The Effect of Social Pension on Material Hardship Among Older Adults in Korea:
Regression Discontinuity Estimation

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Abstract

Background: South Korea's basic pension scheme (hereafter BPS) is a universal public assistance program for senior citizens in South Korea to stabilize the livelihood of older individuals and promote their well-being. The pension scheme is eligible for all senior citizens 1) whose age is over 65, and 2) the sum of annuitized assets and income is below the bottom 70th percentile of the population over 65.

Purpose: This paper explores how the BPS program in South Korea alleviated the risk of material hardship and improved the life satisfaction of the older population.

Data and Method: Using its strict age-based eligibility criterion at 65, we implement a regression discontinuity design (RDD) to estimate the intention to treat (ITT) effect of the BPS on the material hardship and life satisfaction of older people near the age cut (between 61 and 68). The discontinuity of the pension eligibility at age 65 allows us to implement RDD as the policy treatment close to the cutoff at age 65 is as-if random. Data come from Korea Welfare Panel Study (KOWEPS) Wave 12 survey (2017, N=3,932).

Empirical Findings: We find the BPS alleviated the risk of material hardship and improved the life satisfaction of the older population. In particular, the BPS benefit reduces the risks of experiencing housing hardship, utility cutoff/bill payment delay, and food insecurity by 1.6, 1.7, and 5.0 percentage points, respectively. Considering the lower risk of experiencing those hardships (2.3 percent, 2.7 percent, and 7.9 percent, respectively), the effect sizes are substantial. The benefit also was associated with a higher level of life satisfaction (b=0.150). Interestingly, while the effect sizes of the BPS on mitigating the material hardship increase as income decrease, the lower-income groups were less satisfied with the pension provision than middle- and upper-income groups.

Significance: This study contributes to the growing body of literature on material hardship for older adults in the context of an Asian country facing persistent old-age poverty and immature public pensions. The policy response to address the needs of low-income household differ greatly across cultural and institutional context. This study contributes knowledge of East Asia to the Western-based body of knowledge on material hardship. Methodologically, this paper shows the potential for the BPS to be used as a quasi-experimental tool evaluating its impacts on varying outcomes of senior citizens.

1   Introduction

Material hardship or deprivation generally refers to the inability of a household to afford goods and services (e.g., food insufficiency and cutting back on medication) that are common in its societal background or perceived as being 'necessities' (Donni, 2019; Fusco, Guio & Marlier, 2010). As a non-monetary, outcome-based measure of material well-being, a large body of research has illuminated the advantage of material hardship as a direct measure of multi-dimensional poverty compared to the conventional income-based poverty indicator (Nolan & Whelan, 2011). With the global population aging, poverty has urgent policy implications for older adults' economic well-being and promoting social cohesion in society. To date, most anti-poverty policies and programs are designed based on the income-based indicator. For older people, however, standard measures of income poverty may underestimate the level of material hardship (Hancock, 2015) since current income may capture only a fraction of the resources at their disposal (Adena & Myck, 2014), but an age-related decline in physical and cognitive health may exacerbate individual well-being even when income level is relatively high (Levy, 2015).

Focusing on the Korean experience, we examine the effects of public cash transfer program on material hardship among older households in Korea. To date, investigations of various national anti-poverty programs in Korean and international settings have focused predominantly on poverty reduction using an income-based indicator (Amuedo-Dorantes & Juarez, 2015; Lee, Ku, & Shon, 2017). Using a quasi-experimental design and data from a nationally-representative panel survey of South Korean adult households, this study evaluates whether and to what extent the cash transfer program affects older households' material hardship generally and by category. Empirical evidence regarding potential differential effects on more disadvantaged older adults is particularly important for noncontributory pension programs, given policymaking factors that determine whether and how to allocate resources to people with the greatest need (Barrientos, 2015).

This study contributes to the growing body of literature on material hardship for older adults in the context of an Asian country facing persistent old-age poverty and immature public pensions. Starting from European countries with the EU's stated goal to reduce material deprivation and social exclusion, research on material deprivation has gained importance outside

Europe, in countries such as Australia, Canada, and New Zealand (i.e., Saunders & Wong, 2011, Notten 2015, Perry 2015). In the United States, research communities use similar though not identical 'material hardship' indicators (cf. Wu & Eamon, 2010; Huston & Bentley, 2010). To date, little is known about the Asian context. The policy response to address the needs of low-income household differ greatly across cultural and institutional context. This study contributes knowledge of East Asia to the Western-based body of knowledge on material hardship.

2 Background

2.1 Material hardship in old age

The outcomes of welfare policy programs can be evaluated with indirect indicators, such as income or resources, or direct measures, such as expenditure or quality-of-life indicators (Ringen, 1988). As a non-monetary, direct measure of material well-being, material hardship measures a household's actual living standard directly by focusing on the affordability of items considered as essential to have a decent standard of living in the society where people live (Guio, Gordon, & Marlier, 2012). The items typically include food, housing, utilities, medical care, clothing, and consumer durables, which reflect very basic standards of material adequacy that are acceptable to the public (Beverly, 2001). Cumulative research has shown income, poverty, and material hardship are only partially overlapping; in many countries, those are completely distinct between the groups of people deemed poor by the income poverty measure and those deemed poor by the hardship measures (cf. Weon & Rothwell, 2020). The discrepancy is not surprising given that a material hardship can occur when the income of a household is above the national poverty line, just as households below the national poverty line are not necessarily deprived (Whelan et al., 2004).

Existing literature on material hardship tends to focus on the relation between material hardship and health. For example, Doebler and Glasgow (2017) deprivation and the self-reported health of older people in Northern Ireland.; Another study focused on 14 European countries to examine the influence of material and social deprivation in changes in physical and mental health deterioration in old age (Myck, Najsztub, & Oczkowska, 2019). Several epidemiological studies in the U.S. have examined the association between material hardship on health among older

adults with diabetes (Walker et al., 2020), health behaviors such as smoking and drinking (Marshall, Bryson, Ronstant, & Canham, 2019). Among Korean studies, earlier studies showed that correlated material hardship includes factors such as employment status, housing tenure status, and financial assets in low-income households (Lee, 2011). More recent studies focused on the influence of material hardship on mental health. Kim and colleagues (2015) focused on single households found multiple material hardship items (e.g., utility and healthcare) were associated with an increased risk of being depressed among the single older households. Growing research began to focus on older adults. Lee& Lee (2016) showed that between 2007 and 2013, about 12-22 percent of Korean older adults experienced material hardship. Another study (Kim, year) found the rate of material hardship has decreased over time (17.7 percent in 2013 to 12.3 percent in 2015) in aggregate. When examined by domain, hardship experienced in food and housing continued to be the main driver (11.3 percent for food insecurity and 3.49 in housing in 2015).

Despite the growing research on the material hardship among older adults, to date, research on the effect of policy on material hardship among older people remains scarce. Existing studies investigating the various policies' effect on material hardship are (Sabia & Nielsen, 2015; Shaefer & Gutierrez, 2013; Sonik & Parish, Mitra, 2019) limited to low-income households in general, and little is known study about any policy effect on older people's material hardship. As a rare example, Notten and Guio (2020) 's simulation study showed that pension and other cash transfers could substantially reduce material hardship among older households in four European countries (Germany, Greece, Poland, and the U.K.).

2.2   *Policy context: Social pension program in Korea*

The slow expansion of contributory pension programs, combined with the rapid growth of aging populations globally, has led to a significant expansion of the role of social insurance or public transfers (i.e., noncontributory cash payments to older people) (Koh & Yang, 2019). In low-to-middle income countries with public pension systems that are yet to mature, social pensions play a central role in addressing poverty and vulnerability in the later years, since these countries have limited institutional and financial capacity to design and deliver poverty reduction programs

(Barrientos, 2014). As such, social pensions have been prevalent among middle- and low-income countries in Latin America, Africa, and Southeast Asia (Yang, Williamson, & Shen, 2010).

By 2050, 38.2 percent of Korea's population will be aged 65 or older (Ministry of Health and Welfare, 2012). At 49.6 percent, Korea's later year poverty rate is the highest of any OECD country, and four times higher than the OECD country average (OECD, 2015). The high poverty rate reflects rapid shifts in the traditional family system and cultural values. The number of older individuals who live alone has continued to rise (13.6 percent in 1994; 23.0 percent in 2014). The yet-to-mature public pension system has exacerbated this spike in Koreans' later-year poverty. Its 20-year-old contributory public pension scheme, the National Pension Scheme, covers only about 46.5 percent of the older population in 2013 with an income-replacement level of about 20 percent (National Pension Research Institute, 2016). In July 2014, the government replaced the existing meager scale social pension program with the Basic Pension Scheme (BPS), which increased benefit levels while keeping resource-based eligibility rules intact, covering 70 percent of the older population. It provided a maximum monthly benefit of 200,000 KRW (about USD 166.18 as of 2020) to single persons and 320,000 KRW (about USD 265.89) to couples in 2014[1]. By substantially increasing the previous benefit level, the BPS has a dual policy goal of improving the living standards of lower-income older adults, thereby enhancing their economic well-being.

Evidence regarding the effect of social pension is limited, and most of the existing research focused on the effect of income-based poverty reduction or consumption. One descriptive study (Tak, 2016) found the lower-income groups spent more on housing and utilities after the reform. One quasi-experimental study (Lee, Ku, & Shon, 2017) used a difference in difference (DiD) analysis to examine the pre- versus post-program effects of BPS on income, poverty, and total expenditure between low-income older adults (treatment group) and higher-income older adults (comparison group). Their findings showed that six months after the reform was implemented, the benefit associated with gross income increased by 85,000 KRW (about USD 70.63 as of 2020 July), an average increase of 95,000 KRW in total expenditure.

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[1]. As of 2020, the maximum BPS amount is 253,750won (USD 210.84) and 300,000won (USD 249.27) for the low-income for each person. For a couple, the total amount will be reduced by 20 percent reflecting equalized household expense. For example, the maximum benefit amounts for the low-income couple will be 600,000*0.8=480,000.

2.3   *Present Study*

This study examines the BPS's effect on later-year material hardship. We first asked to what extent the Korean social pension for older adults, BPS, affects the material hardship and non-material well-being among older adults. The BPS has a dual policy goal of improving the living standards of lower-income older adults and enhances their well-being. Existing empirical evidence about the BPS has concentrated on poverty reduction, and the rare study looked into whether BPS had any influence on well-being. For material hardship, we examine both in aggregate form and four domain-specific hardship (i.e., housing, utility, health care, and food insecurity). For non- material well-being, we focused on life satisfaction. Next, we examined if and to what extent the effects of BPS on the material and non-material well-being varies by income level. A detailed examination of the social pension on material hardship and well-being can provide a more direct picture of whether and to what extent the cash income may help the lower end of the income distribution range cope with their living (Israel, 2015).

3   Data and sample

This study uses panel data from the Korea Welfare Panel Study (KOWEPS), an annual longitudinal survey of South Koreans aged 15 and above. Since 2006, KOWEPS has annually interviewed, analyzed, and disseminated information from a representative sample of 7,072 families (KOWEPS, 2006), providing information on socioeconomic characteristics, annual household income, and family structure in combination with assessments of health and physical development of each household member. For this study, we used wave 12 (the year 2017).

We restrict to sample to those who are likely to be eligible for the Basic Pension: those whose income and asset level are under or equal to 70 percent of the total older population. As the unit of observation for the asset measurement in KOWEPS is a household, the estimation of income or asset at the individual level was not possible. Therefore, in this study, the sample consists of the head of the household and their spouse. Also, considering the well-known under-reporting of income and asset information in survey data, we did not use the official income and asset levels in 2017 as the receipt of BPS benefit. Instead, we used the 2017 official calculation formula to determine the income and asset levels of the bottom 70 percent of the older

population in this dataset. We then selected those individuals whose income and asset levels were equal to or under 70 percent of this entire sample (N=4985). From this initial sample, we further excluded those who are recipients of National Basic Livelihood Security (NBLS) (N=468), a minimum income guarantee for poor households below the poverty line. For the NBLS recipients, their benefit amount is designed to be reduced by the equivalent of the payout from the BPS. As such, an accurate estimation of BOAP benefit among the NBLSS recipients would be challenging. After deleting observations with missing dependent variables (n= 194, 4.3 percent), the final study sample for a nonparametric Regression Discontinuity Design amount to 4,323 individuals. Then, we additionally restrict sampling to those who are 45 years old or over for the parametric approach to generalize the causal effect of the treatment among the middle-age population (N=3,932).

4   Empirical model design

To evaluate the impact of BPS receipt on material hardships and life satisfaction of older people aged 65 and over, we employed two empirical approaches: a conventional parametric approach and a nonparametric Regression Discontinuity Design (RDD).

4.1   Parametric approach

To estimate the BPS impacts, we firstly employ a set of regression models as follow:

$$Y_i = \beta_0 + \rho D_i + \gamma X_i + \varepsilon_i$$

where Y_i is an outcome measure for observation i, X_i is a set of covariates, and ε_i is a random error term for observation i. Most importantly, D_i is a dichotomous eligibility indicator; i.e., $D_i = 1$ for eligible population, those whose age is above the cutoff (i.e., 66); otherwise, $D_i = 0$. Then ρ estimates the treatment effect of the BPS near the cutoff point ($x_c = 66$). Depending upon the types of dependent variables, we employ Ordinary Least Square regression (overall material hardship indicator and life satisfaction measure) and Logistics regression approaches (four domain-specific hardships measures). For an intuitive interpretation of the logistic regression results, we report marginal effects of each independent variable, which estimate percentage

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points change in the risk of a dependent variable in accordance with a unit increase in the independent variable.

4.1.1 Dependent variables

This study explores the BPS impacts on Older adults' material hardship experience as well as their life satisfaction. Concerning the material hardship experienced, we construct two types of hardship indicators – domain-specific hardship indicators (i.e., housing hardship, utility bill payment, accessibility to health care, and food insecurity) and overall hardship indicator. Building upon previous investigations of the measurement properties of hardship indicators, we selected items from the KOWEPS as follows:

- *Housing problem*: (1) You/your family had to move out due to a default on rent payment for more than two months (1 = yes, 0 = no); (2) You/your family were unable to heat home due to cost (1 = yes, 0 = no).

- *Difficulty with basic utility bills:* (1) Experience the hardship to meet monthly payments on bills (1 = yes, 0 = no); (2) Experienced utility services (i.e., electricity, phone, water) cut off because you failed to pay taxes (1 = yes, 0 = no).

- *Health care hardship:* (1) you/your family members did not seek medical care needed due to a cost (1 = yes, 0 = no); (2) You/your family members had your national health insurance benefit suspended due to a failure of contribution (premium) payment (1 = yes, 0 = no).

- *Food insecurity:* (1) "The food that (I/we) bought just did not last, and (I/we) did not have money to get more" (1 = never true, 2 = sometimes true, 3 = often true); (2) "(I/We) could not afford to eat balanced meals" (1 = never true, 2 = sometimes true, 3 = often true);(3) "In the last 12 months, did (you/other adults in your household) ever cut the size of your meals or skip meals because there was not enough money for food?" (1 = yes, 0 = no); (4) "In the last 12 months, did you ever eat less than you felt you should because there was not enough money to buy food?" (1 = yes, 0 = no); (5) You/your families were ever hungry but did not eat because you could not afford enough food?" (1 = yes, 0 = no)

For each hardship indicator, we coded 1 for those who indicated more than one experience of hardship in each question was defined as having hardship (Nahm, 2010). For the aggregated material hardship indicator, we construct a continuous measure by summing the four recoded items. The total score indicated levels of severity of material deprivation on a continuum that ranged from 0 to 4, with higher scores indicating higher levels of material hardship.

We operationalize overall life satisfaction by adopting a question on it ("How satisfied are you with your life in general?") measured using a five-point Likert scale ranging from one ("very dissatisfied") to five("very satisfied") and treat it as a continuous variable.

4.1.2 Covariates

A set of demographic characteristics is controlled: age, agesquare; gender (women=0, men=1,); education (lower or equal to elementary =1, middle=2, higher than high, not four year college= 3, higher than college =4); working status (not working =0, working for pay=1,); number of family members; living arrangements (single= 1, couple only=2, single with children or other family members=3, couple with children or other=4); and region (rural =0, city=1); number of working persons in the household ; disability status (no disability=0, any disabilities=1); chronic disease history (non-chronic condition=0, any chronic illnesses =1); total amount of private transfers (expressed in logarithm).

4.2   Regression Discontinuity Design

One of the drawbacks of conventional parametric regression approaches is internal validity. That is, due to the potential existence of unobservables as well as endogeneity, results from such parametric models are easily biased (Manski 1993; Keele & Minozzi 2013). The main advantage of RDD over other competing approaches is that it is closer to a natural experimental design as individuals close to a given cutoff are likely to be very similar, and the only thing that makes them different is the treatment assignment below and above the cutoff (David Lee &Thomas Lemieux, 2010; Wilbert van der Klaauw, 2008; Guido Imbens & Thomas Lemieux, 2007). RDD enables us to take into account both observed and unobserved heterogeneity in the estimation of the treatment effect (the impact of the program) because one below the cutoff could be a counterfactual for those who are above the cutoff, and vice versa, if they are close enough to the cutoff. In this study, we adopt the fact that observations just below and above the cutoff (age 65) are likely to be very similar to each other concerning observed and unobserved characteristics; hence, the mean difference in the values of the outcomes identifies a Local Average Treatment Effect (LATE) of the BPS for the subpopulation of individuals whose age is at or near 65.

Because the RDD estimates LATE of the treatment of interest, we limit the sample to those who are close enough to the cutoff. Then an important issue is how to define the term

"close enough" through a bandwidth selection process. In general, the selection of bandwidth in nonparametric estimations aims to balance precision and bias. Using a broader bandwidth is likely to yield more precise effects because of using more data for the regression, but this also leads to bias and vice versa. Although it is advisable to check for the appropriate functional form, in practice, it may not be as critical when one is modeling using data very close to the cut-point—especially if there are very large samples in this interval. This is because the smaller the analytic bandwidth, the more likely it is that the slope of the regression line is approximately linear in this smaller interval (McCall & Bielby, 2012).

Hence local regression models focus on their subsample to estimate the LATE. A distinct difference between the nonparametric RDD approach and other conventional local regression models is that the former determines its bandwidth for the local estimation based upon its given data. Of many bandwidth selection procedures, we adopt mean squared error (MSE) optimal bandwidth selector, which the default bandwidth selector for the RD treatment effect estimator. We also note that the results with the MSE are robust and similar to other bandwidth selection procedures, such as coverage error-rate (CER)-optimal bandwidth selector.

We utilize the "sharp" RDD[2] to estimate discontinuity in outcomes at the age cutoff. Our main estimating equation is given by

$$Y_i = f(x_i) + \rho D_i + \varepsilon_i$$
$$D_i = \begin{cases} 1 \ (if \ x_i \geq 66) \\ 0 \ (if \ x_i < 66) \end{cases}$$

where Y_i is an outcome measure for observation i, $f(P_i)$ is an unknown smooth function of the running variable, i.e., age, and ε_i is a random error term for observation i. Most importantly, D_i is a dichotomous eligibility indicator; i.e., $D_i = 1$ for eligible population, those whose age is above

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[2] RDD consists of the sharp regression discontinuity (SRDD) and fuzzy regression discontinuity (FRDD) approaches. If the treatment (BPS receipt) is strictly defined based on the conditioning variable (age), a so-called sharp regression discontinuity method can be applied. In our context, the idea of the regression discontinuity is to estimate the impact of pensions by comparing the outcomes of pensioners aged 65 and just above 65 and the outcomes of nonpensioners who are aged just below 65. The sharp regression discontinuity identifies the local effect of pensions at the age threshold of 65. The validity of RDD crucially depends on whether individuals are able to manipulate the treatment assignment (Lee & Lemieux, 2010), which would invalidate the assumption of local randomization of the treatment around the cut off. In our context, the manipulation would mean that the older individuals in the sample manipulated their age in anticipation of the benefit payout, which cannot happen. Therefore, manipulation can be ruled out.

the cutoff (i.e., 66); otherwise, $D_i = 0$. Then ρ estimates the treatment effect of the BPS near the cutoff point ($x_c = 66$).

The analyses were conducted in the following order: to check design validity for RDD modeling, we first graphically check the distribution pattern among key variables. Second, parametric and RDD modelings are conducted with the entire sample, then followed up by the same set of analyses with three split samples by income level equalized by household members.

5   Empirical Findings

5.1   Sample characteristics

Table 1 presents summary statistics for the sample used for the parametric model. The largest proportion in the sample had food insecurity (7.9 percent), followed by utility (2.7 percent) and housing (2.3 percent). A clear, descriptive pattern indicates that individuals in the lower-income group tend to have more hardship in food insecurity (18.2 percent), utility (3.8 percent), and housing (5.4 percent). Individuals in this group tend to be older, women, had low education, single. They also had a higher level of disability (22.0 percent) and chronic diseases (85.8 percent).

Table 1. Descriptive characteristics of the variables in use (45 or older)

	Total	By Eligibility		By Income		
		Eligibles	Non-eligibles	Upper	Middle	Lower
Life satisfaction	3.41	3.47	3.37	3.54	3.37	3.23
	(0.68)	(0.65)	(0.69)	(0.65)	(0.64)	(0.71)
Material hardships (aggregate)	0.15	0.09	0.19	0.06	0.16	0.30
	(0.52)	(0.41)	(0.58)	(0.31)	(0.53)	(0.72)
Housing	2.31	1.38	3.00	1.02	1.70	5.42
(%)						
Utility	2.65	0.63	4.15	1.53	3.34	3.75
(%)						
Health care	1.89	1.15	2.43	0.43	3.26	2.73
(%)						
Food insecurity	7.93	6.13	9.25	2.55	7.50	18.16
(%)						
Age	64.0	74.53	56.21	60.36	64.75	69.60
	(10.74)	(6.01)	(5.59)	(8.97)	(10.50)	(11.36)
Gender Male	41.06	39.28	42.37	46.16	39.66	33.71
(%)						

	Female	58.94	60.72	57.63	53.84	60.34	66.29
Educational attainment (%)	Elementary school or lower	36.5	55.46	22.45	20.68	39.85	60.58
	Middle school	19.28	18.99	19.49	20.18	22.16	13.88
	High school or vocational college	33.55	18.36	44.81	43.01	29.78	21.47
	College (4 years) or higher	10.67	7.19	13.25	16.13	8.2	4.07
Marriage (%)		62.76	61.70	63.54	72.75	63.16	44.28
Disability (%)		17.59	18.63	16.83	12.67	20.95	22.07
Chronic diseases (%)		76.24	90.90	65.38	68.72	79.26	85.83
Private transfer (log)		2.73 (4.62)	5.40 (2.38)	0.76 (4.88)	1.89 (4.82)	3.45 (4.40)	3.32 (4.26)
Working status (%)	Working	42.06	25.19	54.55	59.59	36.89	17.27
	Non-working	57.94	74.81	45.45	40.41	63.11	82.73
Family size		2.20 (1.04)	1.75 (0.66)	2.53 (1.15)	2.53 (1.10)	2.13 (0.97)	1.69 (0.80)
Number of working family members		0.85 (0.89)	0.46 (0.65)	1.14 (0.93)	1.31 (0.96)	0.65 (0.66)	0.28 (0.49)
Living arrangements (%)	Single	25.97	34.50	19.65	15.7	23.34	47.87
	Couple only	36.55	53.93	23.68	34.16	43.79	31.4
	Single with other	11.76	4.52	17.12	12.07	13.95	8.35
	Couple with other	25.72	7.05	39.54	38.08	18.91	12.38
Region	Urban	87.92	82.92	91.63	92.43	87.28	80.65
	Rural	12.08	17.08	8.37	7.57	12.72	19.35
Observations		3,932	2595	1337	1170	1343	1419

Note: Mean or Percentage reported
Standard deviations in parentheses

5.2 Analytic Results

5.2.1 Parametric approach

Result in **Table 2** indicates that recipients of the BPS were likely to have a lower level of sense of material hardship in aggregate form (-0.069, p< 0.01), lower level of hardship in housing (-0.021, p<0.01) and food insecurity (-0.055, p< 0.01). Also, the recipients are like to have a high level of life satisfaction (0.13, p< 0.01). By income groups (**Table 3**), we did not find any discernible influence of the benefit on material hardship in aggregate form, except the finding for the lower income group at a marginal degree (-0.150, p<0,1). The positive effect of the benefit persists in housing hardship and food insecurity for the lower-income group only (b=-0.060,

p<0.05 and b=-0.133, p<0.01 respectively). The benefit was associated with a higher level of life satisfaction (b=0.198, p<0.01).

Table 2. Empirical model estimates, parametric approach (OLS & Logit)

	Hardship					**Life Satisfaction**
	Aggregated	*Housing*[M]	*Utility*[M]	*Health*[M]	*Food*[M]	
Treatment	-0.069*	-0.021*	-0.008	-0.001	-0.055**	0.130**
	(0.031)	(0.011)	(0.010)	(0.008)	(0.019)	(0.042)
Age squared	-0.000	-0.000	-0.000	-0.000	-0.000	-0.00
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.013	0.012	0.001	0.004	0.012	0.02
	(0.021)	(0.007)	(0.007)	(0.006)	(0.013)	(0.030)
Treatment * Age	0.013	0.005	0.001	0.001	0.010	0.00
	(0.009)	(0.003)	(0.003)	(0.002)	(0.005)	(0.012)
Gender	-0.014	-0.005	-0.003	0.000	0.005	0.060*
	(0.018)	(0.005)	(0.005)	(0.004)	(0.010)	(0.024)
Educational attainment						
Middle school	-0.002	0.006	0.003	-0.003	-0.009	0.080**
	(0.021)	(0.007)	(0.007)	(0.006)	(0.013)	(0.029)
High	-0.081**	-0.009	-0.010	-0.014**	-0.035**	0.140**
	(0.022)	(0.005)	(0.006)	(0.005)	(0.012)	(0.031)
Higher than college	-0.014	0.003	0.004	-0.005	-0.027	0.220**
	(0.036)	(0.010)	(0.010)	(0.009)	(0.018)	(0.049)
Marriage						
Married	-0.128	-0.573*	-0.569	-0.573	-0.099	0.120
	(0.085)	(0.246)	(0.575)	(0.308)	(0.093)	(0.117)
Disability						
Having a disability	0.009	-0.008	-0.004	-0.003	0.015	-0.08**
	(0.020)	(0.006)	(0.006)	(0.006)	(0.011)	(0.028)
Health						
Having a chronic disease	0.031	0.004	-0.004	-0.005	0.038**	-0.10**
	(0.022)	(0.006)	(0.005)	(0.005)	(0.014)	(0.030)
Private transfer (log)	-0.011**	-0.002**	0.000	-0.000	-0.006***	0.02**
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
Working Status						
Working	0.004	-0.005	0.001	0.004	0.004	0.080*
	(0.024)	(0.007)	(0.006)	(0.006)	(0.016)	(0.033)
Family size	0.033	-0.000	0.006	-0.002	0.023	-0.020
	(0.023)	(0.005)	(0.004)	(0.005)	(0.012)	(0.032)
	-0.075**	-0.013*	-0.009*	-0.007	-0.046***	0.07**

Number of working family members	(0.017)	(0.005)	(0.004)	(0.004)	(0.012)	(0.023)
Living arrangement						
Couple only	0.048	0.416**	0.413	0.416*	0.049	-0.030
	(0.088)	(0.138)	(0.681)	(0.202)	(0.087)	(0.122)
Single with children or other family members	-0.046	-0.000	-0.005	0.006	-0.027	-0.14*
	(0.042)	(0.005)	(0.003)	(0.006)	(0.018)	(0.058)
Couple with children or others	0.071	0.429***	0.424	0.431***	0.012	-0.13
	(0.103)	(0.042)	(0.229)	(0.038)	(0.079)	(0.143)
Urbanicity						
City	0.032†	0.003	0.007	0.007	0.020*	0.03
	(0.018)	(0.005)	(0.005)	(0.004)	(0.010)	(0.025)
N	3,932	3932	3932	3932	3932	3,932

Note: †$p<0.10$ * $p<0.05$ ** $p<0.01$ *** $p<0.001$
Stanrdard errors in parentheses
[M] Marginal effect estimated for Logistic models

Table 3. Heterogeneous treatment effect estimates by income, parametric approach (OLS & Logit)

	Hardship					Life Satisfaction
	Aggregated	*Housing*[M]	*Utility*[M]	*Health*[M]	*Food*[M]	
Panel A: Upper-income group (N=1,170)						
Treatment	-0.035	N/A	-0.010	0	0.010	0.198**
	(0.031)	-	(0.023)	(.)	(0.025)	(0.068)
Panel B: Middle-income group (N=1,343)						
Treatment	-0.059	-0.004	-0.029	0.013	-0.010	0.123†
	(0.045)	(0.018)	(0.022)	(0.018)	(0.028)	(0.070)
Panel C: Lower-income group (N=1,419)						
Treatment	-0.150†	-0.060*	0.003	0.025	-0.133**	0.049
	(0.083)	(0.025)	(0.015)	(0.021)	(0.045)	(0.093)

Note: †$p<0.10$ * $p<0.05$ ** $p<0.01$ *** $p<0.001$
Stanrdard errors in parentheses
[M] Marginal effect estimated for Logistic models

5.2.2   Nonparametric approach

Largely consistent with the results from the parametric analysis, the BPS benefit is likely to reduce the material hardship in aggregate by 0.095 (Table 4) in the RDD model. With respect to domain-specific hardship, the BPS benefit reduces the risks of experiencing housing hardship, utility cutoff/bill payment delay, and food insecurity by 1.6, 1.7, and 5.0 percentage points. Considering the lower risk of experiencing those hardships (2.3 percent, 2.7 percent, and 7.9 percent, respectively), the effect sizes are substantial. The benefit also was associated with a higher level of life satisfaction (b=0.150).

Table 4. Treatment effect estimates, nonparametric approach (RDD)

	Hardship					Life Satisfaction
	Aggregated	*Housing*[M]	*Utility*[M]	*Health*[M]	*Food*[M]	
Treatment	-0.095**	-0.016**	-0.017**	-0.011	-0.050***	0.150***
	(0.020)	(0.006)	(0.006)	(0.005)	(0.011)	(0.029)
	2,228	1,997	2,457	2,228	2,457	2,228

Note: [†]p<0.10 [*] p<0.05 [**] p<0.01 [***] p<0.001
Standard errors in parentheses

Figures 1 and **2** showed the plot for local squared polynomial regression discontinuity estimates. Confirming the results from Table 4, the results indicate a noticeable difference in the slopes for the regression line between the two groups in terms of material hardship in aggregate and life satisfaction.

Figure 1. Local squared polynomial regression discontinuity estimates – Material hardship, aggregated
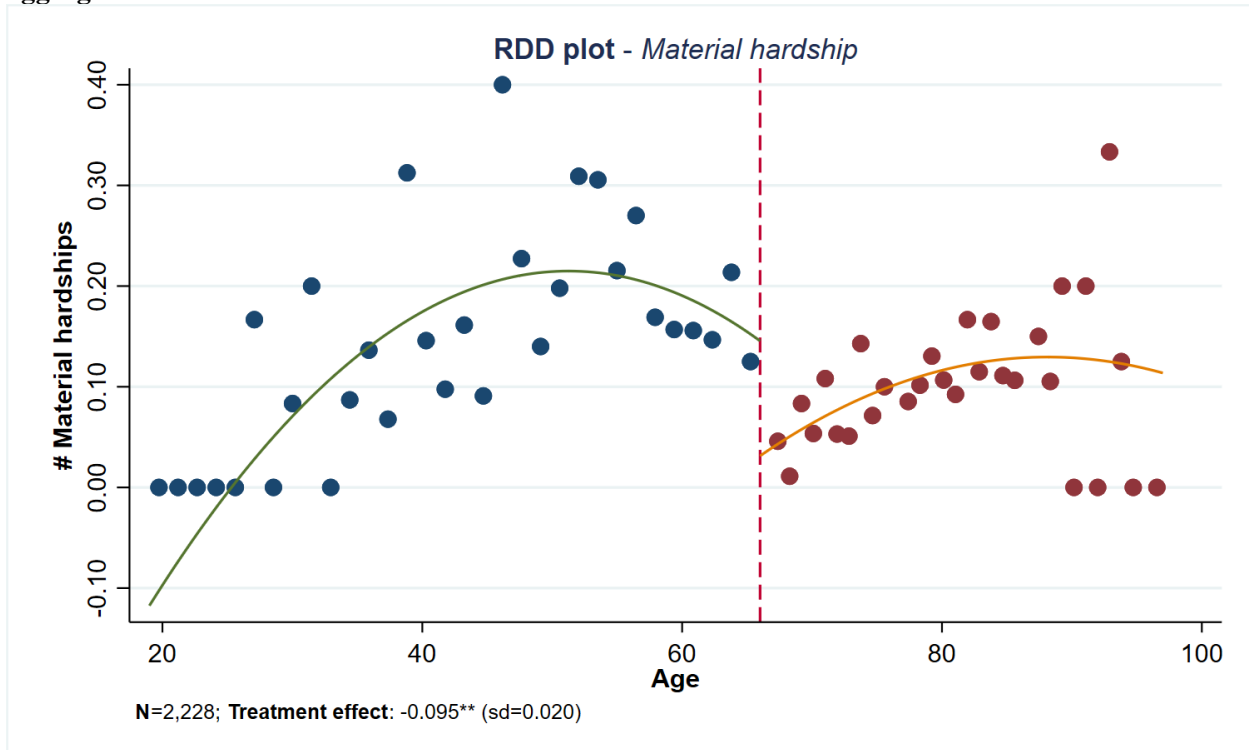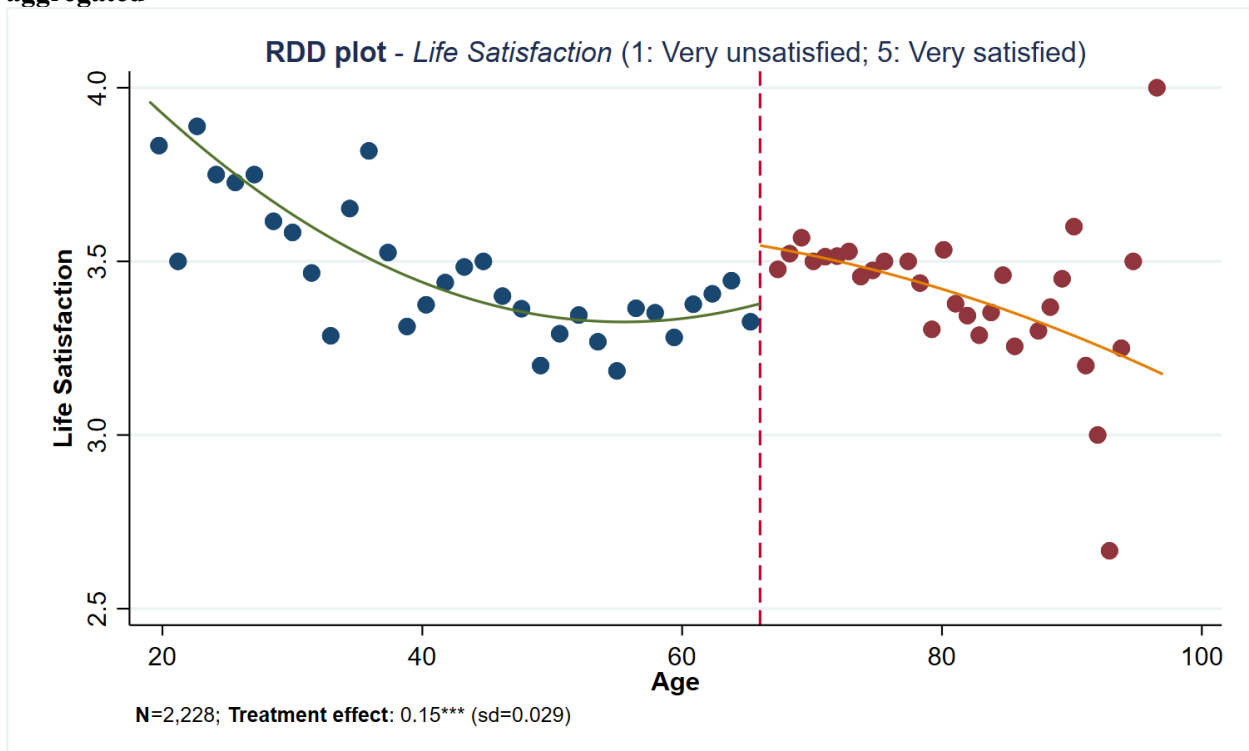

RDD plot - *Material hardship*

N=2,228; **Treatment effect**: -0.095** (sd=0.020)

Figure 2. Local squared polynomial regression discontinuity estimates – Life satisfaction, aggregated

RDD plot - *Life Satisfaction* (1: Very unsatisfied; 5: Very satisfied)

N=2,228; **Treatment effect**: 0.15*** (sd=0.029)

Lastly, **Table 5** shows the results for each income group. Across all the groups, the cash benefit was likely to lead to a lower level of material hardship in aggregate. The positive effect of the benefit in housing and food insecurity persisted only in the lower-income group only (b=-0.062, p<0.01 and b=-0.139, p<0.001 respectively).

**Table 5. Heterogeneous treatment effect estimates by income, Nonparametric approach (RDD)**

	Hardship					Life Satisfaction
	Aggregated	*Housing*^{M}	*Utility*^{M}	*Health*^{M}	*Food*^{M}	
Panel A: Upper-income group (N=748)						
Treatment	-0.050**	N/A	-0.007	N/A	-0.023	0.220***
	(0.016)	-	(0.010)	-	(0.014)	(0.044)
Panel B: Middle-income group (N=837)						
Treatment	-0.150***	-0.004	-0.035*	-0.032*	-0.065***	0.220***
	(0.030)	(0.006)	(0.014)	(0.013)	(0.017)	(0.047)
Panel C: Lower-income group (N=643)						
Treatment	-0.250***	-0.062**	-0.019	0.001	-0.139***	0.160**
	(0.057)	(0.019)	(0.012)	(0.014)	(0.026)	(0.063)

Note: †p<0.10 * p<0.05 ** p<0.01 *** p<0.001
Stanrdard errors in parentheses

5.3   *Empirical design validity*

To test the validity of the RDD, we check the main assumption that individuals do not have precise control over the variable that is used to determine treatment eligibility (i.e., age 66). We confirmed that there was no sudden change in the number of respondents in the study at age 66 since such a discontinuity might imply that individuals had control over their recorded age (**Figure 3**). Second, we checked that there were no discontinuities at age 66 in the following variables: gender; education, working status; marital status; the number of a family member; region, living arrangement, disability status, chronic diseases, private transfer; the number of working family members.

Figure 3. Validity check
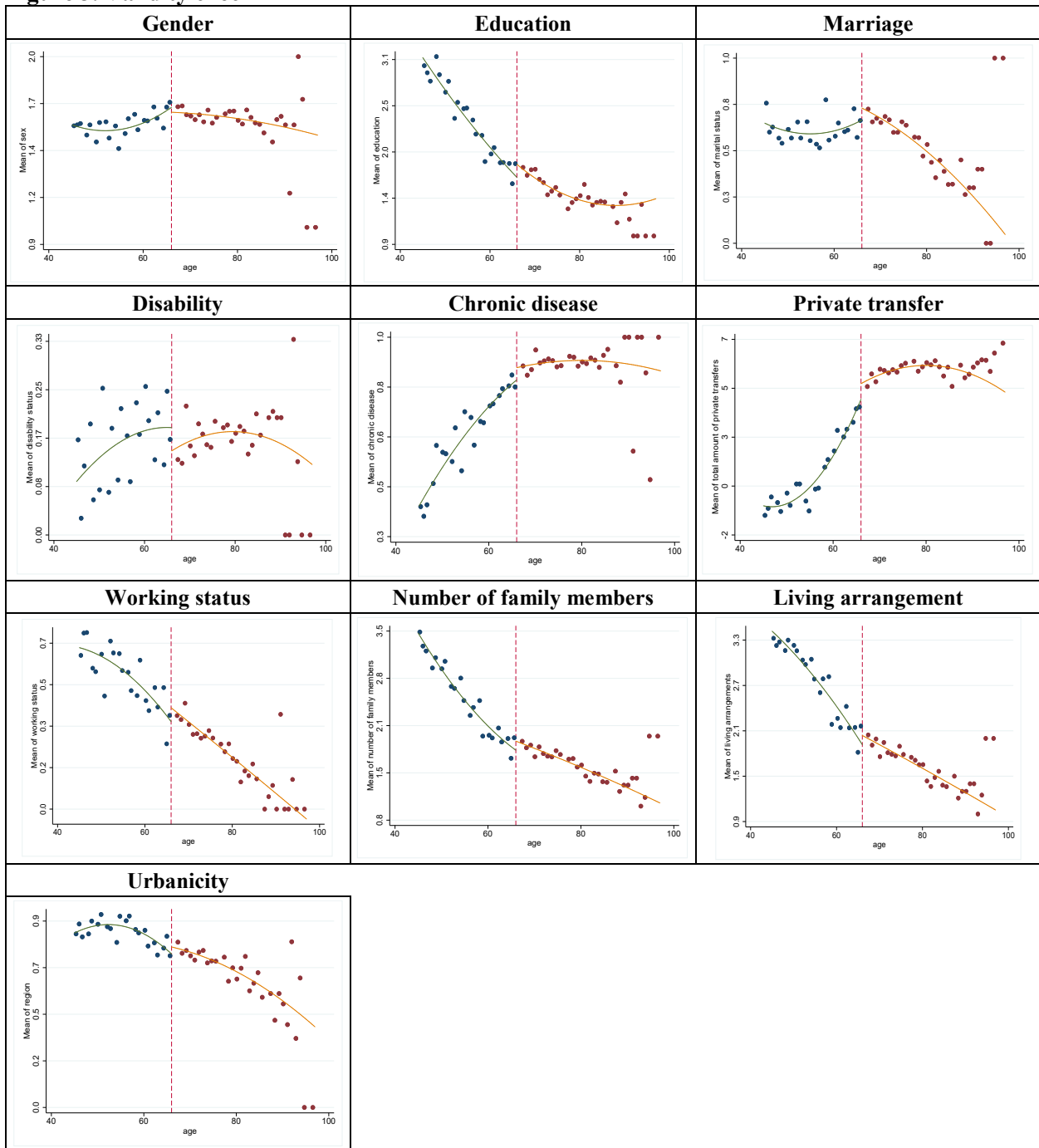
6   Discussion

The main goal of the present study was to examine the effect of a social pension program for older adults in South Korea on overall material hardship and domain-specific hardships for housing, food, utility, and health. Additionally, we classified the sample into three income groups in investigating the policy effect. The examination of policy effect on material hardship, not the conventional income-based poverty, is important since it can better capture differences among individuals who do not meet minimal levels of basic needs (e.g., housing, clothing, and medical care) and thus may suffer from material shortages. This more comprehensive approach to understanding economic vulnerability may help policymakers be more mindful of providing the actual basic needs and targeted services to those in need, not just the minimum income (Beverly, 2001; Heflin & Iceland, 2009). Also, by evaluating the national policy effect of material hardship among older adults in the Asian context, this study expands the knowledge on national efforts at reducing poverty and well-being in old age.

We first examined if and to what extent the BPS affects material hardship among older households. When examined in aggregate, findings from the RDD and parametric model suggests that older people are less likely to experience material hardship when they received the social pension. This finding confirms the positive influence the BPS on reducing material hardship found in one descriptive study's (Kim, 2019). In the domain-specific examination, however, we found the overall decrease in material hardship seems to be primarily accounted for by housing and food only. Existing studies have conceptualized and measure material hardship, largely either focusing on domain-specific hardship or aggregated scores across multiple domains (Ahn & Song, 2017).

From a policymaking perspective, our findings on domain-specific examination of material hardship provided significant implications for both developing and developed countries in the context of the global population aging. In low-to-middle income countries, inadequate levels of material hardship have always been central to the conceptualization of poverty and living standards. Since these countries have limited institutional and financial capacity to design and deliver poverty reduction programs (Barrientos, 2014), it is essential to prioritize public spending by identifying and directly measure specific areas of basic material vulnerability in old

age. For the same reason, it still can be critical evidence needed for policy reform efforts for economically advanced countries as well. South Korea belongs to the high-income group with a real per capita income of $ 37000 as of 2016 by the World Bank criteria. However, due to yet to mature public pension systems, the country suffers from the highest rate of later-year poverty. In this study, we focus on one example of anti-poverty public policy for older people. The findings of this study show that an aggregate measure of material hardship would fail to obtain an accurate picture of any public policy and program to address poverty and vulnerability in the later years.

Turning to specific domain-related findings, a consistent positive effect of the BPS was found in housing hardship and food insecurity. In terms of food insecurity, the older people in both the middle and lowest income group were likely to experience a reduced level of hardship. The noticeably positive effect of the cash transfer on food insecurity reveals the degree of unmet need among Korean older people. Contrasted with the prior research in other countries that shows lower rates of food insecurity for older adults compared to younger adults, Korean older adults are known as one of the most vulnerable populations experiencing food insecurity (Kim et al., 2019). In Korea, in general, low-income people are eligible for congregate meals or home-delivered meals, mostly administrated by local governments and community-based organizations (Lee, 2012). Among the government budget for food assistance programs, only 1 percent is used for older adults, and over two-thirds of older adults who received food assistance programs are dissatisfied with the programs (Lee, 2012). Our findings corroborate these descriptive findings of the wide-spread unmet needs for food and suggest the cash benefit in the BPS may have addressed this problem. That is, two-thirds of the sample in this study benefited from the cash transfer, not just meeting their immediate need for food for material survival, but it seems feasible that the available cash led to an increase of their efficacy by consuming more food with better quality. Considering the consistent and growing evidence on the negative effect of food insecurity on a wide range of health and well-being (cf. Kim et al., 2019; Han & Kang, 2019), and its potential cumulative effect over time, the positive effect of the BPS found provides a critical imperative for continued and expanding policy and program intervention.

With respect to housing hardship, the positive effect of the BPS benefit was found only among the lowest income group. This finding not only reveals the most economically vulnerable

older people's need for basic housing insecurity remains unmet. The problem of housing affordability in Korea is well-known; the housing cost burden facing lower-income households is much higher than the RIR 20% recommended by the OECD (Park, 2013). Solid evidence indicates housing burden among low-income renters are associated with negative health and well-being (Park, 2015). Considering housing cost tends to be a major spending item among older adults (Choi, 2011), financial assistance to reduce the housing cost burden may potentially lead to other positive consequences, including increased spending on food).

Taken together, not only this study confirms that there is heterogeneity in how socioeconomic status is experienced and lived (Beverly 2001) in terms of material hardship, it adds to the limited empirical study that examines the social pension on material hardship for older people with the significant implication that the lower groups in this study, as a near-poor group who are not eligible for such public assistance were likely to be benefited from the public cash transfer. It is well-established that material hardship can occur when the income of a household is above the national poverty line, just as households below the national poverty line are not necessarily deprived (Whelan et al., 2004). We found the positive effect of BPS in housing and food is concentrated in the middle and lower tertile groups. Out of the eligible BPS recipients in the lower 70 percent group of the entire older population's income and asset level, our finding suggests that the cash benefit of the BPS reduced the basic needs such as housing and food for older people in the lower-income group. This finding is notable, considering that the sample in this study excluded the poorest older people for an accurate estimation of the BPS. Finding ways to target transfer programs more precisely to those experiencing hardship involves modifying the eligibility rules for the programs—could also be an important component of efforts to reduce hardship among older people (Levy, 2015). The positive effect of the cash transfer on reducing material hardship among lower-income groups provides significant empirical evidence for such future policy reform efforts. Implying the impact of efforts to reduce hardship by increasing outreach and enrollment among eligible nonparticipants or by increasing benefit levels for those who already participate is inevitably limited.

The cash benefit was likely to lead to a higher level of satisfaction in general, but in close examination, an interesting pattern emerged: while material hardship (either in aggregate form or specific domain), the lower-income group tend to be more benefited, the opposite trend was found for life satisfaction. In the parametric model, the positive effect was found only among the

upper-income group, and in the RDD model, the degree of association tends to decrease in the lower-income groups.

This study points to an important avenue for future research. Like Korea, many countries are experiencing a demographic shift toward an older population, but the degree to which each country can address challenges arising from their population aging would vary by their institutional and cultural context in each country. For example, it is an empirical inquiry to examine to what extent the strongly positive effect in the housing area found in this study can also be found in another society with a national housing policy centered around minimizing affordability. In other societies with no such free health care scheme, or for that matter housing and another area of domain examined in this study, it is an important empirical inquiry to examine cross-cultural disparities to examine the extent to which the effect of social pension or other public assistance programs affects low-income people's domain-specific material hardship.

We acknowledge some limitations in this study. Since the data in this study is annually collected, precise information on the month of the birthday was not available. Given that the participants can start to receive the benefit when the participants reach the age of 65 and apply for the benefit, we used the age of 66 as the age of eligibility for the BPS benefit. Due to this conservative use of age cutoff, the effect of the BPS may be underestimated since some people aged 65 are eligible for the benefit but not considered as such in this study. Another limitation is due to the unit of the beneficiary of the BPS. Since the benefit is provided at an individual level, it is possible that a non-eligible spouse (i.e., 65 years old) in a couple may still be indirectly benefited from the program when the participants share the benefit received by the older, eligible spouse. This confluence also hinders an accurate assessment of the effect of the program.

As social pensions as a strategy for poverty reduction in low-middle income countries, the empirical analysis of social pension's effect on material hardship provide important results with implications for public policy and future research for emerging and developing economies that encounter challenges associated with rapid population aging, and nascent social security systems with limited coverage.

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