-related hospitalizations and deaths. Aguila et al. (2017) find that monthly disbursements lead to better consumption smoothing than disbursements occurring every two months in Mexico, suggesting the importance of accounting for behavioral factors to design an efficient budget-neutral policy alternative. Stephens and

[8] Evans and Moore (2012) and Andersson et al. (2015) show that the mortality rates due to traffic accidents and some acute health conditions (e.g., heart disease and stroke) also increased after income receipt.

Unayama (2011) document that households' spending responses to public pension receipt become smoother when its disbursement frequency changed from quarterly to bimonthly in Japan. To the best of our knowledge, there has been little empirical evidence on the health impact of such a policy alternative. We fill this gap in the literature by exploiting a unique policy change regarding disbursement schedules in Korea. Our suggestive evidence indicates that mortality-reducing effects of pension income may be greater with the smaller but more frequent disbursements of pension income than under a once-a-month disbursement.

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 results. Section 6 concludes.

2. Background

Public Pension Programs in Korea

Korea operates a social security program 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. 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 been raised by 2.4 months each year in order to reach 65 by 2033. As of July 2023, the average monthly NP (old-age) benefit amount was KRW 524,033 (US$396).[9] 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 323,180 (US$244).[10] 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

[9] The average NP benefit amounts for dependents (survivors) and disabled workers are KRW 280,206 (US$ 212) and KRW 507,143 (US$383), respectively. As of 2023, old-age, survivor, and disability beneficiaries account for 90.3 percent, 8.6 percent, and 1.1 percent of the NP program, respectively (National Pension Service, 2023).
[10] As of 2023, the value of monthly equivalent income (a function of labor income, other incomes, and household assets) must be below KRW 2.02 million (US$1,525) for single households and KRW 3.23 million (US$2,441) for married households to be eligible for the BP benefits.

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.[11] Consequently, since June 2009, the disbursement date of the BP program has also been changed from the last day to the 25th of the month.[12] As a result, all public pension programs have disbursed pension benefits on the 25th of the month since May 2012. 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. We use this recurring monthly pension benefit payout date to investigate the short-term impact of income receipts on mortality among older adults aged 65 and over.

Healthcare System in Korea

Korea operates a single-payer universal health insurance system called the National Health Insurance (NHI). The enrollment is mandatory and covers a wide variety of treatments (outpatient visits, hospital stay, vision and dental care, traditional Korean medicine, etc.) and drugs. If an enrollee is self-employed or not working, the insurance premium is determined by their economic means. If an enrollee is working for pay, it is jointly borne equally by the employer and employee (3.825% each). To avoid overutilization of healthcare, the NHI plan imposes patient cost-sharing. For outpatient visits (e.g., primary care physicians), patients aged 65 and above pay KRW 1,500 (US$1.13) for expenses below KRW 15,000 (US$11.4). They are responsible for 10%, 20%, and 30% of the total care expenses if health care expenditure is between KRW 15,000 and KRW 20,000 (US$15.1), KRW 20,000 and KRW 25,000 (US$18.9), and over KRW 25,000, respectively. Referrals are not required to visit a specialist or a general hospital, but the co-insurance rate for outpatient care is significantly higher, e.g., at 40% to visit a specialist in a general hospital. For inpatient care, individuals are responsible for 20% of the total expenses regardless of age. In the case of prescription drugs, patients are required to bear 30% of total costs in general, but the coinsurance rate can be lower (up to 10%) if the total cost is smaller than KRW 12,000 (US$9.04) for those aged 65 and above. The Korean Longitudinal Study of Aging data indicates that the average monthly healthcare spending between 2012 and 2018 is KRW 96,202 (US$73.9) among those aged 65 and above. This figure

[11] 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 those of the NP program.

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

is equivalent to 30.2% of their average monthly NP benefit payment. Although their healthcare expenditure accounts for 4.9% of the total household income, the share increases to 14%, 25.3%, and 50.4% for older adults whose household incomes are below the median, 25th percentile, and 10th percentile, respectively.

3. Data

3.1. Main source: Causes-of-Death Statistics

For the main analysis, we use 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 up to two primary causes of an individual's death 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, we restrict the age of the sample to be aged 65 and over because most of the older adult population are public pension beneficiaries. Thus, we argue that our empirical results can represent the short-term effects of pension benefits. This age restriction also helps remove the potential influence of monthly wage payments made on the 25th because those aged 65 and older are relatively less likely to engage in gainful employment.

In the baseline analysis, we use the CODS data from May 2012 to December 2019 because the disbursement date of both NP and BP programs has been standardized to fall on the 25th of every month since May 2012. In addition, we do not consider the data collected after 2019 due to the COVID-19 pandemic because 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., 2023).

Table A1 describes summary statistics of all deaths and older adult deaths. The CODS data include 2,140,031 deaths from May 2012 to December 2019. The average number of deaths per day is 770. The total number of deaths among older adults aged 65 and over is 1,601,696, and the average number of older adult deaths per day is 554. The average age at the time of death is 73.2 and 80.8 among the entire population and older adults, respectively. Males account for 55 percent and 49 percent of all deaths and deaths of older adults, respectively. 45–47 percent of the individuals who died were married. The shares of above middle school among all the deceased individuals and older deceased individuals aged 65 and over were 32 and 22 percent, respectively.

Our primary dependent variable is the logarithm value of daily mortality counts using the exact date of death. Figure A2 depicts a trend of daily mortality over the period 14 days before and after the receipt of pension benefits. Although there seems to be an upward trend, a large dip in the number of deaths is clearly observed immediately following the disbursement date. To understand potential mechanisms through which receiving pension benefits affect mortality, we also calculate the logarithm values of daily mortality counts by cause. Over 50 specific causes of death are represented in the CODS data, and we recategorize them into i) treatable mortality, ii) acute conditions, iii) chronic conditions, iv) suicide, v) substance abuse, vi) transport accidents. Table A2 reports the description and distribution of the frequent causes of death in our sample.

3.2. Supplementary data

We also examine how Korean older adults' consumption spending and healthcare demand evolve within the monthly payment cycle via additional data sources to better understand potential mechanisms.

Card transaction data

To examine daily spending responses to pension income receipt, we utilize Shinhan Card's proprietary offline card transaction data from 2017 to 2019. Shinhan Card is the largest credit card company in Korea, which holds approximately a 20% market share (Korea Credit Finance Association, 2022).[13] Shinhan Card compiles transaction records from each store's payment terminal and calculates the block-level total card spending within Seoul through their proprietary methodology as the company considers additional factors such as the market share and card usage patterns based on sector, location, time, and demographic subgroups.[14] Since the dataset can be decomposed by cardholder's age in 10-year intervals, we restrict the sample to those aged 60 and above. For dependent variables, we construct the log value of total daily card spending as well as sub-categories of card spending using the sector information of retail establishments.[15]

[13] Unlike the US Consumer Expenditure Survey data used by Stephens (2003), the corresponding Korean household expenditure survey does not provide information on daily consumption spending.

[14] A block, as defined by Statistics Korea, is the smallest officially designated geographic area, measuring less than 0.1 km^2 (0.039 mi^2) on average.

[15] The Shinhan Card data categorizes businesses into 13 major sectors, which include groceries, food, retail business, clothing/accessories, sports/culture/leisure, travel/transportation, beauty services, household/lifestyle services, education/tutoring, healthcare services, furniture/electronics, vehicles/automotive, and fuel.

We acknowledge several limitations in using card transaction data. First, our analysis only covers spending via credit or debit card transactions, and we cannot analyze how cash spending varies within the monthly payment cycle. We argue that this would not cause significant bias in empirical analysis due to the following reasons: i) Under the assumption that patterns of cash spending are similar to those of card spending within the monthly cycle, it would not cause significant bias in estimation; ii) Nonetheless, the patterns of cash spending can be different from those of card spending in the presence of liquidity constraints if individuals are more likely to use credit cards (cash) immediately before (after) the monthly pension income disbursements. If this is the case, the card spending patterns are likely to underemphasize true spending responses, suggesting that our analysis can provide conservative estimates on spending responses of the pension income receipt.

Second, we do not have individual-level card spending data and cannot examine how card spending varies within individuals before and after the pension income receipt. However, we argue that this would not cause significant issues in our empirical analysis when estimating the aggregate-level spending responses to pension income receipt. Since the estimated spending responses capture that of the representative Seoul resident, which is the (weighted) sum of our block-level spending impact, the average of the individual-level estimates should be similar to the average of block-level estimates.

Lastly, our card spending data only covers Seoul residents' spending responses during 2017 – 2019 and the results might not be as representative as those of mortality analyses. To address this limitation, we examine whether the short-term impact of a pension income receipt on the mortality of Seoul residents aged 60 years and older from 2017 to 2019 is similar to those of the baseline analysis.[16]

Administrative healthcare claims data

To investigate healthcare demand responses to pension benefit receipt, we use the 8% random older adult sample (5.12 million individuals aged 60–80) of administrative healthcare claims data provided by the Korean National Health Insurance System (KNHIS) covering the same period (2012–2019). The data includes comprehensive information on healthcare claims, including out-of-pocket payments, total expenditures categorized by medical care type (inpatient/outpatient/emergency room), admission (visit) dates, and diagnosis codes along with patients' demographic information. To make it consistent with the mortality analysis, we

[16] Although we do not report the result to save space, it is available upon request.

restrict the sample to those aged 65 and above. For dependent variables, we calculate the daily number of inpatient admissions, outpatient visits, and drug prescriptions. We use the diagnosis code to analyze the healthcare utilization impact by disease.

4. Empirical Strategy

To examine the short-term relationship between the receipt of public pension benefits and older adults' mortality, we first construct 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 of 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 the 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, making the value of *d* range from -14 to 20. We construct a synthetic year that includes 12 synthetic months, from January to December.

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

$$ln\left(Y_{dmy}\right) = \sum_{w=-2\,(w\neq -1)}^{1} I\left[Payweek_{dmy} = w\right]\beta_w + \sum_{k=1}^{6} I\left[Weekday_{dmy} = k\right]\gamma_k + \sum_{l=1}^{M} I\left[Special_{dmy} = l\right]\varphi_l + \mu_m + \vartheta_y + \varepsilon_{dmy}\,, \qquad (1)$$

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. The values of -2, -1, 0, and 1 are assigned 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.[17] $Weekday_{dmy}$ represents the day of the week (the omitted category is Saturday). $Special_{dmy}$

[17] 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).

denotes various public holidays (e.g., New Year's Day, Independence 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_ws, 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 calculate the standard errors clustered at the synthetic year and month levels.[18]

To examine mortality impact of smaller but more frequent pension disbursements, we exploit the fact that BP and NP benefits were disbursed on different dates within a month during June 2009–April 2012 (treatment period). BP benefits were disbursed on the 25th of the month, while NP benefits were on the last day of the month.[19] We compare changes in the weekly mortality rate within the billing cycle between the treatment period and the baseline period (May 2012–December 2019) by using the following difference-in-differences (DID) model:

$$ln\left(Y_{dmy}\right) = \sum_{w=-2\,(w\neq -1)}^{1} I\left[Payweek_{dmy} = w\right] \times I\left[Treat_{dmy} = 1\right]\alpha_w + \sum_{w=-2\,(w\neq -1)}^{1} I\left[Payweek_{dmy} = w\right]\beta_w + I\left[Treat_{dmy} = 1\right]\gamma + \sum_{k=1}^{6} I\left[Weekday_{dmy} = k\right]\varphi_k + \sum_{l=1}^{M} I\left[Special_{dmy} = l\right]\delta_l + \mu_m + \vartheta_y + u_{dmy}\,, \qquad (2)$$

where most notations are the same as those of equation (1) and $I[Treat_{dmy} = 1]$ indicates whether the death occurred between June 2009 and April 2012. The parameters of interest are α_w,which represent the differences in the weekly mortality rate between the treatment and baseline periods before and after the disbursement of BP benefits, compared to that in the prior week (i.e., 1–7 days before the disbursement date). For statistical inference, we calculate the standard errors clustered at the synthetic year and month levels.

[18] If the daily mortality count is zero, the logarithm value of the dependent variable is not defined. As arbitrarily adding a constant or using log-like transformations can still lead to a sizable bias in estimation, we adopt the quasi-Poisson regression, using mortality counts as a dependent variable, following the recommendation of Chen and Roth (2024).

[19] During the treatment period, 83% of the difference between the BP and NP benefit disbursement dates was 5-7 days.

5. Empirical Results

5.1 Short-term Effects on Card Spending and Healthcare Utilization

Previous studies have documented an increase in consumption spending immediately after receiving a pension or welfare benefit in the US context (Stephens, 2003). Before examining the mortality impact of pension income receipt, we first establish whether older adults' spending responses vary unevenly within the monthly payment cycle in Korea, using equation (1).

Panel A of Figure 1 shows that the logarithm value of card spending increases by 4.4 percent and 4.9 percent during the week after the disbursement week and the following week, respectively, although only the second week impact was statistically significant at the 1 percent level. By contrast, card spending during two weeks prior to the disbursement date was close to zero and statistically insignificant. We also find that card spending on groceries and food increases by 6.0 percent and 4.2 percent during the disbursement week and following week, respectively. The estimates are statistically significant at the 5 percent and 10 percent levels. Card spending during two weeks prior to the disbursement date was close to zero and statistically insignificant. Table A3 reports the corresponding regression results of Figure 1. Columns (3) and (4) of Table A3 show that weekly spending in other non-durable spending categories (leisure/entertainment and beauty) also increases after the receipt of pension income. The results provide evidence of older adults' non-smooth consumption response to pension income receipt in Korea.

Given that we investigate health impacts of income receipt, healthcare utilization is another important behavioral outcome of interest. For example, Gross et al. (2022) argue that healthcare demand can be "liquidity-sensitive" by showing how demand for prescription drugs increases among Medicare beneficiaries right after receiving a Social Security check each month.

Panel B of Figure 1 presents that inpatient admissions, outpatient visits and drug prescriptions increase in the week of the pension income disbursement and the following week. However, there were few changes prior to the pension income receipt. It is noteworthy that the hospital admission rate sharply decreases in the second week of pension disbursement. One possible explanation is that hospitals in Korea are incentivized to discharge patients less than two weeks after the admission because the government reduces the reimbursement of medical

expenses claimed by hospitals for patients whose length of stay exceeds two weeks.[20] We find that inpatient admissions, outpatient visits, drug prescriptions increase by 30.5, 4.0, and 5.6 percent during the disbursement week, respectively. In the following week, inpatient admissions decrease by 17.8 percent compared to the week before the disbursement, while outpatient visits and drug prescriptions increase by 3.0 and 3.6 percent. However, the estimated healthcare utilization impacts during the two weeks prior to the disbursement date were close to zero and statistically insignificant.

5.2 Short-term Effect on Mortality

Figure 2 shows the estimated weekly changes in the mortality rate using equation (1). Older adults' mortality rate decreases by 1.4 percent during the week right after receiving the pension benefit compared to the reference week, and the estimate is statistically significant at the one percent level. In the following week, the magnitude of the mortality reduction becomes 0.9 percent, but the estimate is statistically imprecise. Lastly, older adults' estimated weekly mortality rate remains similar between 7 to 14 days *before* the disbursement compared to the reference week, and the estimates are statistically insignificant. The regression results are reported in Column (1) of Table 1.

We conduct the following checks to examine the sensitivity of our baseline results under alternative specifications. In column (2), we add calendar month- and year- fixed effects. In column (3), we include additional data for deaths occurring from the 29th to 34th synthetic days of the month to estimate the impact on mortality during the second week after the pension benefit receipt. In column (4), we add the mortality data of older adults aged 60–64 years to the sample as the NP benefit-claiming age was set at 60 for those born before 1952. The results indicate that our baseline findings are robust under the alternative specifications.

As a falsification check, we conduct Fisher's permutation test by randomly assigning synthetic weeks and re-estimating the short-term mortality impact of a fictitious pension income receipt 1,000 times. Figure A3 shows the distributions of the estimated effects of fictitious pension income receipt in the week following the pension income receipt, one week after the receipt, and two weeks prior to the receipt 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 calculate the share of estimates of the effects of fictitious pension income receipt, whose absolute values are greater than those of the baseline analysis.

[20] Specifically, the Korean Health Insurance Review and Assessment Service, a statutory board that reviews claims, induces this early discharge behavior by controlling provider payments (Kim, 2012; Cho, 2015).

Panels A and B indicate that the baseline estimates of the impact of pension income receipts on mortality in the disbursement week and the following week are clearly located outside of the left tail of the distributions. The probabilities that the values of false effects are greater than our baseline estimate are 0.01% and 0.5%, respectively. These results imply that randomly generated fictitious impacts of pension income receipt cannot replicate our baseline finding. However, Panel C shows that the baseline estimate of the impact of pension income receipt on mortality two weeks prior to the disbursement date is placed within the distribution of the effects of fictitious pension income receipts. We find that 11.1% of fake estimates are greater in magnitude than the baseline estimate. 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.

Mortality Impact by Cause of Death

To better understand underlying mechanisms through which receiving a pension benefit affects short-term mortality, we examine the heterogeneous mortality impact by (mutually non-exclusive) causes in Table 2.

First, column (1) shows that mortality due to treatable conditions, which could be avoided through timely and effective healthcare interventions, decreases by 2.4 percent in both the week of and one week after receiving a pension payout.[21] These estimates are both statistically significant at the five percent level. Circulatory diseases (predominantly heart attacks and strokes) and pneumonia account for 36% and 46% of early deaths that could be treated, respectively, among other causes. Given the definition of the treatable causes of death, we also examine how healthcare utilization for treatable health conditions varies within the payment cycle. Panel A of Figure A4 shows similar patterns to those of Panel B of Figure 1. The left column shows that inpatient care utilization sharply increases immediately after the receipt of pension income. It is noteworthy that the hospital admission rate decreases while the mortality-reducing effects still remain similar in the following week. As a possible explanation, we conjecture that the mortality-reducing effects of timely healthcare can last longer than a week. However, the middle and right columns indicate that the numbers of outpatient visits and drug prescriptions do not systematically change within the payment cycle. The results

[21] Treatable mortality also includes secondary prevention and treatment (i.e., *after* the onset of diseases). Timely and effective treatment for cancers, such as colorectal and breast cancers, could prevent an additional 26% of deaths from treatable conditions (OECD, 2019).

imply that timely access to inpatient care after the pension income receipt might have decreased treatable causes of death.

Second, we examine the impact on mortality due to acute conditions in Column (2). Acute conditions refer to diseases characterized by a rapid onset and a relatively short duration, referring to cerebrovascular disease, pneumonia, influenza, and other infectious diseases. We find that the mortality rate for those acute conditions decreases by 1.8 and 1.0 percent in the week of and one week after receiving a pension payout. The only former estimate is statistically significant at the 10 percent level. The results are inconsistent with findings of the previous studies such as Evans and Moore (2012) and Andersson et al. (2015), documenting increases in mortality rate due to acute conditions after the receipt of regular income. As a possible explanation, Panel B of Figure A4 presents that the number of inpatient admissions sharply increases after the receipt of the pension income.

Third, in column (3), we examine mortality due to chronic conditions, including cancer, chronic respiratory disease, diabetes, and hypertensive disease. We find that the mortality rate for those chronic conditions decreases by 1.5 and 1.7 percent in the week of and one week after receiving a pension payout. The estimates are statistically significant at the 10 percent and 5 percent, respectively. As these are chronic health conditions, it is difficult to interpret the results as a short-term impact of income on the incidence of these causes. Instead, the results likely capture the short-term impact on health among those with the aforementioned underlying health conditions. One possible mechanism is that the elderly with those health conditions increase healthcare use after the receipt of the pension income. Consistent with this conjecture, Panel C of Figure A4 documents that the number of inpatient admissions, outpatient care visits, and drug prescriptions increased after the receipt of the pension income.

Fourth, we examine how mortality due to suicide evolves within the payment cycle because relaxed financial constraints can improve mental health (Kim and Koh, 2020 and 2021). Column (4) indicates little evidence that the suicide rate decreases after receiving pension income. The estimates are small in magnitude and statistically insignificant.

Fifth, we examine the effects on mortality related to risky health behavior.[22] We find no evidence that the mortality rate due to substance abuse increases following pension benefit receipt in column (5). The estimates in the week of and one week after receiving a pension payout are statistically insignificant. This result is contrary to those of the previous studies that

[22] We followed the definition used by Evans and Moore (2011) to ensure consistency with the terminology used in previous studies.

reported that pension income receipts increased deaths due to substance abuse (Evans and Moore, 2012; Andersson et al., 2015). However, Panel D of Figure A4 presents evidence consistent with Dobkin and Puller (2007). The left column shows that hospital admissions due to substance abuse sharply increase immediately after the pension income receipt, while the middle and right columns provide little evidence of such systematic changes in the number of outpatient use and drug prescriptions due to substance abuse. Possible explanations to reconcile the difference between our results and those of the previous studies are that i) the underlying death rate due to substance abuse is lower in Korea compared to other countries and ii) Korean older adults use cash benefits to receive more proper medical assistance for the treatment of substance abuse after the pension income receipt.

Finally, we examine how mortality due to car accidents varies within the billing cycle as relaxed liquidity constraints could increase individuals' economic activities, thereby increasing mortality risk. Similar to those of the previous studies (Evans and Moore, 2012; Andersson et al., 2015), column (6) shows that mortality due to vehicular accidents increases in the week of and one week after the receipt of pension income by 10.4 and 6.4 percent, respectively, and only the former is statistically significant at the five percent level. The results on car accidents suggest that increased economic activities due to pension income receipt increase mortality among older adults in Korea as in other countries.

Mortality Impacts by Education Attainment

The mortality effects of the pension income receipt can be greater among those who have low socioeconomic status (SES) because i) they could be more liquidity-sensitive or ii) their marginal health impact of income or healthcare use could be greater than those with high SES. The CODS data only has limited information on SES. Thus, we use education attainment as its proxy. We compare the mortality impact by the decedent's education level, between older adults with lower educational attainment (middle school diploma and below; 78% of deaths in our sample) and those with higher educational attainment (above middle school diploma). The regression results are reported in Table 3.

Column (1) of Table 3 shows that the estimated short-term effect of pension income on mortality among older adults with lower educational attainment is greater than that of older adults with higher educational attainment. Compared to the mortality rate one week prior to the disbursement date, older adults' mortality rate decreases in the week of and one week after the receipt of the pension benefits by 1.4 and 1 percent, respectively. The estimate is only statistically significant at the one percent level at the former. 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 statistically insignificant among older adults with higher educational attainment.

Columns (3) and (4) present that the estimated short-term effect of pension income on mortality due to treatable causes is greater among older adults with lower educational attainment. Compared to the mortality rate one week prior to the disbursement date, older adults' mortality rate decreases in the week of and one week after the receipt of the pension benefits by 2.9 and 2.5 percent, respectively. The estimates are statistically significant at the five percent level. 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 (4) presents that the short-term impact of pension income on mortality is statistically insignificant among older adults with higher educational attainment.

Columns (5) and (6) also show that mortality from acute causes declines following the receipt of pension income among older adults with lower educational attainment. Compared to the mortality rate one week prior to the disbursement date, older adults' mortality rate decreases in the week of and one week after the receipt of the pension benefits by 1.8 and 0.8 percent, respectively. Only the former estimate is statistically significant at the 10 percent level. The estimate for the mortality impact two weeks prior to the disbursement date is small in magnitude and statistically insignificant as in the baseline analysis. However, column (6) presents that the short-term impact of pension income on mortality is statistically insignificant among older adults with higher educational attainment.

Table A4 presents thet heterogeneous mortality impacts by education attainment level for other causes of death. Panel A presents results of using the baseline specification. Columns (1) and (2) present that the estimated short-term effect of pension income on mortality due to chronic conditions is greater among older adults with lower educational attainment. Compared to the mortality rate one week prior to the disbursement date, older adults' mortality rate decreases in the week of and one week after the receipt of the pension benefits by 1.7 and 2.0 percent, respectively. The estimates are statistically significant at the 10 percent level. 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 statistically insignificant among older adults with higher educational attainment. Columns (3) to (4) show little heterogeneity in mortality due to suicide and substance abuse. The estimates are statistically

insignificant as in the baseline results (Table 2) regardless of education attainment levels. However, Columns (7) and (8) present that short-term effects of pension income receipt on mortality due to transport accidents are marginally greater among older adults with low education attainment level than those with higher education attainment level.

Since the logarithm value is not defined when the daily mortality count is zero and there are multiple observations with zero value in the dependent variable (i.e., no deaths on the day), we use the quasi-Poisson regression model to estimate percent changes in the mortality count following Chen and Roth (2024).[23] Panel B shows that the results remain similar when using the alternative regression specification. It is noteworthy that short-term effects of pension income receipt on mortality due to transport accidents become statistically insignificant among those with higher education attainment level.[24]

Comparison with the Previous Studies

Although non-smooth spending and health care utilization responses to the pension income receipt are consistent with the previous studies, our mortality-reducing impact of the pension income receipt among the Korean elderly is unique compared to the previous studies documenting the rise in mortality following a pension or salary receipt in US and Sweden (Evans and Moore, 2012; Andersson et al., 2015).

As a possible explanation to reconcile this discrepancy between our study and the previous studies, we first argue that the marginal impact of income on health could vary across beneficiaries' underlying economic status. As stated in the Introduction section, Korea has been experiencing a serious old-age poverty problem. This suggests that many Korean older adults are more liquidity-sensitive compared to those in other contexts.[25] In addition, as the impact of income on health is greater among low-income groups under the classical health production theory (Grossman, 1972), the positive health impact of income receipts or healthcare use among Korean older adults might be larger than those in Western countries.

[23] Tables A5–A7 show that the results of Tables 1–3 remain robust when using the quasi-Poisson regression model.
[24] In Table A8, we also conduct the heterogeneity analysis by age and gender and find that the mortality-reducing effects are similar across age groups while females show large mortality reductions following pension benefit receipt. See Appendix A for the details.
[25] Previous studies have also suggested potential mechanisms of the positive health impact of income within the billing cycle among older adults or low-income households even in the same setting as the previous studies. For example, Gross et al. (2022) show that the receipt of a monthly Social Security check immediately increases low-income Medicare beneficiaries' prescription drug spending. Cotti et al. (2020) find that emergency room visits increase (decrease) immediately before (after) receiving SNAP benefits (formerly, Food Stamp).

Second, older adults' labor force participation and temporary employment rates in Korea are much higher than in other developed countries (OECD, 2024).[26] This reflects inadequate retirement readiness of older adults in Korea (OECD, 2019) and suggests that those engaged in temporary employment to support subsistence needs could have stopped working temporarily after the receipt of pension income during the first two weeks. As economic activities are often closely related to an increase in mortality (Finkelstein et al., 2024), a temporary reduction in labor supply of older adults could have decreased the mortality rate. As indirect evidence, we document that the mortality rate due to acute health conditions decreased after the receipt of the pension income.

The heterogeneity analysis by education attainment level can also help reconcile the discrepancies between ours and the previous studies. Table 3 indicates that reductions in mortality due to any causes and treatable health conditions are mainly driven by those with low education attainment. Under the assumption that older adults with low education attainments are more likely to be liquidity-sensitive, their marginal mortality impacts of income and healthcare use can be greater, and to work for temporary jobs due to inadequate retirement readiness, our results provide additional supporting evidence how the pension income receipt reduces older adults' mortality rate within the monthly payment cycle.

Another possible explanation for the discrepancy between our findings and those of the previous studies is that income gain does not increase substance abuse-related deaths in Korea. Ample evidence reveals that income receipt increases short-term mortality or healthcare use via risky behavior such as substance abuse (Philips et al., 1999; Samet, 2001; Riddell and Riddell, 2006; Dobkin and Puller, 2007; Bruckner et al., 2011; Evans and Moore 2012; Gross and Tobacuman, 2014; Andersson et al., 2015). However, as stated in the Introduction section, substance use has not been as serious a public health threat in Korea as it has been in the US or other European countries.

Finally, Evans and Moore (2011) and Andersson et al. (2015) argue that the procyclical relationship between mortality and income within the monthly payment cycle could be a potential mechanism that explains the procyclical relationship between mortality and income over the business cycle originally documented by Ruhm (2000). The implication of this argument for our study is that procyclical relationships between mortality and income over the business cycle in Korea could be minimal because we did not find evidence of a procyclical

[26] For example, the labor force participation rate of older adults aged 65 and over was 37.3% in 2022, which is nearly three times higher than the OECD average of 13.4%. The proportion of temporary employment among older adults aged 65 and above reached 70%, which is more than four times the OECD average of 17.1%.

relationship between mortality and income over the monthly payment cycle. Table A9 shows that this is indeed the case in Korea. For the detail on the econometric specification and regression results, see Appendix B.

5.3 Health Impact of Smaller but More Frequent Disbursements

The immediate spending responses to a cash transfer payment can also be explained by behavioral traits such as short-run impatience and financial planning failure other than liquidity constraints.[27] This possibility suggests that older adults' spending could have over-responded to the pension income receipt beyond the point where there is no additional health benefit. If this is the case, smaller but more frequent disbursements of social insurance benefits or welfare benefits could be an effective budget-neutral policy alternative (Shapiro, 2005; Puller and Dobkin, 2007): i) A smaller payment may still achieve mortality-reducing effects similar to that of larger disbursements in the week of disbursement, and ii) more frequent disbursements enable the weekly mortality-reducing effects to last longer within the payment cycle.

To test this hypothesis, we compare changes in the mortality rate within the payment cycle between the treatment and baseline periods. Panel A of Figure 3 documents the daily mortality rate trends between the two periods. We find that the trends before the 25th day of the month were similar in general between the two periods. Then, the daily mortality rates sharply decreased immediately after the receipt of pension benefits on the 25th of the month in both periods. However, the reductions in the mortality rate last longer during the treatment period than the baseline period when NP and BP benefits were disbursed on different days of the month, potentially suggesting the positive health impact of a more frequent disbursement schedule. Panel B presents the corresponding DID estimates on weekly mortality impacts, using equation (2). Similar to the findings of Panel A, it shows that the mortality-reducing effects of pension income receipts are greater during the treatment period than the baseline period by approximately 2 percent. There were few differences in changes in the mortality rate before the disbursement date.

Nonetheless, we consider our results as suggestive evidence on the mortality-reducing effects of the smaller-but-more-frequent disbursements. First, the Korean government did not change the frequency of pension payments but consolidated two different payment dates into

[27] For example, quasi-hyperbolic discounting predicts immediate spending responses to the pension income receipt (Laibson, 1997). Shapiro (2005) documents evidence of short-run impatience in food intakes among the SNAP recipients. Ganon and Noel (2019) report a sharp decline in spending on necessities after the well-predicted exhaustion of unemployment insurance benefits in the US.

a single one. Thus, we did not exploit an actual policy change such as Aguila et al. (2017) and Stephens and Unayama (2011) to directly investigate the health impact of frequent disbursements of pension benefits.[28] Second, our DID estimates are not statistically significant.

6. Concluding Remarks

Using the national death registry data, we document evidence of the mortality reducing effects of public pension income. We find similar patterns among deaths due to treatable causes and acute health conditions, but there is little evidence that deaths due to substance abuse increase after the receipt of pension income. As possible mechanisms, we document the positive healthcare utilization impact of the pension benefit receipts. We also show that the beneficial health impacts are greater among those with low education attainment.

Existing studies have documented evidence of increases in hospital admissions and mortality related to substance abuse and accidents after welfare or pension benefit receipt (Dobkin and Puller, 2007; Evans and Moore, 2012). The results imply that the welfare loss caused by non-smooth short-term spending responses to income receipt within the monthly payment cycle as documented in Stephens (2003) can be exacerbated by its negative health impacts. By contrast, our results provide new insights that income receipt can dampen welfare losses arising from non-smooth consumption spending response.

Regarding the disbursement scheduling of pension benefits, we provide suggestive evidence that a smaller-but-more-frequent disbursement schedule can generate larger mortality reductions than a more commonly implemented once-a-month payment. The results suggest that not considering the additional health benefit of a more frequent disbursement can lead to suboptimal policy decision-making due to the underestimation of its overall welfare benefit.

[28] Our coefficient estimate can reflect the impact of other simultaneous changes such as changes in population characteristics (e.g., health status, education attainment) and pension eligibility and benefit amounts. However, given the fact that i) both daily and weekly trends of the mortality rate before pension disbursement are parallel between the two periods and ii) the difference between the two periods is less than 10 years apart and there would be no large improvements in older adults' underlying health conditions at the aggregate level, we argue that our result is unlikely to be biased due to those factors.

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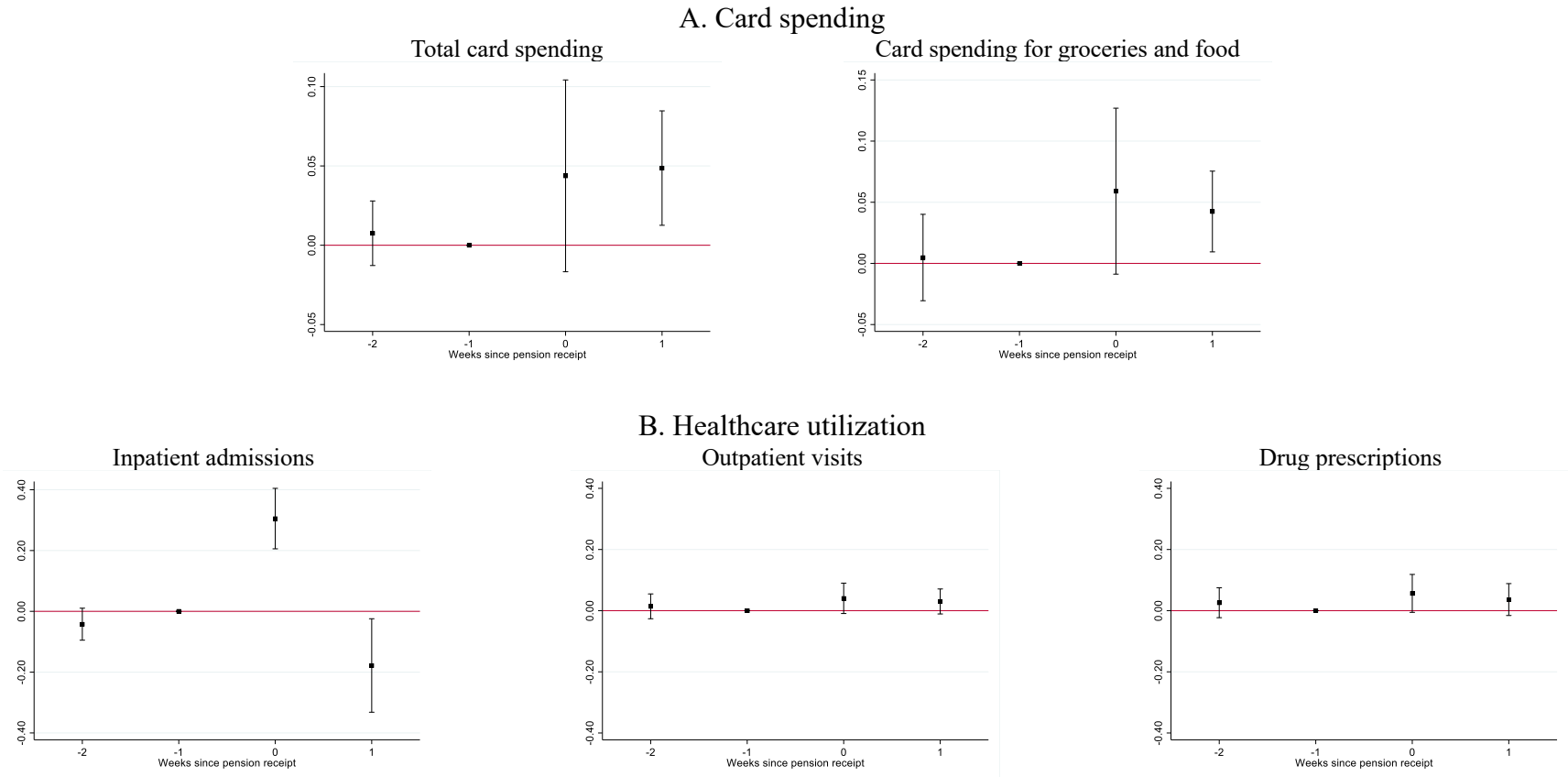
Figures and Tables

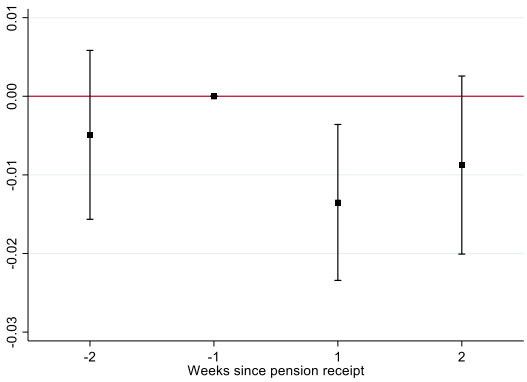
Figure 1. Short-term Impact of Pension Income Receipt on Card Spending and Healthcare Utilization



Data sources: Offline card transaction data in Seoul from Shinhan Card, January 2017–December 2019 (Panel A) and administrative senior-cohort healthcare claims data from the Korean National Health Insurance Service, May 2012–December 2019 (Panel B)

Notes: In Panel A, we restrict the sample to those aged 60 or older and +/-14 synthetic days from the pension disbursement date. We plot estimated changes in the logarithm value of total card spending and spending for food and groceries over the payment cycle after controlling for calendar week fixed effects, public holiday fixed effects, day-of-week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. In Panel B, we restrict the sample to those aged 65 or older and +/-14 synthetic days from the pension disbursement date. We plot estimated changes in the logarithm value of the number of inpatient admissions, outpatient visits, and drug prescriptions over the payment cycle after controlling for calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. Standard errors are clustered at synthetic month and year level. Caps indicate 95% confidence interval.

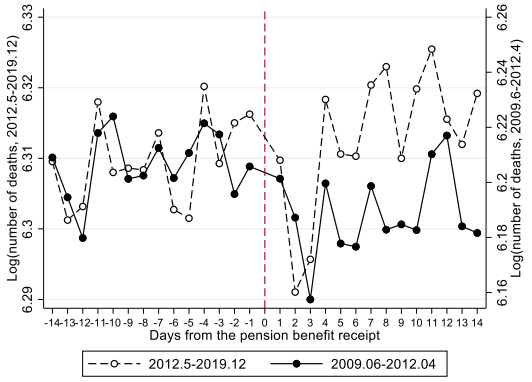
Figure 2. Short-term Mortality Impact of Pension Income Receipt



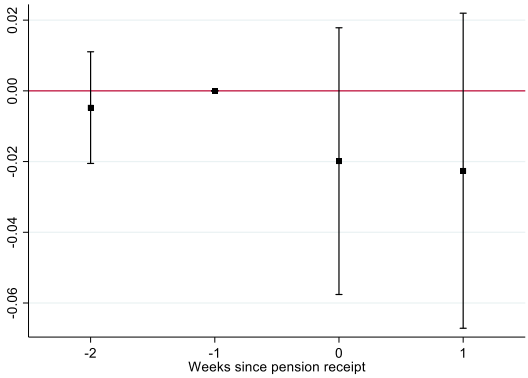
Data source: The Korean Causes of Death Statistics, May 2012–December 2019
Notes: We restrict the sample to those aged 65 or older and +/-14 synthetic days from the pension disbursement date. We plot estimated changes in the logarithm value of weekly mortality counts over the billing cycle after controlling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

Figure 3. Short-term Mortality Impact of Pension Income Receipt Before and After Consolidating the Disbursement Dates

A. Daily Trends of Mortality Rates



B. Estimated Differences in Weekly Mortality Rates



Data source: The Korean Causes of Death Statistics, June 2009–December 2019
Notes: We restrict the sample to those aged 65 or older. We also restrict the sample to +/-14 synthetic days from the pension disbursement date. In panel A, we plot the average logarithm value of daily mortality counts over the billing cycle. In panel B, we plot estimated differences in the logarithm value of weekly mortality counts between June 2009–April 2012 and May 2012–December 2019 after controlling for calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. Black squares represent estimated changes in mortality compared to that in 14 days prior to the pension income disbursement date. Standard errors are clustered at synthetic month and year level. Caps indicate 95% confidence interval.

Table 1. Short-term Mortality Impact of Pension Receipt

	(1)	(2)	(3)	(4)
Payweek(-2)	-0.005	-0.001	-0.003	-0.003
	(0.005)	(0.008)	(0.006)	(0.005)
Payweek(0)	-0.014***	-0.012**	-0.012**	-0.012**
	(0.005)	(0.005)	(0.006)	(0.005)
Payweek(1)	-0.009	-0.008	-0.006	-0.010*
	(0.006)	(0.007)	(0.008)	(0.005)
Payweek(2)			0.005	
			(0.010)	
Observations	2,627	2,627	2,627	2,627
R-squared	0.687	0.707	0.687	0.737
Periods	2012–2019	2012–2019	2012–2019	2012–2019
Calendar month FE		Yes		
Calendar year FE		Yes		
Add 29th–34th days			Yes	
Add 60–64 years				Yes

Data source: The Korean Causes of Death Statistics, May 2012–December 2019.
Notes: We restrict the sample to those aged 65 or older. In columns (1), (2) and (4), we also restrict the sample to +/-14 synthetic days from the pension disbursement date. In column (3), we include the entire sample and estimate the effects of pension receipt on deaths occurring 29th to 34th days. In column (4), we include the sample aged 60 to 64. We estimate change in the logarithm value of mortality counts compared to that in a week prior to the pension benefit receipt. For control variables, we include calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. We calculate standard errors clustered at the synthetic year and month level. *** p<0.01, ** p<0.05, * p<0.1.

Table 2. Short-term Mortality Impact of Pension Receipt
by Cause of Death

Cause of death:	Treatable Conditions (1)	Acute Conditions (2)	Chronic Conditions (3)	Suicide (4)	Substance abuse (5)	Transport accidents (6)
Payweek(-2)	-0.010	-0.013	-0.006	-0.027	0.030	0.001
	(0.011)	(0.009)	(0.007)	(0.036)	(0.038)	(0.041)
Payweek(0)	-0.024**	-0.018*	-0.015*	0.019	-0.059	0.104**
	(0.010)	(0.009)	(0.008)	(0.043)	(0.042)	(0.044)
Payweek(1)	-0.024**	-0.010	-0.017**	0.017	-0.027	0.064
	(0.011)	(0.010)	(0.009)	(0.040)	(0.038)	(0.057)
Observations	2,627	2,627	2,627	2,627	2,615	2,619
R-squared	0.698	0.620	0.229	0.183	0.036	0.118
Mean daily deaths	87.6	105.6	194.7	9.7	6.0	6.0

Data source: The Korean Causes of Death Statistics, May 2012–December 2019
Notes: We restrict the sample to those aged 65 or older. We also restrict the sample to +/-14 synthetic days from the pension disbursement date. We estimate change in the logarithm value of mortality counts compared to that in a week prior to the pension benefit receipt. For control variables, we include calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. We calculate standard errors clustered at the synthetic year and month level. *** p<0.01, ** p<0.05, * p<0.01.

Table 3. Heterogeneous Short-term Mortality Impact of Pension Receipt
by Education Attainment Level

Cause of death:	Any		Treatable conditions		Acute conditions	
Education attainment level:	Middle school graduate and below	Above Middle school	Middle school graduate and below	Above Middle school	Middle school graduate and below	Above Middle school
	(1)	(2)	(3)	(4)	(5)	(6)
Payweek(-2)	-0.004	-0.010	-0.009	-0.019	-0.011	-0.031
	(0.006)	(0.010)	(0.012)	(0.023)	(0.010)	(0.022)
Payweek(0)	-0.014***	-0.012	-0.029**	-0.009	-0.018*	-0.010
	(0.005)	(0.010)	(0.012)	(0.024)	(0.011)	(0.026)
Payweek(1)	-0.010	-0.006	-0.025**	-0.021	-0.008	-0.012
	(0.006)	(0.010)	(0.012)	(0.024)	(0.013)	(0.021)
Observations	2,627	2,627	2,627	2,627	2,627	2,627
Mean daily deaths	0.575	0.777	0.585	0.578	0.502	0.544

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

Notes: We restrict the sample to those aged 65 or older. We also restrict the sample to +/-14 synthetic days from the pension disbursement date. For control variables, we include calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. We calculate standard errors clustered at the synthetic year and month level. *** p<0.01, ** p<0.05, * p<0.1.

Appendix

A. Heterogeneity analysis by age and gender

We conduct additional heterogeneity analyses and report the results in Table A8. First, 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 1.3 percent, 1.5 percent, and 1 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 are statistically significant at the 5 percent level only for those aged 76–85 years. In the following week, the mortality rates are still lower than those in the week before the disbursement date by 0.4 percent, 1 percent and 1 percent for older adults aged 65–75 years, 76–85 years, and older than 85 years, respectively. The estimates are statistically insignificant. We do not find any statistically significant impact two weeks prior to the disbursement date except for those aged older than 85 years.

Second, we estimate the heterogeneous mortality impact by sex. The results indicate that older adults' mortality rate generally declines in the week of and one week after the pension income disbursement date regardless of gender. Specifically, the mortality rates drop immediately after receiving a pension payout by 1.2 percent and 1.5 percent relative to those in the prior week among males and females, respectively. The estimates are statistically significant at the 10 and 5 percent levels. In the following week, the mortality rates are still lower than those in the week before the disbursement date by 0.4 percent and 1.3 percent for males and females, and the estimates are statistically significant at 10 percent level only for females.

B. 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.

The implication of this argument for our study is that we would not find evidence of procyclical relationships between mortality and income over the business cycle in Korea because we did not find evidence of a procyclical relationship between mortality and income over the monthly billing cycle.

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

$$log(mortality_{i,t}) = \alpha UNEMP_{i,t} + \lambda_i + \mu_t + X'_{i,t}\gamma + \epsilon_{i,t}, (3)$$

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 province- and year-specific total population 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.

Table A9 shows that the relationship between macroeconomic conditions and mortality rate is not pro-cyclical.[29] Panel A indicates that the estimated relationship between province-level unemployment rate and mortality rate is small in magnitude and statistically insignificant.

[29] Lee and Kim (2017) also document that the mortality rate is countercyclical over the business cycle in Korea between 2002 and 2012.

As an alternative measure for macroeconomic conditions, we also use the logarithm value of province-level GDP. Panel B presents that the estimated relationship between the logarithm value of GDP and mortality rates is small in magnitude and statistically insignificant. Our analysis provides additional evidence consistent with the literature (Evans and Moore, 2011; Andersson et al., 2015) that the short-term mortality impact of income receipt translates into the cyclicity of the aggregate mortality rate over the business cycle.

Appendix Reference

Lee, C., & Kim, K. (2017). Changing relationship between unemployment and mortality in South Korea. *Health Economics*, *26*(12), 1630-1636.

C. Appendix Tables and Figures

Table A1. Summary Statistics

	All (1)	65 and over (2)
Death		
Total number of deaths	2,071,802	1,552,992
Number of daily deaths	740	554
Characteristics		
Age of Death	73.2	80.8
Share of male	0.55	0.49
Share of married	0.47	0.45
Share of above middle school	0.32	0.22

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

Table A2. Distribution of the Frequent Causes of Death among Individuals Aged 65 and Above

Cause of death	Description	Share (%)
Treatable mortality	Diseases that can be mainly avoided through timely and effective health care interventions, including secondary prevention and treatment	15.82
Acute conditions	Diseases characterized by a rapid onset and a relatively short duration, referring to cerebrovascular disease, pneumonia, influenza, and other infectious diseases	19.08
Chronic conditions	Diseases that progress gradually and can deteriorate over a prolonged period, referring to cancer, chronic respiratory disease, diabetes, and hypertensive disease	35.13
Suicide	A deliberate act in which a person causes their own death with intent, using any means or method.	1.74
Substance abuse	Mental and behavioral disorders due to psychoactive substance use	1.09
Transport accidents	Any incidents involving the machinery designed or commonly used to transport people or cargo from one place to another	1.08

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

Notes: The definition of acute and conditions follows the National Council on Aging, while the definitions of the other causes of death are based on The Korean Causes of Death Statistics. We restrict the sample to those aged 65 or older. In case of substance abuse, we followed the definition of substance abuse used by Evans and Moore (2011) to ensure consistency with the terminology used in previous studies.

Table A3. Short-term Spending and Healthcare Utilization Impacts of Pension Receipt

	Card Spending				Healthcare utilization		
	Total	Groceries or food	Leisure and Entertainment	Beauty services	Inpatient admissions	Outpatient visits	Drug prescriptions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Payweek(-2)	0.008	0.005	0.005	-0.012	-0.042	0.014	0.026
	(0.010)	(0.017)	(0.022)	(0.016)	(0.026)	(0.020)	(0.025)
Payweek(0)	0.044	0.060*	0.058***	0.038	0.305***	0.040	0.056*
	(0.030)	(0.033)	(0.024)	(0.026)	(0.050)	(0.025)	(0.031)
Payweek(1)	0.049***	0.042**	0.100***	0.086***	-0.178**	0.030	0.036
	(0.018)	(0.016)	(0.023)	(0.024)	(0.077)	(0.021)	(0.026)
Observations	1,010	1,010	1,010	1,010	2,627	2,627	2,627
R-squared	0.804	0.695	0.679	0.758	0.615	0.970	0.962
Daily averages	30631.7	6622.4	1057.5	640.4	1356.1	57158.1	29514.0

Data source: Offline card transaction data in Seoul from Shinhan Card, January 2017–December 2019 in Columns (1)–(4) and administrative healthcare claims data from the Korean National Health Insurance Service, May 2012–December 2019 in columns (5)–(7).

Notes: The Shinhan Card data categorizes businesses into 13 major sectors which include groceries, food, retail business, clothing/accessories, sports/culture/leisure, travel/transportation, beauty services, household/lifestyle services, education/tutoring, healthcare services, furniture/electronics, vehicles/automotive, and fuel. In columns (1)–(4), we restrict the sample to those aged 60 or older and +/-14 synthetic days from the pension disbursement date. In columns (5) – (7), we restrict the sample to those aged 65 or older and +/-14 synthetic days from the pension disbursement date. We estimate change in the logarithm value of card spending and healthcare unitization compared to that in a week prior to the pension benefit receipt. For control variables, we include calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. We calculate standard errors clustered at the synthetic year and month level. The unit of card spending is a one million South Korean Won (KRW).

*** p<0.01, ** p<0.05, * p<0.1.

Table A4. Heterogeneous Short-term Mortality Impact of Pension Receipt by Education Attainment Level

Other Causes of Death

Cause of death:	Chronic conditions		Suicide		Substance abuse		Transport accidents	
Education attainment level:	Middle school graduate and below	Above Middle school	Middle school graduate and below	Above Middle school	Middle school graduate and below	Above Middle school	Middle school graduate and below	Above Middle school
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Baseline regression model								
Payweek(-2)	-0.007	-0.004	0.002	0.001	0.009	0.050	0.016	-0.014
	(0.009)	(0.013)	(0.039)	(0.056)	(0.046)	(0.048)	(0.046)	(0.044)
Payweek(0)	-0.017*	-0.011	0.029	-0.017	-0.086	-0.043	0.107*	0.094*
	(0.009)	(0.014)	(0.043)	(0.049)	(0.055)	(0.045)	(0.046)	(0.055)
Payweek(1)	-0.020*	-0.010	0.058	0.049	-0.037	-0.081	0.100*	0.012
	(0.011)	(0.014)	(0.048)	(0.067)	(0.053)	(0.051)	(0.060)	(0.052)
Observations	2,627	2,627	2,621	2,376	2,599	2,042	2,596	1,804
B. Using Quasi Poisson Regression Model								
Payweek(-2)	-0.007	-0.001	0.001	-0.060	0.021	0.062	0.020	-0.031
	(0.009)	(0.012)	(0.033)	(0.063)	(0.038)	(0.059)	(0.036)	(0.072)
Payweek(0)	-0.017*	-0.010	0.015	0.011	-0.064	-0.026	0.111**	0.114
	(0.009)	(0.013)	(0.040)	(0.059)	(0.046)	(0.074)	(0.044)	(0.080)
Payweek(1)	-0.020*	-0.011	0.033	-0.025	-0.049	-0.052	0.096**	-0.019
	(0.011)	(0.014)	(0.041)	(0.077)	(0.048)	(0.072)	(0.049)	(0.087)
Observations	2,627	2,627	2,627	2,627	2,627	2,627	2,627	2,627
Mean daily death	144.1	50.6	7.2	2.5	4.5	1.5	4.8	1.2

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

Notes: We restrict the sample to those aged 65 or older. We also restrict the sample to +/-14 synthetic days from the pension disbursement date. In panel B, we estimate change in mortality counts compared to that in a week prior to the pension benefit receipt using poisson pseudo-likelihood regression. For control variables, we include calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. We calculate standard errors clustered at the synthetic year and month level. *** p<0.01, ** p<0.05, * p<0.1.

Table A5. Short-term Mortality Impact of Pension Receipt
Using Quasi Poisson Regression Model

	(1)	(2)	(3)	(4)
Payweek(-2)	-0.004	0.001	-0.001	-0.002
	(0.005)	(0.008)	(0.006)	(0.005)
Payweek(0)	-0.014***	-0.012**	-0.013**	-0.012***
	(0.005)	(0.005)	(0.005)	(0.005)
Payweek(1)	-0.009	-0.008	-0.006	-0.010*
	(0.006)	(0.007)	(0.008)	(0.006)
Payweek(2)			0.007	
			(0.011)	
Observations	2,627	2,627	2,627	2,627
Periods	2012–2019	2012–2019	2012–2019	2012–2019
Calendar month FE		Yes		
Calendar year FE		Yes		
Add 29th–34th days			Yes	
Add 60–64 years				Yes

Data source: The Korean Causes of Death Statistics, May 2012–December 2019.
Notes: We restrict the sample to those aged 65 or older. In columns (1), (2) and (4), we also restrict the sample to +/-14 synthetic days from the pension disbursement date. In column (3), we include the entire sample and estimate the effects of pension receipt on mortality. In column (4), we include the sample aged 60 to 64. We estimate change in mortality counts compared to that in a week prior to the pension benefit receipt using poisson pseudo-likelihood regression. For control variables, we include calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. We calculate standard errors clustered at the synthetic year and month level. *** p<0.01, ** p<0.05, * p<0.1.

Table A6. Short-term Mortality Impact of Pension Receipt by Cause of Death
Using Quasi-Poisson Regression Model

Cause of death:	Treatable Conditions (1)	Acute Conditions (2)	Chronic Conditions (3)	Suicide (4)	Substance abuse (5)	Transport accidents (6)
Payweek(-2)	-0.010	-0.012	-0.005	-0.015	0.031	0.010
	(0.011)	(0.009)	(0.007)	(0.031)	(0.032)	(0.033)
Payweek(0)	-0.025**	-0.018**	-0.015**	0.014	-0.055	0.112***
	(0.010)	(0.009)	(0.008)	(0.037)	(0.037)	(0.041)
Payweek(1)	-0.023**	-0.010	-0.018**	0.018	-0.049	0.074*
	(0.010)	(0.010)	(0.009)	(0.035)	(0.038)	(0.045)
Observations	2,627	2,627	2,627	2,627	2,627	2,627
Mean daily deaths	87.6	105.6	194.7	9.7	6.0	6.0

Data source: The Korean Causes of Death Statistics, May 2012–December 2019
Notes: We restrict the sample to those aged 65 or older. We also restrict the sample to +/-14 synthetic days from the pension disbursement date. We estimate change in mortality counts compared to that in a week prior to the pension benefit receipt using quasi-Poisson regression. For control variables, we include calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. We calculate standard errors clustered at the synthetic year and month level. *** p<0.01, ** p<0.05, * p<0.01.

Table A7. Heterogeneous Short-term Mortality Impact of Pension Receipt by Education Attainment Level

Using Quasi-Poisson Regression Model

Cause of death:	Any		Treatable conditions		Acute conditions	
Education attainment level:	Middle school graduate and below	Above Middle school	Middle school graduate and below	Above Middle school	Middle school graduate and below	Above Middle school
	(1)	(2)	(3)	(4)	(5)	(6)
Payweek(-2)	-0.003	-0.006	-0.008	-0.015	-0.010	-0.020
	(0.006)	(0.009)	(0.012)	(0.020)	(0.010)	(0.019)
Payweek(0)	-0.014***	-0.015	-0.028**	-0.014	-0.017*	-0.023
	(0.005)	(0.009)	(0.012)	(0.022)	(0.010)	(0.023)
Payweek(1)	-0.009	-0.007	-0.023**	-0.024	-0.008	-0.021
	(0.006)	(0.010)	(0.011)	(0.022)	(0.012)	(0.018)
Observations	2,627	2,627	2,627	2,627	2,627	2,627
Mean daily deaths	434.0	120.0	68.4	19.2	85.1	20.5

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

Notes: We restrict the sample to those aged 65 or older. We also restrict the sample to +/-14 synthetic days from the pension disbursement date. We estimate change in mortality counts compared to that in a week prior to the pension benefit receipt using quasi-poisson regression. For control variables, we include calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. We calculate standard errors clustered at the synthetic year and month level. *** p<0.01, ** p<0.05, * p<0.1.

Table A8. Short-term Mortality Impact of Pension Receipt by Age and Gender

Characteristics:	Age			Gender	
Groups:	65–75 years	76–85 years	Older than 85 years	Male	Female
	(1)	(2)	(3)	(4)	(5)
Payweek(-2)	0.007	-0.006	-0.014*	-0.005	-0.005
	(0.008)	(0.006)	(0.008)	(0.006)	(0.007)
Payweek(0)	-0.013	-0.015**	-0.010	-0.012*	-0.015**
	(0.009)	(0.007)	(0.009)	(0.006)	(0.007)
Payweek(1)	-0.004	-0.010	-0.010	-0.004	-0.013*
	(0.010)	(0.007)	(0.008)	(0.006)	(0.008)
Observations	2,627	2,627	2,627	2,627	2,627
R-squared	0.437	0.607	0.759	0.556	0.624
Mean daily deaths	152.4	244.0	169.4	274.0	287.5

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

Notes: We restrict the sample to those aged 65 or older. We also restrict the sample to +/-14 synthetic days from the pension disbursement date. We estimate change in the logarithm value of mortality counts compared to that in a week prior to the pension benefit receipt. For control variables, we include calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. We calculate standard errors clustered at the synthetic year and month level. *** p<0.01, ** p<0.05, * p<0.1.

Table A9. Associations between Macroeconomic Conditions and Mortality Rate

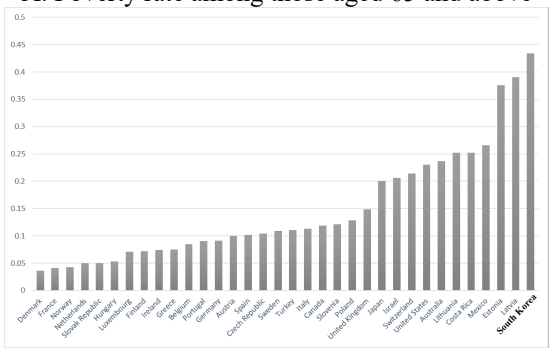
Age groups:	25 years or older	25–64 years	65 years or older
	(1)	(2)	(3)
A. Measure for macroeconomic condition: unemployment rate			
Unemployment rate	0.014	0.014	-0.008
	(0.034)	(0.034)	(0.005)
Observations	128	128	128
R-squared	0.996	0.996	0.999
B. Measure for macroeconomic condition: log(GDP)			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

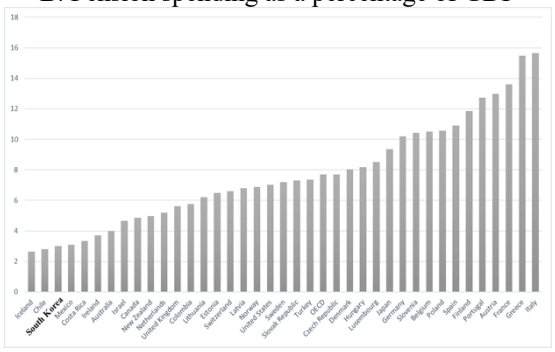
Notes: We calculate heteroskedasticity-robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.

Figure A1. Older adults' Poverty Rate, Public Pension Spending and Labor Market Participation

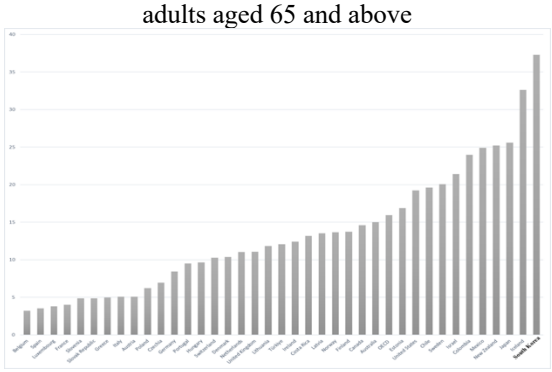
A. Poverty rate among those aged 65 and above



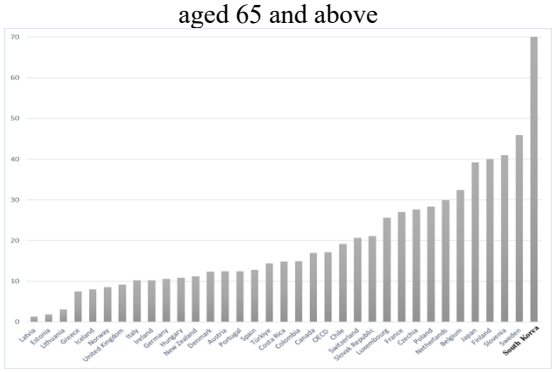
B. Pension spending as a percentage of GDP



C. Labor market participation rate among older adults aged 65 and above



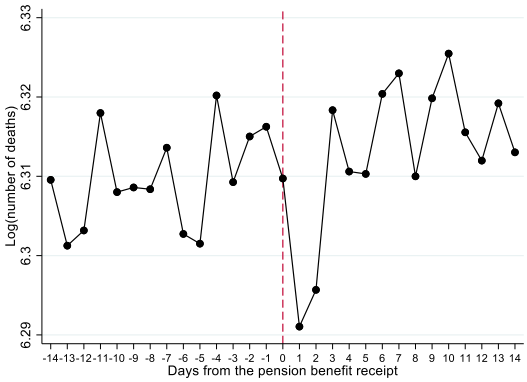
D. Temporary employment rate among older adults aged 65 and above



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. OECD (2024), Labor force participation rate (indicator). doi: 10.1787/8a801325-en (Accessed on 29 February 2024) for panel C. Temporary employment (indicator). doi: 10.1787/75589b8a-en (Accessed on 29 February 2024) for panel D.

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' pension. The labor force participation rates are calculated as the labor force divided by the total working-age population among those aged 65 and over. Temporary employment includes wage and salary workers whose job has a pre-determined termination date.

Figure A2. Trend of Daily Mortality Rate

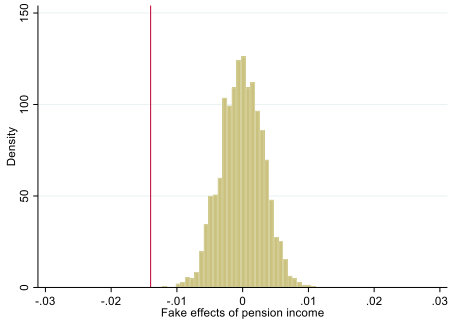


Data source: The Korean Causes of Death Statistics data, May 2012–December 2019

Notes: We restrict the sample to those aged 65 or older. We also restrict the sample to +/-14 synthetic days from the pension disbursement date. We plot the average logarithm value of daily mortality counts over the billing cycle.

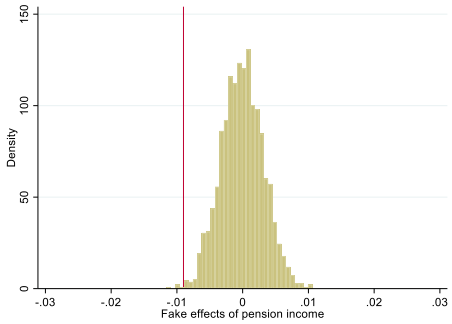
Figure A3. Distribution of Estimates of False Pension Income Receipt

A. In the week of pension income disbursement date



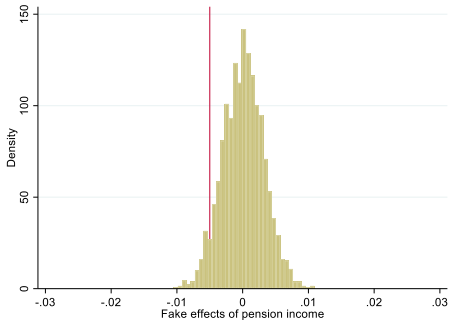
Pr(false effects≤0.014)=0.0001

B. One week after pension income disbursement date



Pr(false effects≤0.009)=0.005

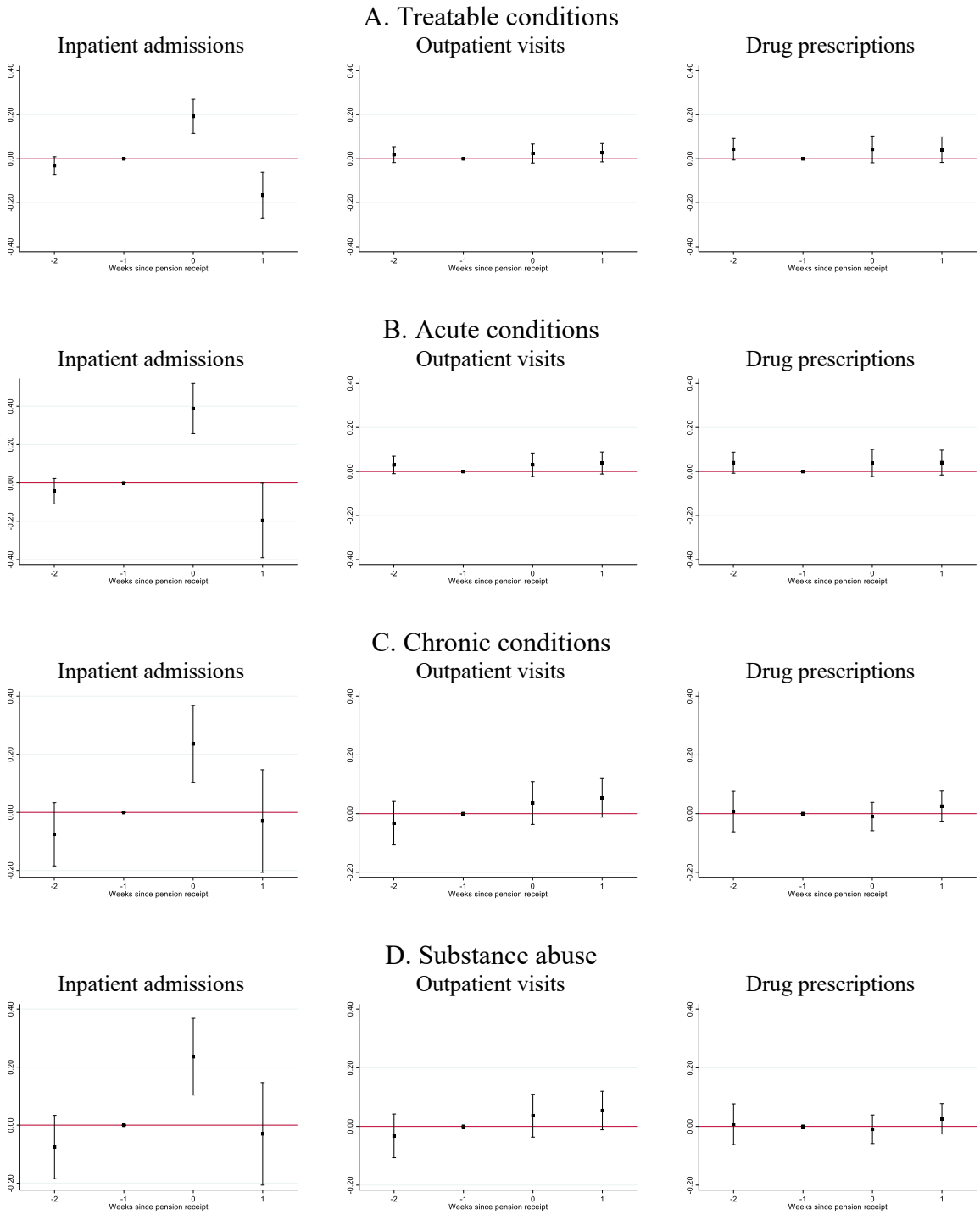
C. Two weeks prior to pension income disbursement date



Pr(false effects≤0.005)= 0.111

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

Figure A4. Short-term Effects of Pension Receipt on Healthcare Use by Health Conditions



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

Notes: We restrict the sample to those aged 65 and above. We also restrict the sample to +/-14 synthetic days from the pension disbursement date. We plot estimated changes in logarithm value of the number of inpatient admissions, outpatient visits and drug prescriptions in over the billing cycle after controlling for calendar week fixed effects, public holiday fixed effects, day of week fixed effects, synthetic month fixed effects, and synthetic year fixed effects. Standard errors are clustered at synthetic month and year level. Caps indicate 95% confidence interval.