

**Health Capacity to Work at Older Ages:  
Evidence from the Republic of Korea and the People's Republic of China**

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**Abstract**

Using the methodology of CMR (Cutler, Meara, and Richards-Shubik, 2013), this paper estimates the extent to which older adults can potentially extend their work lives due to the improvement of health status (health capacity to work) in the Republic of Korea (Korea) and the People's Republic of China (the PRC). Besides, we estimate the growth potential when utilizing the capacity to work by linking the results to the National Transfer Accounts (NTA) of each country. Unlike the other advanced countries, only a part of the elderly receives old-age pensions in both countries, which further enables us to simulate the health capacity to work for the eligible pension group and the other who is not. The estimated health capacity to work is also reported for various sub-groups. The results suggest that the two countries seem to have much smaller economic gains from the health capacity to work, compared with other advanced countries. The results also imply that the unused health capacity to work is concentrated only on wealthy older people. The results for the PRC suggest that while the elderly in rural areas tend to work more regardless of their pension status, urban residents show very similar patterns to Korea. We explain the results by linking them to Korea and the PRC's labor markets and their old-age support systems. All these results indicate that it might be misleading to interpret the results in Coile, Milligan, and Wise (2017) as a major outcome of the statutory retirement age for the economies in countries with the less developed pension system.

Keywords: population aging, elderly's health capacity, pension eligibility, old-age support system

JEL Classification: J11, J14, J19

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## 1. Introduction

With a rapid decline in fertility and an increase in life expectancy, East Asian countries, such as the Republic of Korea (Korea hereafter) and the People's Republic of China (PRC hereafter), have been witnessing a rapid change in their age structures. The rapid population aging is one of the most important economic and social risks in these countries, which hinders sustainable growth and social cohesion, and worsens social conflicts (Bloom, Canning, and Fink, 2010; Lee, 2016). The market system has limited power to deal with the risks, and the elderly of Korea and the PRC are particularly vulnerable because of the insufficient public support system for the elderly. Complicating the response is a fiscal burden through a rapid increase in welfare expenses, intergenerational conflicts, and poverty of the older population.

The Korean and Chinese governments have considered policies to reduce the negative impact of population aging. One of the main reforms has been to retain older adults in the workforce, such as by increasing retirement age.<sup>1</sup> As people live longer and healthier, it is reasonable to consider utilizing healthy older workers to sustain growth and support old workers. How much more can older people work given their health status (health capacity to work)? How does that contribute to economic growth (growth potential)? This paper attempts to quantify the health capacity to work for older males in both countries and evaluate the economic gains from their unused additional work.

There is a growing body of literature examining the relationship between health improvement and work capacity. Recently, the International Social Security (ISS) project team of 12 countries has estimated the health capacity to work (Coile, Milligan, and Wise, 2017b). Matsukura et al. (2018) also calculated the health capacity to work of the older people at the

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<sup>1</sup> Korea's current official retirement age is 60. In the PRC, it is 60 for males, 50 for manual female workers, and 55 for white-collar female workers.

national level and showed that there is a substantial untapped capacity to work in Japan.

However, little is known about Korea and the PRC. In Korea's case, Lee (2013) reports that older workers aged 50-64 with good or very good health status are more likely to work by about ten percentage points than those with poor or fair health status. However, Lee does not quantify the additional capacity. By using the Milligan-Wise method (MW) (Milligan and Wise, 2015), Kim (2019) shows that there is additional employment capacity in Korea. The MW uses the relationship between mortality and employment. One of the critical problems of the MW method is that the estimation is sensitive to comparison years, and the selection of the years seems to be arbitrary.

As used in Coile, Milligan, and Wise (2017a) and Matsukura et al. (2018), we use the methodology by Cutler, Meara, and Richards-Shubik (CMR hereafter, 2013) to estimate the health capacity to work in Korea and the PRC. We also estimate the growth potential of the two countries due to the health capacity to work by linking the results from the Korean Longitudinal Study of Aging (KLoSA) and the the PRC Health and Retirement Longitudinal Study (CHARLS) to National Transfer Accounts (NTA) of Korea and the PRC, respectively.

The previous literature using the CMR methods does not identify the source of health capacity to work. It is assumed that older workers are not working, although they can, in large part, because of the statutory retirement age (Coile, Milligan, and Wise, 2017b). Many countries do not have the statutory retirement age, which is the age at which a person is expected or required to cease work. However, this is usually considered the age at which they may be entitled to receive government pension benefits. Thus, the employment rate drops very rapidly around these ages as generous pension benefit discourages older workers from working. Also, the CMR method assumes that the relationship between the health condition and an individual's capacity to

work does not vary for adjacent age groups. However, if the propensity to work in terms of health decreases by age, the estimated health capacity to work can be overestimated.

We improve our estimates by addressing these critical issues, which have little been addressed in the previous literature. Unlike other advanced countries, only some portion of the elderly receives old-age pensions in Korea and the PRC; one-third of elderly Korean and half of older Chinese are recipients of their old-age pensions. This enables us to simulate the health capacity to work for two groups, one for the eligible pension group and the other who is not. In our study, the estimated health capacity to work is also reported for various subgroups such as healthier group vs. less healthy group separately to check if the relationship between health and working varies across people with different health status. We also conduct several sensitivity analyses by changing base age groups and the simulated age groups to check the robustness of the results.

Our central finding is that Korea and the PRC have a much smaller untapped health capacity to work than many other countries. We explain the results using various factors, such as pension benefits, the productivity of older workers, and the labor market characteristics of the two countries.

The following section briefly describes population aging and the labor market of the two countries. Section 3 presents the data sets and methodologies. Estimation results are reported in Section 4. In the last section, we provide conclusions, some policy implications, and limitations of this research.

## **2. Older Workers in Korea and the PRC**

### **Population Aging**

Korea and the PRC are very interesting study cases for several reasons. While the two countries are different in the stage of economic development, their demographic trends are quite comparable.

Most of all, both countries have been experiencing very rapid aging. In Korea's case, the share of the population ages 65 and older grew from 3.1 percent in 1970 to 14.3 percent in 2018. The percentage of older people is projected to reach 40 percent in 2050 (Statistics Korea, 2020). The percentage of Chinese older adults ages 65 and older increased from 3.7 percent in 1970 to 7.1 percent in 2002, and the share is forecasted to exceed 14 percent in 2025, according to the World Population Prospect 2019 (United Nations Population Division, 2019).

The speed of aging in the two countries is also unprecedented. According to the United Nations, a society is classified as an aging, aged, and super-aged society if the percentage of people aged 65 and older exceeds 7 percent, 14 percent, and 20 percent of their total population, respectively. It took only 18 years (2000-2018) for Korea to move from aging to an aged society, and it is predicted to take 23 years for the PRC for the same transition (2002-2025). These are much faster than the experience of other advanced countries, even compared with the most rapidly aged countries such as Japan (24 years: 1970-1994) or Germany (40 years). It took 46 years for the United Kingdom, 70 years for the United States, 84 years for Sweden, and 116 years for France. Japan has a record of moving from an aged society to a super-aged society, taking 12 years (1994-2006), followed by 37-38 years for Germany and Sweden. Korea is projected to enter the super-aged society in 2025, transitioning to a super-aged society in only seven years. the PRC will become a super-aged society in only ten years (2025-2035).

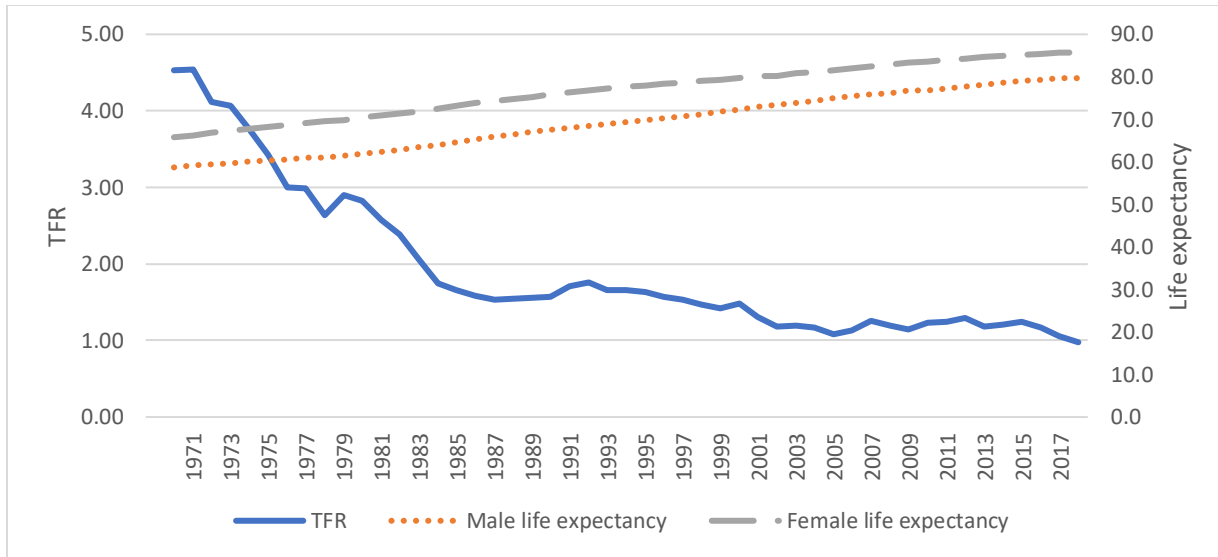
The rapid population aging of Korea and the PRC is in large part due to its extremely low fertility. The Total Fertility Rate (TFR) of Korea decreased from 4.53 births per woman in 1970

to 2.06 in 1983, around the population replacement level. It held at 1.6 from the mid-1980s to the mid-1990s. It fluctuated around the range of 1.05 and 1.3 between 2002 and 2017. However, the TFR decreases further and has remained below one since 2018, recording 0.98 in 2018 and 0.92 in 2019, respectively. In the PRC, the population control policies began in the early 1970s, and they became a strictly enforced policy in 1979, requiring one family to have no more than one child (so-called one-child policy). Since then, the TFR of the PRC has decreased rapidly. It was 5.73 births per woman in 1970, which fell to 2.14 in 1991. It further decreased steadily, which became below two births (1.98) in 1992, and it dropped to 1.60 in 1998. The TFR held at 1.60 until 2003. It has begun to grow slightly since 2004, increased from 1.61 in 2004 to 1.67 in 2015. However, the TFR does not rise a lot despite the official abolishment one-child policy in 2016, remaining around 1.69 in 2018.

Life expectancy has been increasing in both countries. The introduction of Western medical and healthcare facilities, better standards of living, and sharp increases in educational attainment, among other factors, led to a dramatic rise in life expectancy in both countries. In Korea, it rose to 70.1 years old (men 65.9, women 74.4) in 1987 from 62.3 years old (male 58.7, female 65.8) in 1970. Life expectancy in Korea continued to improve over the next three decades and jumped to 82.7 years old (men 79.7, women 85.7) in 2018. In the PRC, it increased from 60.3 years old (men 58.6, women 62.0) in 1971 to 70.1 years old (men 68.2, women 72.4) in 1996, and it reached 76.7 years old (men 74.6, women 79.1) in 2018.

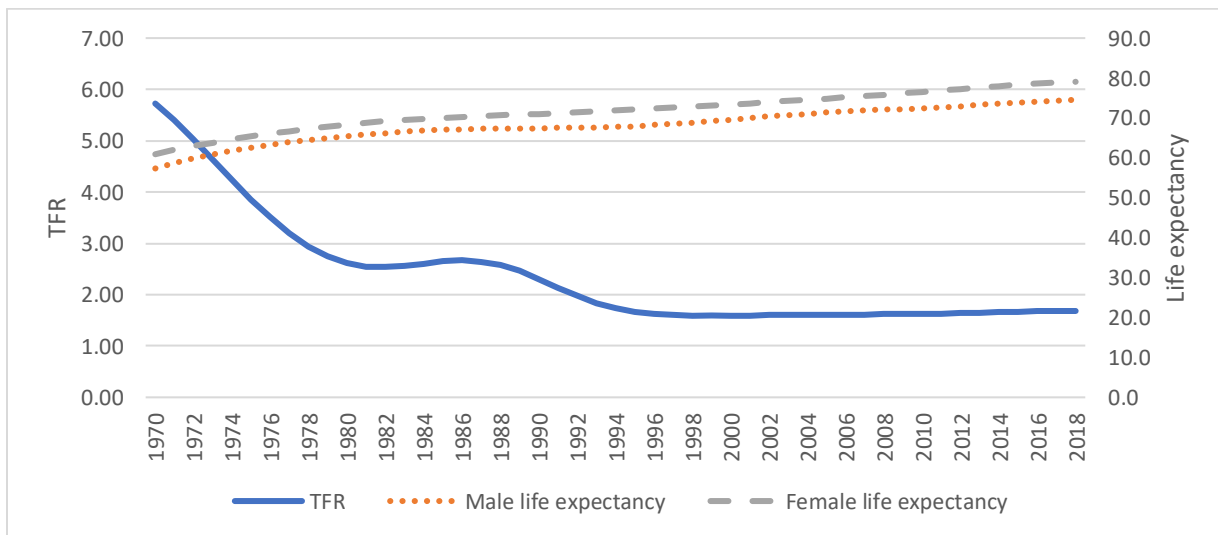
Figure 1. Total Fertility Rate (TFR) and Life Expectancy at Birth, 1970-2018

<Korea>



Source: Statistics Korea, [www.kosis.kr](http://www.kosis.kr). Accessed March 1, 2020.

### <The PRC>



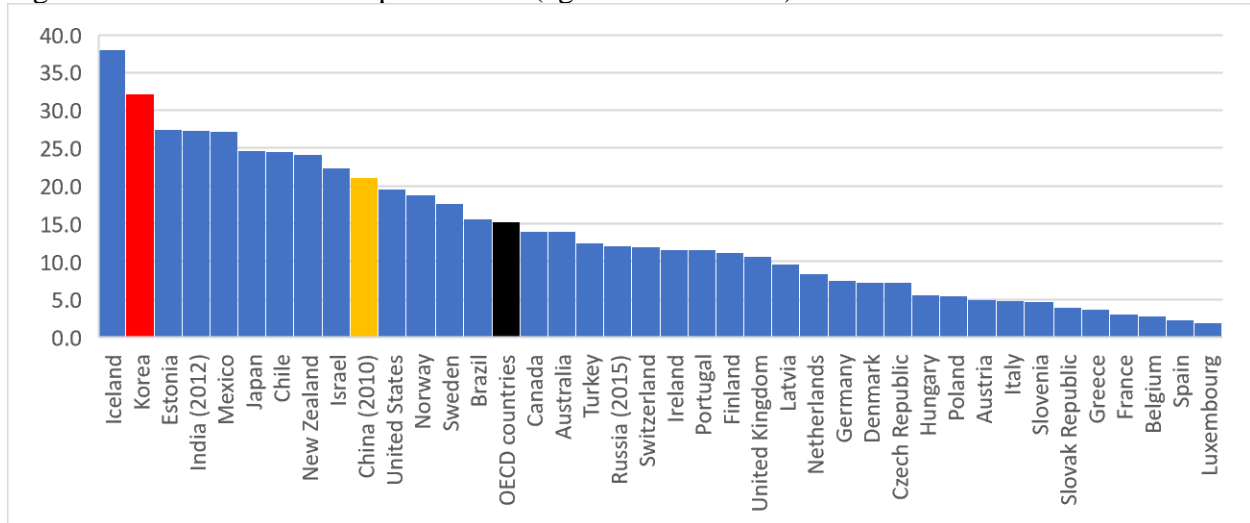
Source: World Population Prospects 2019 (United Nations), [www.population.un.org/wpp/](http://www.population.un.org/wpp/). Accessed March 1, 2020.

### Older Labor Forces

The labor force participation rates of the Korean and Chinese elderly are quite high among OECD and BRICS countries. Whereas the average labor force participation rate of people aged 65 and older of the OECD members is 15.3 percent (males 20.7, females 11.0), that of Korea is 32.2 percent (males 42.3, females 24.7) and that of the PRC is 21.1 percent (males 27.6, females

15.1). The labor force participation rate of Korean elderly is the second-highest among OECD countries; only Iceland (38.1 percent) has a higher labor force participation rate of older people than Korea. The labor force participation of Korean older people ages between 65 and 69 is also very high, at 45.5 percent.

Figure 2. Labor Force Participation Rate (aged 65 and above) in OECD & BRICS Countries



Note: Data are for 2018, or the latest available year.

Source: OECD data portal. [www.data.oecd.org](http://www.data.oecd.org). Accessed March 1, 2020.

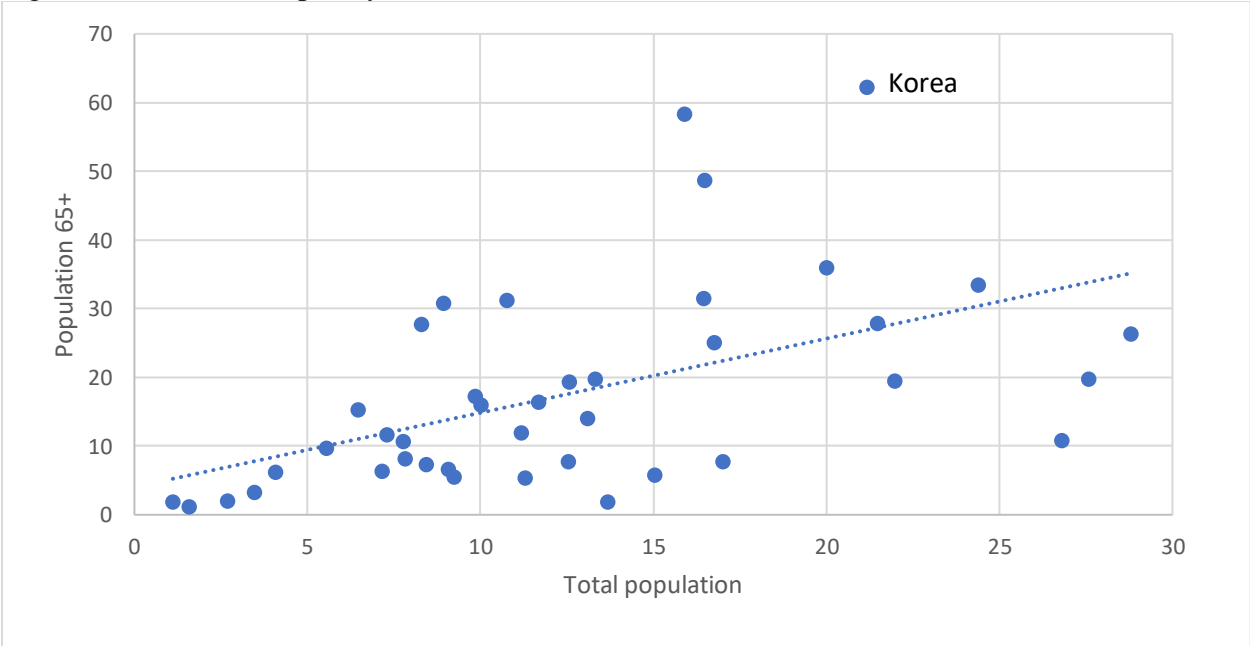
However, the ratios of temporary workers to the total population of elderly Koreans are also among the highest in OECD countries. In detail, the retirement age from "career jobs" in Korea was only 49.1 years (males 51.4, females 47.1) in 2018 (Statistics Korea, 2020). Thus, on average, people left their career jobs around age 50 and have another job. These so-called "bridge jobs" are more likely to be temporary.<sup>2</sup> Figure 3 compares the share of total temporary workers with the share of temporary workers ages 65 and older for OECD countries. As can be

<sup>2</sup> There are no internationally unified standards for temporary or bridge jobs. However, for cross-country comparison, the OECD identifies and reports "temporary workers" based on the time limits of normal employment. For example, in 2002, Korea's Tripartite Commission defined the temporary workers as fixed-term workers, short-term workers, and dispatched workers, but excluded part-time workers, service workers, and home workers. In general, a bridge job is considered a temporary position that workers take at the end of a full-time career or transitioning to a different one. The term most often applies to people who leave career employment but take on a part-time role, although there is no comparable statistics.



seen from the figure, while the share of temporary workers in Korea is high, at 21.2 percent, the share of temporary workers aged 65 and older is 62.2 percent in Korea, making Korea the highest among OECD countries. The bridge jobs are also concentrated in some industries and occupations. For workers ages 55 and older, over 45 percent of workers are working in business facilities and management projects, such as building guards. This high percentage is quite remarkable, considering the share of all workers in these sectors is only 17 percent. The share of older workers in high-paying sectors, such as telecommunications and financial insurance, is very low in Korea.

Figure 3. Share of Temporary Workers: All Workers versus Older Workers (OECD, 2018)

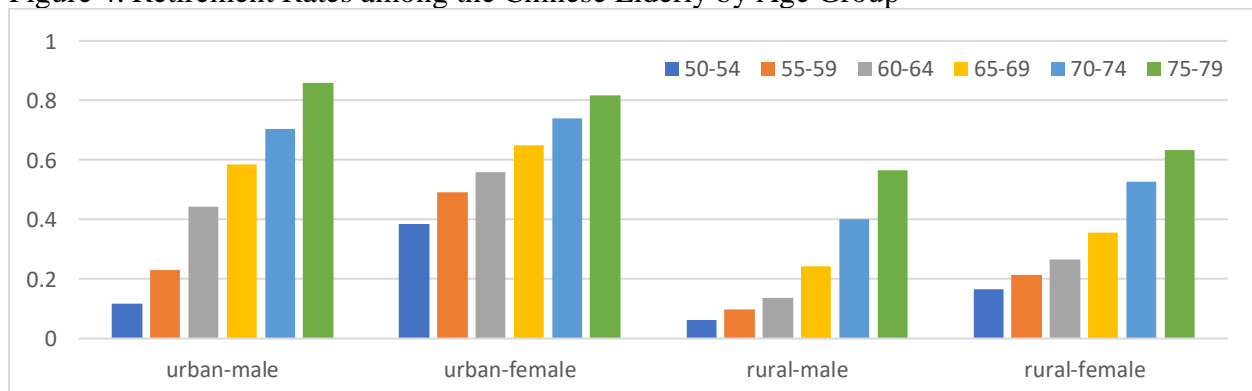


Source: OECD data portal. [www.data.oecd.org](http://www.data.oecd.org). Accessed March 1, 2020.

The Chinese labor market of the elderly is distinctive in the institutional segregation of urban and rural registered residents (Giles et al., 2015). The retirement patterns of rural and urban citizens are quite remarkable. The worker's retirement system (mandatory retirement policy) covers only urban residents, ages 60 and older for men, 50 and older for manual female workers, and 55 and older for white-collar female workers. On the other hand, since there is no official retirement policy in rural areas (Cai et al., 2012), rural Chinese elderly work until they

are forced to do due to some reasons such as illness (Fang, Brauw, and Rozelle, 2004). Most rural elderly work at farms or farm-related activities, which does not have an official retirement age. As we can see the Figure 4, almost half of the male elderly in urban areas retire around the pension eligibility age (60 years), at which the retirement rate doubles, from 22.9 percent (those aged 55 to 59) to 44.2 percent (those aged 60 to 64). Female workers in urban areas are more likely to retire earlier than their male counterparts. However, rural elderly generally are likely to retire gradually. The ratio of retirement in rural areas tends to increase smoothly for both males and females. For male older workers in rural areas, the ratio of retirement in near-elderly (ages 55-59) is 9.9 percent, and the ratio continues to rise, reaches 56.4 percent for people aged 75-79. While about half of the elderly (44.6 percent) in rural areas are still working in their 70s, working urban counterparts is just 14.2 percent.

Figure 4. Retirement Rates among the Chinese Elderly by Age Group



Note: Calculated by the author using CHARLS (2011-2015).

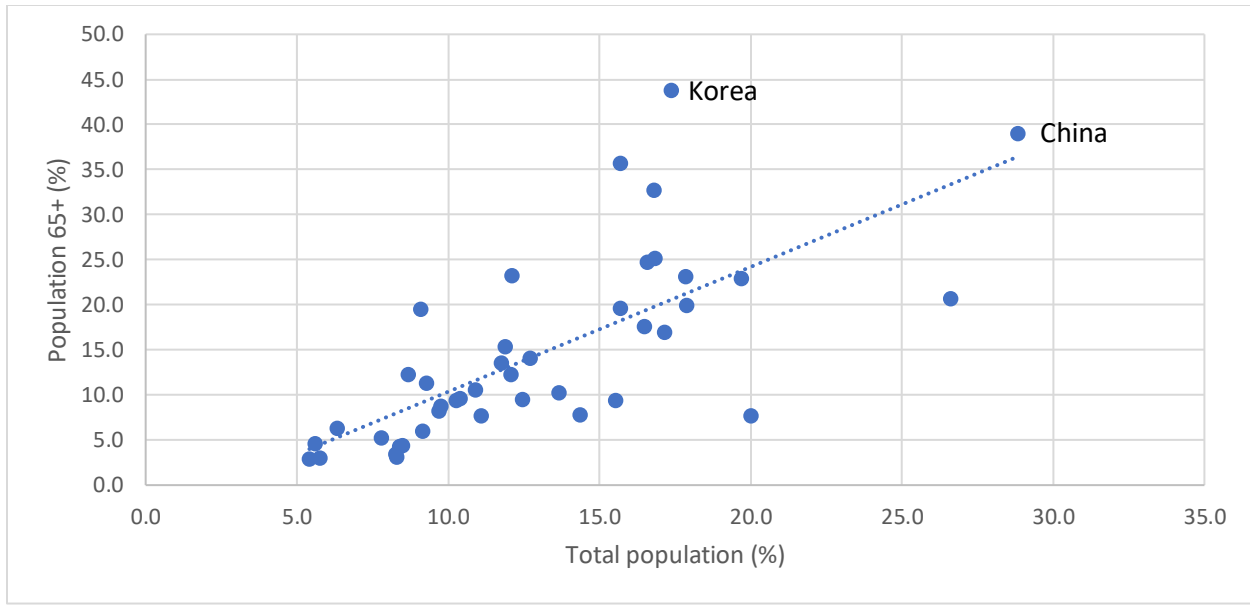
### Poverty Rate of Older People

The poverty rates of older people aged 65 and over in Korea and the PRC are very high. Notably, the poverty rate of the Korean elderly is the highest among OECD and BRICS countries. Figure 4 compares the poverty rate of people aged 65 and over with the poverty rate of the entire population. In 2016, the poverty rate of people aged 65 and above in Korea was 43.8 percent, the

first highest among OECD countries, while the OECD average was only 13.5 percent. That is, more than 4 out of 10 older adults in Korea aged 65 and above earned less than 50 percent of the median income. As the poverty rate of Korea as a whole was 17.4 percent, the gap between the poverty rate of the population and the poverty rate of the elderly was also highest in Korea among OECD countries.

The poverty rate of older Chinese aged over 65 is 39.0 percent, the second-highest among the OECD and BRICS countries. However, the pattern of the poverty rate is quite distinctive from that of Korea. While the gap in the poverty rates between the total population and the elderly is quite substantial in Korea, the poverty rates of both population age groups in the PRC are all very high. In the PRC, the poverty rate of the total population is the highest (28.8 percent), as well as that of the Chinese elderly (39.0 percent). The high poverty rates of both age groups may reflect a low level of economic growth in the PRC. However, the unbalanced growth strategy of the PRC between urban and rural areas led to the vast disparity of living standards between rural and urban elderly. Hence, this paper focuses on the discrepancy of the old-age support system in rural and urban areas.

Figure 4. Poverty Rates: Population as a Whole versus Older People



Note: Data are for 2016, or the latest available year.

Source: OECD data portal. [www.data.oecd.org](http://www.data.oecd.org). Accessed March 1, 2020.

The high poverty rates of older adults in both countries are primarily due to the low coverage of the public pension scheme for older adults. In Korea's case, the public pension scheme for older adults in Korea has been developed relatively recently, and it has stricter eligibility criteria, compared with other advanced economies. The Korean seniors depend on two public programs; the basic welfare program and the national pension system. The basic welfare program (the Basic Livelihood Security Program) is a welfare system that provides cash and other benefits such as housing and education for citizens below 40 percent of the median income.<sup>3</sup> However, this program does not provide much complete relief to seniors as it has strict criteria<sup>4</sup> to be accepted in the program. This has caused many people to be turned away from the program. The other major program, the primary public pension system, is the National Pension

<sup>3</sup> The Korean government changed the official poverty line from the minimum cost of living (absolute criterion) to 40% of the median income (relative poverty line) since 2015.

<sup>4</sup> Including means test (income criterion), every applicant must show that insufficient or no support from family members (family support criterion). In some cases, if any family member has the potential to support the applicant, then the application to the program may be refused regardless of actual support from that family member. Given the strictness of the family support criterion, the Korean government has loosened the family support criterion. For example, the educational benefits abolished the family support criterion in 2015.

Scheme (NPS), created in 1988 in Korea initially required companies with at least ten employees. It expanded to companies with five employees in 1992 and to all companies in 2003. Self-employed were also included in 1999. Residents living in regions associated with retirement pension plans can also join. Despite its expansions over time, however, only about one-third of the elderly are receiving old-age pensions from the NPS (Statistic Korea, 2020). Furthermore, the general government's public social spending per GDP in Korea is the lowest among the OECD countries, only half of the OECD average.

One of the main reasons for the high poverty rate for the Chinese elderly is insufficient pension benefits in the PRC. Notably, the disparity of pension coverage and generosity between rural and urban areas may be a driving force behind the longer working of rural elderly. the PRC has different pension systems between rural and urban areas. In urban areas, the Chinese government launched the pension system in the 1950s for the government and state-owned enterprises with 100 employees. Even though during the chaotic period of the Cultural Revolution (1966-1976), the pension had managed by the government relatively stable. The pension program for urban residents is expanded for all urban enterprise employees since 1997. On the other hand, the pension program for rural people was just launched in 1992. However, poor management made the growth of the public pension program stagnated. In 2009, the Chinese government introduced the New Rural Pension Program (NRPP), which is more generous than the older pension program (Old Rural Pension Program). However, the new pension program (NRPP) still has lower coverage and less generosity<sup>5</sup>, compared with those of the pension program for the urban elderly. One research (Giles et al., 2015) shows the large gap

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<sup>5</sup> The Chinese government integrated the basic pension for urban and rural residents in 2016 to deal with unequal pension benefits across regions (Kim et al., 2018). However, since this research uses CHARLS data for 2011-2015, we do not consider integrating the pension system.

between rural and urban pension programs in terms of pension coverage and generosity. While the coverage by at least one pension<sup>6</sup> for the urban elderly was about 76 percent in 2012, the coverage of the rural elderly is just 41 percent. They also show a substantial disparity of the median pension income with at least one pension between rural and urban retirees. Urban retirees aged 45 and above received 1,500 yuan/month, while the median pension income of the rural counterparts was just 65 yuan/month in 2012.

Korea is also among the countries with the lowest pension replacement rates. The future gross (net) replacement rates for full-career workers in Korea is 37.3 (43.4) percent. Among OECD countries, there are only a few countries, such as Chile or Lithuania, which show a lower replacement rate than Korea (OECD, 2019). However, this calculation should be interpreted with caution as it assumes that full-career workers from age 22 until retirement (in the case of Korea 65). The estimated replacement rate could be substantially overestimated as many Koreans leave their career jobs around age 50. Besides, the share of self-employed workers is much higher in Korea, reaches 25.1 percent in 2018 (OECD, 2020), whose replacement rate is much lower than those of full-career employees (OECD, 2019).

The traditional family support system has also been deteriorated in both countries, even though public pension support is quite low compared to other developed countries. In particular, in the PRC, the one-child policy and mass moving from rural to urban areas of the younger generation have led to a deterioration of the traditional old-age support system. Many Korean elderly have relied on income from financial and non-financial assets, which has declined largely due to the low-interest rate since 2000. Thus, together with the insufficient pension system, the incentive for the Korean and Chinese elderly to continue to work is currently very high.

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<sup>6</sup> The main types of pension programs in urban areas are the firm's pension, government or institutions' pension, and urban residents' pension. In rural areas, the New Rural Pension Program is almost only pension program.

However, given the tight labor market, they are driven into bridge jobs, which are characterized by temporary.

In the following two sections, we will estimate the health capacity to work at older ages and the extent of its potential gains at the national level. The estimated results are somewhat different from other countries, which will be explained by using the old-age support system of each country and its labor market characteristics.

### **3. Methodology and Data**

#### **Methodology**

There are two main approaches to measuring the health capacity to work at older ages. The first is the Milligan-Wise method (MW) (Milligan and Wise, 2015), which uses the relationship between mortality and employment. They use a decrease in mortality as a proxy for improvement in health status over time to estimate the potential gains in employment. It answers the question of "how much more older people could work today if they worked as much as those with the same mortality rate in the past." Then, the difference in the two employment rates is interpreted as the health capacity to work. Milligan and Wise (2015) show a substantial health capacity to work in all 12 countries. For example, American men aged 55-69 in 2007 would have worked an additional 3.7 years if they had worked as much as people with similar mortality rates as in 1977, i.e., the health capacity to work is 3.7 years. A severe caveat of the MW method, however, is that the estimation results could be quite sensitive to comparison years, and the years' selection is very arbitrary.

The second approach is the Cutler, Meara, and Richards-Shubik method (CMR, 2013). The CMR method measures the health capacity to work as the difference between the actual and

the simulated employment rates. When simulating the employment rate, they assume the relationship between health and employment of the younger is the same as that of the elderly. In more detail, they assume the health status is similar between near-age groups (i.e., group aged 57-61 and people aged 62-64)<sup>7</sup> because health deteriorates slowly as a person ages (Van Doorslaer and Jones, 2003). Thus, estimation of the impact of health status on labor force participation among people aged 57-61 can make us simulate work capacity for older group people. Their estimation takes two steps. First, they run a baseline regression to get the relationship between health conditions and work status for people aged 57 to 61 (younger group). Next, they simulate the health capacity to work for those aged 62 to 64 (older group) under the assumption that the relationship between health status and an individual's capacity to work is the same to the younger counterparts. The capacity to work is then calculated as the difference between the actual and the simulated employment rates. It answers the question of "how much the older group could work if they with a given level of health were to work as much as their younger counterparts with comparable health status." Their results show that there is a substantial health capacity to work, in which the labor force participation rate of older people can be increased by more than 15 percentage points in the US.

The comprehensive study on health capacity to work has been carried out by the International Social Security (ISS) project team of 12 countries<sup>8</sup> (Coile, Milligan, and Wise, 2017b). The ISS team shows vast additional potential health capacities to work at older ages in all 12 countries. By using the CMR method, Matsukura et al. (2018) show that there are more than 10 million potential workers aged 60 to 79 in Japan. Their estimation takes two steps, like

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<sup>7</sup> They argue that the reason to choose the people aged 62 to 64 to estimate health capacity is that people aged 62-64 can currently claim early entitlement for Social Security Benefits (Cutler, Meanra, and Richards-Shubik, 2013).

<sup>8</sup> Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, UK, and the USA.



the CMR method, but the sample group is different.<sup>9</sup> First, they run a baseline regression for people aged 50 to 59 to get the coefficients of the relationship between health status and employment. Second, they simulate work capacity for older adults aged 60 to 79. Moreover, they evaluate the health capacity to work at the national level by using the National Transfer Accounts (NTA) of Japan and demonstrate the untapped additional labor force, if realized, can boost the economy substantially.

We closely follow Matsukura et al. (2018), but we also try to improve our estimate by addressing two critical issues. First, the CMR method does not explain the source of health capacity to work. It is assumed that older workers are not working although they can, in large part, because generous pension benefits discourage older people from working. For many developed countries, including those 12 countries in the ISS projects, this might be true as the labor force participation rate drops dramatically around the pension eligible age. However, Korea and the PRC's labor force participation rates decline almost linearly as the older people age. As mentioned in the previous section, this might be because only a part of Korean and Chinese older people are receiving the old-age pension. Only about one-third of the Korean elderly and half of the Chinese older people are recipients of the old-age pensions. Also, the two countries' pension incomes are not sufficient, encouraging older people to work longer. So, we can test the effect of pension by estimating the health capacity to work for two groups: the pension-eligible group and the others who are not. For the analysis for the Chinese elderly, this research simulates the health capacity to work by rural and urban residents, as explained in the previous section. Under holding their characteristics constant, it is expected that the health capacity to work is larger for the pension-eligible group. Second, the CMR method assumes that the relationship between the

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<sup>9</sup> Since the mandatory retirement age is 60 in Japan, they use the younger group as people aged 50-59.

health condition and an individual's capacity to work does not vary for adjacent age groups. However, the estimated health capacity to work can be overestimated if the propensity to retire in terms of health deterioration increases by age. To deal with this issue, we conduct sensitivity analyses by changing the base groups as well as simulated age groups to see if the results are robust. We also estimate the effect for various sub-groups, such as healthier and less healthy groups, to see whether the relationship between the health condition and an individual's capacity to work varies by their characteristics. We also check whether some health variables, such as self-reported health status, have interaction effects with pension status.

Like the other studies, we only focus on males. Research on female cases is rare since the increasing trend of labor force participation rates of females over time makes it difficult to interpret the results for females (Coile, 2018). It would be even more difficult in Korea as there is a frequent career break for married women. Following Matsukura et al. (2018), we also focus on the age effect of health capacity to work, but we do not investigate the cohort effects of health capacity to work. Like Matsukura et al., our baseline regression uses the males' samples ages 50-59. We will apply the estimated coefficients from the baseline regression to men aged 60-79 to measure the health capacity to work.

For the baseline regression, this research employs a reduced form logit model to regress a binary variable, which is equal to 1 if the individual is in the labor market and 0 if the person is not in the labor force. This paper utilizes a pooled logit model, as shown in equation (1). Assume that  $r_{it}^*$  is the unobserved labor force participation propensity given by the logit index function for individual  $i$  at survey year  $t$  by:

$$r_{it}^* = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + c_r + \delta_t + \varepsilon_{it} \quad (1)$$

where  $X_{it}$  are health variables of individual  $i$  at survey year  $t$ ,  $Z_{it}$  is a set of individual's characteristics,  $c_r$  are regional fixed effects whereas  $\delta_t$  are year fixed effects.

After estimating employment probabilities for those aged 50-59, we apply the coefficients estimated to actual values of the older group (those aged 60 to 79) to predict labor force status for the latter group, assuming that they continue to work as much as the younger people. We can simulate the probabilities of participation in the labor force at each age since we have the same variables for both groups. Then, a slack, which is the difference between the actual and the predicted probability, is the health capacity to work at each age.

Once the health capacity to work is estimated, we apply the estimated capacity to an Economic Support Ratio (ESR) using the National Transfer Account (NTA) of each country. The ESR incorporates the population age structure and age-specific patterns of production and consumption that comprise the lifecycle (Lee and Mason, 2011; Mason et al., 2017). The total labor income in year  $t$ ,  $Y(t)$  and the total consumption in year  $t$ ,  $C(t)$ , and the population in year  $t$ ,  $N(t)$  are respectively defined as:

$$Y(t) = \sum_{x=0}^w y(x)n(x, t), \quad y(x) = \frac{y_l(x)}{y_l(30-49)} \quad (2)$$

$$C(t) = \sum_{x=0}^w c(x)n(x, t), \quad c(x) = \frac{c_l(x)}{c_l(30-49)}$$

$$N(t) = \sum_{x=0}^w n(x, t)$$

where  $y(x)$  is the labor income per capita by age  $x$  relative to per capita income of persons aged 30-49 years,  $n(x, t)$  is the population aged  $x$  in year  $t$ , and  $c(x)$  is the consumption per capita by age  $x$  relative to per capita consumption of persons aged 30-49.  $w$  is 100 because we use the population data for people aged 0-100. Labor income and consumption are divided by the

average value of persons aged 30-49 to normalize the numbers, enabling us to compare more consistently across nations.

The NTA methodology does not estimate separately the proportion of the population at each age that is working and the labor income of that working population. However, labor force participation rates by age are available from the International Labor Organization (ILO), so it is possible to measure the working population's productivity by dividing the per capita labor income by labor force participation rates for each age group. While this may not provide very accurate decomposition results, it may provide some useful insights.

The new ESR is estimated by calculating the new  $y'(x)$  which is augmented by the health capacity to work, assuming the age profiles of productivity ( $p(x)$ ) do not change over time. The new ESR of each country can be expressed by equation (3):

$$y'(x) = p(x)h'(x) \tag{3}$$

where  $p(x)$  represents labor productivity index at age  $x$  and  $h'(x)$  is the proportion of the working population at age  $x$ , augmented by the additional workforces.

## **Data**

This study relies on two data sets; the Health and Retirement Studies (HRS) and the other is the National Transfer Accounts (NTA) of Korea and the PRC. Concerning HRS, we use the harmonized HRS<sup>10</sup> data sets to guarantee comparability across countries; the Korean Longitudinal Study of Aging (KLoSA) and the the PRC Health and Retirement Longitudinal Study (CHARLS).

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<sup>10</sup> University of Southern California (USC) program on Global Aging, the Gateway to Global Aging (Gateway), provides the harmonized HRS data across countries. The Gateway can be accessed at <https://g2aging.org/>.

The KLoSA began in 2006, with 10,254 respondents who were at least 45 years old. The survey includes detailed information on demographic characteristics, health outcomes, employment, income, and assets. The panel data consists of a nationally representative sample in 15 municipalities, but it excludes *Jeju* island. We employ six waves of the KLoSA, a biennial survey spanning 2006-2016.

The CHARLS is a nationwide survey for older people aged 45 and above and their spouses of all ages. After a pilot study in two poor and rich provinces (*Gansu and Zhejiang*) in 2008, the national baseline survey was conducted during 2011-2012. In the first wave, they successfully interviewed 17,708 respondents in 450 villages in 150 countries/districts (2011-2012 National Baseline User's Guide of CHARLS, 2013). So far, data for the fourth waves of CHARLS are available. However, since the third wave (2014) is just about the life history of the respondents, this study uses three waves of CHARLS (2011, 2013, and 2015).

The independent variables are as follows; (1) self-rated health status (five-point scale: poor, fair, good, very good, and excellent), (2) dummy variables for measuring the prevalence of limitations on activities of daily living (ADL), and limitations on instrumental activities of daily living (IADL),<sup>11</sup> (3) dummy variables of self-reported depressive symptoms based on the Center for Epidemiologic Studies Depression (CESD),<sup>12</sup> (4) variables measuring cognitive ability (normal, mild impairment, and severe impairment),<sup>13</sup> (5) dummy variables for having chronic

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<sup>11</sup> A dummy variable for ADL is equal to 1 if the person has at least one difficulty with using a bathroom, wearing and taking off a dress, and eating (Wallace and Herzog method), and 0 otherwise. A dummy variable for IADL is equal to 1 if the respondent has at least one difficulty with using a telephone, taking medication, handling money, shopping, and preparing meals, and 0 otherwise.

<sup>12</sup> CESD measures depression by asking questions about whether a respondent felt depressive symptoms during the past week. KLoSA and CHARLS include 10-items (total score ranges 0-30). CESD is equal to 1 if the total score is more than 10 (cut-off  $\geq 10$ , Anderson et al., 1994), and 0 otherwise.

<sup>13</sup> Cognitive skill measures are different by data.

(1) KLoSA scores cognitive ability immediately (0-3) and delayed word recall (0-3), serial 7's (0-5), dates naming (0-3), day of week (0-1), naming 1st object (0-1), naming 2nd object (0-1), drawing picture (0-1), repeat sentence (0-1), following direction (0-3), read and close eyes (0-2), and writing (0-1), total score 0-25. Using

diseases (hypertension, diabetes, cancer, lung disease, heart disease, stroke, and arthritis), (6) a dummy variable for using a hearing aid. In addition to health variables, this study includes demographic, regional factors, and survey years such as (7) dummy variable for marital status, (8) education attainments (less than secondary school, upper secondary school or vocational training school, and tertiary school), (9) a dummy variable for rural residence, (10) survey regions, and (11) survey years.

To estimate the economic support ratios of two countries, we use the Korean NTA of 2016 and the Chinese NTA of 2014. NTA is the analytical tool developed for analyzing a wide range of socioeconomic and demographic changes caused by age structure change. The accounts are designed to be consistent with the UN System of National Accounts and measures of economic flows for both private and public sectors. A more detailed explanation of NTA's concept, NTA data sets by country, and methodology are available at the NTA global project website (<http://www.ntaccounts.org>) or Lee and Mason (2011). This study also uses a couple of complementary data sets such as the World Population Prospects 2019 (United Nations Population Division, 2019) for population projections and the International Labor Organization labor statistics (ILOSTAT) for the activity rate by age as well as OECD statistics.

Table 1 shows the means and standard deviations for the dependent variable and some key control variables of the KLoSA and CHARLS. Both Korean and Chinese older males show very high labor force participation rates, which reach about 88 percent of the elderly aged 50-59. Especially, as we have seen before, the rural Chinese elderly are more likely to work than the

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Langa-Weir approach (Langa, Kabeto, and Weir, 2009), cut-off is set as 0-6 (severe impaired), 7-11 (mild impaired), and 12 or higher (normal).

(2) CHARLS scores immediately (0-10) and delayed word recall (0-10), serial 7's (0-5), dates naming (0-4), drawing a picture (0-1), and season naming (0-1), the total score is ranging 0-31. Following the Montreal Cognition Assessment (Saczynski et al., 2015), the cut-off is set as 0-9 (severe impaired), 10-17 (mild impaired), and 18 or higher (normal).

urban counterparts. The patterns of educational attainment are quite distinctive between the two countries. While about 23 percent of Koreans aged 50-59 have more than tertiary education, the ratio of Chinese is just 2.9 percent. Besides, Chinese rural education programs seem to have been in poor shape than those for urban residents. The ratio of rural people with tertiary schools is less than one percent (0.9 percent), while the ratio reaches about 6 percent in urban areas. Concerning health status, Chinese older people are less healthy than their Korean counterparts. Among older Koreans, 10.3 percent report poor or fair health, while 58.5 percent said their health status is either very good or excellent. However, 68 percent of Chinese older people say that their health status is poor or fair, and the percentage of people with very good or excellent health status is just 14 percent. 4.8 percent of Chinese older adults have problems with ADL, while that of the Korean elderly is just 1.2 percent. Also, the ratio of Chinese people having problems with IADL exceeds by two percentage points that of Korea (Korean 9.7 percent, Chinese 11.7 percent). Only 4.6 percent of elderly Korean report impairment of cognitive ability, while the percentage of elderly Chinese reaches 67 percent. The percentage of Korean older adults having chronic diseases ranges from 1 percent (cancer) to 19.4 percent (hypertension), and 10 percent of people reported that they have diabetes. Lung disease (11.4 percent) and arthritis (32.2 percent) seem to be common chronic diseases among Chinese older people, compared with those of the Korean elderly. Hypertension is a common disease in both countries (Korea 19.4 percent, the PRC 24.7 percent). The place of residence in the two countries is quite different between the two countries. While 16.7 percent of older Korean live in rural areas, more than 58 percent of Chinese older adults live in rural areas.

Table 1. Summary Statistics

	Korea		the PRC		the PRC_Rural		the PRC_Urban	
	Mean	SD.	Mean	SD.	Mean	SD.	Mean	SD.
Working (1=in the labor force)	0.886	0.317	0.877	0.328	0.916	0.278	0.821	0.383
Age	54.825	2.731	54.569	2.953	54.644	2.937	54.465	2.974
Education								
less than secondary school	0.250	0.433	0.766	0.424	0.827	0.379	0.680	0.467
upper secondary school	0.516	0.500	0.205	0.404	0.165	0.371	0.262	0.440
tertiary school)	0.234	0.423	0.029	0.169	0.009	0.094	0.058	0.235
Currently married	0.923	0.267	0.863	0.344	0.847	0.360	0.884	0.320
Self-rated health status								
poor	0.017	0.129	0.168	0.374	0.188	0.391	0.139	0.346
fair	0.086	0.280	0.513	0.500	0.509	0.500	0.519	0.500
good	0.312	0.463	0.178	0.382	0.171	0.377	0.187	0.390
very good	0.537	0.499	0.128	0.335	0.120	0.325	0.141	0.348
excellent	0.048	0.214	0.013	0.111	0.011	0.106	0.014	0.119
CESD (1=depressed)	0.153	0.360	0.254	0.435	0.287	0.453	0.204	0.403
ADL (1=having limitations)	0.012	0.110	0.048	0.214	0.052	0.222	0.043	0.203
IADL (1=having limitations)	0.097	0.296	0.117	0.322	0.135	0.342	0.092	0.289
Cognition ability								
normal	0.954	0.209	0.329	0.470	0.285	0.452	0.391	0.488
mild impairment	0.004	0.060	0.446	0.497	0.488	0.500	0.387	0.487
severe impairment	0.042	0.201	0.225	0.417	0.226	0.419	0.222	0.416
Hearing aid (1=yes)	0.028	0.166	0.004	0.064	0.004	0.061	0.005	0.067
Chronic diseases								
Hypertension (1=yes)	0.194	0.396	0.247	0.431	0.231	0.422	0.269	0.444
Diabetes (1=yes)	0.102	0.302	0.069	0.253	0.048	0.214	0.100	0.300
Cancer (1=yes)	0.015	0.120	0.008	0.092	0.008	0.090	0.009	0.094
Lung disease (1=yes)	0.010	0.100	0.114	0.317	0.119	0.324	0.106	0.307
Heart disease (1=yes)	0.027	0.163	0.097	0.296	0.079	0.270	0.124	0.330
Stroke (1=yes)	0.022	0.147	0.024	0.152	0.019	0.135	0.031	0.173
Arthritis (1=yes)	0.033	0.178	0.322	0.467	0.357	0.479	0.270	0.444
Place of residence (1=rural)	0.167	0.373	0.584	0.493				
Observations	6,337		6,933		4,050		2,883	

Note: Calculated by the author using the KLoSA and CHARLS data.



## 4. Estimation Results

### Baseline Regression Results for Health Capacity to Work

Table 1-2 reports the estimation results for the probability of labor force participation in Korea and the PRC. The coefficients indicate that education is not a very important predictor for the labor force participation of older male workers in both countries. For the urban Chinese elderly, however, people with tertiary schools are more likely to be in the force than those with less than secondary schools. People with a spouse are more likely to join the labor market than their counterparts in both countries.

Table 1-2. Results for Labor Force Participation (Working? 0=No, 1=Yes)

	Korea	the PRC	the PRC_Rural	the PRC_Urban
<b>Education</b>				
less than secondary (ref.)	-	-	-	-
upper secondary	-0.003 (0.008)	-0.014 (0.011)	-0.009 (0.013)	-0.023 (0.021)
tertiary	-0.007 (0.011)	0.034** (0.015)	-0.019 (0.061)	0.065** (0.025)
Currently married (1=married)	0.080*** (0.010)	0.022* (0.012)	0.002 (0.012)	0.060** (0.026)
<b>Self-rated health status</b>				
poor (ref.)	-	-	-	-
fair	0.248*** (0.065)	0.093*** (0.016)	0.077*** (0.016)	0.116*** (0.033)
good	0.394*** (0.066)	0.106*** (0.018)	0.083*** (0.018)	0.141*** (0.036)
very good	0.428*** (0.067)	0.093*** (0.019)	0.062*** (0.021)	0.135*** (0.039)
excellent	0.450*** (0.068)	0.080** (0.040)	0.053 (0.053)	0.113 (0.076)
CESD (1=depressed)	-0.030*** (0.009)	-0.005 (0.010)	0.003 (0.010)	-0.018 (0.021)
ADL (1=having limitations)	-0.098*** (0.026)	-0.087*** (0.015)	-0.067*** (0.013)	-0.101*** (0.036)
IADL (1=having limitations)	-0.022** (0.011)	-0.054*** (0.011)	-0.044*** (0.010)	-0.069*** (0.025)
<b>Cognition ability</b>				
normal (ref.)	-	-	-	-
mild impairment	-0.144 (0.125)	-0.002 (0.009)	0.010 (0.010)	-0.022 (0.018)
severe impairment	-0.006	-0.046***	-0.040**	-0.033

	(0.017)	(0.016)	(0.017)	(0.032)
<b>Chronic Diseases</b>				
hypertension (1=yes)	0.003 (0.009)	-0.008 (0.009)	-0.004 (0.010)	-0.015 (0.018)
diabetes (1=yes)	-0.033*** (0.010)	-0.035** (0.014)	-0.006 (0.017)	-0.069*** (0.027)
cancer (1=yes)	-0.021 (0.022)	-0.075** (0.034)	-0.023 (0.036)	-0.199** (0.078)
lung disease (1=yes)	0.037 (0.028)	-0.001 (0.012)	-0.014 (0.012)	0.032 (0.029)
heart disease (1=yes)	0.015 (0.019)	-0.030*** (0.012)	-0.020 (0.013)	-0.045* (0.023)
stroke (1=yes)	-0.104*** (0.017)	-0.076*** (0.021)	-0.080*** (0.021)	-0.068* (0.040)
arthritis (1=yes)	-0.033** (0.015)	0.024*** (0.009)	0.007 (0.009)	0.052*** (0.020)
Hearing aid (1=use)	0.027 (0.017)	-0.135 (0.089)	-0.044 (0.083)	-0.266 (0.164)
Place of residence (1=rural)	-0.016 (0.012)	0.058*** (0.010)	-	-

*Notes:* Marginal effects at means are reported. Robust standard errors in parentheses. \*, \*\*, and \*\*\* indicate statistical significance at the 10, 5, 1 percent level, respectively. The estimation includes region FE and year FE.

The results suggest that the health gradient is one of the most critical determinants for participation in the labor market for older adults in both countries. Among elder Koreans, having good health status increases the probability of working by about 39 percentage points compared to those who have poor health. Korean older males with excellent health status are more likely to work by 45 percentage points than those in poor health. Chinese citizens with good health status are more likely to work by 11 percentage points than those with poor health. The magnitude of the Chinese elderly is less intense than that of the Korean elderly, and the probability of working is more distinctive for urban Chinese older adults than for rural counterparts.

CESD, ADL, and IADL show negative coefficients for all cases, suggesting that adverse health conditions tend to decrease working probability. Koreans who have some problems with IADL, such as preparing meals, are less likely to work by 2.2 percentage points than those who do not. Having limitations in ADL decreases the probability by 9.8 percentage points. Among

the Chinese elderly, health limitations such as CESD, ADL, and IADL also negatively affect labor force participation. Although all coefficients are negative, only the coefficient of CESD for rural residents is positive. This suggests that rural Chinese older people tend to work regardless of their depression symptoms, even though the coefficient is insignificant. The effects of having problems in ADL or IADL are more distinctive for urban Chinese than those of rural old Chinese. However, the cognitive ability does not show a statistically significant effect on the probability of work in Korea, although the estimated effects are all negative. The elderly with severe cognitive impairment are more likely to stop working than those who have no cognitive ability problems, and the coefficient for the rural residents is statistically significant. People who reported having chronic diseases of diabetes, stroke, and arthritis are less likely to be in the labor force than those who did not. The effect is the biggest for stroke in both countries; the elderly diagnosed with a stroke are less likely to join the labor force by 10.4 percentage points (Korea) or 7.6 percentage points (the PRC) compared with those who did not. When we examine the effects of chronic diseases by rural and urban areas, the effect of cancer is the biggest among urban Chinese elderly (20 percentage points), while that of stroke is the biggest in rural areas (8 percentage points). While living in rural areas does not have significant effects on labor force participation in Korea, rural Chinese older adults are more likely to work by 5.8 percentage points than their urban counterparts, which is not investigated in Korea.

### **Health Capacity to Work**

Based on the estimated coefficients for those aged 50-59, we simulate the untapped health capacity to work for people aged 60-79 by a single year of age. The potential health capacity to

work (the *slack*) is calculated as a gap between the actual and the predicted labor force participation rate.

Table 3 shows the predicted work capacities of Korea and the PRC. By and large, for all people aged 60-79, the capacity increases with age almost monotonically. In Korea's case, the slack increases from 9 percentage points at age 60 to 19 percentage points at 65 and reaches a peak at 43 percentage points at age 78. The estimated total amount of potential health capacity to work is about 900 thousand people, which accounts for about 23 percent of the labor force ages 60 and older<sup>14</sup>. The additional workforces for the PRC increase with age continuously. The capacity (slack) increases from 6 percentage points at age 60 to 50 percentage points at 77, and the slack decreases a little to 47 percentage points at 78. The total amount of potential working capacity is about 20 million people, which composes 21 percent of the total population aged 60 and above.

Table 3. Actual and Predicted Labor Force Participation Rates and Additional Workforces

<Korea>

Age	Predicted (%)	Actual (%)	Slack (%p)	Workforces (1,000)
60	0.88	0.79	0.09	29.85
61	0.86	0.77	0.09	28.51
62	0.86	0.75	0.11	32.86
63	0.86	0.75	0.11	28.91
64	0.86	0.69	0.17	41.34
65	0.84	0.65	0.19	45.04
66	0.83	0.65	0.18	39.01
67	0.83	0.58	0.24	51.47
68	0.82	0.57	0.25	49.38
69	0.82	0.54	0.28	52.89
70	0.81	0.51	0.30	53.30
71	0.80	0.47	0.33	56.81
72	0.78	0.44	0.35	56.21
73	0.78	0.45	0.33	49.64
74	0.77	0.40	0.37	52.77

<sup>14</sup> We also estimated the health capacity to work using female samples (not shown). Although it is not the focus of the paper, it is worth mentioning that females' slacking is smaller than that for males.

75	0.77	0.39	0.38	50.63
76	0.77	0.36	0.41	51.05
77	0.73	0.35	0.39	44.08
78	0.75	0.32	0.43	45.00
79	0.73	0.33	0.40	37.18

<The PRC>

Age	Predicted (%)	Actual (%)	Slack (%p)	Workforces (1,000)
60	0.87	0.81	0.06	476.68
61	0.85	0.77	0.07	635.10
62	0.85	0.73	0.12	997.95
63	0.85	0.71	0.14	1,142.37
64	0.86	0.69	0.16	1,167.63
65	0.83	0.68	0.16	1,004.85
66	0.86	0.69	0.17	946.97
67	0.83	0.61	0.22	1,103.63
68	0.84	0.61	0.22	1,007.60
69	0.83	0.51	0.32	1,357.84
70	0.82	0.54	0.28	1,078.19
71	0.81	0.54	0.27	964.24
72	0.80	0.53	0.27	890.73
73	0.79	0.52	0.26	797.90
74	0.79	0.44	0.35	989.91
75	0.80	0.35	0.45	1,173.83
76	0.77	0.28	0.49	1,199.34
77	0.79	0.29	0.50	1,120.14
78	0.77	0.31	0.47	950.42
79	0.80	0.31	0.49	867.23

Note: Calculated by the author using the KLoSA and CHARLS data, respectively.

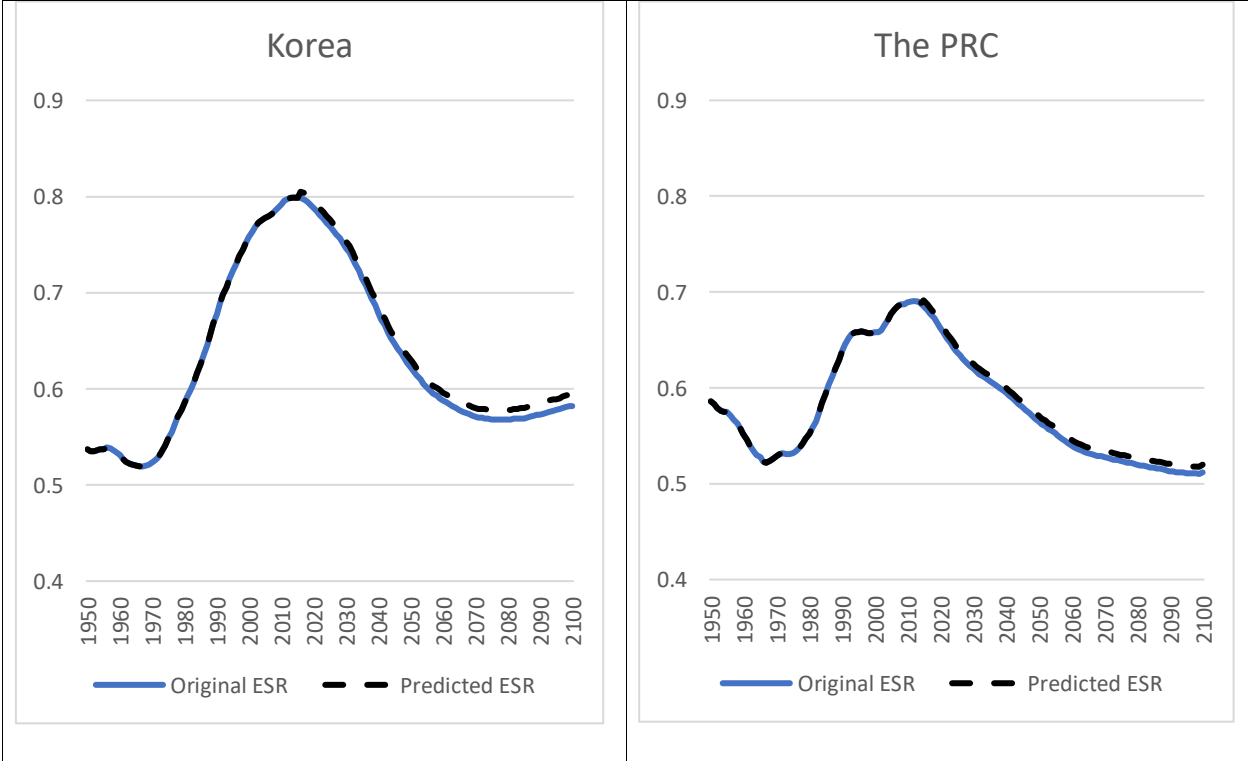
### The Economic Support Ratio (ESR)

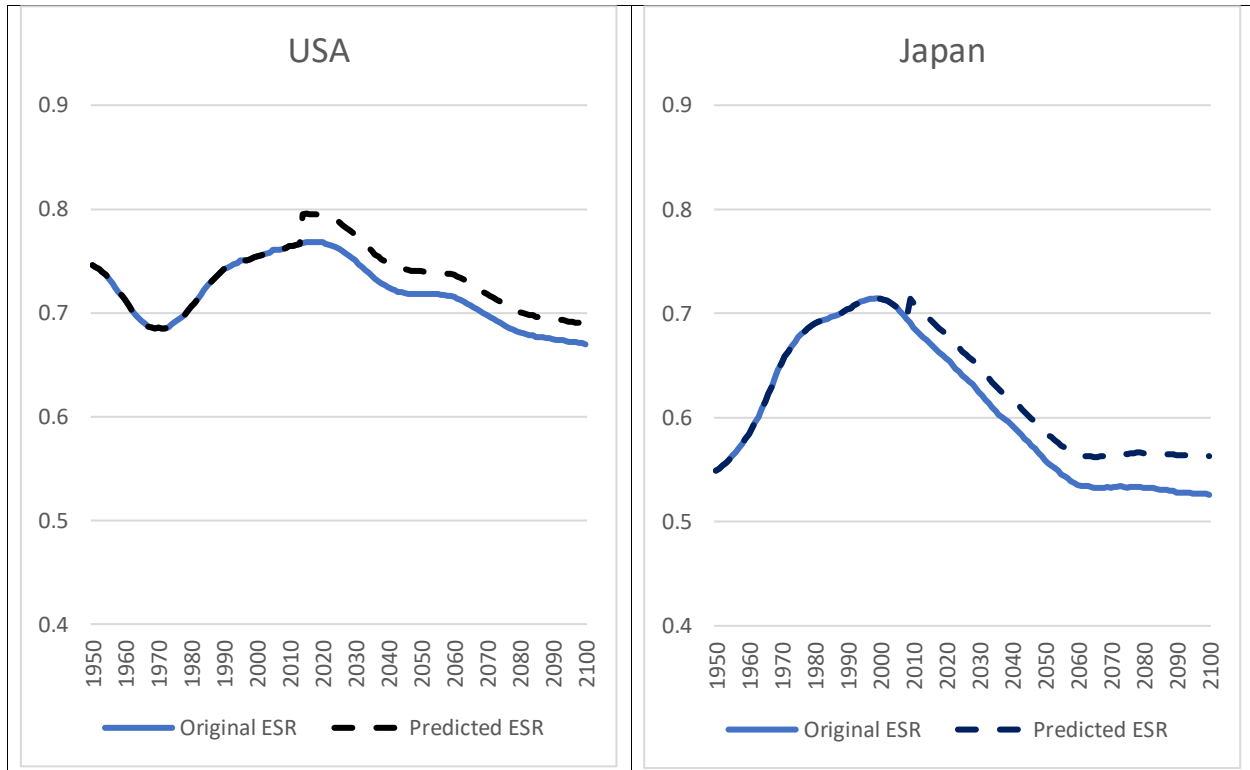
By using the computed results of the health capacity to work, this section quantifies the potential economic gains at the national level, named the *silver dividend* (Matsukura et al., 2018). First, we include the age-specific additional workers into the population of people ages 60-79 through 2100. Second, we calculate the economic support ratio (ESR) under the new estimated health capacity to work in each country.

Figure 6 shows the results for 1950-2100. First, between 1950-2016, the ESR of Korea had increased from 0.519 in 1966 to 0.798 in 2016. The year 2016 is its peak point, and it is projected to decrease after that. If the potential health capacity to work is utilized, the ESR will

be higher by 0.83 percent in 2016, and it will increase continuously to 2.04 percent in 2100. Second, the ESR of the PRC had increased from 0.522 in 1967 to 0.691 in 2012, and it is projected to decrease after 2012. If the untapped working capacity is utilized, the ESR will be higher by 0.84 percent in 2017, and it will rise steadily to 1.49 percent in 2100. The economic gains may seem small, but these are not negligible as the gains are increased over observation years. However, the potential benefits are much smaller than that of Japan at 3.46 percent in 2017 and 7.06 percent in 2100 (Matsukura et al., 2018). We can also compare using the Coile et al. (2017a) results for the US using US NTA data. Between 2017-2100, the predicted US gain is 3.52 percent in 2017 and 2.8 percent in 2100 if the health capacity to work is utilized. Thus, the silver dividend of Korea or the PRC is much smaller than those of Japan or the US.

Figure 6. Additional Economic Gains in terms of Economic Support Ratio (ESR)



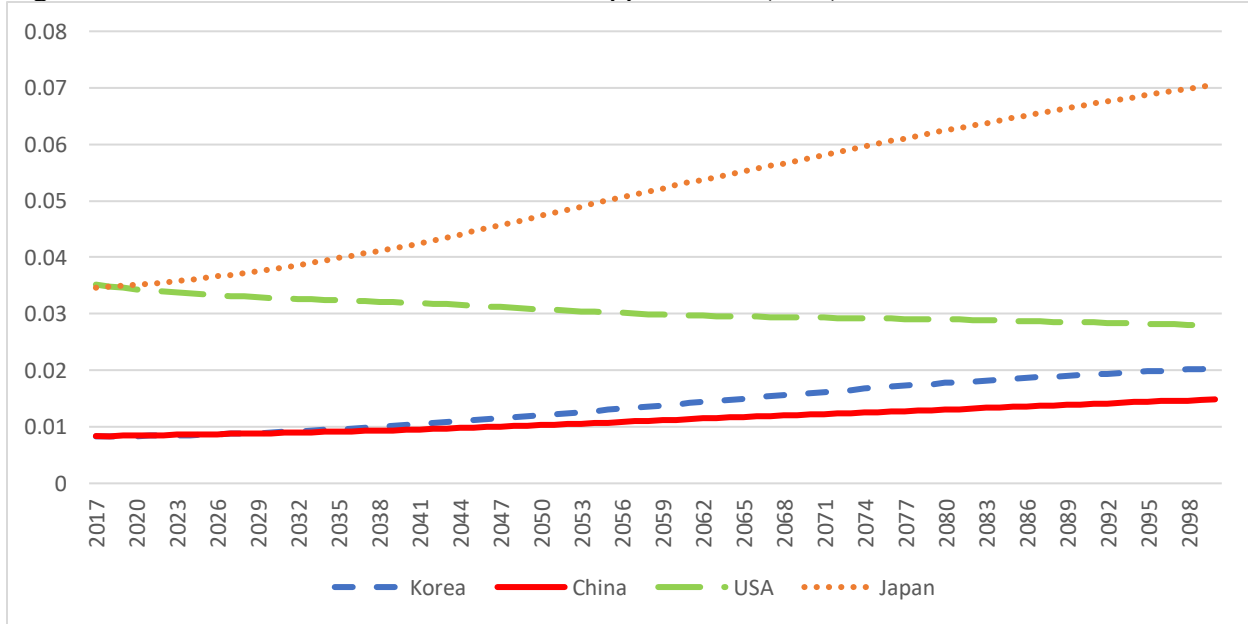


Notes: ESR of each country is estimated by using NTA data in 2016 (Korea), 2014 (the PRC), 2011 (USA), respectively. ESR of Japan is calculated by the author using data from Matsukura et al. (2018). All ESRs are normalized by the average value of persons aged 30-49.

Figure 7 shows the ratio in the increase of ESR of three countries when utilizing additional workforces during 2017-2100. Although the ESRs of Korea and the PRC increase over time, the economic gains are lower than that of the US or Japan. The lower economic gains of health capacity to work in Korea and the PRC are partly due to the low productivity of older workers in the two countries (Lee and Ogawa, 2011). Hence, the insight from these results is clear. Korea and the PRC (especially in rural the PRC) have higher labor force participation rates for older people, but their productivities are low. The effect of low productivity dominates the impact of elders' high labor force participation in shaping the labor income profiles for people in both countries. Korean and Chinese governments have considered policies to mitigate the economic effects of population aging by increasing the labor force participation rate of older people. As people live longer and healthier, utilizing health capacity to work appears to be an

obvious option. However, our results show that it may have a limited effect on labor incomes for the elderly as they are more likely to work in low productive sectors, and mostly as temporary workers in Korea or farmers in rural the PRC.

Figure 7. Ratio in the Increase of Economic Support Ratio (ESR), 2017-2100



Note: The ratio in the increase of ESRs of each country is estimated by dividing the original ESR by the predicted ESR of each country.

#### 1-4-4. Health Capacity to Work for Heterogeneous Groups

As mentioned in the previous section, the CMR method does not explain the source of health capacity to work. They assume that since the generous pension scheme tends to discourage older adults from working more, the elderly are not working although they can (Coile, Milligan, and Wise, 2017b). This might be true for the majority of developed countries, as the labor force participation rate drops dramatically around pension eligible ages.

However, the labor force participation rates of Korean and Chinese elderly decline almost linearly between 60 and 79 since only some of the elderly in both countries are recipients of old-age pensions. Only one-third of the Korean older adults and half of the Chinese elderly are



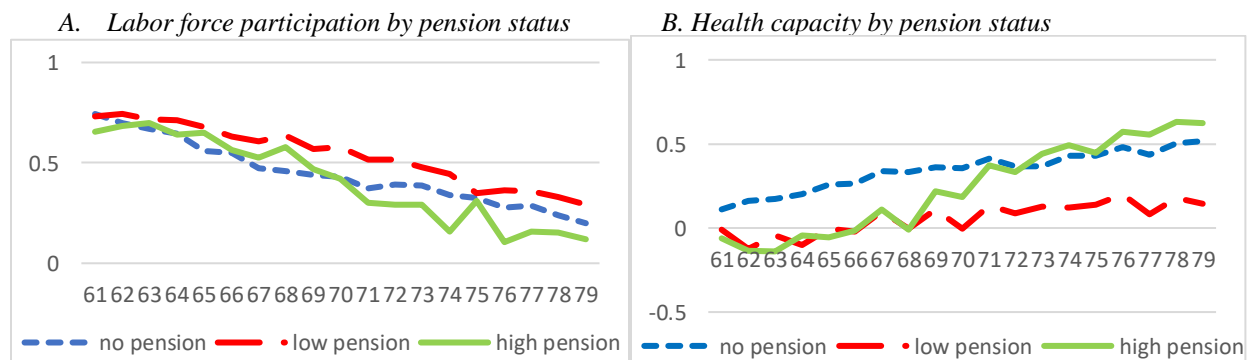
currently receiving old-age pensions. The pension replacement rate of Korea is also very low, and the pension incomes for the Chinese elderly are not sufficient, especially pension for rural Chinese elderly has less generosity and lower coverage than that for urban counterparts. Hence, all these insufficient social welfare systems of the two countries tend to encourage older adults to work longer. Thus, we can simulate the health capacity to work for two groups, one for the eligible pension group and the other who is not. However, one issue is that pensioners are very heterogeneous in Korea and the PRC. In Korea's case, the Basic Livelihood Security Programme (BLSP) provides very small and minimum incomes, while the NPS provides much more benefits to the retirees. Hence, those who receive the BLSP can have a smaller health capacity to work than non-pensioners of NPS. Although KLoSA does not distinguish the public pension receivers by pension type clearly, we can still estimate the health capacity to work for three groups, i.e., non-pensioners, pensioners receiving a below-average pension benefit, and pensioners receiving more than average.

Pensioners are also heterogeneous in the PRC. The ratio of old-age pensioners in urban areas aged 61 and above is 40 percent, while that of rural counterparts is more than 60 percent. It seems to contradict what we mentioned in the previous section, where pensions in urban areas are more generous than rural residents. However, since about 43 percent of urban residents receive the firms' or government institutions' pension, which is more generous than a public pension, non-pensioners of old-age pension in urban areas may be wealthier than pensioners. Even though the ratio of pensioners is more than 60 percent in rural Chinese residents, the mean pension income (920 yuan/month) is about half of that of urban elderly (1,656 yuan/month). Given the vast disparity of pension benefits between rural and urban areas, we simulate the health capacity to work by place of residence (rural or urban areas). We estimate the health

capacity to work for three groups like Korea, for non-pensioners, pensioners receiving a below-average pension benefit, and pensioners receiving more than average.

Figure 8 presents the analysis results by pension status in the two countries. Panel A shows the labor force participation by their pension status, while Panel B shows the health capacity to work, measured by the difference between the actual and predicted labor force participation by age (*slack*) by pension status. There are several interesting findings. Most of all, labor force participation decreases very smoothly for all groups in both countries, although it is more rapid for the high pensioner group in Korea. This is in stark contrast with other Western countries or Japan, where the labor force participation drops quite rapidly around the pensionable ages. It also appears that the labor force participation rate of the no pensioner group is lower than both pensioner groups before age 69, which is not observed in the other countries. The results of Panel B in Korea show that high pensioners have the highest health capacity to work after age 73. This suggests that a high level of pension indeed discourages older people from working although they can work. However, there is a substantial health capacity to work even for non-pensioners, suggesting that pension alone is not a reason for non-working, controlling their health status. Besides, low pensioners have the smallest health capacity, implying that a low pension benefit level does not discourage older people from working.

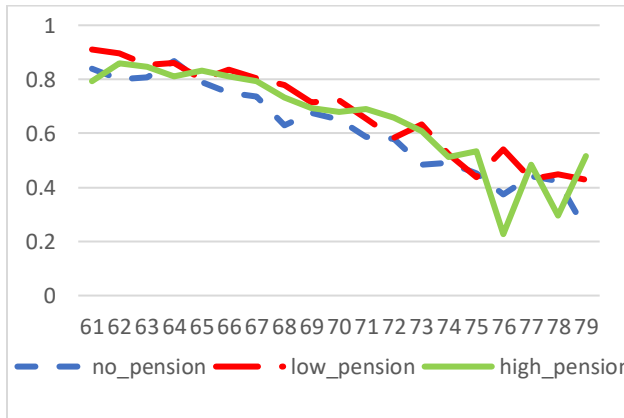
Figure 8. Health Capacity to Work by Pension Status  
<Korea>



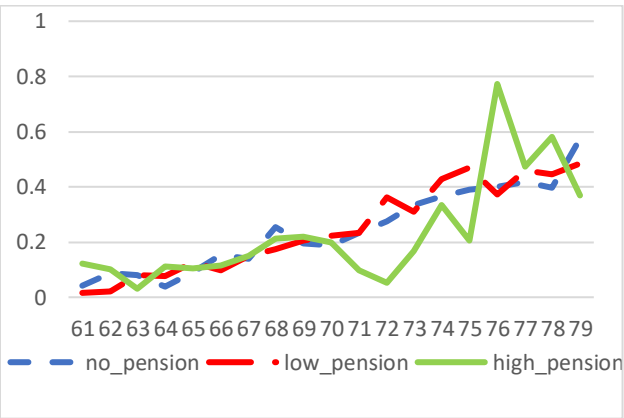
<The PRC>

(rural areas)

A. Labor force participation by pension status

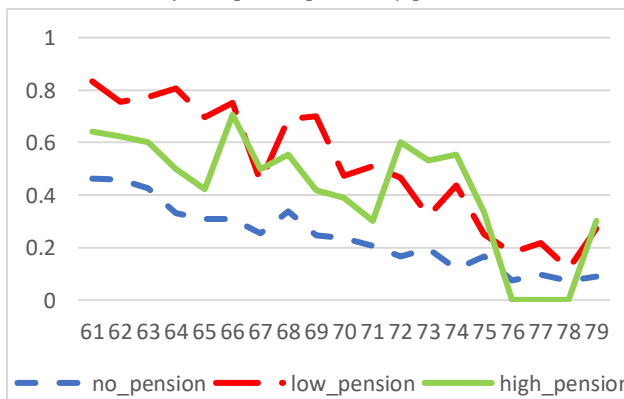


B. Health capacity by pension status

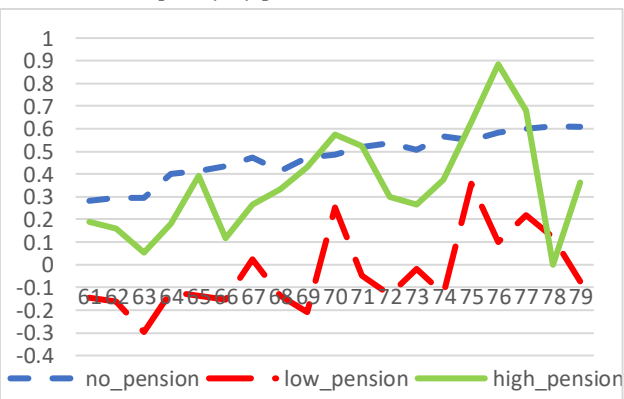


(urban areas)

A. Labor force participation by pension status



B. Health capacity by pension status



The results in the PRC are also interesting. In Panel A in rural the PRC, there are little differences in the labor force participation rates among the three pensioner groups. Panel B in rural the PRC also presents that the health capacities to work among the pensioner groups are very similar. All the results in rural areas imply that old-age pension is not a critical factor related to the decision-making of working more, and rural Chinese elderly are already working to their health limits. On the other hand, in urban areas, the labor force participation and health capacity to work are very similar to those of Korea. No-pensioners tend to stop working faster as they age than low-pensioners and high-pensioners, while low-pensioners tend to work more than

the other two groups. The work capacity of low-pensioners is the smallest among the three groups (Panel B in urban areas), and even the health capacity to work for low-pensioners shows negative values in their 60s, suggesting low-pensioners in urban areas are working to exceed their health limits. The results for urban the PRC suggest that old-age pension is not the only determinant for working longer, and a low-level of pension does not discourage urban Chinese elderly. Also, in urban areas, low-pensioners may live in more poor environments than non-pensioners or high-pensioners.

All these findings generally point to the fact that the pension effect on retirement can vary substantially by country; hence, it is misleading to solely interpret the health capacity to work in the CMW (2017b) as a labor market outcome of the pension benefit. The health capacity to work can result from many sources other than pension benefits, such as labor market rigidity and other labor market conditions, other old-age support systems such as savings and family transfers, and the productivity of old workers.

The first graph of Figure 9 presents the results by health status for two groups, poor and fair (bad group), and good and very good and excellent (good group).<sup>15</sup> Since health status is a health capital that affects the productivity of workers, which is closely associated with labor supply, we estimate health capacity to work to investigate whether health capital affects the capacity. In Korea, the labor force participation rate (Panel A in Korea) is much lower for older people with bad health status. People with good health status have higher labor force participation rates than older adults with bad health. Thus, it is bad health status that makes a difference in the labor market participation decision-making. Panel B shows that the health

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<sup>15</sup> We also analyze the health status of three groups, poor and fair (group1), good (group2), and very good and excellent (group3). The results show 1) the labor force participation rate is much lower for people with poor or fair health status, 2) people with very good or excellent health condition have higher labor force participation rate than others, but the difference between excellent, very good, and good are not significant.

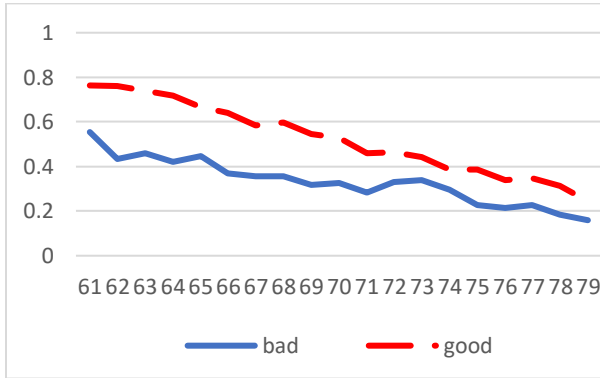
capacity to work is larger for people with good health status than those with bad health. The gap of the health capacity to work between two groups is widening by age, suggesting that the health effect on labor force participation increases by age, which is not addressed in the previous literature.

In the PRC's case, the results by health status provide several interesting findings. First, rural Chinese elderly with good health status tend to work longer than older rural adults with bad health, implying that bad health status tends to discourage the rural Chinese elderly from working more, even though the magnitude is smaller than that of Korea. The result is consistent with previous literature that pointed out that rural Chinese elderly work until dropping (Fang, Brauw, and Rozelle, 2004). Concerning health capacity to work, for rural elderly, we find very similar health capacities between bad and good health groups, suggesting that rural elderly tend to work longer regardless of their health status. There is little difference in labor force participation rates between bad health and good health groups in urban areas, suggesting that health status is also not an essential factor in working more for the urban elderly. Rather than health conditions, other factors like pension benefits may be one of the critical elements related to working more among urban citizens. Second, urban residents tend to stop working earlier in two health groups than their counterparts in rural areas. The absolute values of labor force participation rates are higher for urban elderly than those of rural elderly. In urban areas, the capacity of older people with good health is larger than that of older adults with bad health status, although the difference is not larger. This suggests that healthy urban elderly tend to retire faster even though they can work longer.

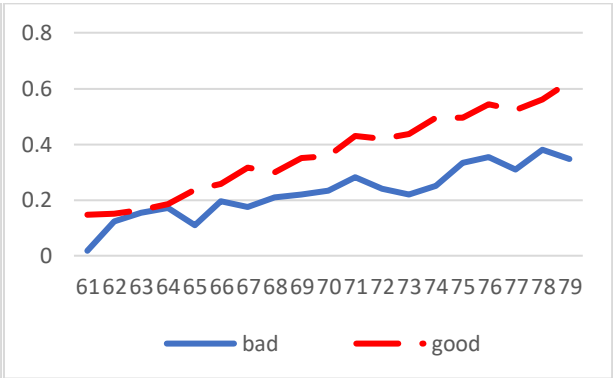
Figure 9. Health Capacity to Work by Health Status

<Korea>

A. Labor force participation by health status



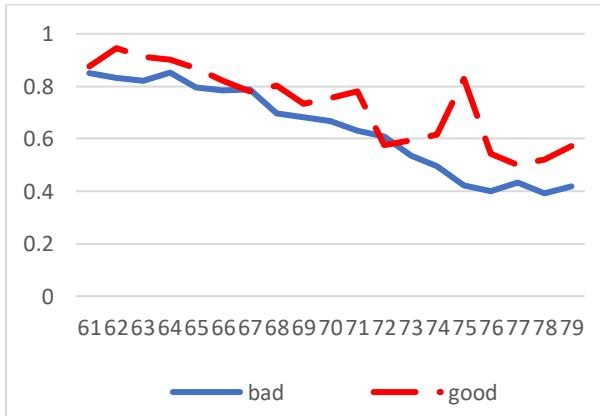
B. Health capacity by health status



<The PRC>

(rural areas)

A. Labor force participation by health status

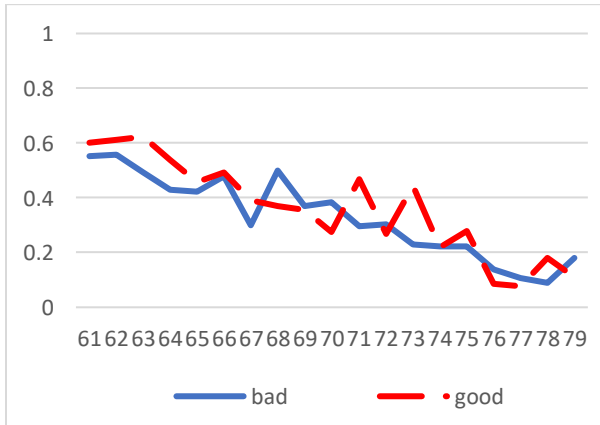


B. Health capacity by health status

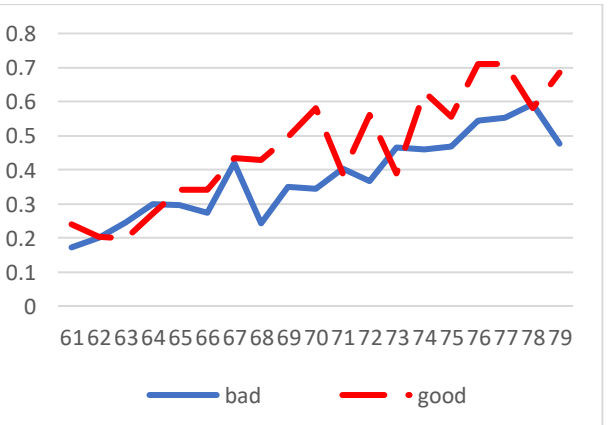


(urban areas)

A. Labor force participation by health status



B. Health capacity by health status

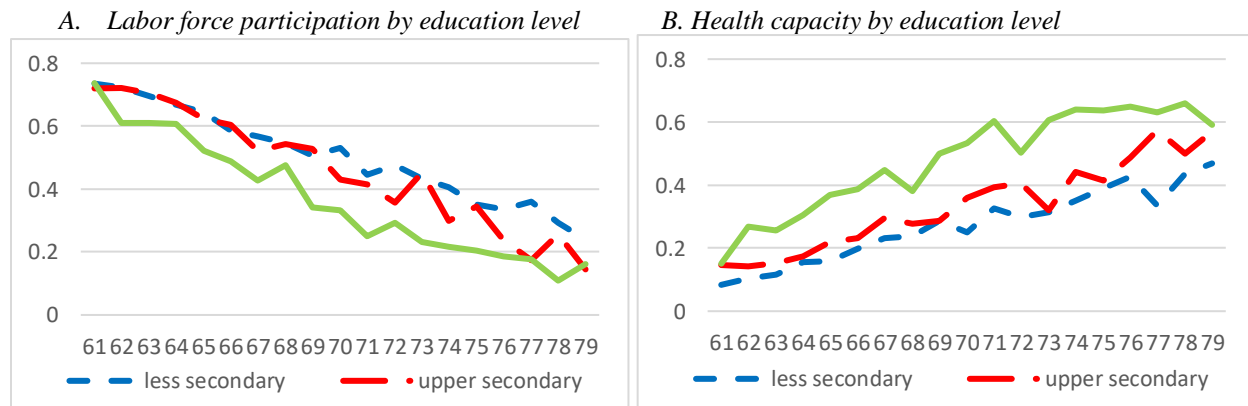


This paper also analyzes the health capacity to work by educational attainments for three groups: people with less than secondary schools, upper secondary schools, and tertiary schools. However, for the PRC, we analyze the capacity to work by education levels for two groups as people with tertiary schools in the PRC are really small: people with less than secondary school (lower-educated group) and upper secondary schools or above (high-educated group). As can see the previous estimation results, education level seems to have no significant impact on the labor force participation of the elderly in both countries. However, we can regard educational achievement as the accumulation of human capital or productivity, closely associated with labor supply. Hence we can still simulate the health capacity to work by educational achievement. Figure 10 presents labor force participation and health capacity to work for educational groups in Korea and the PRC. In Korea, Panel A shows that labor force participation for people with tertiary schools declines faster than those of other educational groups. Besides, there are little differences in the ratio of joining the labor market between graduates with less than secondary and upper secondary schools. Panel B shows that people with tertiary schools have a larger health capacity to work than lower-educated older adults, and the gap between the two groups widens by age, suggesting that the educational effect on labor force participation increases by age.

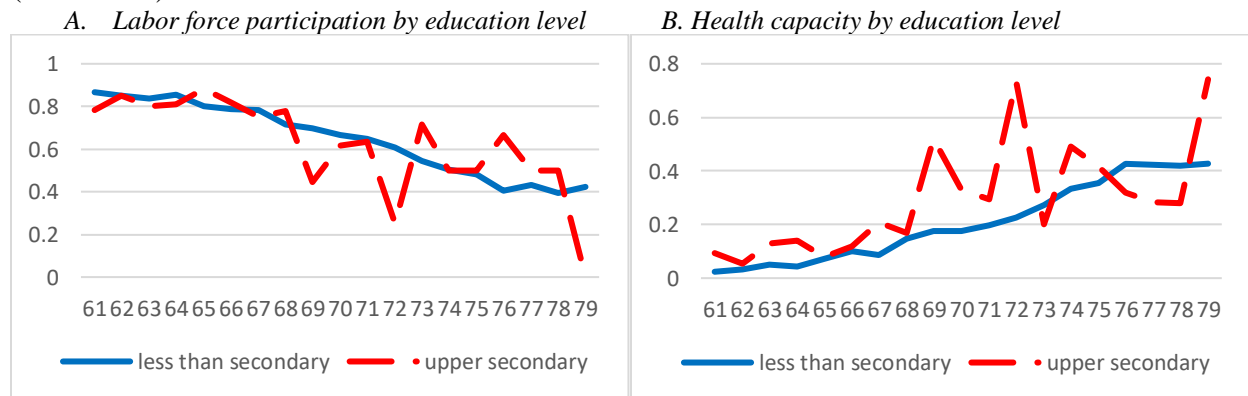
The results of the PRC also provide interesting implications. Among rural Chinese elderly, the labor force participation of two educational groups is very similar (Panel A in rural areas). This suggests that education is not a key element in decision-making for working longer, although the higher-educated group has a little larger health capacity to work (Panel B in rural areas). However, the patterns of urban older adults are quite different from those of rural elderly. Among urban older Chinese, highly-educated people tend to stop working faster than low-

educated older people (Panel A in urban areas). The health capacity to work for people with higher education is larger than that of the elderly with lower education (Panel B in urban areas). This implies that the health capacity to work is partly due to the difference in human capital or productivity, and the effects are more distinctive in urban areas than in rural areas.

Figure 10. Health Capacity to Work by Education Attainment  
<Korea>



<The PRC>  
(rural areas)



(urban areas)

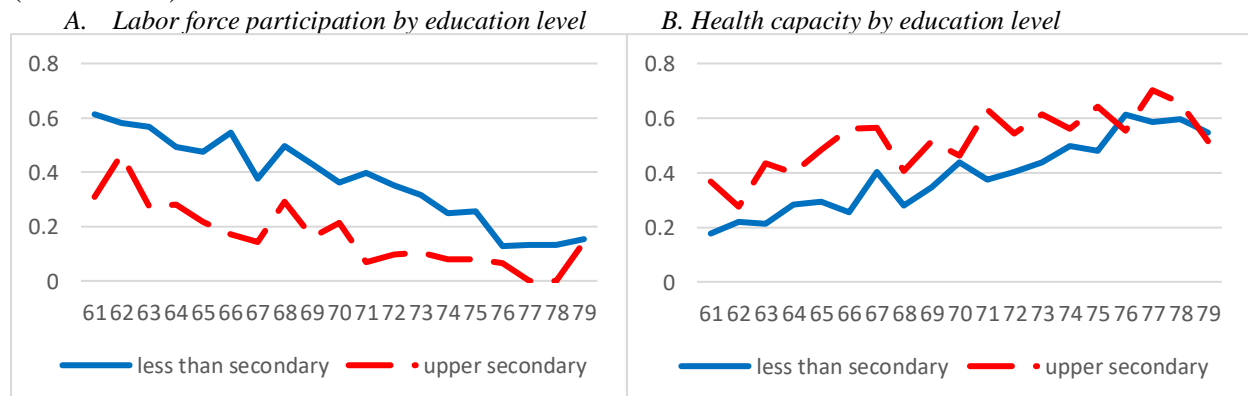




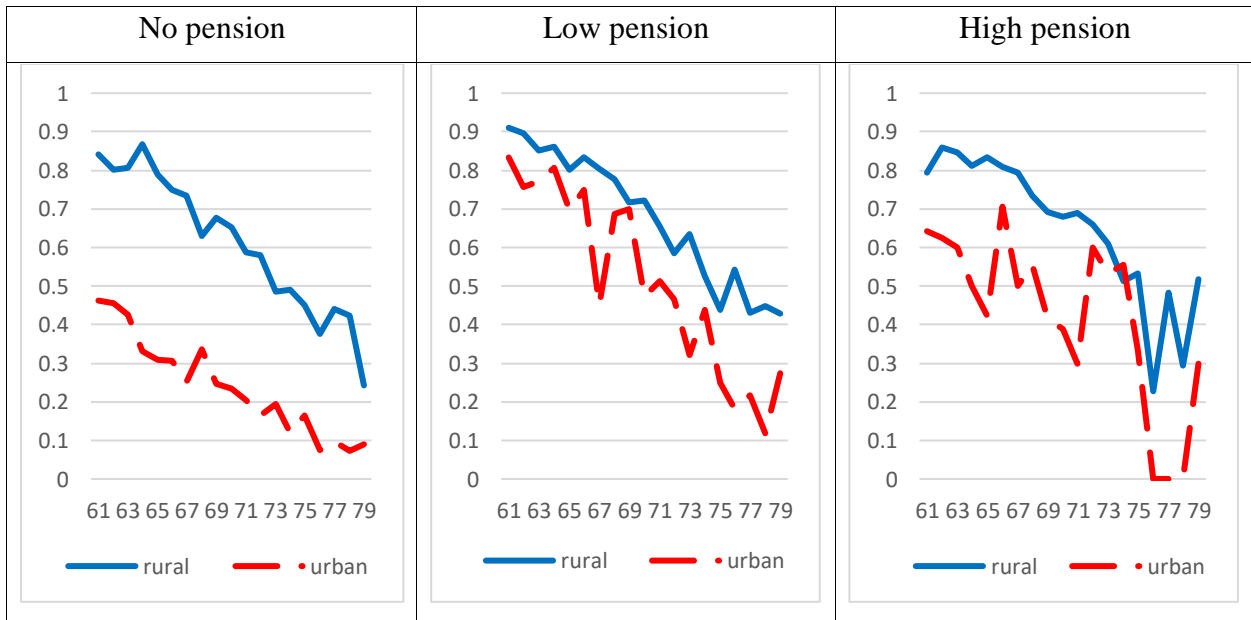
Figure 11 presents the summary of subgroup analysis for the health capacity to work by rural and urban areas in the PRC. There are several interesting findings. First, Panel A in pension status shows that urban elderly with no pension tend to stop working faster than their rural counterparts, suggesting that the urban elderly with no old-age pension may have other resources in their old age, such as savings, assets, or institutional pensions. Second, Panel B in pension status shows that low pensioners in urban areas have less small health capacity than rural counterparts, and even the capacity shows minus values in their early 60s, unlike no- or high-pensioners. Besides, the gap of labor force participation between rural and urban residents with a low pension is smaller than that of people with no pension or people with a high pension. These imply that low pensioners in urban areas are already working up to their health limits, and their living standards may be more impoverished than those of rural counterparts. Third, results by health status show that urban elderly have a higher health capacity to work than their rural counterparts regardless of health status. That is, urban elderly tend to retire earlier than their rural counterparts, although they can work longer in terms of health status, suggesting that health status is not a critical factor for working longer among urban older adults (Panel A and Panel B in health status). Fourth, in the two education groups, labor force participation decreases faster in urban areas than in rural areas, while the gap in labor force participation between rural and urban residents is larger among highly-educated people. Besides, the gap of health capacity to work is also more substantial in higher educated people. These suggest that it is human capital or productivity to make substantial differences in working longer between rural and urban elderly. Given that the education programs for rural residents have been in poor shape than those of urban counterparts (Fang, Brauw, and Rozelle, 2004), the results reflect current significant gaps

of educational institutions across regions. Hence strengthening education programs in rural areas can reduce the disparity of living standards between rural and urban residents.

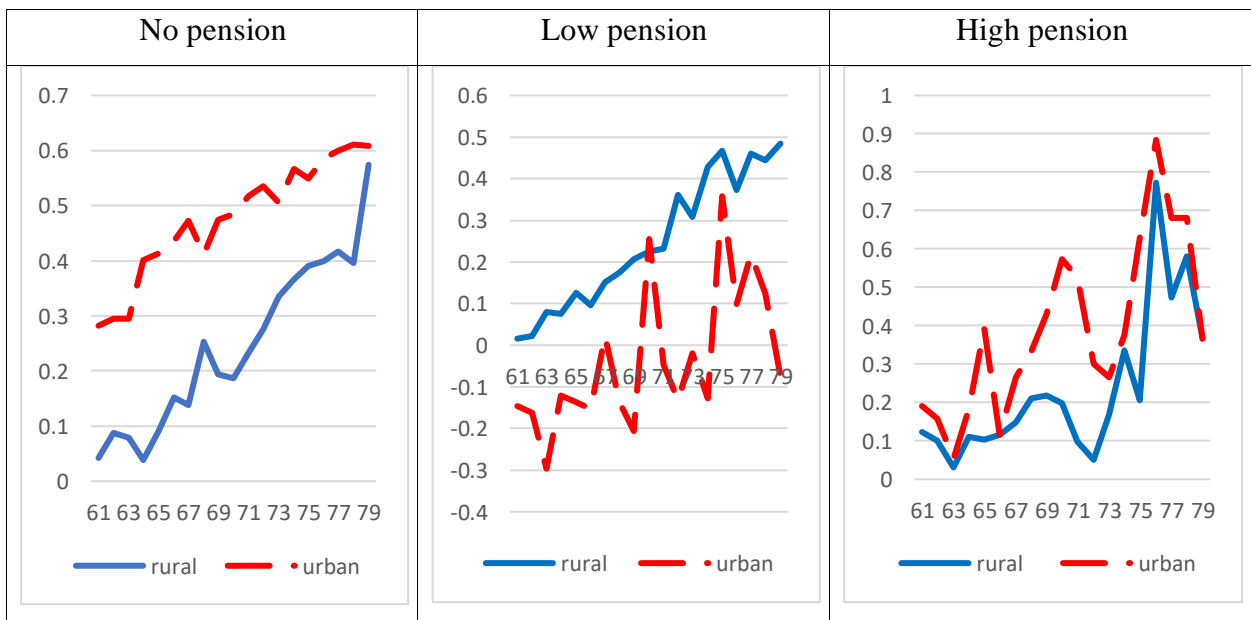
Figure 11. Health Capacity to Work by Place of Residence in the PRC

<By pension status>

A. Labor force participation by pension status

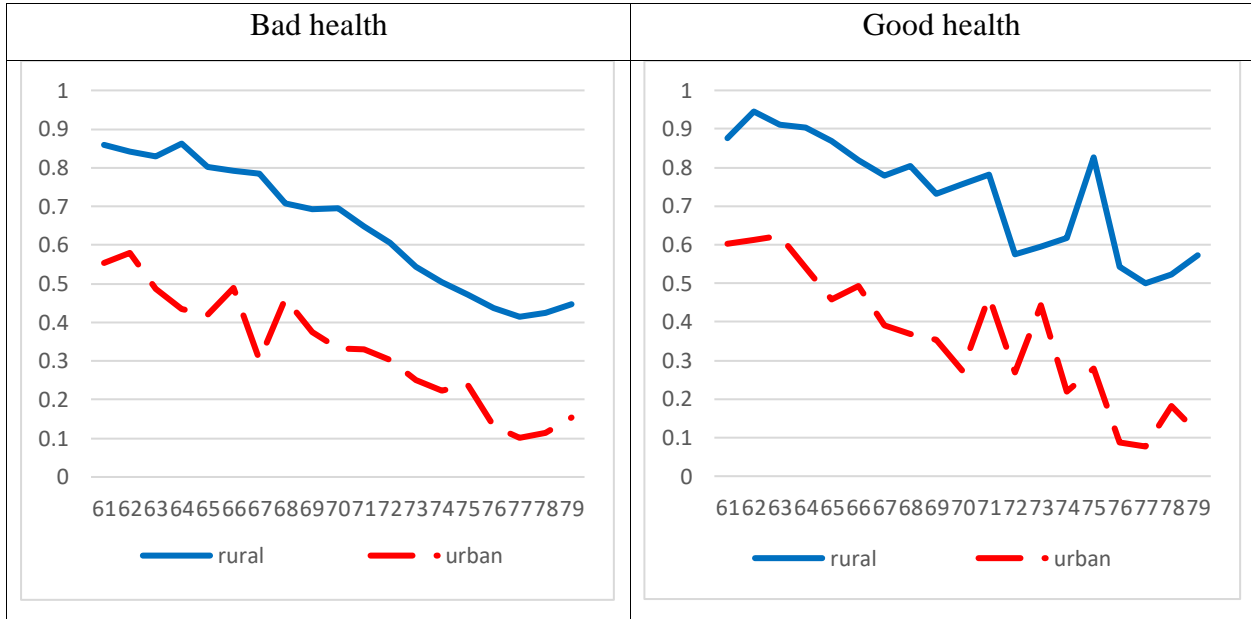


B. Health capacity by pension status

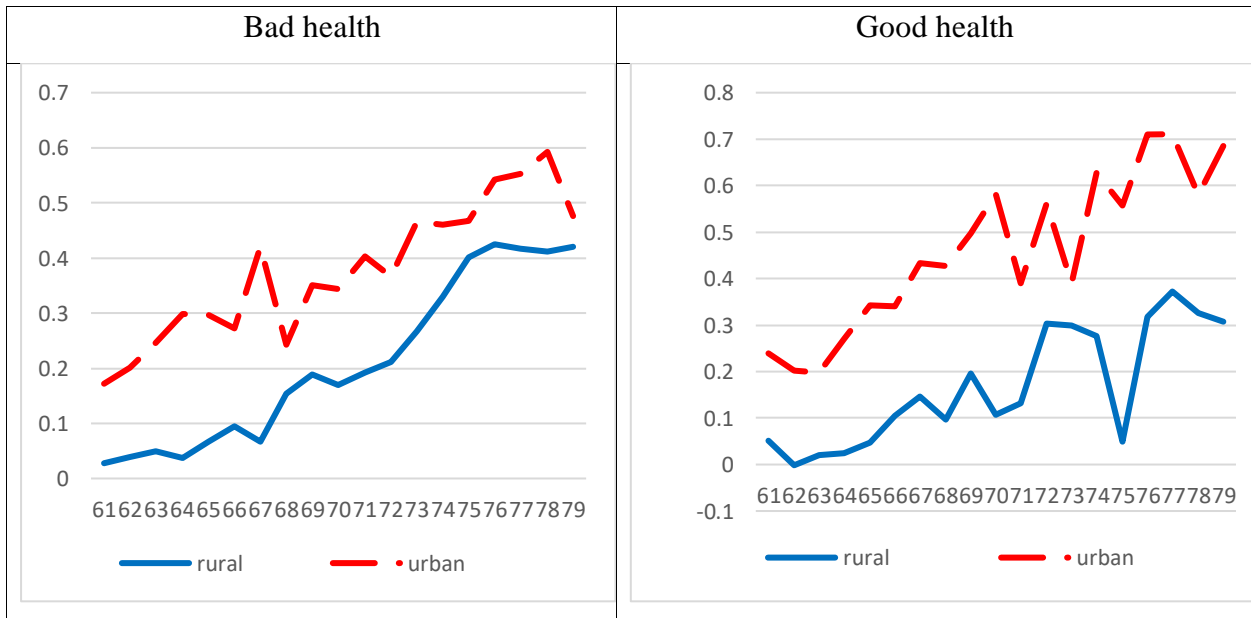


<By health status>

A. Labor force participation by health status

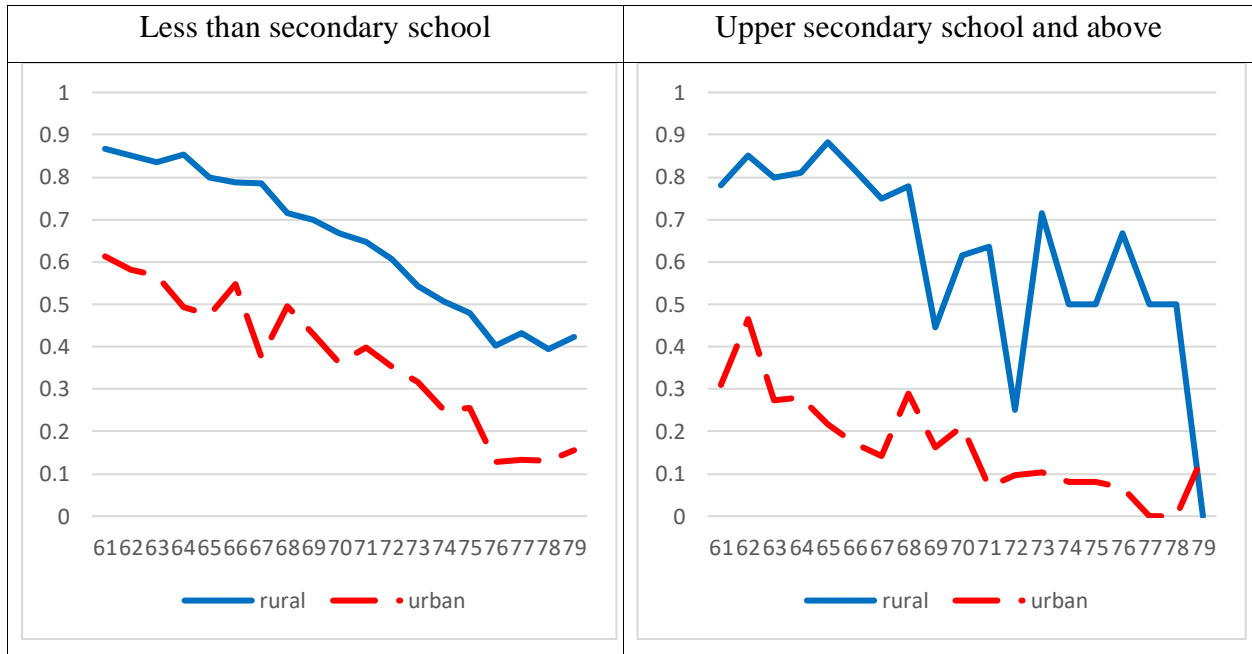


B. Health capacity by health status

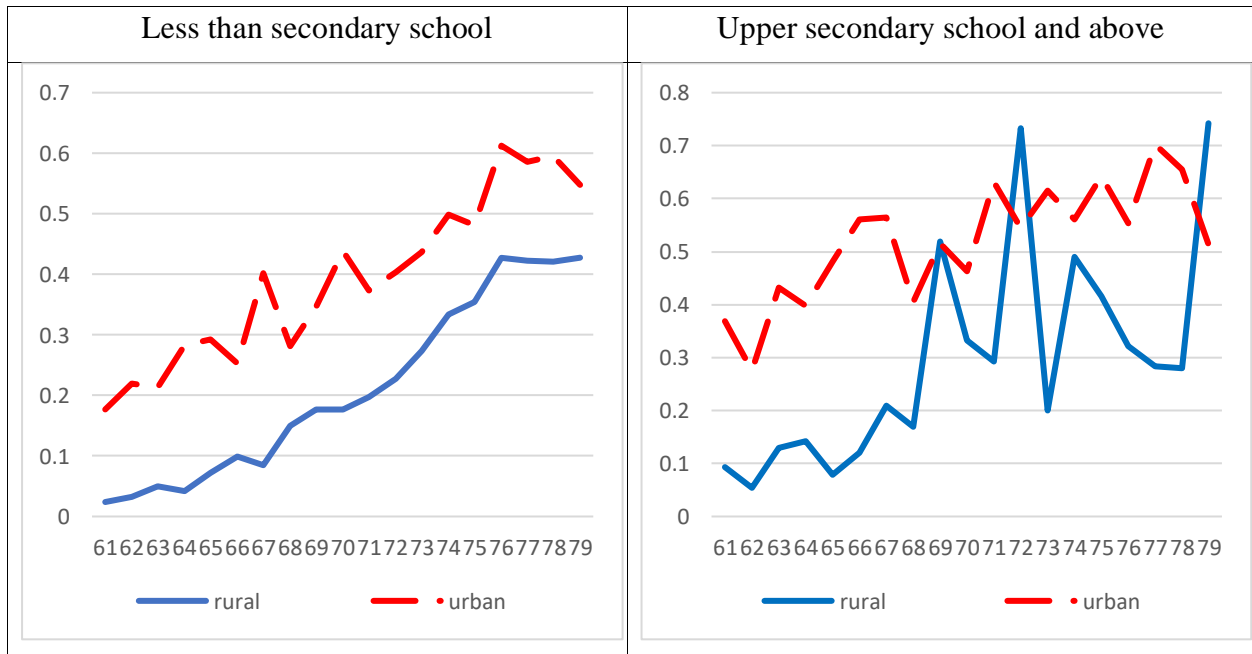


<By education attainment>

A. Labor force participation by education level



B. Health capacity by education level



We have conducted several sensitivity analyses, too. First, we further breakdown the group by pension and health status. The results are qualitatively the same as before (not shown).

However, as the number of observations gets small, the results are less precise. We also changed the base age groups and the simulated age groups to see if the results are robust regardless of the change of the base and simulated groups. Like CMR, we use people ages 57-61 as a base group, and 62 and older as a simulated group to see if the results are sensitive to the choice of age groups. The results are not very sensitive to the choice of sample selection, suggesting that CMR's assumption about the relationship between health and labor force participation is valid, at least for Korea and the PRC (results are shown in the appendix). However, as we include people above 62 into the base group, the health capacity to work gets smaller as pension effects contaminate the estimation results.

## **5. Conclusion and Policy Implications**

As people live longer and healthier, utilizing health capacity to work is an obvious option for keeping the country's social security system at a sound sustainable level. The results in this paper suggest that lots of health gradients are significant determinants for the labor force participation decision for the elderly in Korea and the PRC. However, measured by the Economic Support Ratio (ESR), Korea and the PRC seem to have much smaller economic gains from the health capacity to work, compared with other countries.

The lower economic gains of health capacity to work in Korea and the PRC are partly due to the low productivity of older workers in both countries. Korea and the PRC (especially in rural the PRC) have higher labor force participation rates for older people, but their productivities are low. The effect of low productivity dominates the impact of elders' high labor force participation in shaping the labor income profiles for people in both countries. Korean and Chinese governments have considered policies to mitigate the economic effects of population

aging by increasing the labor force participation rate of older people. However, our results show that it may have a limited effect on labor incomes for the elderly as they are more likely to work in low productive sectors, and mostly as temporary workers in Korea or farmers in rural the PRC. Our results generally point to the fact that the pension effect on retirement can vary substantially by country. Hence, the results from the CMW method should be interpreted with caution when we apply it to countries, especially countries where the pension system is not fully developed. The health capacity to work can vary depending on many sources other than pension benefits, such as labor market rigidity and other labor market conditions, other old-age support systems such as savings and family transfers, and the productivity of old workers.

The study suggests some areas of improvement for the labor market and old-age support policies, which might also shed light on countries with similar conditions. In Korea's case, removing the labor market rigidity can be a pivotal determinant to improve the situation. It is most crucial to make the wage system and labor market more flexible, transitioning from seniority-based to a performance-based wage system. As a short-term solution, an extensive introduction of the peak wage system would be desirable. Second, as the pensionable age is raised, it is expected that good job creation suitable for the elderly will emerge as a core agenda for labor market policies. It is necessary to set clear goals for the elderly's job program from an integrated perspective with the old-age support system. While increasing the employment of the elderly or utilizing health capacity to work is the mainstream agenda, our results suggest that they have limitations given Korea's current labor market conditions. Instead, it is more important to change the structure of aged employment to enhance the productivity of older workers. For those with relatively high productivity or ability, it is necessary to strengthen training programs for productivity improvement. Since there are few formal retraining programs for middle-aged

retirees in Korea, employment promotion policies for the aged should accompany tailored re-education programs. The poverty rate of the elderly is the highest among OECD countries, but the level of social welfare is at the lowest level, so it is also urgent to establish a social safety net for poor elderly to combat poverty.

For the PRC, healthy and wealthy urban older adults tend to retire earlier, while rural elderly are working to their health limits regardless of pension and health status. Hence, pension reform, which includes reducing the disparity of pension benefits between urban and rural areas, is one of the urgent policy agendas to encourage the healthy urban Chinese elderly to work longer and rural elderly to enjoy higher living conditions. Despite the integration of pension systems in 2016, there is still a vast gap of old-age pension benefits between rural and urban areas. Second, low pensioners in urban areas are already working to their health limits or exceeding their health capacity. Their health capacity is even lower than their rural counterparts. Hence policies for extending the social safety net should consider informal sector workers in urban areas. Third, since highly educated people have a larger health capacity to work in rural areas, investing in education services or retraining programs for rural residents may be an effective way to accumulate human capital or increase productivity, reducing the disparities of living standards between rural and urban residents effectively.

This research has some limitations. First, we do not measure the health capacity to work by job type, such as full-time, part-time, and self-employed. More detailed information on employment history is needed to estimate the health capacity by job type, which is not available from our data sets. Second, the sensitivity analysis suggests that CMR's assumption about the relationship between health and labor force participation is still largely valid for Korea and the PRC. However, the health capacity to work gets smaller as we use more elderly in the base

(estimated) group. Hence, it is still possible that the relationship between health and labor force participation is different by pension eligible groups for the base group. This issue is not addressed in this paper.



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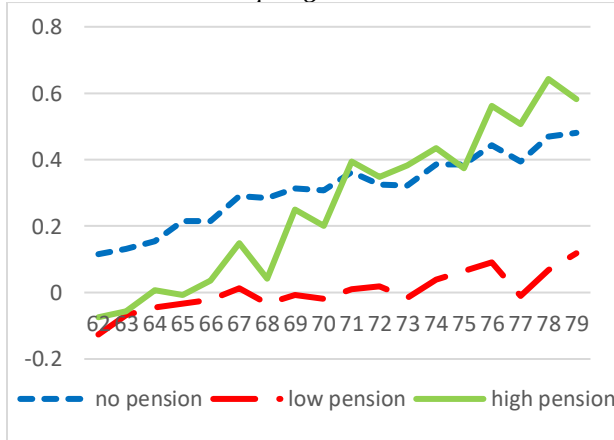
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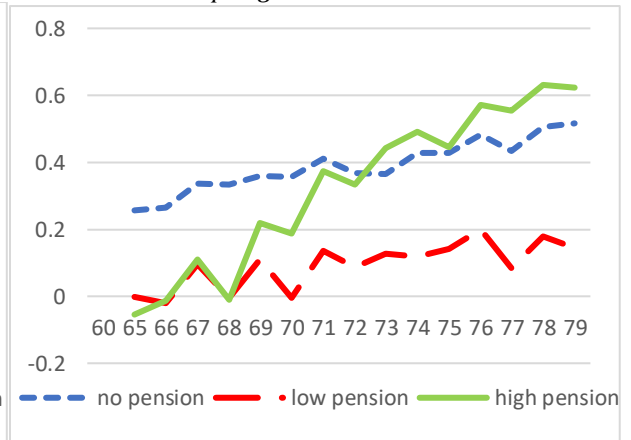
# Appendix: Sensitivity test

## 1. Korea

A. Baseline Group: Aged 57-61

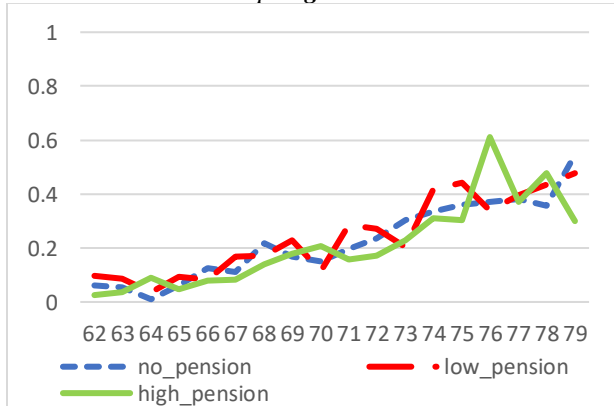


B. Baseline Group: Aged 50-59

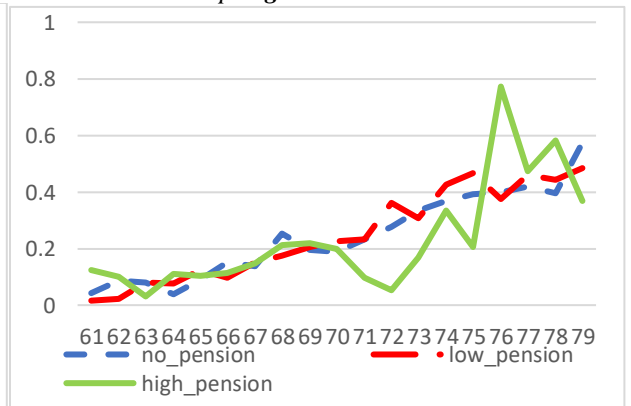


## 2. The PRC (Rural Areas)

A. Baseline Group: Aged 57-61

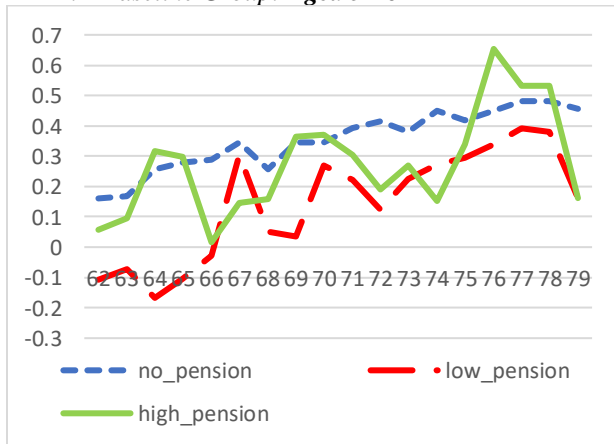


B. Baseline Group: Aged 50-59



## (Urban Areas)

A. Baseline Group: Aged 57-61



B. Baseline Group: Aged 50-59

