

DEMOGRAPHICS AND INNOVATION
IN THE ASIA-PACIFIC

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and Gi-Wook Shin

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**TECHNOLOGY, AGE STRUCTURE, AND THE
POLITICAL ECONOMY OF INNOVATION**

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1 Demographics and Innovation in the Asia-Pacific

An Introduction

Karen Eggleston and Joon-Shik Park

Few concepts are as critical for sustained improvement in living standards as innovation. New ideas and ways of doing things, technologies and inventions, and greater productivity in transforming inputs into outputs—these aspects of innovation define how societies and economies progress and develop. However, little is known about how innovation interacts with two of the largest forces shaping the twenty-first century: the demographic transition and the economic and geopolitical re-emergence of Asia.

This book delves into how demographic change shapes the supply of innovation and the demand for specific kinds of innovation in aging Asia. Social scientists from several Asia-Pacific countries offer multidisciplinary perspectives from economics, demography, political science, sociology, and public policy. Each of the eight chapters focuses on questions of political economy and policy surrounding demographic change and innovation. Topics range from the macroeconomic productivity effects of population age structure, to the microeconomic labor force effects of changing demographics and technology, to the broader implications for human well-being.

This introductory chapter first provides an overview of demographic change in the region and several leitmotifs in the research. We then provide a tour of the book, previewing the central argument of each chapter, before offering a few concluding thoughts about a future research agenda.

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Asia's Demography

Throughout this volume, the authors illustrate the multiple aspects of demographic change in the Asia-Pacific, from the historical process of declining fertility to urbanization and gender imbalance. Most prominent among the demographic trends, however, is the extent of population aging, and how aging interacts with innovation.

While we all know that populations around the globe are aging, the extent to which East Asia leads the world in the magnitude and scope of the demographic transition bears underscoring. Figure 1.1 illustrates population aging trends for the Asian economies covered in this volume and some comparators with the standard metric of proportion of older adults. Figure 1A shows the increase in share of population in the traditional retirement ages (65 and older) between 2017 and 2050, and figure 1B shows the increase of the “oldest of older people” (age 80 and older) over the same period. Note that the countries of East Asia—especially Asia's Organization for Economic Cooperation and Development (OECD) countries of Japan and South Korea—have some of the oldest age structures on the planet, with Korea's pace of change strikingly rapid. Between now and 2050, the population that is age 65 and older will increase to more than one in four Chinese, and to more than one in three Japanese and Koreans. China's median age already exceeds that of the United States, at a much larger absolute scale and at a lower per-capita income. India is much younger, although it is still aging. India's share of age 80+ will almost triple, albeit while remaining less than 3 percent, whereas in Japan and Korea, more than 15 percent of the total population will be age 80 or older according to projections for 2050.

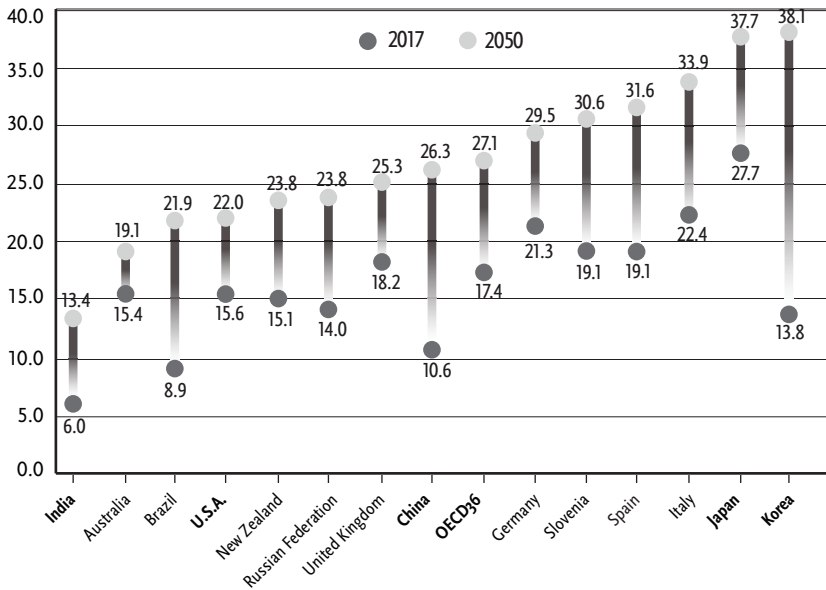
[Insert Fig. 1 about here.]

As figure 1.1 illustrates, this pace of aging in East Asia far surpasses that of the United States or the OECD average, while India and other parts of South and Southeast Asia are considerably younger. Thus, the demographic challenges facing Asia range from how the oldest age structures can continue innovation for improved well-being, to how some of the younger age structures can reap the demographic dividend from productively engaging large working-age cohorts for social progress.

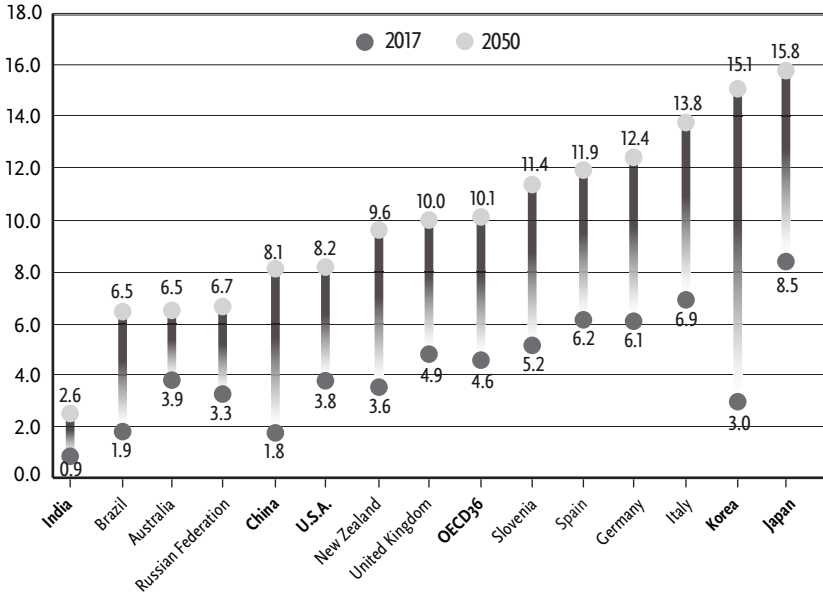
How will these large demographic changes shape the future of the world's most dynamic economies? The constituent chapters delve into the multiple close links between innovation and populations, as well as whether those links represent causal relationships, and which way the causal arrow points.

FIGURE 1.1 Asia's population aging in comparative perspective, 2017–50

A. Increase in percentage of population age 65 and older between 2017 and 2050



B. Increase in percentage of population age 80 and older between 2017 and 2050



SOURCE: Health at a Glance 2019; OECD Indicators. OECD Library. Data extracted from OECD Health Statistics 2019, OECD Historical Population Data and Projections Database, 2019. Data link: <https://doi.org/10.1787/888934018260>.

A Tour of the Rest of the Volume

The first half of the book focuses on how demography shapes productivity and the labor supply of older workers. Contributions shine a spotlight on topics ranging from the macroeconomic productivity effects of demographic change analyzed by Feyrer, to the microeconomic labor force effects of changing demographics and their interaction with new technologies, as analyzed by Ogawa et al. and Chulhee Lee. This introduction discusses the primary contours of each chapter in turn.

In chapter 2, “Demographics and Productivity in Asia,” James Feyrer of Dartmouth examines the macroeconomic relationship between workforce demographics and aggregate productivity in Asia. First, he describes the patterns of demographic change across the region, including the timing of fertility decline to below-replacement levels and changes in the working-age population. Then, in careful empirical analyses that build upon and extend his earlier work, Feyrer shows that changes in aggregate productivity among over 100 countries between 1960 and 2010 are significantly correlated with the age structure of the countries’ workforces. In addition to multiple variants of these cross-country regressions, Feyrer discusses possible mechanisms for how demographics might impact productivity, including the implications of demography for management quality and innovation. Applying the regression results to the demographic structure of specific Asian countries, Feyrer confirms that the high-income Asian nations like Japan and Korea, and even some middle-income countries of the region, will no longer enjoy a “demographic dividend” boosting aggregate productivity. By contrast, lower-income Asian nations like India are entering the more positive period of demography, helping to spur productivity. Feyrer concludes with a discussion of countervailing forces and the need for caution in using history to predict the future relationship between demographic structure and aggregate productivity.

In the third chapter, Karen Eggleston examines the case of China in “Demographics and Innovation in China: Correlation or Causation?” She starts by reviewing the literature regarding demography and innovation, and some evidence of the causal arrow running from innovation to demographics in China’s case (e.g., public health interventions have spurred China’s demographic transition since the Mao era). The remainder of the chapter probes the correlation of demographic change in the post-Mao era with innovation in China’s economy, and whether the causal arrow may also run from demographics (in terms of scale and age structure) to innovation. Focusing on the most recent decade, she provides statistics on research and

development investment and patents in China in comparative international perspective, and discusses several key industries in more depth, including healthcare technologies and the impacts of the COVID-19 pandemic on China's economy and innovation.

Whether future predictions about productivity and age structure hold true depends to a significant degree on whether future cohorts of older adults will be healthier than earlier generations, with ill health “compressed” into older ages and capacity to function independently preserved well into conventional retirement years. This is the question addressed in the fourth chapter, by Naohiro Ogawa, Hidehiko Ichimura, Taiyo Fukai, and Rikiya Matsukura, providing new empirical evidence on the changing cognitive performance and untapped work capacity among older persons in Japan. The first part of their chapter provides a broad overview of rapid changes in the demographic and economic landscape in postwar Japan, including fertility and mortality patterns, economic growth and the “two demographic dividends,” the age structure of the workforce, and the recent modifications to traditional employment practices. The authors stress that, in light of fiscal pressures, Japan needs effective policies to boost national productivity. They evaluate the cognitive performance and work capacity of Japan's aging labor force by using detailed individual-level data from the Japanese Study on Aging and Retirement (JSTAR). Ogawa, Ichimura, Fukai, and Matsukura find that the cognitive performance of Japanese aged 60 to 75 is similar to that of their counterparts in many European countries. Moreover, higher educational levels, better childhood nutrition, and other improvements in health suggest that the future older adults in Japan may be even more mentally fit than the current generations. Thus, they suggest that putting these older workers into productive employment could boost Japan's gross domestic product by 3.2 to 6.0 percent. Their analyses suggest that, despite the declining overall and working-age population, Japan's labor force could harness older workers to bolster the workforce in productive ways going forward.

But will the jobs to harness this work capacity exist? And will the older citizens be willing to take those jobs? These were open-ended questions even before COVID-19. They are all the more pressing, given the economic devastation in the wake of a pandemic that may reignite the debate about older workers “stealing” younger workers' jobs, and give reluctant employers an excuse to dismiss or avoid older workers in the name of protecting their health. Thus, a pressing question is whether older workers will be able to adjust to the changing job requirements and technologies, and whether the productivity of older adults will be sufficient for employers to hire them in those positions. Some historical perspective from the United States and

Korea in the next chapter provides a less sanguine perspective.

Chulhee Lee, a prominent Korean economist, contributes the fifth chapter, “Sectoral Shift, Technological Change, and Older Labor: Evidence from the United States and Korea.” As he writes, the labor force participation of middle-aged and older citizens and its interaction with technological change remains critical for understanding how aging impacts innovation. His chapter provides evidence for how economic and technological changes affected older workers during the industrialization periods of 1880 to 1940 in the United States and 1960 to 2015 in South Korea (hereafter Korea). His research contributes to the limited literature empirically examining how technological changes affect young and older workers differently. These contributions cover technological changes that impact both the appropriateness or quality of matching individuals’ skills to specific jobs, as well as sectoral shifts in employment between industries with different flexibility in work schedules. Examining the early twentieth century United States and how industry-specific technological, organizational, and managerial characteristics affected older male manufacturing workers, he analyzes rich data from Union Army veterans as well as the Integrated Public Use Microdata Series. Comparative empirical analysis focuses on South Korea’s economic development era when it moved from a largely agrarian to an industrial economy, when urbanization and agricultural decline were offset by the increased labor force participation of older men in rural areas. In addition, analyzing a 2 percent random sample of Korea’s population and housing censuses between 1980 and 2000, Chulhee Lee finds that pressure to leave the labor market at middle or older ages differed across sectors, with employment for older adults somewhat stable in agriculture and other sectors like insurance and real estate, compared to manufacturing. The most important factor explaining the labor force participation rate of older males in Korea has been the relative decline in the agricultural workforce, with additional impetus from industrial structure shifting away from the sectors most conducive to older workers.

Finally, Professor Lee discusses the important lens of technological change and its disproportionate impact on older workers, who face obsolescence of skills, less efficiency in learning, and limits on mobility across locations and jobs. Using Workplace Panel Survey data from 2005 to 2015, he confirms the negative effect that automation and information technology investments have on the employment of older workers in Korea. Thus, Lee’s research reinforces and expands upon the cross-country productivity impacts of age structure highlighted by Feyrer. Based on his analysis of individual- and firm-level data from both the United States and Korea, Lee concludes that

“the remarkably parallel findings obtained from the two countries at different times strongly suggest that radical changes in technology may bring unfavorable labor market consequences for older people, at least compared with the young” and present an additional challenge for aging societies in search of innovation.

If technological change to date has clearly had a negative impact on older workers, perhaps future technological change could be friendlier to older populations. After all, we know that societies will need to promote longer work lives to support the sustainable financing of social protection while protecting living standards (Eggleston and Fuchs 2012). Thus, endogenous innovation for older-age structures seems critical. In the subsequent sections of the book, we explore whether technology itself is being developed, or will be developed, to assist older workers, focusing on endogenous innovations for an aging population. Such innovations mitigate the labor-replacing effects of new technologies and may enable productive harnessing of the growing populations of older but still cognitively engaged and physically functional workers.

What is the political economy of technological development itself in aging economies, from subsidizing robots for long-term care in Japan (Eggleston [Ⓘ] Lee [Ⓘ] Iizuka 2021) to developing innovations that “upskill” older workers (as discussed in Kushida’s chapter)? These are some of the topics covered in the latter half of the volume, with themes of aging, technology, and the political economy of innovation. The focus of these chapters turns toward the aging population as consumers of technologies and drivers of innovations to meet their own needs, as well as the political economy of spatial development, agglomeration economies, urban-rural contrasts, and differential geographies of aging.

In chapter 6, Kenji Kushida addresses how Japan’s aging demographics have affected pathways of technological development. After a brief overview of Japan’s demographic challenges, Kushida examines a series of specific sectors within which technological innovations address labor shortages and the needs of older workers. The cases range from construction, agriculture, and transportation, to digitalization of administrative records in healthcare, land transactions, and housing. Kushida emphasizes that the demographics of Japan’s aging society have galvanized a wide range of corporate efforts, supported both directly and indirectly by the government, to aggressively develop artificial intelligence and related technologies. The examples and case studies provide a vivid picture of how Japan’s economy adapts and leverages population aging in search of a new competitive advantage, counterbalancing the narrative of “lost decades” in one of the world’s largest economies and

the society with the oldest age structure.

To offer a window on the diversity of Asia's demography and how it shapes innovation in various sectors, we next turn to India and its vital agricultural sector. While agriculture may seem far removed from what high-growth entrepreneurship connotes (e.g., visions of Silicon Valley "unicorns"), it is important to remember that farming remains the foundation of hundreds of millions of livelihoods across Asia. Moreover, agricultural productivity shapes global disparities and catch-up growth. Indeed, the difference between rich and poor countries in real labor productivity is more than thirty-five-fold in agriculture, compared to less than fivefold in nonagricultural sectors (Restuccia, Yang, and Zhu 2008).

While India's demography is far younger than that of Japan, many aspects of innovation for India's sustainable development are also closely linked to its demography. In chapter 7, "Innovation, Demographics, and Technology for Agriculture Productivity in India," Aparajita Goyal and Karen Eggleston describe the demographic challenges facing India, home to the world's largest rural population. The authors assess the need for innovation to raise agricultural productivity in India to reduce poverty and reap the "demographic dividend" that earlier spurred the economic development of its now aging East Asian neighbors.

The book concludes with two chapters on Korea and the political economy of aging and innovation. Technologies for aging societies are not confined to enabling a productive workforce or formally measured economic output. Instead, technologies can also be critical for broader social issues of meaningful lives and continuing social engagement. Healthy aging includes social connectedness—especially highlighted during the COVID-19 pandemic and the need for physical distancing with social connection. But "digital divide" means that those who might benefit the most from connecting through technologies—older persons who are isolated—are least able to engage, even in a very tech-savvy society like Korea, with the filial piety of young people helping the older generation.

Technologies' importance for meeting the demographic challenges of Asian societies extends beyond the work-a-day issues of employment. In the twenty-first century, those in and outside the labor force rely increasingly on technologies of communication to connect with society on multiple levels. The 2020 pandemic has underscored the importance of communication while physically distancing, especially for older persons, who are the most vulnerable to infectious disease, but unfortunately also the most likely cutoff from social integration if unable to access information and communication technologies (ICT). It is this aspect of the social value of ICT technologies

that is explored in chapter 8, “Population Aging, ICT Innovation, and Media Literacy in South Korea,” by Sun-Ho Jeong and Kyung-Hee Kim. South Korea is an “aged society” (defined as having at least 14 percent of its population aged 65 and older), and it is expected to become a “super-aged society,” with more than 20 percent of its population over 65 years old in less than a decade. With one in five of its people becoming 65 or older, this population’s ability to use media is becoming more important, because it prevents isolation and further contributes to successful aging and quality of life. In this regard, South Korea offers an ideal environment for active aging, with 96 percent of adults connected to the internet. At the individual level, however, a divide due to socioeconomic factors may exist in their access and use of digital media, which calls for discussions at the societal level. In this chapter, the authors analyze topics reflected in the news coverage about the aging population and ICTs between 2000 and 2019, and look at national survey data examining levels of ICT access among older adults in South Korea. Findings indicate that there have been continuous efforts to extend ICT access to older adults by technology companies and local welfare centers. Although there persists a divide in access and use due to socioeconomic factors, reduced differences in the level of education by generation and gender give us the hope of closing the gap in the not-too-distant future.

The volume concludes with Young-Bum Kim, Joon-Shik Park, and Dong-Il Jung’s chapter, “Population Cliffs, Crisis of Local Society, and the Politics of Innovation in South Korea.” South Korea is a particularly important case for studying the local geography of aging, given its rapid aging and extreme concentration of population in Seoul, which has prompted measures such as moving government agencies to a newly developed separate city, Sejong City, over the past decade. The purpose of the chapter is to examine changes in the population and age structure in South Korean regions and to explore its implications for regional development. First, the study describes the change of demographic structure by age in South Korea over the last 20 years according to administrative area, and investigates how those changes to the population structure are related to human-made amenities in each area. Second, the study explains how quality and quantity of human-made amenities can contribute to fostering regional innovations and suggests strategies for closing the gap between the capital and noncapital areas, thereby achieving regionally balanced socioeconomic development in Korea.

The results of the empirical analysis on the relationship between changes in population and age structure and human-made amenities can be summarized as follows. First, an increase in the senior population is correlated with expansion of cultural and medical facilities. An increase in the ratio of

seniors increases the demand for the services they desire and brings about the expansion of the facilities that meet such needs. Second, a reduction in the number of children reduced the number of elementary schools. Third, the number of cultural facilities and medical facilities such as clinics were found to increase when the population increased, and to decrease when the population decreased. The authors suggest that counties in South Korea where the population has already declined considerably may face a situation where the population may not receive the necessary services. Some counties are even missing specific medical facilities, such as maternity clinics.

However, the potential impact of low fertility and aging on innovation is not totally negative. First, if the quantity of human resources was important in the industrial age, their quality is important in the digital era. The reduction in the school-aged population will provide an opportunity to increase the quality of education. Second, population pressure caused by a reduced labor force and increased support costs can promote a range of technological innovations. The various social problems brought about by aging provides the opportunity to boost innovative activities. For instance, Japan's Society 5.0 is a roadmap for transnational growth, which aims to solve social problems, such as labor shortages due to population aging, by applying the technology of the fourth industrial revolution, such as artificial intelligence, robots, and internet of things, across the society. Much progress can be made in technological, cultural, and social sectors related to the health, culture, leisure, and the livelihood of seniors. Such innovation can also contribute to reducing the social burden resulting from a reduced labor force, as well as enhancing social vitality, by expanding the opportunities for seniors to participate in the labor market and the society.

Thus, the question is how to detect and utilize such opportunities. While various factors may be involved in building innovative capabilities in Korea's local regions, a unipolar system, in which a super-big city absorbs all human, financial, and technological resources, may not be an effective way of augmenting nationwide innovation outcomes. From a national standpoint, for instance, two cities, each with a population of five million, may be more conducive for innovation than one city with a population of 10 million. The authors conclude that "multipolarization" of areas, each supporting regional innovation, should be a goal, so that through the dispersion of the population, various forms of innovation using social, economic, spatial, and cultural resources can thrive in all regions. Such innovation initiatives could in turn lead to balanced development and effective responses to population aging.



Future Research Agenda

The terrain covered in this volume, while expansive and focused on key bumps ahead, also points out the vast horizon of unanswered questions. Each author provides windows onto different vistas of inquiry that could themselves constitute books of further conceptual and empirical research. These contributions lay out a research agenda for further policy-relevant research on demography and innovation. What will be the macroeconomic and productivity effects of changing population age structures, and to what extent can and do economy-specific policies shape that narrative? What are the underlying mechanisms linking demography to innovation? Throughout this chapter, we have raised questions that future research will need to address.

At a microeconomic and behavioral science level, the relationship between demography and innovation depends on the responses of individuals, families, communities, and polities, shaped by policy responses designed to change the incentives and framework for innovative activity. While we have reviewed in this chapter many researchers' advice about policies to stimulate appropriate innovation and entrepreneurship, one must filter these recommendations through a skeptical lens. Much careful empirical evidence does point toward responsible approaches. However, we do not have a plethora of well-established policy results for the determinants of economic growth and improved well-being independent of the details of history, institutions, culture, and their interaction with events such as global pandemics and recovery therefrom. Arguably, any narrow focus on economic growth overlooks the broader social goals of raising human well-being beyond material living standards, although raising the latter for the world's poorest should surely remain a central goal.

Will we be able to innovate to not only raise average well-being, but to close disparities while uplifting all? The answer for the Asia-Pacific will depend primarily on the young people of the region. What innovations will spring from the minds of Asia's youth over the coming decades because they are endowed with longer, healthier lives than their grandparents and parents enjoyed? One thing is certain: the interplay between innovation and demographic change will shape the future of Asia, and with it, the globe. Readers in many disciplines will find these expert social scientists' contributions fruitful food for thought for their research and a rich source of case studies for teaching at both the undergraduate and graduate levels.

References

- Eggleston, Karen N., and Victor R. Fuchs. 2012. "The New Demographic Transition: Most Gains in Life Expectancy Now Realized Late in Life." *Journal of Economic Perspectives* 26, no. 3: 137–56.
- Eggleston, Karen  Yong Suk Lee  Toshiaki Iizuka. 2021. "Robots and Labor in the Service Sector: Evidence from Nursing Homes," Stanford Asia Health Policy Program working paper, <https://aparc.fsi.stanford.edu/asiahealthpolicy/publication/robots-and-labor-service-sector-evidence-nursing-homes>; and NBER Working Paper 28322, <https://www.nber.org/papers/w28322>.
- OECD Library. *Health at a Glance 2019: OECD Indicators*. <https://doi.org/10.1787/888934018260>.
- Restuccia, Diego, Dennis Tao Yang, and Xiaodong Zhu. 2008. "Agriculture and Aggregate Productivity: A Quantitative Cross-Country Analysis." *Journal of Monetary Economics* 55, no. 2: 234–50.
- The World Bank. "DataBank. GDP per Capita (current US\$)." Accessed June 6, 2020.