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Global Aging and Growth: Is there a Silver Dividend?

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Global Aging and Growth: Is there a Silver Dividend?

Despite concerns about the negative economic impact of population aging, research suggests that aging populations can yield a silver dividend by extending working lives in the face of increasing longevity. This study examines the factors that enhance this dividend and finds that the impact of aging on economic growth is highly nonlinear, with adverse effects concentrated in advanced and more aged countries. Labor shortages caused by aging are often offset by increased labor force participation while higher life expectancy, human capital accumulation, and greater trade openness amplify these mitigating effects. Additionally, we observe that countries with relatively larger governments, measured by government consumption, suffer less severe negative effects of aging on growth. However, when government size is measured by tax levels, the adverse effects of aging are most pronounced in high-tax economies. Based on these findings, we provide policy implications to help mitigate the economic challenges associated with population aging.

Keywords: Aging, growth, worklife, labor force participation, silver dividend
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Introduction

Over the long term, the demographic transition toward aging populations is an inevitable global phenomenon. Even regions that are currently characterized by youthful demographics will eventually undergo population aging. By the end of the 21st century, fertility rates are projected to fall below replacement levels in all but twelve African countries and the Pacific Island nation of Vanuatu (World Fertility Report 2024). The Philippines, for instance, remains a relatively young country and continues to send millions of workers abroad. However, its recent decline in fertility to below replacement levels indicates that it too will experience demographic aging in the coming decades. Consequently, population aging and its economic implications will become increasingly relevant even for developing countries that are currently in the earlier stages of demographic transition.

Population aging affects economic growth through multiple channels. The most prominent channel emphasized in the literature is the decline in the working-age population, which slows the growth of labor input (Park and Shin, 2012; 2023; Mason and Lee, 2012). A relatively large labor force benefits economic growth. For instance, the rapid expansion of the working-age population—commonly referred to as the 'demographic dividend'—was a key driver of the remarkable economic growth in East Asian countries (Bloom and Williamson, 1998). However, as these economies undergo population aging, this demographic advantage is gradually giving way to a 'demographic deficit,' adversely affecting their economic prospects.

However, a more optimistic view has emerged recently as longevity increases and the older population becomes healthier. Better health enables older workers to remain longer in the labor force, generating the so-called ‘Silver Dividend’—potential economic benefits arising from extended working lives in aging societies. For example, AEIR (2019) argues that an elder-population workforce can contribute positively to economic growth. In particular, the adoption of technologies that help older workers work better can mitigate the negative effects of aging on economic growth. Ogawa et al. (2021) argue that the silver dividend alone could substantially increase Japan's real GDP, with the positive output effect ranging from 3.2% to 6%, depending on the wage level of the additional elderly workers.

In this chapter, we investigate the role of the silver dividend in mitigating the adverse impacts of population aging on economic growth. In particular, we will empirically analyze the factors that augment the silver dividend and investigate whether it is sufficient to fully offset the negative impacts of population aging on economic growth.

Additional Channels through which Population Aging Affects Economic Growth

Beyond the labor input channel, population aging affects economic growth through at least three additional channels. First, the life-cycle hypothesis suggests that older populations tend to dissave, thereby reducing aggregate savings (Park and Shin, 2012; Park et al., 2010). This decline in savings can lower aggregate investment, thus slowing physical capital accumulation and economic growth. However, a reduced labor supply may encourage the substitution of physical capital for labor, mitigating the effects of a shrinking workforce. For instance, Cutler et al. (1990) argue that population aging leads to capital deepening, which can offset the slower growth of labor input.

Similarly, Acemoglu and Restrepo (2022) contend that aging drives greater automation, enabling economies to overcome shortages of middle-aged workers[1].

Second, a decline in the number of children allows parents to invest more in their children's human capital, which can contribute positively to economic growth. This quantity-quality substitution in child-rearing, first introduced by Becker (1960) and Becker and Nigel (1973), suggests that limited resources compel parents to reduce the number of children but allocate more resources to the education and skills development of each child. In other words, the loss in utility from having fewer children can be offset by greater investments in human capital per child, leading to a higher-skilled workforce. If the improvement in quality sufficiently compensates for the reduction in quantity, per capita growth may not necessarily decline.

Third, population aging affects productivity growth, although perspectives on this channel vary. One view posits that population aging lowers productivity growth, as older populations are generally less innovative and entrepreneurial. For instance, Jones (2010) argues that an increase in the proportion of older individuals slows technological development, which negatively affects Total Factor Productivity (TFP). Aksoy et al. (2019) support this perspective, emphasizing that innovative activities are predominantly carried out by middle-aged individuals, particularly those aged 40–49. Conversely, another perspective suggests that population aging can positively influence TFP. This view dates back to Habakkuk (1962), who argued that labor scarcity creates stronger incentives for innovation. Romer (1990) further finds that the United States experienced rapid productivity growth during periods of slow labor force growth. Furthermore, using cross-country data from 1960 to 1985, Cutler et al (1990) find a negative correlation between productivity growth and labor force growth. More recently, Acemoglu and Restrepo (2022) argue that in aging economies, labor shortages drive up labor costs, incentivizing the development and adoption of automation technologies such as robotics that substitute for labor. Since automation technologies tend to advance rapidly, aging economies can achieve faster technological progress through automation.

To fully understand the effects of population aging on economic growth, it is important to examine the various channels collectively. Empirical studies based on this approach consistently identify reduced labor productivity growth or TFP growth as the most significant channel through which population aging influences economic growth. For instance, analyzing a large panel of countries, Feyrer (2007) decomposes per capita output growth into three channels—growth in per capita physical capital, human capital, and TFP—and concludes that TFP is the primary channel through which demographic change influences per capita output growth. Similarly, using U.S. state-level data, Maestas et al. (2016) decompose per capita output growth into growth in hours per worker, employment per capita, and labor productivity. They find that two-thirds of the negative effect of aging on per capita growth stems from slower labor productivity growth. Employing the same three channels as Feyrer (2007) for country-level European data, Aiyar, Ebeke, and Shao (2016) confirm that reduced TFP growth is the major channel. Expanding on these findings, Lee and Shin (2021) and Park and Shin (2023) identify six channels and conclude that reduced TFP is the predominant source of the adverse growth effects of aging. Using regional data from Korea, Shin (2025) finds that 80% of aging's negative impact on regional growth is attributable to its adverse effect on TFP.

A limitation of most previous studies is their failure to account for the silver dividend. To our knowledge, Lee and Shin (2021) is the first study to explicitly incorporate it as one of the channels. They expanded the analysis to include six channels: (1) physical capital, (2) human capital, (3) average working hours, (4) labor force participation rate, (5) the share of the population aged 15 and over, and (6) TFP. Channels (4) represents the silver dividend while channel (5) is the demographic deficit due to population aging. Using data from 35 OECD countries, Lee and Shin (2021) confirm that the primary channel through which aging adversely impacts economic growth is a slowdown in TFP growth. Additionally, they find evidence of a demographic deficit since the decreasing share of the working-age population [channel (5)] negatively affects growth. However, this negative effect is more than offset by increases in the labor force participation rate [channel (4)]. More recently, expanding the dataset to include developing countries Park and Shin (2023) re-confirm the findings of Lee and Shin (2021).

Empirical specification and data

Park and Shin (2023) adopt a Cobb-Douglas production function framework, which they reformulate to express output per capita as::

$$\mathrm{y} = A^{1/\alpha} k^{(1-\alpha)/\alpha} h v p n_{15} \tag{1}$$

where $\mathrm{y} = \frac{Y}{N}$, $k = \frac{K}{Y}$, $n_{15} = \frac{N_{15}}{N}$, A representing the TFP level, α is labor income share, h as average human capital, v as average working hours, p as the labor force participation rate, N_{15} as population aged 15 and over, and N as the total population. Taking the logarithmic time difference of this equation allows us to decompose changes in per capita output into seven distinct components:

$$\Delta \ln y = \frac{1-\alpha}{\alpha}\Delta \ln k + \Delta \ln h + \Delta \ln v + \Delta \ln p + \Delta \ln n_{15-64} + \Delta \ln n_{15-64}^{15} + \frac{1}{\alpha}\Delta \ln A \quad (2)$$

where Δ represents the time difference. This decomposition allows for an empirical investigation of the relative importance of these channels in explaining the economic impacts of population aging. Note that $\Delta \ln n_{15}$ is decomposed into $\Delta \ln n_{15-64}$ and $\Delta \ln n_{15-64}^{15}$, where the first term reflects the change in the proportion of the working-age population, and the second captures the change in the ratio of those aged 15 and above to the working-age population. While these two components are estimated separately, they can be aggregated and considered as a single channel.

This study utilizes a sample of 166 countries, including both advanced and less developed economies, spanning the period from 1960 to 2019. Five-year averages are calculated for each period: (Period 1: 1960–64), (Period 2: 1965–69), ..., and (Period 12: 2015–19), and annualized growth rates are derived from these averages.[2] Data on output, population, capital stock, human capital stock, average working hours, and TFP are sourced from the Penn World Table (PWT) 10.0 update. Information on old-age and youth dependency ratios is obtained from the World Bank's World Development Indicators, while labor force participation rates are based on International Labour Organization (ILO) modeled estimates accessed through ILOSTAT.

Empirical Findings

Table 1 reproduces the results reported in Park and Shin (2023)[3]. Using equation (2) as a basis and treating the five-year averages as observations, they present panel estimation results with country fixed effects. In these estimations, the annualized growth rates of per capita output and the variables representing each of the six channels on the right-hand side of equation (2) are regressed on the old-age and youth dependency ratios (or population shares) and the initial level of per capita GDP. To address endogeneity concerns, they employ instrumental variable regression, using past birth rates as instruments. Demographic variables are not exogenous to economic growth, as young populations tend to emigrate from low-growth countries, creating reverse causality from low economic growth to population aging.

< Table 1 here>

The upper panel of Table 1 presents results based on the old dependency ratio—the ratio of the population aged 65 and over to the working-age population (aged 15 to 64)—used as an indicator of aging. According to Equation (2), the sum of the coefficients from columns (2) to (8) should equal to the coefficient reported in column (1), illustrating how the negative impact of aging is decomposed into the individual channels represented in columns (2) through (8)[4]. Column (1) shows the coefficient is negative and statistically significant at the 10 percent level. The estimate in column (1) indicates that a 1 percentage point increase in the old dependency ratio results in approximately a 0.1 percentage point reduction in the annual per capita growth rate over the next five years. The estimate in column (3) reveals that human capital accumulation contributes negatively to economic growth, accounting for about one-third of the adverse impact of aging. Columns (5) and (6) highlight the roles of the silver dividend and demographic deficit in economic growth. Specifically, the estimate in column (6) shows that more than half of the negative impact of aging is attributed to the demographic deficit. However, the estimate in column (5) indicates that this demographic deficit is almost entirely offset by increased labor force participation, suggesting the potential for a silver dividend. Finally, column (8) reports the impact of aging on TFP growth. Although the coefficient is not statistically significant, it is sizable and explains over half of the total impact of aging on economic growth as reported in column (1).

In the lower panel of Table 1, we present the results using the old population share—the ratio of the population aged 65 and over to the total population—as an indicator of population aging. In column (1), the coefficient for the old population share is negative and highly statistically significant at the 1 percent level. The estimate suggests that a 1 percentage point increase in the old population share leads to approximately a 0.23 percentage point reduction in the annual per capita growth rate over the next five years. Human capital accumulation continues to contribute negatively to growth, accounting for slightly less than one-quarter of the adverse impact of aging on economic growth. The estimates in columns (5) and (6) indicate that the demographic deficit accounts for about one-third of the negative impact of population aging, which is entirely offset by increased labor force participation, as shown in column (5). Notably, the estimate in column (8) is now statistically significant and larger in absolute value than that in column (1), suggesting that reduced TFP alone can fully explain the negative impact of aging on economic growth.

Lee and Shin (2019), however, find that the impact of aging is highly non-linear. Given the differences in the degree of population aging between advanced and less-advanced countries, we present in Table 2 the same IV panel regression results for the sample of non-OECD countries to explore these variations.[1] To save space, we report the estimated coefficient of the old dependency ratio only in the upper panel and that of the old population share in the lower panel for non-OECD countries, corresponding to the two sets of estimations reported in Table 1. Although the number of observations differs slightly between these two sets of estimations, we report only the number of observations for the latter, as the difference is negligible.

< Table 2 here>

Table 2 indicates that the impact of aging on economic growth is not statistically significant. In the upper panel, the estimated coefficient for the old dependency ratio is even positive. As highlighted by Lee and Shin (2019), the adverse impact of aging on economic growth is primarily concentrated in advanced countries. However, even in non-OECD countries, evidence of both the demographic deficit and the silver dividend is present, as indicated by the statistical significance of the coefficients in columns (5) and (6) in both panels. Notably, the magnitude of the silver dividend is larger than in Table 1 and nearly twice as much as the demographic deficit. Finally, while the

[1] These results are also reported in the updated version of Park and Shin (2023).

estimated coefficient in column (8) for TFP growth is negative, it is not statistically significant.

<Figure 1 here>

The highly nonlinear impact of aging, as emphasized by Lee and Shin (2019), arises because commonly used indicators of aging in the literature fail to fully capture the evolution of the working-age population share—the ratio of individuals aged 15–64 to the total population—which is more directly relevant to the size of the labor input. Figure 1 illustrates how the working-age population share evolves as the old dependency ratio (left panel) and the old population share (right panel) increase.[5] The linear fitted line is represented by dashed lines. In the left panel, the figure shows that until the old dependency ratio reaches a sufficiently high level (i.e., above 0.2), the working-age population share actually increases alongside the old dependency ratio. This occurs because, in younger countries—those predominantly composed of younger populations—both the old dependency ratio and the working-age population share initially increase during the early stages of aging, as the youth-age population share—the ratio of individuals under 15 to the total population—declines rapidly. However, as the population distribution shifts toward older age groups, the working-age population share begins to decline as the old dependency ratio further increases. A similar pattern is observed in the right panel when the old-age population is used in replace of the old dependency ratio. Since labor input is mainly determined by the working-age population share, economic growth can initially increase despite rising old-age dependency or old population shares. However, once the aged population share surpasses a certain threshold, the working-age population share begins to decline, potentially adversely affecting economic growth.

<Figure 2 here>

In Figure 2, we compare the evolution of the working-age population share between OECD countries (panel A) and non-OECD countries (panel B). Although the fitted lines consistently exhibit positive slopes, the figures reveal that many OECD countries have surpassed the threshold where the working-age population share begins to decline. In contrast, the non-OECD sample is predominantly composed of younger countries, where the positive relationship between aging and the working-age population share is more pronounced.

< Table 3 here>

In Table 3, we present the same IV panel regression results for the sample of countries with an old dependency ratio below the sample mean. The upper panel reports the estimated coefficients for the old dependency ratio, while the lower panel reports those for the old population share. In column (1), both estimated coefficients are positive, with the coefficient in the lower panel even achieving statistical significance. This finding suggests that when countries are relatively younger, the simultaneous increase in the old dependency ratio (or the old population share) and the working-age population share leads to economic growth, despite increases in conventional measures of aging. The table does not show evidence of a demographic deficit in column (6) or a silver dividend in column (5). In contrast, human capital accumulation contributes positively to economic growth, as indicated in column (3). Finally, the estimated coefficients for TFP growth in column (8) are negative but statistically insignificant. Overall, the impact of aging observed in Table 3 differs significantly from the patterns reported in either Table 1 or Table 2.

Our findings thus far indicate that increased labor force participation plays a crucial role in offsetting the negative impact of labor shrinkage caused by population aging, particularly in advanced countries. Park and Shin (2023) demonstrate that this increase in labor force participation primarily stems from elderly workers, underscoring the significant role of the silver dividend. Additionally, Park and Shin (2023) identify several factors that amplify the silver dividend, including higher life expectancy, enhanced human capital, and greater trade openness. In other words, the mitigating effect of increased labor force participation is significantly stronger in countries with these characteristics. Although higher labor force participation can help mitigate labor shortages, it is insufficient to fully counteract the negative effects of reduced TFP growth.

<Figure 3 here>

As emphasized by Aaronson et al. (2014), the overall labor force participation rate tends to decline as an economy ages, given the lower participation rates of older individuals. For instance, Cuadrado et al. (2023) estimate that population aging over the past decade has reduced the labor force participation rate in Spain by approximately 3.4 percentage points. However, the labor force participation rate for older individuals tends to increase as an economy ages. According to Fry and Braga (2023), in the United

States, while 11% of individuals aged 65 and over were working in 1987, this figure rose to 19% by 2023. Using the sample of countries in this study, Figure 3 illustrates the relationship between the labor force participation rate for individuals aged 65 and over and the level of the old-age dependency ratio. As the figure shows, there is no consistent increase (and even a potential decrease) in the labor force participation rate of older individuals during the initial stages of aging. However, once the old-age dependency ratio surpasses a certain threshold, the labor force participation rate of older individuals begins to rise.

Fry and Braga (2023) identify several factors contributing to the increase in the labor force participation rate of older individuals in the US. First, older workers today tend to have higher levels of education, which increases their employment opportunities compared to less-educated older workers. Second, the health of older workers has improved, enabling them to extend their working lives. Third, retirement plans have evolved, with employers shifting from defined benefit plans to defined contribution plans. Traditional defined benefit plans encouraged retirement at a specific age, whereas defined contribution plans do not incentivize early retirement. Fourth, policy changes, such as adjustments to the Social Security System, have raised the age for full retirement benefits from 65 to 67, discouraging early retirement. Lastly, jobs have become more 'age-friendly.' Older workers often prefer roles with less physically strenuous activities and more flexible schedules, and many occupations now accommodate these preferences.[6]

Supporting Fry and Braga (2023), Park and Shin (2023) provide evidence that some of the factors identified by Fry and Braga have indeed enhanced the silver dividend. Specifically, Park and Shin (2023) examine whether longer life expectancy, higher human capital, and greater trade openness amplify the silver dividend. They include trade openness as an additional factor, arguing that workers in more open economies have a stronger incentive to remain in the labor market as they age, driven by increased job opportunities and potentially higher demand for experienced workers.

<Figure 4 here>

In Figure 4, we illustrate the findings from Lee and Shin (2023). While their analysis employs a more rigorous approach, we present supporting evidence using graphical representations. In the upper left panel, we show the relationship between the initial level of the old-age dependency ratio and the annual growth rate of the labor force participation rate for individuals aged 65 and over the next five years. The dashed line, representing a linear fitted trend, indicates that as an economy ages, the annual growth rate of labor force participation among older workers increases.

In the upper right panel, we display the relationship between the initial level of life expectancy at birth and the annual growth rate of the labor force participation rate for individuals aged 65 and over the next five years. Similarly, in the lower left panel, we present the relationship between the initial level of human capital and the annual growth rate of the labor force participation rate for this age group. Finally, the lower right panel shows the relationship between the initial level of trade openness and the annual growth rate of the labor force participation rate for individuals aged 65 and over over the next five years. In all panels, the dashed lines represent linear fitted trends, and all three graphs demonstrate positive relationships. These findings suggest that the silver dividend is stronger in economies with longer life expectancy, higher human capital, and greater trade openness.

More broadly, Lee and Shin (2023) identified factors that influence the channels through which population aging impacts economic growth. By grouping countries into high, middle, and low categories based on seven characteristics—(1) old dependency ratio, (2) human capital, (3) life expectancy, (4) labor market flexibility, (5) government size, (6) trade openness, and (7) capital market openness—they found that the importance of these channels varies depending on the levels of these characteristics. For instance, they observed that the negative impact of aging, along with its effect on labor shortages and the offsetting role of the labor force participation rate, is more pronounced in countries with a high old dependency ratio, higher levels of human capital, and longer life expectancy.

In this study, we extend this approach by investigating how the importance of each channel changes as the size of government differs across countries. We measure government size using two indicators: the share of government consumption in GDP and the ratio of taxes to GDP. Based on these measures, we classify countries into three groups: those with high values, low values, and middle values, representing one-third of the sample each.

<Table 4 here>

In Table 4, we report the same regression results for the three groups.[7] In the upper panel, government size is measured by the government consumption share of GDP, while in the lower panel, it is measured by the ratio of taxes to GDP. To save space, we present only the estimated coefficients from the instrumental-variable panel regression results for countries in each group. Interestingly, our findings indicate that the negative impact of population aging on economic growth is most severe in the low group, less pronounced in the middle group, and nearly negligible in the high group, where the effect approaches zero. This suggests that appropriately directed government spending has the potential to significantly mitigate the negative impacts of aging on economic growth.

Additionally, we find that the mitigating role of labor force participation in addressing labor shortages due to population aging is most pronounced in larger-government economies. These economies typically provide more generous social security benefits and pensions, including incentives such as deferred retirement credits or increased benefits for delayed retirement, which encourage older individuals to remain in the workforce (Lumsdaine and Wise, 1994). Larger governments also tend to offer more comprehensive healthcare systems, supporting the well-being of older workers and enabling them to stay employed (Tang et al., 2022). Moreover, older workers often find employment opportunities in the public sector, which larger governments are better equipped to provide (Abbey and Boyd, 2002). These economies are also more likely to regulate and protect good work environments, which are vital for older workers (Bohle et al., 2010; OECD, 2024). Lastly, government-sponsored job training and education programs facilitate older workers' transitions to new roles

(OECD, 2024). Overall, our results suggest that the adverse effects of population aging on economic growth are less pronounced in countries with larger governments.

In the low panel, where government size is measured by the ratio of taxes to GDP, reveals somewhat opposing effects of government size. In this case, the negative impact of aging on economic growth is most pronounced in high-tax economies. Although not statistically significant, the negative effect on TFP growth is also largest in these economies. The compensatory effect of higher labor force participation in response to aging is evident across all three groups but is most prominent in high-tax economies. In general, high taxes on capital income can reduce incentives for investment in productivity-enhancing technologies, which are crucial for mitigating the economic effects of aging (Vartia, 2008). These taxes may also contribute to capital flight, further weakening economic growth (Edwards, 2019). Overall, our findings suggest that high tax rates alone are insufficient to effectively address the negative impacts of aging on economic growth.

Policy Implications

The most significant and policy-relevant finding of our empirical analysis is that the adverse economic impact of population aging primarily stems from its negative effect on TFP growth, rather than from a reduction in the labor force. This challenges the conventional wisdom that population aging inevitably leads to labor shortages, which, in turn, constrain an economy's productive capacity. Consequently, policymakers in rapidly aging countries should prioritize strategies aimed at sustaining and enhancing TFP growth, rather than focusing solely on mitigating labor shortages.

A key consideration in formulating policy responses to population aging is that the demographic profile of a country significantly influences the appropriateness and effectiveness of growth-promoting strategies. Our empirical analysis, which examines a large cross-country sample of demographically diverse nations, indicates that the negative economic impact of population aging is more pronounced in countries that are already at an advanced stage of demographic transition. Consequently, the policy recommendations derived from our findings are particularly relevant for economies that are further along in the aging process. These include not only advanced economies such as the US, Japan, and most Western European countries but also an increasing number of developing nations. For example, while China's rapid economic growth since 1978 was largely driven by a youthful population and a rapidly expanding workforce, the country is now undergoing one of the fastest demographic transitions in the world. Similarly, other middle-income Asian countries, such as Thailand and Vietnam, are experiencing accelerating population aging. Furthermore, Latin America—another predominantly middle-income region—is aging even more rapidly than Asia, underscoring the growing relevance of aging-related economic challenges across different levels of development.

Just as countries vary in their demographic structures, they also differ in the relative size of their governments. In our empirical analysis, we assessed government size using two key indicators: government consumption as a share of GDP and the ratio of tax revenues to GDP. Interestingly, when we use government consumption as our measure of size, we find that the negative impact of population aging on economic growth is most pronounced in countries with the smallest governments and least severe in those with the largest governments. This suggests that relatively larger governments provide some degree of insulation against the adverse economic consequences of aging. However, it is unlikely that government size alone directly influences economic outcomes. Instead, the effectiveness of government spending depends on how resources are allocated. The key policy implication for aging economies, therefore, is not simply to expand the size of government but to prioritize programs that enhance the productivity and well-being of the elderly such as healthcare. Additionally, government-sponsored training and re-skilling programs support the employability of older workers, allowing them to adapt to evolving labor market demands.

Interestingly, and in stark contrast to our findings based on government consumption, our empirical analysis reveals a completely different pattern when tax revenues are used as the measure of government size. Specifically, among the three groups of countries, those with the highest tax-to-GDP ratios experience the most severe negative impact of population aging on economic growth. In other words, larger governments, as measured by tax revenues, appear to exacerbate the adverse economic effects of aging—an outcome that is the polar opposite of what we observe when government size is assessed through consumption. However, it is unlikely that the tax-to-GDP ratio itself directly influences these outcomes. Rather, the key driver of this empirical pattern is the way different types of taxes, particularly those distorting economic incentives. The policy implications, therefore, stem not from the overall tax burden but from the specific incentives created by tax structures.

A sustained improvement in living standards depends on a continuous increase in income per person, which, in turn, is driven by long-term growth in TFP. One crucial policy avenue of increasing TFP growth involves enhancing the human capital of older workers. Lifelong learning, continuous education, and re-skilling initiatives are essential for ensuring that aging workers remain employable and productive in a rapidly evolving labor market. In this context, digital skills are particularly critical, given the increasing importance of digital literacy across nearly all sectors. As workplaces become more technology-driven, equipping older workers with digital competencies can help bridge the skills gap and enhance their economic contribution. For example, assistive robots can support older workers in carrying out such tasks more effectively [Park et al. (2021, 2022)]. Additionally, artificial intelligence (AI) can enhance productivity across all age groups, including older workers, by facilitating decision-making.

Discouraging workplace discrimination against older workers (ageism) and fostering a culture that values their experience, knowledge, and wisdom contribute to a more inclusive work environment that benefits employees of all ages. For instance, when age is no longer a barrier between younger and older workers, the two groups are more likely to collaborate effectively, improving the productivity of both. A specific example of productive collaboration is mentorship programs, where older workers share their industry knowledge and expertise with younger employees, facilitating knowledge transfer and enhancing overall workforce performance.

While the focus of our chapter has been the impact of population aging on economic growth, an equally important priority for policymakers is the happiness and well-being of older individuals. According to the Asian Development Policy Report (2024), the well-being of older individuals is supported by four key pillars: (1) health, (2) work and retirement, (3) old-age economic security and pensions, and (4) family, care, and social engagement. Several policy measures aimed at strengthening these pillars have already been outlined. For instance, education and re-skilling initiatives for older workers, as previously discussed, are directly relevant to ensuring their continued economic participation and well-being. However, old-age well-being extends beyond productivity, encompassing broader aspects of quality of life.

Conclusion

In this study, we examined ways to strengthen the silver dividend, which mitigates the labor shortages caused by population aging. Our findings reveal that labor shortages due to aging are often offset by increased labor force participation. This is especially true in countries with higher life expectancy, human capital accumulation, and greater trade openness, all of which amplify the silver dividend. Furthermore, when categorizing countries by government size, we find that the negative effects of aging on economic growth are less pronounced in countries with larger governments, as measured by government consumption. However, when government size is measured by tax revenues to GDP, the adverse effects of aging on growth are most pronounced in high-tax economies—i.e. large-government economies. Based on our empirical findings, we set forth some policy implications that can help mitigate the economic challenges associated with population aging..

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[1] Acemoglu and Restrepo (2022) even argue that adoption of automation leads to higher productivity growth.
[2] We calculate the growth rate using these averages and divide by 5 to obtain the annualized growth rates.
[3] These results are reported in Table 4 in Park and Shin (2023).
[4] This equality does not hold exactly due to differences in the number of observations across columns.
[5] A similar figure for the old population share is reported in Figure 4 of Lee and Shin (2019).
[6] Acemoglu et al. (2022) find that occupations in the U.S. have become more accommodating to the preferences of older workers, with approximately three-quarters of occupations experiencing an increase in age-friendliness between 1990 and 2020. Park et al. (2021, 2022) also find that introduction of automation mitigates the adverse impact of population aging on economic growth.
[7] We report the results using the old-age dependency ratio as an indicator of population aging. The results for the old-age population share are qualitatively similar and are therefore not reported.

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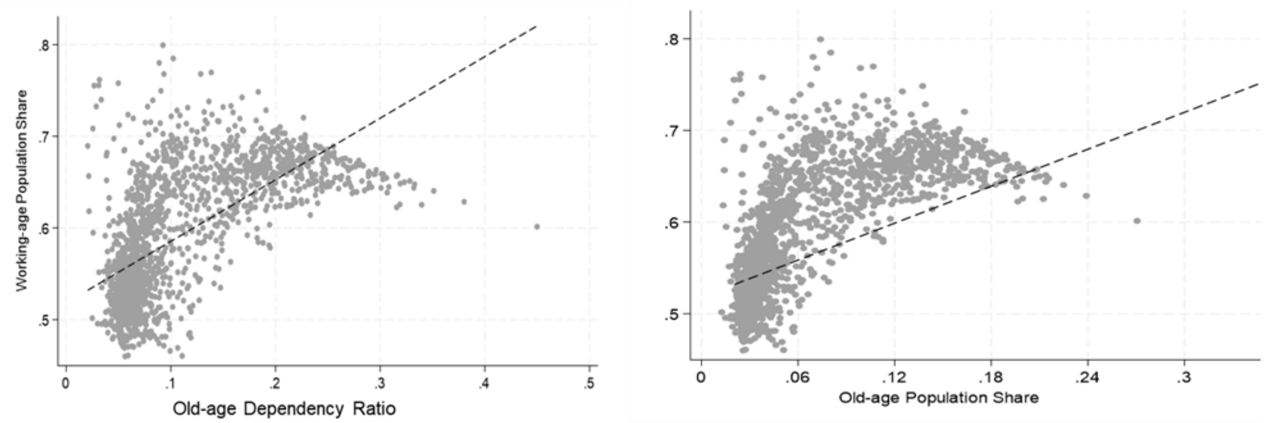
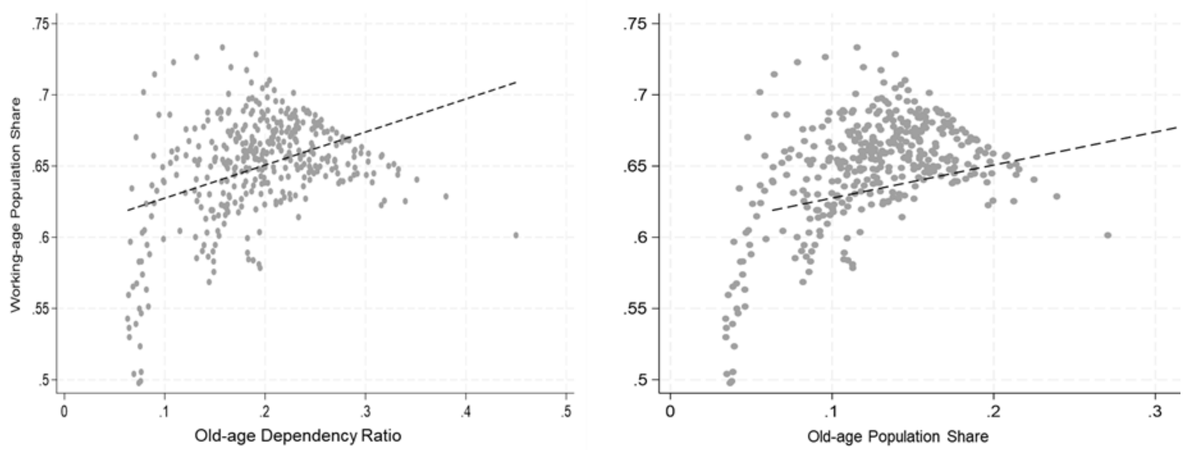
Figure 1. Population Aging and Working-Age Population Share



Notes: Using a sample of 166 countries spanning the period from 1960 to 2019, we calculate 5-year averages for each period: (Period 1: 1960–64), (Period 2: 1965–69), ..., and (Period 12: 2015–19). The relationship between the old dependency ratio and the working-age population share is plotted in the left panel, while the relationship between the old population share and the working-age population share is shown in the right panel. The dashed lines are linear fitted lines.
Sources: Authors' calculations.

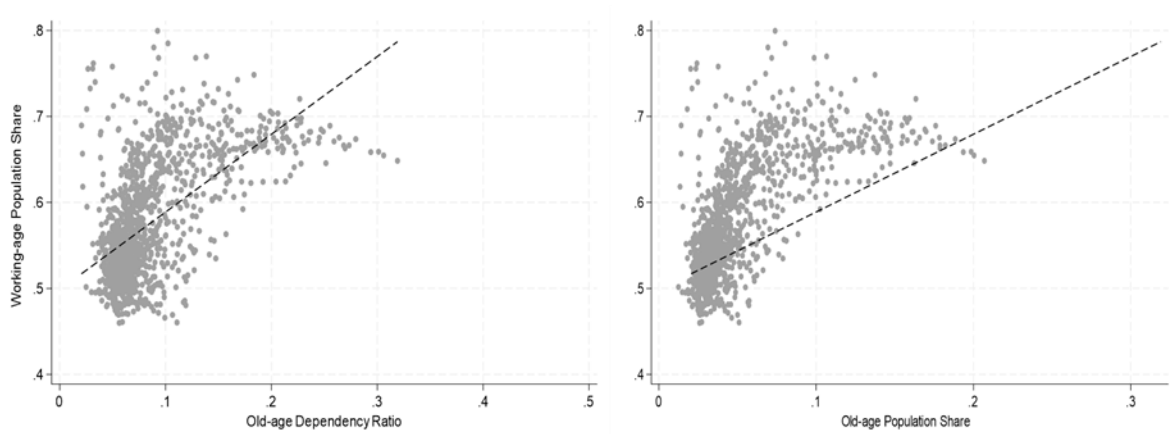
Figure 2. Aging and Working-Age Population Share: OECD vs. Non-OECD Countries

A. OECD Countries



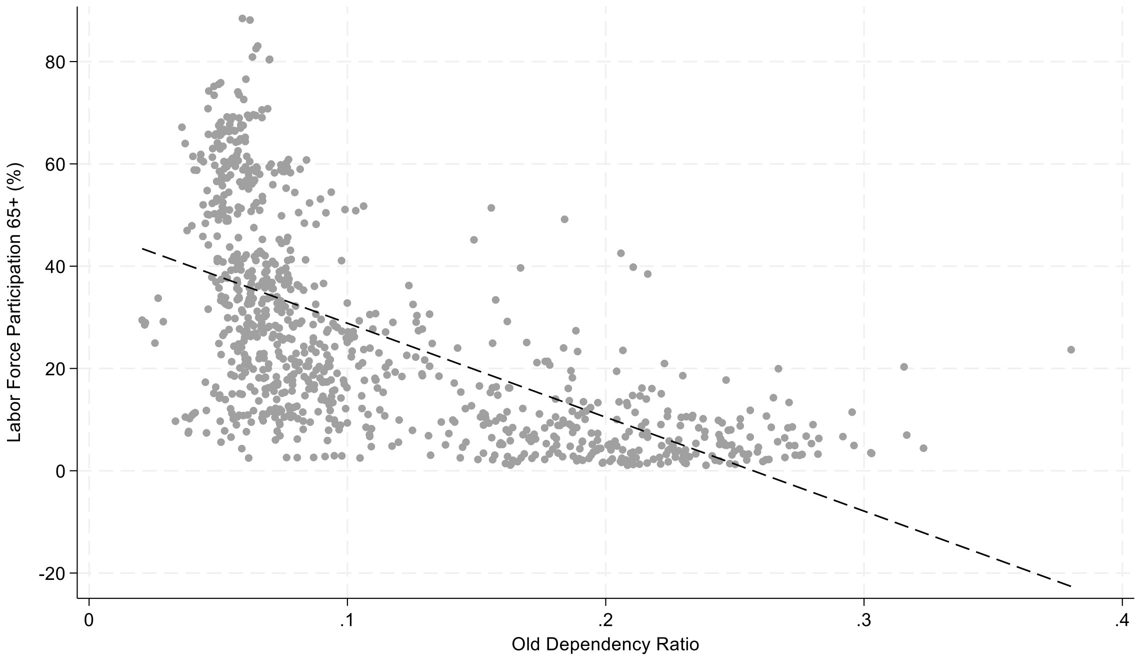
Notes: Using a sample of 36 OECD countries spanning the period from 1960 to 2019, we calculate 5-year averages for each period: (Period 1: 1960–64), (Period 2: 1965–69), ..., and (Period 12: 2015–19). The relationship between the old dependency ratio and the working-age population share is plotted in the left panel, while the relationship between the old population share and the working-age population share is shown in the right panel. The dashed lines are linear fitted lines.
Sources: Authors' calculations.

B. Non-OECD Countries



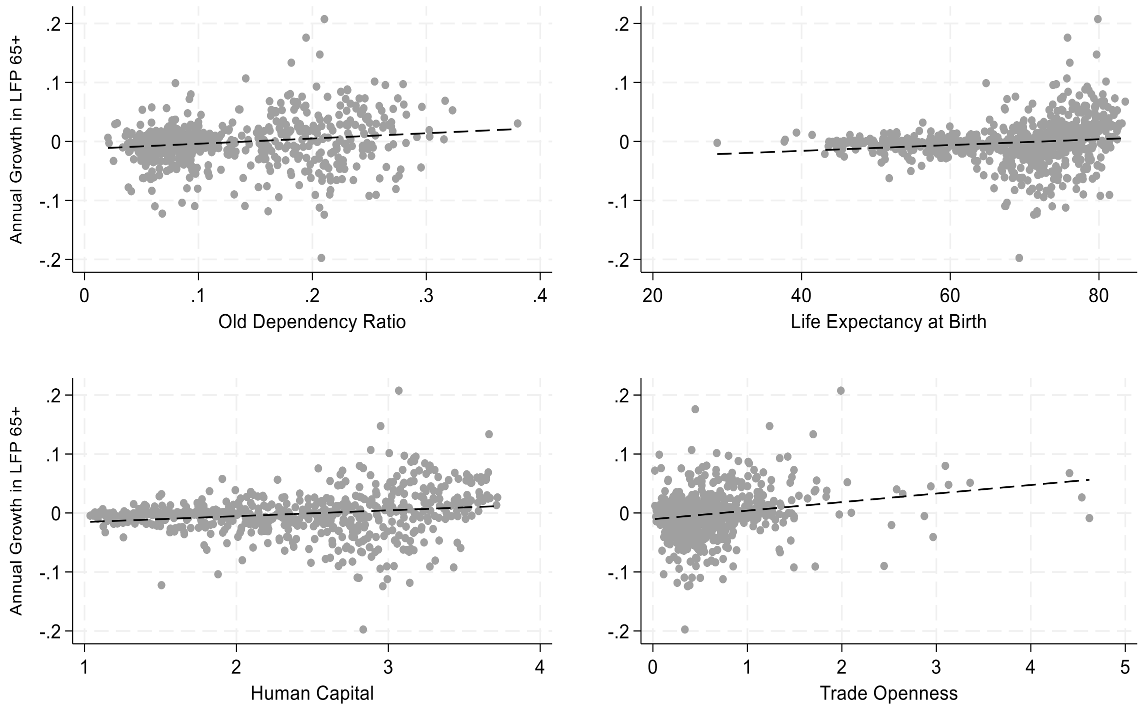
Notes: Using a sample of 130 non-OECD countries spanning the period from 1960 to 2019, we calculate 5-year averages for each period: (Period 1: 1960–64), (Period 2: 1965–69), ..., and (Period 12: 2015–19). The relationship between the old dependency ratio and the working-age population share is plotted in the left panel, while the relationship between the old population share and the working-age population share is shown in the right panel. The dashed lines are linear fitted lines.
Sources: Authors' calculations.

Figure 3. Aging and Labor Force Participation of Old Workers



Notes: Using a sample of 166 countries spanning the period from 1960 to 2019, we calculate 5-year averages for each period: (Period 1: 1960–64), (Period 2: 1965–69), ..., and (Period 12: 2015–19). The relationship between the old dependency ratio and the labor force participation rate for individuals aged 65 and over is plotted. The dashed line is a linear fitted line.
Sources: Authors' calculations.

Figure 4. Factors Affecting Old Workers' Labor Force Participation Rate



Notes: Using a sample of 166 countries spanning the period from 1960 to 2019, we calculate 5-year averages for each period: (Period 1: 1960–64), (Period 2: 1965–69), ..., and (Period 12: 2015–19). Based on these averages, we compute annualized 5-year growth rates of the labor force population for individuals aged 65 and over. The relationships between this growth rate and the old-age dependency ratio (upper left), life expectancy at birth (upper right), human capital (lower left), and trade openness (lower right) are plotted. Dashed lines represent linear fitted trends.
Sources: Authors' calculations.

Tables 1. The Effects of Aging on GDP Growth and Its Seven Channels

VARIABLES	(1) GDP per capita	(2) K/Y	(3) Human Capital	(4) Work Hour	(5) LF Participation	(6) 15-64 Population	(7) the share of 15 and above	(8) TFP
Lagged Old dependency ratio	-0.094*	-0.070	-0.035***	-0.008	0.053***	-0.054***	-0.006	-0.057
	[0.050]	[0.059]	[0.012]	[0.011]	[0.014]	[0.008]	[0.006]	[0.087]
Lagged Youth Dependency Ratio	-0.022	0.034	0.007	0.014**	-0.009***	0.015***	-0.002***	-0.117**
	[0.016]	[0.040]	[0.006]	[0.006]	[0.003]	[0.002]	[0.001]	[0.058]
Lagged GDP per Capita	-0.032***	0.034***	-0.000	-0.003**	0.001	-0.000	0.000	-0.062***
	[0.003]	[0.011]	[0.001]	[0.001]	[0.001]	[0.001]	[0.000]	[0.016]
Lagged Old population share	-0.227***	-0.048	-0.050**	0.009	0.077***	-0.074***	-0.009	-0.316*
	[0.079]	[0.114]	[0.023]	[0.019]	[0.022]	[0.012]	[0.009]	[0.167]
Lagged Youth Population Share	-0.071	0.089	0.016	0.034**	-0.019**	0.046***	-0.007***	-0.338**
	[0.044]	[0.113]	[0.016]	[0.016]	[0.009]	[0.006]	[0.002]	[0.160]
Lagged GDP per capita	-0.032***	0.034***	0.000	-0.003*	0.000	0.000	0.000	-0.064***
	[0.004]	[0.012]	[0.001]	[0.002]	[0.001]	[0.001]	[0.000]	[0.017]
Observations	1,418	1,060	1,173	521	758	1,418	1,418	961

Notes: The dependent variable is the annualized log-difference of five-year period averages for the variable listed in the first row. In the upper panel, we report the results using the lagged old and youth dependency ratios as demographic variables. In the lower panel, we report the results using the lagged old and youth population shares as demographic variables. In addition to the demographic variables, the initial level of GDP per capita, calculated from output-side real GDP per capita, is included as an additional regressor. Instrumental-variable panel regression results with country fixed effects are reported, using 15-year lagged values of the old and youth dependency ratios and the birth rate as instruments for the lagged old-age dependency ratio. Period dummies are included, but their coefficients are not reported. Robust standard errors are shown in brackets. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

Sources: Authors' calculations (reported in Table 4 of Park and Shin (2023)).

Table 2. The Effects of Aging on GDP Growth and Its Seven Channels: Non-OECD Countries

VARIABLES	(1) GDP per capita	(2) K/Y	(3) Human Capital	(4) Work Hour	(5) LF Participation	(6) 15-64 Population	(7) the share of 15 and above	(8) TFP
Lagged Old dependency ratio	0.041	-0.059	-0.011	-0.022	0.062***	-0.042***	-0.013**	-0.034
	[0.090]	[0.137]	[0.026]	[0.035]	[0.021]	[0.016]	[0.006]	[0.215]
Lagged Old population share	-0.044	0.030	-0.012	-0.038	0.090**	-0.041*	-0.025**	-0.409
	[0.151]	[0.283]	[0.047]	[0.047]	[0.035]	[0.024]	[0.011]	[0.445]
Observations	1,102	744	857	216	588	1,102	1,102	645

Notes: The dependent variable is the annualized log-difference of five-year period averages for the variable listed in the first row. In the upper panel, we report results using the lagged old and youth dependency ratios as demographic variables. In the lower panel, we report results using the lagged old and youth population shares as demographic variables. To save space, we present only the estimated coefficient of the old dependency ratio in the upper panel and that of the old population share in the lower panel for non-OECD countries, corresponding to the two sets of instrumental-variable panel regression results with country fixed effects reported in Table 1. Although the number of observations differs slightly between these two sets of estimations, we report only the number of observations for the latter, as the difference is negligible. Robust standard errors are shown in brackets. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

Sources: Authors' calculations.

Table 3. The Effects of Aging on GDP Growth and Its Seven Channels: Countries with Aging Variables Below the Sample Mean

VARIABLES	(1) GDP per capita	(2) K/Y	(3) Human Capital	(4) Work Hour	(5) LF Participation	(6) 15-64 Population	(7) the share of 15 and above	(8) TFP
Lagged Old dependency ratio	0.308	0.230	0.141**	0.048	-0.031	0.001	-0.029***	-0.229
	[0.193]	[0.495]	[0.056]	[0.105]	[0.034]	[0.035]	[0.006]	[0.718]
Lagged Old population share	0.771*	1.244	0.352***	0.282	-0.103	0.080	-0.060***	-1.437
	[0.412]	[1.285]	[0.104]	[0.330]	[0.071]	[0.067]	[0.012]	[1.821]
Observations	913	608	734	178	460	913	913	529

Notes: The dependent variable is the annualized log-difference of five-year period averages for the variable listed in the first row. In the upper panel, we report results using the lagged old and youth dependency ratios as demographic variables. In the lower panel, we report results using the lagged old and youth population shares as demographic variables. To save space, we present only the estimated coefficient of the old dependency ratio in the upper panel and that of the old population share in the lower panel for countries with aging variables below the sample mean, corresponding to the two sets of instrumental-variable panel regression results with country fixed effects as reported in Table 1. Although the number of observations differs slightly between these two sets of estimations, we report only the number of observations for the latter, as the difference is negligible. Robust standard errors are shown in brackets. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

Sources: Authors' calculations.

Table 4. The Size of the Government and the Seven Channels

Variables	Groups	(1) GDP per capita	(2) K/Y	(3) Human Capital	(4) Work Hour	(5) LF Participation	(6) 15-64 Population	(7) the share of 15 and above	(8) TFP
Government Consumption	Low	-0.220**	-0.106*	-0.052***	0.008	0.043**	-0.062***	-0.014**	0.005
		[0.092]	[0.065]	[0.018]	[0.018]	[0.019]	[0.016]	[0.006]	[0.127]
	Middle	-0.127*	-0.120	-0.021	-0.024*	0.015	-0.075***	0.004	0.013
		[0.068]	[0.111]	[0.017]	[0.012]	[0.018]	[0.017]	[0.008]	[0.148]
	High	0.005	-0.166	-0.047	-0.193**	0.115***	-0.038***	-0.021**	0.039
		[0.098]	[0.199]	[0.030]	[0.076]	[0.019]	[0.014]	[0.010]	[0.283]
Tax	Low	-0.089	-0.288*	-0.022	0.010	0.025***	-0.050***	0.007	0.183
		[0.078]	[0.151]	[0.016]	[0.019]	[0.008]	[0.010]	[0.009]	[0.205]
	Middle	0.040	0.020	-0.064***	-0.065	0.045*	-0.062***	-0.002	-0.056
		[0.132]	[0.178]	[0.025]	[0.063]	[0.027]	[0.019]	[0.006]	[0.238]
	High	-0.193***	0.036	-0.019	-0.014	0.088***	-0.042**	-0.026***	-0.208
		[0.073]	[0.084]	[0.022]	[0.020]	[0.031]	[0.017]	[0.008]	[0.144]

Notes: The dependent variable is the annualized log-difference of five-year period averages for the variable listed in the first row. Countries are classified into three groups: those with high, middle, and low values of government size, each representing one-third of the sample. In the upper panel, government size is measured by the government consumption share of GDP, while in the lower panel, it is measured by the ratio of taxes to GDP. To save space, we present only the estimated coefficients from the instrumental-variable panel regression results for countries in each group, as reported in Table 1. Robust standard errors are shown in brackets. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

Sources: Authors' calculations.