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Edited by Sang-Chul Park, Naohiro Ogawa, Chul Ju Kim, Pitchaya Sirivunnabood, and Thai-Ha Le

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Abbreviations

2SLS	two-stage least squares
3Ms	Medisave, MediShield, and MediFund
3SLS	three-stage least squares
ADF	augmented Dickey–Fuller
AES	adult equivalence scale
ASEAN	Association of Southeast Asian Nations
ATM	automated teller machine
B2B	business-to-business
B2C	business-to-consumer
BAU	business-as-usual
BMWi	Federal Ministry for Economic Affairs and Energy
BRS	Basic Retirement Sum
CDR	crude death rate
CECODES	Centre for Community Support Development Studies
CGE	computable general equilibrium
CHAS	Community Health Assist Scheme
COVID-19	novel coronavirus disease
CPF	Central Provident Fund
CRM	cash recycling machine
ERS	Enhanced Retirement Sum
EU	European Union
FDI	foreign direct investment
FE	fixed effects
FIES	Family Income and Expenditure Survey
FY	fiscal year
G2P	government-to-person
GDP	gross domestic product
GHG	greenhouse gas
GLS	generalized least-square
GNI	gross national income
GSO	General Statistics Office
HDB	Housing Development Board
HDI	Human Development Index
ICT	information and communication technology
IMF	International Monetary Fund
IoT	Internet of Things
IT	information technology
KPSS	Kwiatkowski–Phillips–Schmidt–Shin

Lao PDR	Lao People's Democratic Republic
LFP	labor force participation
LFP	Labor Force Survey
LM	Lagrangian multiplier
LTC	long-term care
MFS	mobile financial service
MINT	mathematics, engineering, natural sciences, and technical
MPC	marginal propensity to consume
NPISS	National Institute of Population and Social Security Research
NSFIE	National Survey of Family Income and Expenditure
NTA	National Transfer Accounts
NTUC	National Trades Union Congress
OA	Ordinary Account
ODAR	old-age dependency ratio
OECD	Organisation for Economic and Co-operation Development
OLS	ordinary least squares
P-OLS	pooled ordinary least squares
P2P	person-to-person
PAiCE	Platforms for Additive Manufacturing/Imaging/ Communication/Engineering
PAPI	Provincial Governance and Public Administration Performance Index
POS	point of sale
PP	Phillips–Perron
PRC	People's Republic of China
R&D	research and development
RE	random effects
RMSE	root mean square error
SAARC	South Asian Association for Regional Cooperation
SCB	Statistics Sweden
SEP	self-employed person
SES	Socio-Economic Survey
SIRS	SEP Income Relief Scheme
SOE	state-owned enterprise
SOPT	Survey of Older Persons in Thailand
SPIAS	SciREX Policy Intelligence Assistance System
STI	science, technology, and innovation
SURE	seemingly unrelated regression
TFP	total factor productivity
TFR	total fertility rate

UK	United Kingdom
UN	United Nations
UN DESA	United Nations Department of Economics and Social Affairs
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
US	United States
WBS	Workfare Bonus Scheme
WHO	World Health Organization
WIS	Workfare Income Supplement

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Introduction

Sang-Chul Park, Naohiro Ogawa, Chul Ju Kim,
Pitchaya Sirivunnabood, and Thai-Ha Le

Many countries in Asia and Europe, especially the more developed economies, have already entered either the stage of the aged or the aging society. At the same time, a number of developing countries in Asia, which are in the midst of the demographic transition, are experiencing rapid shifts in the age structure of their populations owing to declining fertility and improving mortality. At present, in approximately half of the countries in Asia, the economic support ratio, which is defined as the ratio of effective workers to effective consumers,[1] is increasing, which provides them with an opportunity to seize the so-called "first demographic dividend", which contributes to faster economic growth (Lee and Mason 2011; Ogawa et al. 2021).

Although demographic transition in Asia and Europe has occurred in different time periods, both continents went through more or less comparable processes and patterns of change. Japan is currently the most aged country in the world, surpassing all industrialized European countries. In Japan, a host of adverse effects of population aging have affected various segments of its socioeconomic system. A number of other Asian economies, such as Singapore; Taipei,China; the Republic of Korea; the People's Republic of China (PRC); and Thailand, are following in Japan's footsteps.

Demography is one of the principal driving forces facilitating economic growth and social development in all nations. In view of the important nexus of demographics and economic growth, in this book we focus on both sides of the story—the one seen in aged and aging societies, and the other found in young societies in Asia and Europe.

In Europe, Sweden became an aged society in the 1980s and 1990s and managed to effectively overcome aging-related socioeconomic problems and difficulties by raising its fertility to a marked extent. It is well known that some other European countries, such as Germany, Italy, and Spain, are experiencing rapid population aging at present. There is no doubt

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[1] Effective workers are calculated as a weighted sum of the population, using the labor income age profile. Effective consumers are calculated in a similar fashion, using the consumption age profile.

that the two continents can share their accumulated wisdom to better prepare for the onslaught of the aging society, maintain their national competitiveness, and promote sustainable economic growth while properly administering their social security systems. In order to provide useful lessons and policy recommendations for the rest of the world, this book sheds light on important processes and factors commonly observed in the aging society: risks, costs, economic impacts, and strategies that have been implemented in Asia and Europe. Furthermore, this book highlights a variety of socioeconomic transformations induced by the process of demographic transition in Asia and Europe.

In the recent past, a host of important economic challenges have been appearing in the changing demographic landscape of East Asia and Southeast Asia. In Chapter 1, while paying attention to these demographic-economic developments in Asia, Upalat Korwatanasakul, Pitchaya Sirivunnabood, and Adam Majoe highlight the impact of demographic shifts on problems such as declining tax revenues leading to fiscal imbalances and possible increases in government spending intended for coping with rising health care expenses and pension payments. The authors provide insights into balancing the fiscal revenue against growing pension payouts and healthcare expenditure. To achieve these research objectives, by utilizing panel data gleaned from 178 countries (including 43 Asian economies) across 18 years from 2000 to 2017, the authors estimate three models to shed light on the relationships between (i) the demographic transition and government balance; (ii) the demographic transition and government health expenditure; and (iii) the demographic transition and government debt. The computed results show that although demographic shifts do not generate a direct effect on the government fiscal balance, the demographic transformation has an indirect effect on the government fiscal balance through the increased government expenditure brought about by higher costs of treating a growing number of elderly individuals who are at greater health risks. These empirical findings point to important policy implications with regard to (i) the fiscal sustainability, which necessitates comprehensive reviews of public health spending; (ii) health care reforms that prioritize accessibility for all and efficiency in healthcare services; and (iii) cost-sharing measures to mitigate the age-related fiscal burden. In addition, these findings are expected to provide a useful base for formulating effective policies and programs for protecting vulnerable elderly persons from infectious diseases such as the coronavirus disease (COVID-19).

In Chapter 2, Kidjie Saguin discusses housing and low fertility issues in East Asian and Southeast Asian economies in general, and Singapore in particular. The author explains that a key feature of the demographic transition in prosperous East Asian and developing Southeast Asian economies is fertility decline. Although various pro-natalist policy measures, including baby bonuses and universal childcare, have been undertaken by some governments in the region, their outcomes have often been disappointing. Conducting cointegration analysis of housing, income, and fertility, he concludes that the belief in "no flat, no child" is prevalent among young Singaporeans, which, in the long run, has a negative effect on generating the country's economic dynamism.

In Chapter 3, Maria Rebecca Valenzuela, Mikio Suga, and Yasuo Nakatani study consumption profiles and demographic and social factors in Japan, Thailand, and the Philippines. By using household expenditure data sets for these three countries, they examine the mechanism of household behavioral changes in the process of population aging in Asia. Their virtual household analysis shows higher gains in economies of scale from marriage or cohabitation in the three studied countries, to a higher degree in Thailand and the Philippines

Chapter 4, written by Michael C. Huang and Masahiro Kuroda, investigates Japan's value chain by looking at research and development and innovation in the process of changing demographics and their implications for the supply chain system patterns driven by massive production and consumption. The authors also examine the effectual demand for information and communication technology. Furthermore, Huang and Kuroda analyze how the transition of workstyles based on telecommunications stimulates a radical movement toward the Internet of Things and artificial intelligence, contributing to the creation of an environment that fosters a super-smart society. Their finding is that an active structural reform for promoting innovation is desirable in the circumstances of drastic demographic changes and in the post-COVID-19 era.

In Chapter 5, Kazi Arif Uz Zaman and Tapan Sarker investigate, by taking Bangladesh as their study case, the link between the demographic dividend, digital innovation, and economic growth. As a result of a rapid age structural transformation induced by substantial fertility declines and mortality improvements since the early 1970s, Bangladesh has been enjoying a window of opportunity for generating the first demographic dividend over the past few decades and is projected to be in a position to seize it during the next 3 to 4 decades. With this notable demographic change in mind, the authors set up a three-stage least squares model to analyze how and to what extent digitalization and the above-mentioned demographic transformations contribute to faster economic growth in the rapidly developing Bangladesh economy. The calculated results show that, with an increase of 1 percentage point in internet users, the country's gross domestic product would rise by 0.11%, while a 10-basis point decrease in the total dependency ratio would boost the country's

GDP by 7.2%. The principal driving factors for digitalization are the labor force participation rate, workers' productivity, and mobile phone penetration. In contrast, the study shows that the urbanization rate adversely affects the growth of the number of internet users. Moreover, the estimated results reveal that the Human Development Index score and the urbanization rate negatively affect the total dependency ratio to a significant extent, while female labor force participation has a positive impact on it. These findings provide insights for the government policy makers and planners to design a roadmap for Bangladesh on how to utilize its demographic transformation to achieve faster economic growth while promoting digitalization and technological innovation.

In Chapter 6, which is based upon research similar to Chapter 5, Shristi Tandukar, Tapan Sarker, and Sima Rani Dey examine the links between the first demographic dividend, the digital economy, and sustainable development in the context of Nepal. Over the past few decades, Nepal has gone through a remarkable demographic transition, which has produced a window of opportunity for facilitating sustainable development. For this reason, the study attempts to shed light on how to capture the optimum advantage of the first demographic dividend in relation to the emerging techno-economic paradigm to promote economic sustainability. By focusing their analytical attention on understanding the convoluted influence of the first demographic dividend on the digital economy, the authors employ multiple regressions that incorporate various economic variables and in which the demographic dividend is represented as the dependent variable, and the indicators of the digital economy, such as internet access, as explanatory variables. In addition, environment-related variables, such as greenhouse gas emissions and urbanization, are also introduced into the regressions as explanatory variables. The estimated results offer rich information for drawing up a roadmap for attaining sustainable development goals for Nepal.

Over the past few decades, fertility in East Asian economies has been at the lowest level in the world. Taipei,China is a salient example. Because of its prolonged low fertility, together with steadily improving longevity, rapid age compositional shifts have been under way in Taipei,China, generating the first demographic dividend, which has had a favorable impact on the per capita income growth. In Chapter 7, Chin-Peng Chu and Kuo-Chun Yeh discuss Taipei,China's population aging and its impacts on economic growth. Although the authors are of the opinion that the adverse impact of fast population aging on the island's socioeconomic system has not been very serious yet, they are concerned about the gloomy future prospect. The authors propose several policy options to cope with the negative effects of population aging on the economy. For instance, the burden of the rising old-age dependency ratio can be alleviated by an adequate influx of foreign labor immigration. It is also conceivable that long-term economic growth could be achieved through the augmentation of educational attainment. Moreover, the authors point out that because individuals in all age groups require some form of wealth to support their old-age consumption, a substantial proportion of them accumulate capital during their working years, which serves as a source of support in retirement and as funds for investment that improve national productivity. In conclusion, the authors encourage the government to allocate resources to help labor-intensive and low-skilled industries become more innovation oriented and knowledge intensive.

In Chapter 8, Sang-Chul Park describes how Sweden's demographic transition proceeded since 1790 and examines to what extent a number of the country's demographic factors will change by the end of the 21st century. The author also discusses the country's long-term levels and trends of vital rates, and age compositional shifts. Besides the historical evolution of these key demographic indicators, the chapter pays attention to the long-run pattern of economic growth in Sweden. Utilizing Sweden's rich long-term database on demographic and economic variables, the author examines the nexus between demographic transformations and economic growth performance, particularly in terms of the changing pattern of the first demographic dividend. The author concludes that, in view of the fact that the demand for social welfare services for elderly persons will constantly grow in the years to come, the Swedish welfare system needs to be modified for maintaining the sustainable efficiency of the welfare system in due course.

Chapter 9 discusses the relationship between the labor supply of older workers and the role of co-residence, and health and pension in Thailand. The authors, Sasiwimon Warunsiri Paweenawat and Lusi Liao, explain that Thailand's aging society faces many challenges, particularly the issue of older people who still have to work for a living due to insufficient savings. The authors' main findings are that pensions and poorer health status reduce the labor force participation of older Thais. Furthermore, while the health status of older persons is significant across all analyses, pensions have less impact on the lower-status workers, indicating that even if they receive a pension, they may still be too poor to retire. Finally, co-residence decreases the labor force participation only among older people in rural, but not in urban areas.

In Chapter 10, Damien Huang and Christopher Gee write about re-allocating the Workfare Income Supplement (WIS) to improve retirement adequacy outcomes of low wage workers in Singapore. The authors point out that the population above 65 years old in Singapore will grow by 20.9 percentage points between 2019 and 2050, a close second behind the Republic of Korea. There is, thus, a need to, in the next phase of growth, examine social support in the absence of the rapid rise in wages seen in the earlier stages of Singapore's economic development. They conclude that the key pillar of social support is the WIS introduced in 2008 to supplement take-home disposable income and retirement savings in the context of Singapore's defined contribution pension scheme, the Central Provident Fund. The WIS will help counter the tide of increasing expenditure on social programs as Singapore ages in the next few decades by supplementing personal savings through work.

In Chapter 11, Huong Vo deals with urban migration in Viet Nam from micro- and macroeconomic perspectives. The author emphasizes that demographic shifts from rural to urban areas in Viet Nam are one of the major research areas. To address this important research topic, the author develops an empirical framework for measuring the relative impact of location characteristics versus individual characteristics in determining the destination choices of migrants. She concludes that most location-specific factors, such as employment-related factors and infrastructure, are found to be significant for all types of migrants in the urban areas. However, the intensity of significance varies, depending on migrants' gender, purpose of migration, and social capital.

In Chapter 12, Dieter Eissel elucidates the economic impact of the demographic transition in the case of Germany. The author points out that Germany, like many other developed countries, is experiencing an aging society, with one of the lowest birth rates in the world. The data he presents have, aside from the challenges regarding the future pension system, caused an intensive public debate on how to counter the enormous shrinking of the country's labor force, especially of highly qualified workers, in the increasingly digitalized world of today. His finding is that there are three strategies to meet these challenges. First, by postponing the age of retirement—older people should work longer. Second, women are perceived as an additional resource for the labor market. Third, Germany should attract more immigrants from abroad and also utilize the potential of refugees by integrating them into the labor market. Nevertheless, there are social, political, and financial obstacles to implementing the desired measures in the optimal way.

In conclusion, this book highlights various aspects and related factors in relation to demographic transition in different economies in both regions. Among others, the issues of the first demographic dividend, fiscal sustainability, social security and pension schemes, the role of digitalization, the labor market, and social behavioral changes, are included in different contexts subject to the studied economies across the chapters. Given the fast-growing rate of population aging in selected Asian economies and European developed countries, we hope that this publication will offer practical academic analysis, useful policy implications, and insights to relevant authorities and policy makers in Asian developing countries. It is crucial, for developing economies in particular, to build on comprehensive policy frameworks that address these demographic challenges in order to prepare a society for resilient economy and sustainable development.

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1

Demographic Transition and Its Impacts on Fiscal Sustainability in East Asia and Southeast Asia

Upalat Korwatanasakul, Pitchaya Sirivunnabood, and Adam Majoe

1.1 Introduction

East Asian and Southeast Asian economies are advancing toward or have become aging societies, although some countries are in the early stages, while others are more advanced. This revolution in longevity is being demonstrated through longer life expectancies due to medical innovation, improvements in medical care, and people living healthier lifestyles. Meanwhile, a continuously decreasing trend in fertility rates due to changes in economic and social values is being witnessed across the two regions. These two factors combined create the demographic transition of population aging, and its multifaceted impacts have spread widely across East Asia and Southeast Asia, although the degree of population aging varies by economy. This chapter will examine the impacts of population aging on the fiscal balance and assess how to achieve fiscal sustainability in economies at differing demographic stages.

Theoretically, changes in the population age structure, i.e., demographic transition, cause a shift in the balance between the number of people who produce and the ones who consume. The early phase of demographic transition is characterized by a larger proportion of workers, which increases aggregate consumption, cumulative investment, and total labor inputs—thus, output increases. This stage provides the first demographic dividend. Countries in this demographic phase are Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic (Lao PDR), Myanmar, and the Philippines. As the transition progresses, economies experience a significant drop in labor supply due to lower total fertility rates and a decrease in the mortality rate, which reduces potential gross domestic product (GDP) as well as domestic savings. Although lower productivity is not necessarily implied from a rising aging population, changes in patterns of economic behavior are observed toward lower consumption and less investment, which in turn hamper overall economic growth. This stage requires supplements to technological advancement and investment in human capital to achieve the second demographic dividend. The second dividend is possible if demographic transition leads to an increase in the productivity of workers. Economies in this transition phase can be referred to as economies with population aging—among them are the People's Republic of China (PRC), Malaysia, Singapore, Thailand, and Viet Nam. The last demographic group comprises economies with aged or super-aged populations or societies with a high ratio of old-age dependency, such economies are Japan and the Republic of Korea.

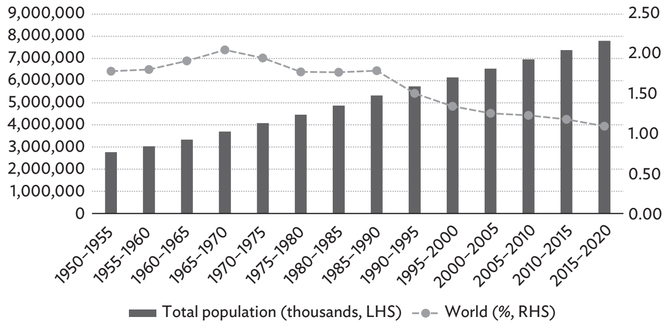
As an economy transitions to becoming an aged or aging society, fiscal imbalance may occur due to declines in tax revenues and potential increases in government expenditures, especially those related to care expenses for the aged and pension schemes. A shrinking working population and lower productivity negatively affect government tax revenues, while a growing aged or aging population creates a fiscal burden through an increase in public health expenditure and, probably, protection and pension schemes. The challenge then emerges of how to balance fiscal revenue against the increasing burdens from social security, pension systems and rising health care expenditures.

This chapter is developed equivalently to a policy paper. Thus, the focus is on the empirical trends of the demographic change in various economies and its relationship to fiscal balance. Section 1.2 presents the demographic outlook in East Asia and Southeast Asia, while Section 1.3 shows the status of fiscal balance in the two regions. Section 1.4 assesses the relationship between population aging and fiscal balance through economic and demographic models. Section 1.5 derives the policy implications from the statistical findings from Section 1.4. Finally, Section 1.6 concludes the chapter.

1.2 Demographic Outlook in East Asia and Southeast Asia

Over the past 70 years, the world population has grown constantly, but at a decreasing rate (Figure 1.1). In 2019, the total world population reached 7.7 billion; however, projections by the United Nations (UN) predict a slower growth, with estimates of 8.5 billion in 2030, 9.7 billion in 2050, and 10.9 billion in 2100, respectively (UN DESA 2019). During the 1970s and 1980s, Asia and Latin America and the Caribbean were

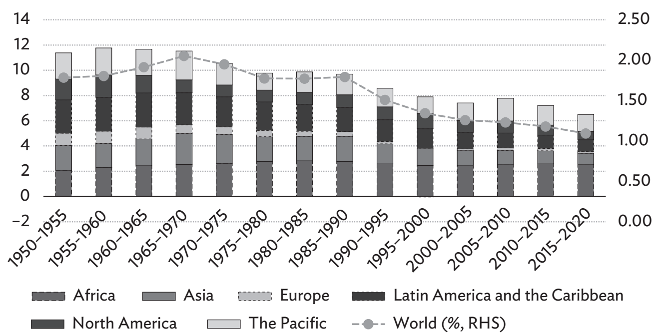
Figure 1.1: World Population



LHS = left-hand scale, RHS = right-hand scale.

Source: UN DESA (2019).

Figure 1.2: World Population Growth by Region
(%)



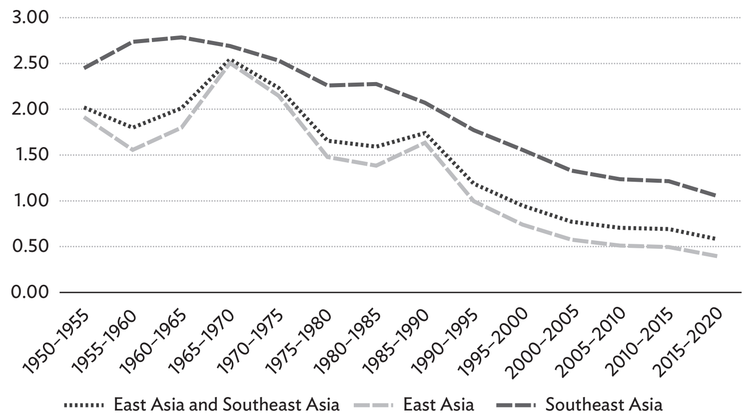
RHS = right-hand scale.

Source: UN DESA (2019).

the two regions that contributed the most to the global population. After 1990, the trend shifted to Africa, while the population growth in Asia has shrunk significantly since 2000 (Figure 1.2).

The East Asian and Southeast Asian regions combine three groups of populations, based on their demographic stage. Overall, the population growth in East Asia and Southeast Asia has continued to decrease since 1970, particularly as East Asian economies have experienced stronger

Figure 1.3: Population Growth in East Asia and Southeast Asia
(%)



Source: UN DESA (2019).

impacts of population aging (Figure 1.3). More than half of the countries in these two regions had less than a 1% population growth between 2015 and 2020. These circumstances signal that the regions are entering the phase of becoming aging or aged societies.

As referred to by the World Health Organization (WHO) and the United Nations (UN), an "aging society" is one in which more than 7% of the population is 65 years or older; an "aged society" is a society in which more than 14% of the population is 65 or over; and a "super-aged society" is a society in which more than 21% is 65 or older. These criteria are used for analytical purposes throughout this study. Table 1.1 shows the demographic status of countries in East Asia and Southeast Asia in comparison with the global population in 2020 according to the criteria. Six countries are still classified as young societies, and five countries are considered as aging societies. The Republic of Korea has entered the aged society category, while Japan has progressed to becoming a super-aged society.

Although the working population has been gradually increasing for several decades in East Asia and Southeast Asia, the proportion of the aged population (those aged 65+) has also grown progressively during this time (Figure 1.4). If we consider the population size by age group, the ratio of the working population to the total population in Southeast Asia

Table 1.1: Demographic Status in East Asia and Southeast Asia, 2020 (estimated)

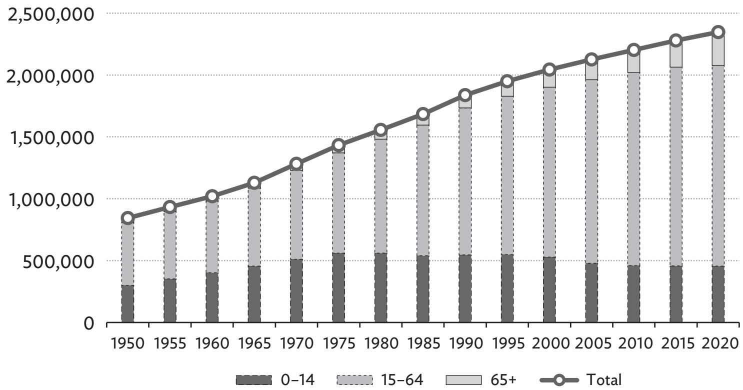
	Total Population	Population Aged 0–14	Population Aged 15–64	Population Aged 65+	Share of Population Aged 65+	Status
World	7,794,799	1,983,649	5,083,544	727,606	9.3%	Aging society
People's Republic of China	1,439,324	254,930	1,012,131	172,262	12.0%	Aging society
Japan	126,476	15,744	74,816	35,916	28.4%	Super-aged society
Republic of Korea	51,269	6,431	36,743	8,096	15.8%	Aged society
Brunei Darussalam	437	98	315	24	5.6%	Young society
Cambodia	16,719	5,170	10,737	811	4.9%	Young society
Indonesia	273,524	70,941	185,453	17,129	6.3%	Young society
Lao People's Democratic Republic	7,276	2,324	4,641	310	4.3%	Young society
Malaysia	32,366	7,589	22,452	2,325	7.2%	Aging society
Myanmar	54,410	13,867	37,150	3,393	6.2%	Young society
Philippines	109,581	32,921	70,620	6,040	5.5%	Young society
Singapore	5,850	720	4,350	781	13.4%	Aging society
Thailand	69,800	11,554	49,202	9,044	13.0%	Aging society
Viet Nam	97,339	22,577	67,105	7,657	7.9%	Aging society

Sources: UN DESA (2019) and authors' calculations.

is relatively larger than the ratio for East Asia. However, the increase in the population aged 65 and over from 1990 to 2020 in both regions was almost the same: approximately 160% (Figure 1.5).

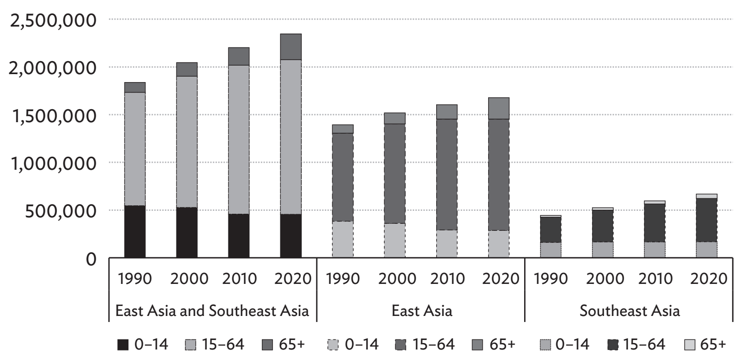
The continuous increase in the population aged 65 and over has caused a rising old-age dependency ratio in East Asia and Southeast Asia overall. The ratio, however, varies across different countries in the two regions. Two out of three East Asian countries have higher rates than

Figure 1.4: Total Population in East Asia and Southeast Asia
(thousands)



Source: UN DESA (2019).

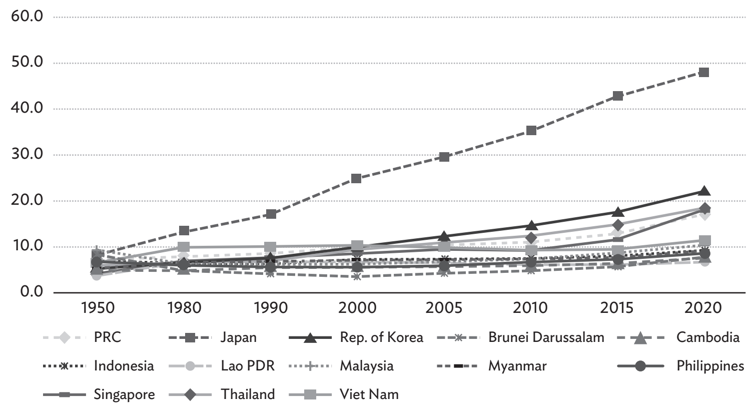
Figure 1.5: Total Population by Age Group
(thousands)



Source: UN DESA (2019).

countries in Southeast Asia, and this can be seen particularly over the past 10 years. Thailand's old-age dependency ratio is the highest among Association of Southeast Asian Nations (ASEAN) member states and even higher than the PRC's ratio.

Figure 1.6: Old-Age Dependency Ratio
(%)



Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Sources: UN DESA (2019).

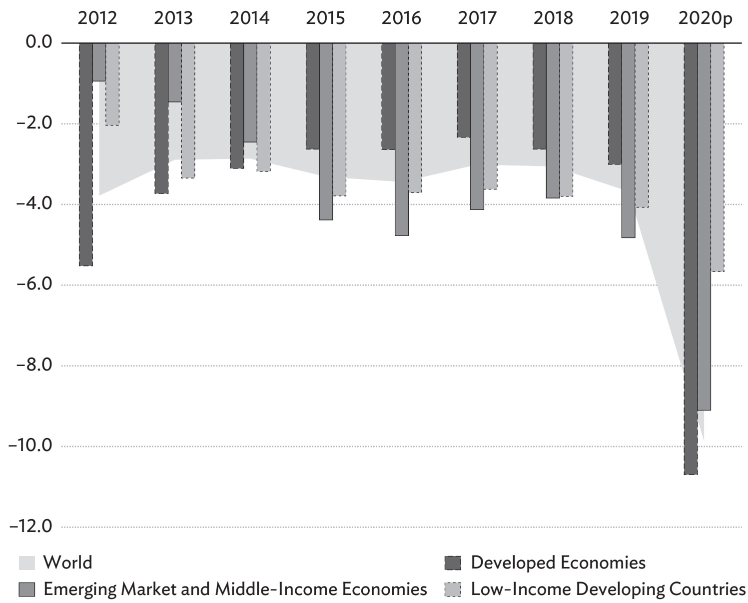
Consequently, these population trends reveal one important fact about the economies in East Asia and Southeast Asia, which is that the number of their elderly is continuously increasing, parallel with a potential shrinking of their working populations.

1.3 Fiscal Balance in East Asia and Southeast Asia

The global outlook of the general government fiscal balance has always demonstrated a fiscal deficit (Figure 1.7). Since 2015, the deficit of emerging and middle-income economies has been larger than that of other economies and has remained higher than the global average. For 2020, taking into account the impacts of the coronavirus disease (COVID-19)[1] on health and economic sectors, the International Monetary Fund (IMF) projects overshooting of the fiscal deficit in all three country groups due to increased spending on health and additional financial support for people, firms, and sectors. The overall deficit is expected to increase more in developed economies due to the tremendous amount of

1 For fiscal policies to protect the elderly from the COVID-19 pandemic, see Box 1.1.

Figure 1.7: General Government Fiscal Balance by Country Group, 2012–2020
(% of GDP)



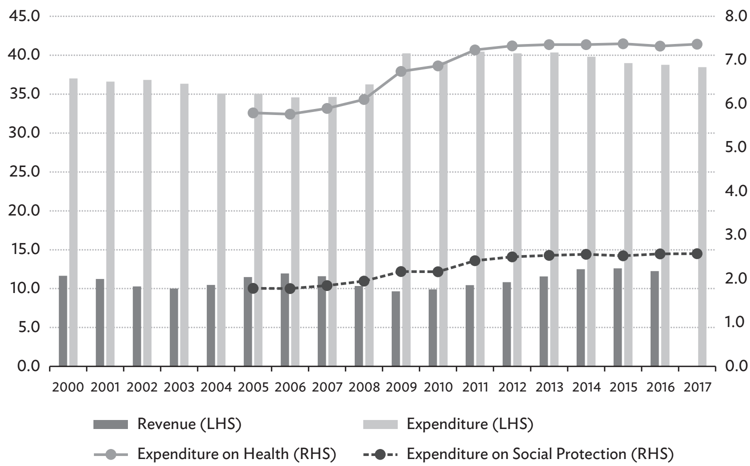
GDP = gross domestic product.

Source: IMF (2020a).

fiscal stimulus and a more pronounced projected economic contraction (IMF 2020a).

The fiscal balance varies among the economies of East Asia and Southeast Asia. Three economies are selected in this section to present the difference in the fiscal balance for each group of economies subject to its demographic stage—aged, aging, and young societies. First, Japan represents an aged society. Japan's fiscal position (Figure 1.8) has shown a continuous fiscal deficit since 2000. Japan has run a government deficit over a decade. The government deficit has usually been financed by the issuance of government bonds and external debt. The Japanese government's expenditure in terms of the percentage of GDP has exceeded government revenue. A big proportion of government spending is allocated to both health and social security expenditures.

Figure 1.8: Japan's Fiscal Position
(% of GDP)



GDP = gross domestic product, LHS = left-hand scale, RHS = right-hand scale.

Note: No data are available for expenditure on health and social protection before 2005 and revenue for 2017.

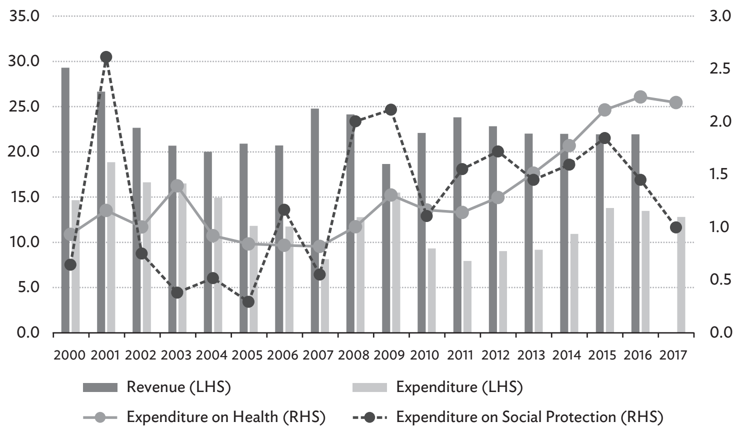
Source: ADB (2020).

This is the government's effort to keep its promises to provide health and long-term care and pension benefits to the country's rapidly aging population. The data show that government health expenditure is relatively high and gradually rising.

Representing an aging society, Singapore's revenue as a percentage of GDP has exceeded its expenditure as a percentage of GDP. Government health expenditure has constantly increased since 2011, while expenditure on social protection has fluctuated in the past decade (Figure 1.9).

The Philippines presents a young society. The levels of government revenue and government expenditure are almost comparable. Although government health expenditure is relatively low, an increasing trend has been evident since 2008. Expenditure on social protection, however, was comparatively high during the 2000–2013 period. Although expenditure on social protection dropped drastically in 2014, it bounced back in 2015 and has continued to increase (Figure 1.10).

Figure 1.9: Singapore's Fiscal Position
(% of GDP)

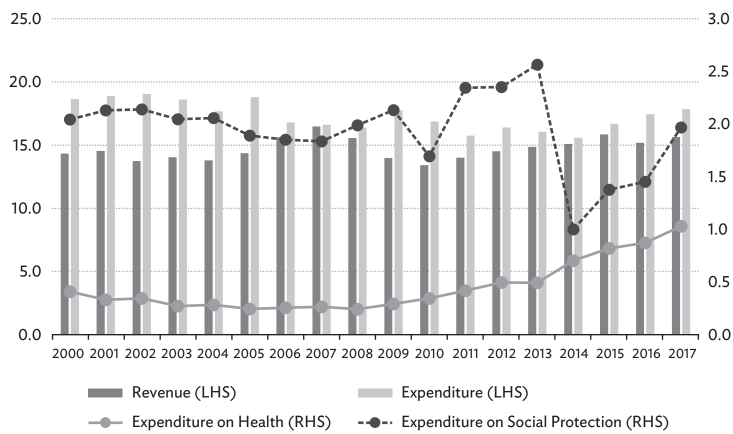


GDP = gross domestic product, LHS = left-hand scale, RHS = right-hand scale.

Note: No data are available for revenue for 2017.

Source: ADB (2020).

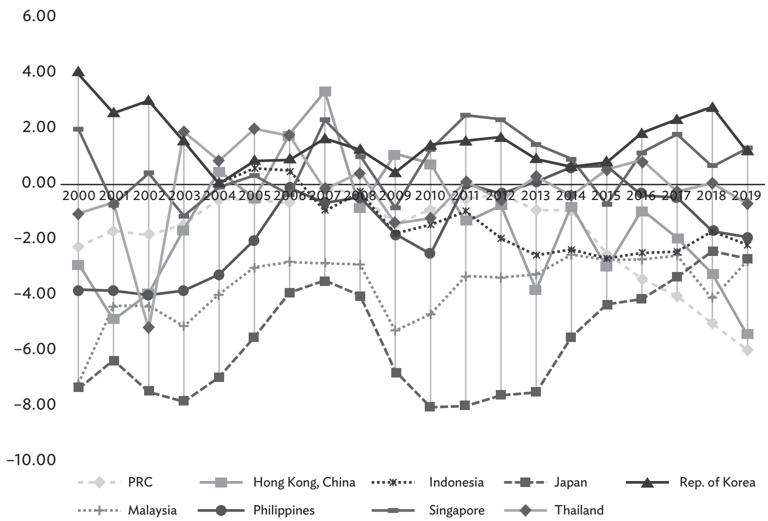
Figure 1.10: The Philippines' Fiscal Position
(% of GDP)



GDP = gross domestic product, LHS = left-hand scale, RHS = right-hand scale.

Source: ADB (2020).

Figure 1.11: Fiscal Balance
(% of potential GDP)



GDP = gross domestic product, PRC = People's Republic of China.

Source: IMF (2020a).

It is common that the fiscal balance is negative for most economies. Figure 1.11 shows the fiscal balance as a percentage of GDP for selected economies in East Asia and Southeast Asia. As expected, Japan shows the largest fiscal deficit. The PRC and Malaysia have also observed a fiscal deficit since 2000. In general, for these economies, the trends in the fiscal balance have fluctuated over time.

Box 1.1: Fiscal Policies to Protect the Elderly from the COVID-19 Pandemic

Amid the COVID-19 pandemic, older people tend to be left out from policy responses or financial safety nets introduced to cope with the effects of COVID-19. In developing countries, the impacts are greater due to their having less-mature health care systems, resulting in the overburdening of health and medical institutions. Due to this burden, two possible outcomes are expected. First is inadequate health care services and discrimination against the elderly population in providing health care. Second, inefficiencies in the health care system caused by this overburdening can threaten the fiscal balance as governments are likely to spend more than necessary on public health and support to medical institutions. Moreover, risks associated with older people who require aged care and caretakers of the elderly have risen in all environments, i.e., in nursing homes, among family members, and in refugee camps. These outcomes imply a burden on the fiscal balance, particularly on health expenditure. It seems that the greater the elderly population in a society, the higher are the costs of the pandemic that need to be absorbed by the government.

Consequently, it is inevitable to take efforts to protect older populations while maintaining fiscal sustainability in the face of the pandemic. First, it is crucial to integrate a focus on older people into policy responses or policy design, both in socioeconomic and humanitarian contexts. Table A1 in the Appendix shows the age-related policy measures available in East Asia and Southeast Asia. The coverage of social protection systems should include older people while ensuring income security for them. Along with continuing investment in universal health care coverage, a universal health care scheme should provide adequate benefits and equal access for older people. When a health crisis hits a society, a government should endorse the immediate provision of relief measures and social safety nets to guarantee basic needs (for example, food and clean water), and basic health care for all groups of people. Together, governments should make efforts in strengthening the legal frameworks that ensure the protection of human rights, including those of the elderly. Second, during social distancing and travel restrictions, disruption to essential care and medical support for the elderly tends to occur. Although access to health care can be facilitated through technological advances, the digital divide can hinder such access for the elderly. Governments should implement measures or action plans to help boost social cohesion and solidarity by facilitating access to health care for the elderly as well as enhancing knowledge of digital technology. Third, in designing response measures or policy framework, socioeconomic factors should be included for social inclusiveness. The policy-corresponding model, data analysis, and the database for policy-making decisions should include variables such as those for various age groups, gender, income level, etc. In addition, transparent and comprehensive standards should be adopted for a COVID-19 surveillance and monitoring system. Such a system would improve reporting on the

continued on next page

Box 1.1 *continued*

COVID-19 situation by capturing the risks among older people categorized by their gender, age, and underlining health conditions. In sum, to ensure safety nets in an aging society, protection, prevention, and inclusive measures must be put in place. It is also essential to disseminate knowledge of health services, sanitation and humanitarian support to the elderly, their families, and caretakers. Furthermore, promoting care and support across the life cycle through investment in universal health care and social protection schemes is critical, particularly for the aged.

The biggest lesson learned from the COVID-19 pandemic is that it is necessary and mandatory to prepare enough fiscal space for these kinds of unprecedented events in order to guarantee social and economic stability. The pandemic causes challenges in forecasting the tax revenue, with the possibility to underestimate a decline in revenue due to highly asymmetric shocks across sectors and by the size of businesses (IMF 2020b). On the other hand, the inclusive framework for health expenditure to protect and prevent the elderly from the negative effects of the pandemic requires an adequate amount of public health funding.

Source: Authors.

1.4 Population Aging and Fiscal Burden

In order to better comprehend the association between population aging and fiscal burden in East Asia and Southeast Asia, we next conduct a panel data analysis to empirically investigate the relationship and allow us to draw potential policy measures and insights.

1.4.1 Data and Methodology

The country-level panel dataset used in this study combines data related to demographic transition, fiscal balance, and other macroeconomic indicators from two sources: the World Bank's World Development Indicators and the International Monetary Fund's Fiscal Monitor (IMF 2020a). Data from 178 countries[2] (including 43 Asian countries) around the globe from 1991 to 2019 (29 years) are used in the analysis. Non-Asian economies are also included in the regression analysis since analysis with more observations provides a better estimation. Table 1.2 provides the summary statistics for each variable.

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2 The number of estimated countries depends on the estimation model. Refer to Table 1.3 for more details.

Table 1.2: Summary Statistics

Variable	Description	Observations	Mean	Standard Deviation	Minimum Value	Maximum Value
Fiscal balance variables						
Government balance	Net lending (+) / net borrowing (-) (% of GDP)	2,915	–1.38	10.26	–203.72	236.56
Government balance	Cyclically adjusted balance (% of GDP)	1,535	–2.35	3.92	–57.21	46.22
Government revenue	Revenue (% of GDP)	3,349	29.06	13.38	0.64	163.94
Government debt	Gross debt (% of GDP)	3,043	53.82	37.30	0	495.20
Demographic transition variables						
Government health expenditure	Current health expenditure (% of GDP)	3,350	6.30	2.79	1.03	25.48
Old age dependency	Age dependency ratio, old (% of working-age population)	5,809	11.47	7.35	0.80	47.12
Population aged over 64	Population aged 65 and above (% of total population)	5,812	7.33	5.11	0.69	28.00
Control variables						
GDP growth	GDP growth (annual %)	5,808	3.51	6.20	–64.05	149.97
Inflation rate	Inflation, GDP deflator (annual %)	5,803	33.97	461.67	–31.57	26,765.86
Population growth	Population growth (annual %)	6,427	1.46	1.53	–9.08	17.51
Trade	Trade (% of GDP)	5,288	87.54	55.91	0.02	860.80
Unemployment rate	Unemployment, total (% of total labor force) (modeled ILO estimate)	5,394	8.08	6.21	0.09	37.98

GDP = gross domestic product, ILO = International Labour Organization.

Source: Authors.

The analysis uses four variables related to fiscal balance. These are (i) government balance, calculated as the net government lending or borrowing as a share of GDP; (ii) government balance, cyclically adjusted as a share of GDP; (iii) government revenue as a share of GDP; and (iv) government debt, calculated as gross debt as a share of GDP.

For demographic transition, the analysis uses three main variables: (i) government health expenditure, calculated as the current expenditure on health as a share of GDP, including health care goods and services consumed but excluding capital health expenditures; (ii) old-age dependency, defined as the share of older dependents (older than 64) in the working-age population (those aged between 15 and 64), and (iii) the share of the population aged over 64 years old in the total population (all residents).

As control variables, the estimation uses variables for (i) the annual GDP percentage growth; (ii) the annual percentage rate of inflation; the annual population percentage growth rate (for all residents); (iii) trade, calculated as the sum of exports and imports as a share of GDP; and (iv) the unemployment rate, defined as the percentage of the workforce that is unemployed but seeking employment.

1.4.2 Estimation Models

Demographic Transition and Government Balance

In order to investigate the relationship between demographic transition and government balance, we employ an adjusted form of the model used by Tujula and Wolswijk (2004) as follows:

$$Government\ balance_{it} = \beta_0 + \beta_1 Demographic\ transition_{it} + \beta_2 X_{it} + \epsilon_{it}$$

Here, *government balance* is proxied by the net lending or borrowing of country i in year t as a share of GDP. To represent *demographic transition* toward becoming an aging or aged society, we use two explicit proxy variables: the ratio of older dependents, people older than 64, to the working-age population (hereafter, old-age dependency); and the share of the population aged 65 and over in the total population (hereafter, population aged over 64). As an implicit proxy, we use government health expenditure as a share of GDP. This indicator is used as older people have a greater tendency of suffering from chronic conditions that are costly to treat. Medical technology related to aging has also been shown to be an important contributor to health expenditure growth (De Meijer et al. 2013), and thus, a large share of health expenditure is likely to result from the effects of having an aging or aged population. X_{it} represents a set of control variables: GDP growth, government revenue, the unemployment rate, and trade. ϵ_{it} is the disturbance term. The unemployment rate captures the changes in fiscal expenditure that are made to stabilize macroeconomic conditions. These changes are mostly automatic and come from unemployment-related expenditures to act as stabilizers. Fiscal expenditures are also used to dampen the effects of cyclical unemployment, and this leads to downward pressure on the government balance particularly in times of recession.

Demographic Transition and Government Health Expenditure

Next, we examine the relationship between demographic transition and government health expenditure using a model adapted from that used by Xu, Saksena, and Holly (2011):

$$\begin{aligned} Government\ health\ expenditure_{it} = {} & \beta_0 + \beta_1 Demographic\ transition_{it} \\ & + \beta_2 X_{it} + \epsilon_{it} \end{aligned}$$

Where *government health expenditure* is again the current health expenditure as a percentage of GDP for country i in year t. For *demographic transition*, we use the old-age dependency ratio and the population aged over 64. We expect the population structure to have an impact on government health expenditure. Previous literature often uses the share of the population aged over 60 or the share of those under the age of 5 or 15. However, we use the population aged over 64 in this study since we aim to focus specifically on the impacts of population aging, and the share of the population aged under 5 and over 60 (or 64) can often be highly correlated.

It is clear that aged and aging populations need more health services, leading to higher government health expenditure. Therefore, in our estimations, we expect to see a positive correlation between having an aged or aging population and government expenditure on health care. We would expect to observe this particularly for the upper-middle-income and high-income economies that are experiencing rapid aging and facing strains on their health care systems due to the elderly's health care-related needs. Countries with lower income levels generally do not face the issue of population aging and, as such, are unlikely to have a strong association between population aging and health expenditure. As previously mentioned, X_{it} is the set of control variables of GDP growth, the inflation rate, and population growth. ϵ_{it} is the disturbance term. The estimations were carried out using a random effects model based on Hausman test results.

Demographic transition and government debt

Lastly, we examine the association between demographic transition and government debt by using a model adapted from Bittencourt (2015). The empirical model is specified as follows:

$$Government\ debt_{it} = \beta_0 + \beta_1 Demographic\ transition_{it} + \beta_2 X_{it} + \epsilon_{it}$$

Where *government debt* is the gross debt of country *i* in year *t* as a percentage of GDP. The indicators for *demographic transition* to becoming an aging/aged society are old-age dependency and the population aged over 64. X_{it} is the set of control variables—GDP growth, inflation rate, government revenue, and the unemployment rate—and ϵ_{it} is the disturbance term. Economic growth is likely to have a strong association with government and external debt as higher growth can help to suppress rising debt and even reduce it. Conversely, a higher rate of inflation can lead to increased government debt through higher nominal interest rates. Similarly, unemployment can increase the debt through greater unemployment-related expenditure and fiscal stimulus packages.

All necessary tests, including the Granger causality test, Hausman specification test, panel-data unit-root test, and time-fixed effect test, were carried out for all the estimation models. No major problems were found, and the model specifications followed the results of the tests. Robust standard errors were used, and all regressions include country- and time-fixed effects, except when indicated.

1.4.3 Limitations of the Study

Good data availability across an 18-year time series for a large sample of 178 countries allowed us to conduct robust analyses on fiscal budget, government debt, and health expenditure. However, some limitations of the study do exist. While 18 years of data is likely to be sufficient for drawing implications from these analyses, a longer time series would allow us to observe even longer-term impacts. The data quality is also likely to have affected the estimation results to some degree due to the variance in the reporting methods used by countries. Meanwhile, due to a lack of panel data, this study does not include some important variables such as the share of private services, private health expenditure, old-age pension costs, and provider payment mechanisms. The private health care sector has been growing and plays a significant role in some developing countries due to their underdeveloped or overcrowded public health care sectors. This is particularly obvious in developing Asian countries, which are still in the early stages of economic development and demographic transition. Moreover, the old-age pension costs are left out from the analyses despite their importance in the social security systems in East Asia. The lack of these variables may affect the estimated results to some extent. Finally, issues with the model specifications may mean that endogeneity could be problematic in the analyses, but we hope that, where possible, these issues have been kept minimal. In this study, we have utilized both a standard fixed effects model and different proxies for variables of interest in order to test the sensitivity of the results. The limitations of the study warrant future research to improve upon the data and methodology.

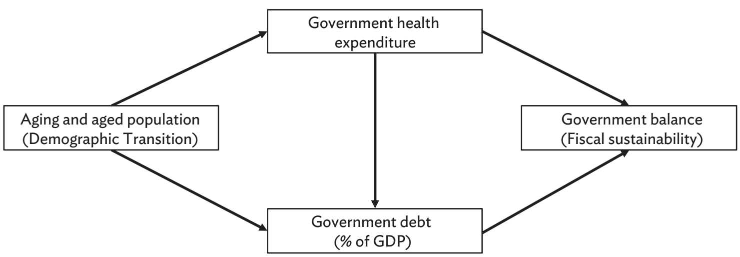
1.4.4 Estimated Results

The estimation results of Table 1.3 point to the mechanisms of demographic transition and its impacts on fiscal sustainability. Estimation Model 1 (Columns 1–3) shows the effects of the demographic transition proxied by different variables, including old-age dependency (Column 1), population aged over 64 (Column 2), and government health expenditure (Column 3). The coefficient for health expenditure is statistically significant and shows a negative sign. A 1% increase in health expenditure is associated with a 1% decrease in the government balance. In contrast, the estimated coefficients of the other two proxies are not statistically significant. The results are quantitatively and qualitatively robust when using the cyclically adjusted balance (% of GDP) as a dependent variable. However, the sample size decreases by half and, therefore, we opt to report only the results with the net lending or borrowing (% of GDP) as the dependent variable.

The impacts of old-age dependency and the population aged over 64 on the fiscal balance cannot be observed from the estimation in Model 1. Yet, when considering the estimated effects of the demographic transition (explicit proxies) on health expenditure (Model 2), old-age dependency and the population aged over 64 show a statistically significant positive impact on health expenditure. That is, economies with a higher proportion of middle-aged and elderly populations tend to experience higher health spending (as a share of GDP). The estimated results show that a 1% increase in the aging and aged population share is associated with a 0.1%–0.2% increase in health expenditure. The results from estimation Models 1 and 2 imply that the explicit proxies of demographic transition, i.e., old-age dependency and the population aged over 64, do not have a *direct* effect on the government balance. However, they *indirectly* and negatively affect the fiscal balance through the effect of a higher share of government expenditure. Aging in the population indicates a higher incidence of chronic illnesses, which are inherently more costly to treat, requiring higher expenditure. Moreover, there is evidence that medical technology related to population aging is the most important driver of health expenditure growth (De Meijer et al. 2013). Therefore, it is likely that a large share of health expenditure comes from the costs associated with the middle-aged and elderly populations.

The estimated results for Model 3 (Columns 6–8) reaffirm the mechanisms of the demographic transition variables. The dependent variable in this model is gross government debt as a percentage of GDP, which is related to the government balance variable in Model 1. All the demographic transition variables are statistically significant and positively associated with gross debt. A 1% rise in the middle-aged and elderly population share corresponds to a 5%–9% increase in gross debt, whereas a 1% increase in health expenditure raises the debt by 2.5%. Both the explicit and implicit proxies of demographic transition *directly* affect gross debt, the effects of which in turn reflect on the fiscal balance. Even though the actual relationship between demographic transition and government budget may be more complex and involve more factors, Figure 1.12 illustrates the mechanisms and the directions of the impacts of demographic transition on the fiscal balance, derived from the estimation models. In short, a middle-aged or elderly population *indirectly* affects the government balance through two channels: health expenditure and government debt. In order to achieve fiscal sustainability, government balance needs to be managed.

Figure 1.12: Mechanisms and Directions of Demographic Transition Impacts on Fiscal Balance



GDP = gross domestic product.

Source: Authors.

The control variables in all estimation models are statistically significant. Their coefficients express the expected signs, which are consistent with previous studies (e.g., Bittencourt 2015; Tujula and Wolswijk 2004; Xu, Saksena, and Holly 2011). In Model 1, GDP growth, government revenue, and trade openness contribute positively to the fiscal balance, while unemployment shows a negative effect. In Model 2,

Table 1.3: Demographic Transition and Its Impacts on Fiscal Sustainability

	Dependent Variable							
	Model 1			Model 2		Model 3		
	Government balance	Government balance	Government balance	Government health expenditure[a]	Government health expenditure[a]	Government debt	Government debt	Government debt
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Demographic transition variables								
Old age	0.193			0.128***		5.057***		
Dependency	−0.127			−0.0138		(0.284)		
Population aged over 64		0.312			0.226***		8.964***	
		−0.241			−0.0259		(0.552)	
Government health expenditure			−1.050***					2.479***
			−0.164					(0.874)
Control variables								
Government revenue	0.452***	0.497***	0.551***					
	−0.0802	−0.104	−0.0637					
Trade	0.0183**	0.0180**	0.0235***					
	−0.00862	−0.00859	−0.00796					
Unemployment rate	−0.249***	−0.253***	−0.131***			2.306***	2.341***	2.700***
	−0.073	−0.0719	−0.0494			(0.199)	(0.201)	(0.228)

continued on next page

Table 1.3 *continued*

	Dependent Variable							
	Model 1			Model 2		Model 3		
	Government balance	Government balance	Government balance	Government health expenditure[a]	Government health expenditure[a]	Government debt	Government debt	Government debt
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
GDP growth	0.218***	0.158**	0.252***	−0.0207***	−0.0206***	−0.741***	−0.640***	−0.709***
	−0.0474	-0.0615	−0.0381	−0.00688	−0.00688	(0.149)	(0.160)	(0.128)
Inflation rate				−0.000918***	−0.000947***	0.0372**	0.0367**	0.0290***
				−0.000158	−0.00016	(0.0188)	(0.0187)	(0.0107)
Population growth				−0.0497***	−0.0486***			
				-0.0156	−0.0156			
Constant	−20.42***	−21.88***	−14.02***	4.957***	4.715***	−36.27***	−48.80***	25.50***
	−3.41	−3.958	−2.278	−0.204	−0.241	(5.312)	(6.430)	(6.005)
Observations	1,853	1,855	1,396	3,136	3,136	2,740	2,742	1,973
Number of countries	97	97	96	178	178	113	113	112
Number of years	28	28	18	18	18	29	29	18
R-squared	0.304	0.3	0.674	0.884	0.884	0.691	0.688	0.725

GDP = gross domestic product.

[a] According to the Hausman test, regressions were carried out with random effects estimators.

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.
Robust standard errors are reported in parentheses. All regressions include country- and time-fixed effects, except when indicated.

Source: Authors.

all the control variables, i.e., GDP growth, inflation rate, and population growth, are negatively associated with health expenditure. Developing countries have high GDP and population growth rates, and place relatively less emphasis on domestic health care and social services and, therefore, have lower health spending as a share of GDP. Lastly, in Model 3, the coefficients of the unemployment and inflation rates show positive signs for gross debt, whereas the coefficient for GDP growth is negative. Unfavorable macroeconomic conditions, particularly the unemployment rate, adversely affect the overall economy. This in turns leads to higher government debt as the debt is used to finance and boost the economy when necessary.

1.5 Policy Implications

The policy implications in this chapter are categorized by the results from Section 1.4. First, we address the direct policy implications, which are derived from the results of the three main models, showing the relationships between the demographic variables and government fiscal balance. Then, in the next subsection, we provide the indirect policy implications derived from the relationship between the control variables and the government fiscal balance.

1.5.1 Direct Policy Implications

The results from Section 1.4 imply an indirect effect of demographic transition on government fiscal balance through an increase in public health expenditure and government debt. Additionally, a positive relationship between public health expenditure and government debt is evident, which indirectly implies an increase in fiscal imbalance.

According to the abovementioned results, the following recommendations are proposed. First, a comprehensive review of public health expenditure will help improve the government fiscal balance and achieve fiscal sustainability. To diagnose their fiscal status, governments need accurate information on health care spending and funding sources. Generally, reviews of public health expenditure will help governments address issues related to the distribution of health spending and services across the population. Moreover, such reviews will also improve the efficiency of health care provision and help evaluate the macroeconomic impacts of revenues and expenditures on societies. Certain analysis is required for comprehensive reviews, such as those on public resource mobilization, health risks, benefit incidence, health-sector outputs, and health policy.

Medium-term assessments and long-term forecasts on spending will shed light on better scenarios for the decision-making processes. According to Schick (2005), budget reviews offer fiscal tools to assess governments' fiscal position. Although a medium-term expenditure review applies too short a time horizon for assessing sustainability, that framework with fiscal rules introduces techniques that facilitate the analysis of a country's future fiscal position. For long-term fiscal sustainability, the assessment and forecast frameworks should include information on estimated trends in health care spending, spending requirements in different periods, possible funding and revenue sources, funding availability, the actual spending for budget targets, and detailed spending in sub-categories. Social and economic factors (e.g., demographic factors, inflation, etc.) should be taken into account together in the assessment and analysis. Many Organisation for Economic Co-operation and Development countries conduct periodic and systemic spending reviews, particularly on sub-category spending, to ensure savings in health expenditure (OECD 2015).

Cutting or removing unnecessary health expenditures and subsidies that do not translate into improvement in health care services, health care technology, inclusive social protection, and economic development must be prioritized. Such reviews will in turn help to control (unnecessary) government spending and stabilize public or government debt, resulting in fiscal efficiency and sustainability. The benefits of comprehensive reviews are highlighted particularly for developing Asia to follow and implement. However, several limitations are identified in developing economies, such as data and resource limitations. The costs of data assessment and analysis can be very high and unaffordable to some developing member countries. It is also worth noting that the review of government spending usually takes time—some countries conduct it annually while others may take 2 or 3 years, or more.

Second, health care reforms are needed to not only strengthen social and economic inclusiveness but also to maintain buoyant fiscal balance. They will also promote the development of effective health care systems for aging societies. Given the characteristics of health care services, policy makers might find it difficult to strike a balance between promoting equitable and affordable access to a set of basic health and social services and modernizing the health and social services sector with recent technologies. Reforms should be conducted on three principles: accessibility for all (universal health care), efficiency in health care services, and cost control and/or monitoring. Accessibility and efficiency in health care services can be improved by competitiveness and technological advances. Promoting competition in the industry, such as through trade liberalization of health-related and social services, will bring market efficiency, with possibly lower costs and improved quality. It can also provide more health care and insurance options to consumers. In addition, trade liberalization and regional cooperation in health care services play a crucial role in addressing many of the national and regional technical, financing, and knowledge-capacity constraints, while providing sustained quality of such services in the region (Korwatanasakul et al. 2020).

Together, the new health care technologies extend the scope, range, and quality of medical services (OECD 2015). Although some health care innovation can be expensive, it can help reduce other health care costs through shortened morbidity or by allowing for less-costly treatment inputs, which will help relieve some of the health-related fiscal burden. Additionally, countries can set cost ceilings and/or budget caps on their public health expenditures to limit overshooting expenses. Cost controls should be set where a reasonable level of spending is determined at the equilibrium of demand for and supply of health services. In order to impose spending controls on health expenditure, the central government should consult with both local government and health care stakeholders, such as hospital, pharmaceutical, and insurance sectors. The consultations will help the central governments to prioritize health expenditures as well as promoting the effectiveness of the health care system.

In relation to aging and aged populations, countries have implemented various approaches to seek a suitable balance between government health spending and requirements and/or demands for different health care services for the elderly. Some elderly need intensive care, while some only need basic age-related care and have no health complications. The latter group can stay at home while receiving basic care, but the former may have to stay in hospitals or nursing communities for more intensive care or treatment. To support aging and aged populations, social and economic evaluations are required to strengthen health care performance and enable policy-making processes that will ensure fiscal sustainability as an economy faces population aging.

In addition, cost-sharing measures should be considered to reduce the age-related fiscal burden. Health financing can help lower the government fiscal burden in the short run; however, this may cause an adverse impact on access to care and patients' health outcomes, particularly for vulnerable groups. The cost-sharing approach usually involves insurance and pension schemes through individual contributions. Private health insurance can be encouraged; however, there is no concrete evidence to suggest this will lead to a significant reduction in public health spending (OECD 2015). The out-of-pocket approach requires individuals and health care consumers to pay a proportion of their health care expenses in addition to the financial support from the government. This approach can potentially reduce the fiscal burden, particularly on public health expenditure, as some of the responsibility is pushed to the health care consumers. Some arguments, however, suggest that increased cost-sharing in public schemes may lower the volume of health care services; thus, total health spending may not necessarily fall (OECD 1995). It is also necessary for governments to take into account social protection for vulnerable groups, such as the poor and elderly, when implementing such cost-sharing measures.

The pension scheme, on the other hand, helps prepare younger populations for life after retirement and possibly diminishes fiscal burden or fiscal imbalance in the future. In many developing countries, pension schemes are still immature and need to be further developed. An upgrade of social security systems, together with public and private pension schemes, will improve social security contributions and savings after retirement. Thus, fiscal sustainability is possible when the fiscal burden is lessened. A comprehensive assessment for such upgraded social security systems includes socioeconomic factors, i.e., human capital, financial education, labor movement, informality, and equality.

1.5.2 Indirect Policy Implications

Turning attention to the results of the control variables, indirect policy implications are derived for government revenue and GDP growth in relation to the government balance. The positive relation between government revenue and government balance implies an upgrading of the fiscal balance with an increase in government revenue. Population aging may cause the shrinking of the working population, which pays taxes. A tax reform can help maintain the taxpayer base, as well as compensate for such a potential decline in government revenue. In developed economies, a shift in the tax-mix is proposed toward other types of taxes, beyond individual income tax. For example, some countries have turned their focus to environmental taxes, including carbon and emission taxes, to raise substantial government revenue without compromising efficiency. Other economies impose "sin taxes", such as excise duties on alcohol and tobacco, to finance public contributions to health care, even though the impact is limited (OECD 2015). Japan, to compensate for a potential shortfall in individual income tax, increased its consumption tax from 8% to 10% from September 2019 (Sirivunnabood 2020). Developing countries, on the other hand, rely heavily on income taxes for their government revenue. A timely recommendation is that tax administration be strengthened to improve the taxation process and, thus, enhance governments' revenue-generating capacity. In addition, improving transparency through a thorough review procedure and application of digital technology in the tax collection process can also improve government revenue. In sum, the tax system should be designed, upgraded, and customized subject to each economy's characteristics and demographic stage. Some changes in fiscal design may have more impact and be more politically feasible if done earlier than later (OECD 2019).

Another indirect way to increase government revenue is to improve GDP growth through upgrading productivity. Lower productivity can negatively affect government revenue. Sheiner (2017) explored the implications of productivity growth for a long-term outlook for government budgets at both the state and local sectors. He suggested that lower productivity growth would have real effects on taxpayers, i.e., a slowdown in labor productivity growth would increase primary deficits relative to GDP due to its tie with revenue. Technological advances and skills development can help offset the impacts of a growing aging or aged population on productivity in an economy. The application of technological innovation and automation will boost overall productivity in all sectors, which in turn will increase GDP growth. In light of the digital economy and the fast-changing world, new skill sets and knowledge are required to overcome the barriers to productivity caused by innovation and rapid technological advances. In relation to demographic transition, life-long education and training programs offered to the working and aging populations will enhance human capital and provide such skills to workers in different age groups. In parallel, in preparation, countries with younger populations should invest more in education and skills development to prepare their labor markets and, thus, ensure long-term productivity. A quality labor force will bring in higher productivity, resulting in economic growth and an increase in government revenue. Another idea that has always been discussed for enhancing productivity is to promote labor participation through labor market reforms, which include an increase in female participation, the extension of the retirement age, and accommodative migration policies for shortages of in-demand skills. The greater the labor participation, the bigger the base of taxpayers, which leads to higher government revenue.

Consequently, various recommendations are made to achieve fiscal sustainability, both in terms of boosting government revenue and reducing government expenditure. The most important point to recognize is that there is no simple solution for all. The fiscal strategy must be designed and/or customized based on specific characteristics and the demographic status of each economy.

1.6 Conclusion

In this study, we have analyzed the global trends in demographic change and highlighted the progression of East Asian and Southeast Asian economies toward becoming aging and aged societies. The impacts of these are multifaceted and far-reaching, and include declining tax revenues, which leads to fiscal imbalances and possible increases in government expenditures for health and nursing care and pension schemes. This study hopes to provide insight into possible ways to balance fiscal revenue against costly pension and social security systems and increasing health care expenditures.

Using panel data for 178 countries across 18 years to capture the state of fiscal balance (variables representing the government balance, government revenue, and government debt) and data on demographic transition (variables for government health expenditure, old age dependency, and the population aged over 64), we conducted estimations of three models to analyze the relationships between (i) demographic transition and government balance; (ii) demographic transition and government health expenditure; and (iii) demographic transition and government debt.

The results first established that health expenditure is negatively associated with the government balance. Then, for the relationship between demographic transition and health expenditure, old age dependency and the share of the population over 64 years of age showed a significant positive relationship with health expenditure. We found that demographic transition did not have a direct effect on the government balance, but, rather, an indirect effect through higher government expenditure. This can be explained by the high costs of treating health conditions related to old age, such as chronic illnesses. Our findings provide important implications for fiscal sustainability and necessitate comprehensive reviews of public health spending combined with the appropriate assessments and forecasts to optimize spending on health care and allow for effective planning and decision making. Through these measures, governments can reduce unnecessary expenses and stabilize their debt to achieve fiscal efficiency and sustainability. A health care reform that prioritizes accessibility for all, efficiency in health care services, and cost control and monitoring will also be beneficial for the purposes of maintaining fiscal balance, strengthening social and economic inclusiveness, and building an effective health care system for aging and aged societies. Finally, cost-sharing measures, such as through insurance and pension schemes based on individual contributions, should be encouraged to mitigate the age-related fiscal burden. In doing so, governments should ensure that vulnerable groups, such as the poor and elderly, are appropriately protected and that the relevant schemes are efficiently and carefully designed, especially for developing countries, where the schemes may still be relatively immature. In addition to these, as indirect policy implications, the findings suggest that it would be prudent for governments to consider a shift in the tax mix, strengthening of the tax administration, and measures to upgrade productivity to improve GDP growth.

These proposed measures should be tailored and combined in a way that meets the specific needs and characteristics of each economy in order to implement a strategy for fiscal sustainability by boosting government revenue and reducing government expenditure. Working toward fiscal sustainability will be particularly important amid the COVID-19 pandemic as the elderly are particularly vulnerable to the virus. Governments of aging and aged societies will have to manage spending to cope with the increased strain placed on their health care systems and ensure the elderly receive adequate social protection. This can be achieved by incorporating support for the elderly in policy design, facilitating access to health care, and considering socioeconomic factors for social inclusiveness.

This study has highlighted the rising challenges that economies in East Asia and Southeast Asia are facing from the current trends in demographic transition. Ensuring fiscal sustainability while protecting and addressing the needs of aging and aged populations will be a key priority for governments and will require careful policy planning and implementation, and we expect that the findings of this study and its implications will be valuable in achieving these objectives. Although there are some limitations in the analysis, this study serves as an initial stepping-stone for contributing to future findings on the relationships between (i) demographic transition and government balance; (ii) demographic transition and government health expenditure; and (iii) demographic transition and government debt. Future research may improve upon the data and methodology to handle the endogeneity issue.

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Appendix 1.1

Table A1: Age-Related Policy Measures in Selected East Asian and Southeast Asian Countries

Country	Policy Measures
Brunei Darussalam	- Activity centers for senior citizens - Action plan emphasizing the rights and protection of the elderly
Cambodia	- National Aging Policy 2017–2023 - Training institute for elderly care nurses was opened in 2018
Indonesia	- National Action Plan for the Elderly 2016–2019, which focuses on creating a healthy, independent, active, productive, and efficient elderly population
Japan	- Social security system for elderly people - Long-term care insurance system in 2000
Lao PDR	- National Committee for the Elderly was established in 2005 - Sequences of the legislation to support the health and welfare of the elderly - Declaration of Application of the National Policy towards the Elderly
Malaysia	- Private Aged Healthcare Facilities Act and the National Health Policy for Older Persons - Private Health Facilities and Services Act 1998
Myanmar	- The Elderly Care Scheme by the Ministry of Social Welfare, Relief and Resettlement since 1992 - Older People Law in 2016
Singapore	- Pioneer Generation Package - Enhancement for Active Seniors - Silver Support Scheme
Thailand	- Establishment of ASEAN Centre for Active Aging and Innovation under Thailand's ASEAN Chairmanship - 12 Social Welfare Development Centers for Older Persons
Viet Nam	- 153 Social Protection Establishment in 2015

ASEAN = Association of Southeast Asian Nations. Lao PDR = Lao People's Democratic Republic.
Sources: Korwatanasakul et al. (2020), Japan Ministry of Health, Labor, and Welfare (2016).

2

"No Flat, No Child" in Singapore: Cointegration Analysis of Housing, Income, and Fertility[1]

Kidjie Saguin

2.1 Background

Fertility decline forms a key component of the demographic transition in many countries all over the world. Various economies in Asia like Singapore; Taipei,China; Hong Kong, China; the Republic of Korea; the People's Republic of China (PRC); and even Viet Nam have a total fertility rate below replacement level. European countries such as Spain, Portugal, Italy, and Greece share a similar predicament. But the sheer scale and speed of fertility decline is a particularly remarkable feature in Asia, with estimates revealing the rate of decline per decade ranging from 1.6 to 2.1 in these economies (Feeney 1994).

A few cultural and social institutions around work and education have been posited as important in suppressing decisions to have more children. There is an uneasy relationship between the traditional gender roles in marriage, childbearing, and employment (Kim and Cheung 2015). The so-called "marriage package" often involves the postponement of childbearing that increases its attendant costs, as it implies the expectation that the wives will work less or become fulltime homemakers (Bumpass et al. 2009). "Education fever", or the strong orientation toward high investment in child education, among

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Asian parents also drives up the cost of rearing children (Anderson and Kohler 2013). For instance, spending on "shadow education" such as cram schools and home tutoring accounted for 0.19% and 1.72% of the gross domestic product (GDP) in Japan and the Republic of Korea, respectively (Bray and Lykins 2012). These social elements are some of the factors that McDonald (2000) calls the marriage and direct-costs factors that skew preferences for delayed family formation and smaller family size.

As a result of such thinking about fertility decline, pro-natalist policies geared toward incentivizing larger family sizes began to emerge in the past 40 years. These family policies typically include financial incentives and support for parents to balance work–family tensions, as well as broad social changes to support parenting and childrearing (McDonald 2000, Jones and Hamid 2015). Taipei,China recently introduced measures such as parental leave allowances, subsidized childcare, tax deductions for preschool children, and even more flexible regulations for military enlistment of men for family reasons (Lee and Lin 2016). In the early 2000s, Singapore introduced a package of incentives to foster early marriage and larger families, which includes the provision of cash benefits on the birth of children, a co-saving scheme for child development, a priority housing scheme for couples with children, parental leave, and match-making services for singles. Although it is hard to establish whether these policies have worked, Jones and Hamid (2015) conjecture that without them, Singapore's total fertility rate (TFR) would be much lower, at similar levels to East Asian cities with low fertility such as Seoul and Hong Kong, China.

These policy responses are consistent with the demographic transition theory that posits societies as moving from high birth and high death rate to a low birth and low death scenario. Some calibration of the theory identified ideational, cultural, and sociological factors as important determinants of the demographic transition. However, Caldwell (1976) reformulated these theories as a function of change in the flows of wealth. With the decreasing role of extended families, modern societies value nuclear families and feature a flow in the wealth from parents to children, rather than children supporting the extended family. Given the increasing cost of living and westernized values for smaller families, households may see childlessness as a rational choice as they also begin to find utility in other social institutions such as work and education, at the cost of marriage and family (Kirk 1996).

One crucial implication of this view of demographic transition as a flow of wealth is the role of housing as a source of wealth for the family. Along with education and work, housing has been argued as one of the three institutions that affect fertility tempo (Rindfuss and Brauner-

Otto 2008). The adequacy in the supply of housing, crowdedness of apartment living in dense areas, as well as the flexibility of the housing market, such as the existence of affordable rental apartments, are well-known constraints to family formation decision (Chesnais 1996, Felson and Solaún 1975, Billari 2005). Expensive housing, particularly in densely urbanized cities, is believed to significantly increase the cost of childrearing, leading many couples to have fewer children. It also makes marriage contingent to owning a house, as is the case throughout Central and Eastern Europe (Frejka and Sobotka 2008, Stropnik and Šircelj 2008, Tello 1995). Low fertility rates were found to be particularly acute among countries with high home ownership and low access to mortgages, factors that are seen as important in the transition to adulthood (Mulder and Billari 2010).

Despite the importance of housing in shaping fertility, as shown by these studies in Europe, studies on how housing shapes fertility remains limited in the Asian region. Some preliminary studies on the determinants of fertility in the region show that housing in urban areas disincentivizes large family sizes. For instance, 13% of respondents covered by a national fertility survey in Japan reported "house being too small" as a reason for not realizing the couple's ideal family size (Gauthier 2016). Some studies also posit a negative relationship between housing prices and fertility through time series analysis but often tend to be of limited value to policy makers because of the missing mechanisms that link the two variables (Yi and Zhang 2010; Hui, Zheng, and Hu 2012). These studies establish demographic factors such as infant mortality rates and maternal mortality rates, as well as social institutions like work and education as crucial determinants of female fertility. The mechanisms in which such social factors impact female fertility are largely identified from the perspective of costs vis-à-vis income (Subramaniam, Loganathan, and Devadason 2018). Despite its saliency in the demographic transition, studies that examine housing as a policy lever for shaping fertility are limited, leaving the potential effects of house prices on family decisions largely unexamined (McDonald 2000).

This chapter serves to fill this gap by primarily examining the long-run relationship between fertility, housing, and income through the mechanism of wealth formation. Specifically, it tests the linkage between housing prices, along with income, and fertility in the long run. It uses resale prices of public flats to model a household making interrelated decisions about maximizing on the capital gains from upgrading and forming a family, including deciding on the number of children. Using annual data at the aggregate level that cover the period from 1990 to 2019 in Singapore, the chapter finds a negative long-run effect: a unit increase in the Housing and Development Board (HDB) flat resale index reduces the total fertility rate by 0.0036, statistically significant at 1%. The impact of income, although very small in magnitude, is also negative. The variables in the error correction model are also sensitive to disequilibrium. The chapter further provides robust evidence that housing prices Granger cause fertility in the short and long-run. These findings suggest the coupling of housing and fertility decisions as implied by the "no flat, no child" belief popular among young Singaporeans.

The chapter is organized as follows. Section 2.2 reviews the theoretical and empirical foundations of the relationship between housing and fertility. While it has long been acknowledged that housing negatively affects fertility, recent studies point to the potential positive relationship through wealth formation. The ambiguous effect found in the literature could be attributed to the diversity in housing markets as well as the stage of household formation. Section 2.3 situates the debate within Singapore, a country whose asset-based welfare system makes house ownership an important source of wealth. Singapore is also one of the few countries in Asia that have used housing as a policy instrument to shape fertility behavior but little evidence exists on their relationship. The chapter adopts a cointegration analysis, as will be elaborated in Section 2.3, to determine whether there is any short-term and long-term causality between housing and fertility in Singapore. Sections 2.4 and 2.5 present the main empirical finding of a negative relationship between housing and fertility, and generate implications on how the findings fit into the theoretical propositions. Some remarks on future research and policy implications conclude the chapter.

2.2 Housing and Fertility

Using the long-standing theoretical approaches from economics, housing can be expected to negatively affect fertility. Gary Becker's New Family Economics formulates the number of children as a function of opportunity costs of childbearing and rearing. Children can be viewed as durable goods that yield income (both material and psychological) to parents (Becker 1960). Households perform a cost-benefit analysis of bearing children and come up with an optimal number of children based on their net cost.[2] Sexual division of labor dictates women to take on tasks in which they hold comparative advantage, such as childbearing (Becker 1985). Thus, it is not surprising to see recent growth in income,

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2 This is computed as present value of expected outlays, plus imputed value of parent's services, minus present value of expected money return, plus imputed value of child's services (Becker 1960).

particularly among women, contributing to fertility decline (Becker, Murphy, and Tamura 1990). Housing price inflation would have a negative income effect on households, as time away from the labor force means lower income for consuming other goods.

The second theory is a relative income hypothesis developed by Richard Easterlin (1976). The decision to bear children is based on the process of managing the gap between aspirations and the current level of resources. According to Easterlin (1976, 422), "the number of children [a household] can 'afford' will depend on the outlook for multiplying his initial capital over the course of his lifetime," which indicates that an increase in the cost of living would affect the optimal number of children per household (Easterlin 1980). Fertility decisions would be largely based on relative income to achieve aspirations, which are dependent on the standard of living in the parental home (Easterlin, Pollak, and Wachter 1980). The aspiration is largely determined by past consumption and family-size decisions the husband and wife experienced during their childhood. Housing prices can influence decisions to marry if the income is not rising sufficiently to maintain the level of lifestyle afforded to them by their parents. The relative income hypothesis of a negative relationship between housing prices and fertility has been confirmed by empirical studies in developed countries such as the United Kingdom (UK) (Ermisch 1988) and the United States (US) (McNown 2003).

That housing prices negatively affect fertility rates has long been confirmed by studies that examined housing and fertility decisions as jointly made among young households. Öst (2012) used a cohort study in Sweden to demonstrate a strong statistical correlation of the simultaneity of decisions about home ownership and family formation. The study further found that the relationship was stronger among younger cohorts that experienced greater housing market uncertainty. Various studies have confirmed the existence of such a relationship based on survey data in Italy (Vignoli, Rinesi, and Mussino 2013), the US (Clark 2012), and Finland (Kulu and Steele 2013). These studies show that the perception about the housing market can affect the likelihood of having children in the next 2–3 years, suggesting a long-run relationship. Fertility intentions are concluded to shape residential mobility, particularly in contexts where there are opportunities to move to cheaper housing markets, as in the cases of Australia (Li 2019) and the UK (Ermisch and Steele 2016).

Given these considerations, it is important to situate the debate within Asia, where highly urbanized areas tend to have less diverse, expensive housing markets. The high cost of living spaces would disincentivize larger family size as well as discourage early fertility timing. Using pooled data from the PRC, Clark, Yi and Zhang (2020) reinforced the negative relationship between housing prices and fertility in urban areas, that Pan and Xu (2012) had earlier found. Their study established that a 1% increase in house prices among urban households causes a 0.94% decrease in the probability of having a child. Yi and Zhang (2010) utilized time series to provide evidence of a long run cointegrating relationship between fertility and housing in Hong Kong, China. The authors found a 1% increase in housing prices to be related to 0.45% decrease in total fertility rates. Hui, Zheng, and Hu (2012) also validated this negative relationship in Hong Kong, China, where a 1% increase in housing prices reduces the birth rate by 0.52%. The findings of these studies point to a convergence in empirical expectations of a negative impact of housing prices on fertility decisions in restricted housing markets in the region.

However, recent studies contend that many of these negative relationships could just be correlations and that, in fact, the relationship could be positive. For homeowners, house price inflation can serve as an income shock and can increase household wealth. If children are normal goods as asserted by Becker, then increases in house prices would improve the outlook for the household income and encourage larger family sizes. Using a panel study, Lovenheim and Mumford (2013) found that an increase of $100,000 in housing wealth would result in a 16%–18% increase in the probability of having a child among homeowners. Washbrook (2013) corroborated this finding, but the relationship is only short term. The author found that a 10% increase in house prices leads to a 2.4% increase in fertility among homeowners in the following year. The analysis further showed that cumulative fertility rates normalize in the longer term. Similarly, Clark and Ferrer (2019) looked into the effect of house prices on "non-mover" homeowners and found a positive relationship in Canada. In one of their models, they established an 11% increase in the probability of giving birth in relation to a $10,000 increase in average house prices.

There is thus an ambiguous relationship between housing—particularly housing prices—and fertility. What the existing literature suggests, however, is that the relationship may be contextual, as the nature of the housing market can sharpen the effect of house price inflation on fertility. The relationship could also be differentiated according to the modelling of the type of household. One must consider what kind of a decision (e.g., concerning ordering of birth, family formation, etc.) is affected by house prices (e.g., cost of a new house vs renting, etc.). The negative relationship could be pronounced in contexts where there is a greater concern for home ownership and first-order birth. These are households at the start of their formation, when couples are deciding on getting a house and having children, where the income flow would have a more pronounced effect. On the other hand, the evidence that shows a positive relationship has been limited to existing homeowners and higher-order births, where wealth formation is more likely. Thus, in order to rule out the wealth effect, subsequent research on the relationship between housing prices and fertility should examine how housing relates to income.

2.2.1 Singapore: "No Flat, No Child"

Singapore is emblematic of the dilemmas posed by demographic transition in developed Asian economies. Since its independence, Singapore has experienced continuous economic growth with its GDP per capita (at current market prices) growing exponentially from $1,915 in 1970 to $73,167 in 2016. Its economic development journey followed an export-oriented model and consistent economic restructuring, but is also characterized by exceptionally high savings and low inflation throughout its history (Huff 1995). However, due to slow local population growth, Singapore's economic growth relied heavily on foreign workers to take on low-skilled service jobs (Fong and Lim 1982, Hui 1997). Such dependence on foreign workers, who accounted for 30% of the total resident population in 2016, is representative of the social transformation that had simultaneously occurred. Today, social indicators show that Singapore's society is rapidly aging. Many young couples are marrying older, with a median age at first marriage of 30 years old for males and 28 years old for females. Singaporeans are also marrying less, with only under 50% of unmarried residents (15–49 year olds) ever getting married.

The issue of continuous fertility decline lies at the core of these policy challenges. Singapore's fertility rate has been declining rapidly since the late 1960s owing in part to vigorous anti-natalist policies of the government carried out as part of its economic growth policies (Graham 1995). By the mid-1970s, the total fertility rate fell below the replacement level. Since 1984, Singapore's government adopted a pro-natalist approach, introducing several policies and programs to encourage procreation and marriage (Yap 2003). These programs were a mix of policies prioritizing certain demographics (e.g., the Graduate Mother Scheme), and containing childcare subsidies, tax relief, hospitalization coverage, among many others. The impact of these programs, particularly based on survey data, has been mixed (Drakakis-Smith et al. 1993, Graham 1995, Teo and Yeoh 1999). Aggregate trends show that the fertility decline is intractable, with the TFR currently standing at an alarming level of 1.2.

Despite the recognition of the problem, little empirical evidence exists on the determinants of fertility decline in Singapore. Many of the studies on fertility in Singapore have largely been descriptive of the consequences of low fertility and effectiveness of pro-natalist policies (Asher and Nandy 2008, Yap 2003, Graham 1995, Cheung 1990, Pyle 1997). Using survey data, Hashmi and Mok (2013) identified age at marriage, household income, and number of siblings' children as affecting fertility rates among Singaporean women. Studies attempting to identify macro-level factors that contribute to the decline have been limited. Using an ordinary least squares (OLS) regression of time series data, Park (2005) finds a small but positive effect of the Qualified Child Relief (tax exemption for parents), where a 1% increase in the tax relief is associated with an increase in TFR of about 0.1%–0.2%. Lee and Ng (2012) reveal that infant mortality, total education expenditure, and female labor force participation are important determinants of fertility in Singapore. The authors also find long-term effects of these variables on fertility where infant mortality rate and total education expenditure take a negative sign, while female labor participation is positive. More recently, Subramaniam, Loganathan, and Devadason (2018) found negative and cointegrating relationships between fertility rates, income, infant mortality rates, and female labor force participation across major Association of Southeast Asian Nations (ASEAN) countries, including Singapore.

Despite theoretical expectations, housing variables often do not make it into these studies examining the causes of the fertility decline in Singapore. Singapore's housing market can be subdivided into two segments: public housing, where 81% of the population lived in 2018, and private housing estates. The supply of public housing is regulated by the HDB, and can be further subdivided into sold flats and public rental flats. Only 3% of the population resides in these public rental flats, but this figure has been growing over the past few years. Part of the reason why there is a significant public housing component in the market is due to the government's home ownership scheme introduced in 1964. It linked home ownership with affordable housing undergirded by principles of stability, affordability, financial security, and strong familial ties (Tan and Naidu 2014). The fact that a significant portion of the population lives in public housing provides an indirect pathway for the government to influence citizens' decisions on family formation.

In fact, housing has long been used to disincentivize and incentivize fertility in Singapore. In the 1970s, the government removed priorities given to large families in the allocation of public flats as part of a larger anti-natalist scheme (Palen 1986). However, this was eventually reversed and larger, more educated families came to be favored. The government has been using housing policy to shape fertility decisions as the historical emphasis on house ownership made housing a basic good among Singaporean households (Chua 1991, Teo 2010, Teo and Lin 2011). Policies are configured to construct “normal families” as house-owning families (Teo and Yeoh 1999). The HDB allows young couples to rent flats before the completion of their own flats to discourage delays in marriage and childbearing (Kong and Chan 2000). Young couples, compared to older couples, have access to rental flats and the resale market with some flexibility (Wong and Yeoh 2003). The government also actively discourage early-age singlehood—only those aged 35 and above have access to subsidized housing under the Joint Single Scheme or Orphans Scheme. Social policies are essentially directed at normal nuclear families.

Apart from rental flats, there also exists a market for private condominiums and a resale market of public flats. Prices are often pegged to the average household income to make housing affordable to a large chunk of the population (Phang 2001). Nonetheless, there is a perception of social mobility if families move from HDB flats to private condominiums (Sing, Tsai, and Chen 2006). Savings through the Central Provident Fund can be used to pay for an HDB flat, while the proceeds from its resale can finance the shift to a private residence. However, there are some restrictions concerning the trade in HDB flats, intended to constrain the ability of households to monetize the housing subsidies. These restrictions are essential to sustaining the principle of home ownership and ensuring that Singaporeans do not use “HDB units as investment vehicles” (Tan and Naidu 2014). In order for households to sell their flats in the resale market, a minimum occupation period of 2 to 7 years must be met, depending on how the flat was sold and the number of rooms. Another restriction is imposed on non-Singaporeans, non-Malaysian families, whose flats cannot be sold if the ethnic quota or permanent resident quota has been reached. Lastly, a resale levy of between S$15,000 to S$55,000 (depending on the flat type) is imposed on households who have received subsidies and wish to sell their flats.[3] Also, resale flats became a source of political contentions during the 2011 general elections and were further subjected to restrictions, such as higher stamp duties and higher total debt servicing ratio for borrowers who wish to buy a second flat (Tan and Naidu 2014).

Although there are restrictions, the existence of the HDB flat resale market means there is a permanent source of wealth for public house owners (Bardhan et al. 2003). The public resale market was estimated

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[3] More information can be found at: https://www.hdb.gov.sg/cs/infoweb/residential/selling-a-flat/financing/computing-your-estimated-sale-proceeds/selling-a-flat---resale-levy (accessed 19 September 2021).

to be five times larger than the private housing market at the beginning of the 21st century (Tu and Wong 2002). Resale applications increased to 23,714 in 2019 from just over 17,000 in 2014, a sign of recovery from a slump in the market in 2013. In fact, the resale volume has gone up even during the COVID-19 pandemic and a rise in resale prices has been recorded, reflecting optimism by buyers and sellers in the market (Ng 2020). In a market that exhibits a "property ladder" between highly subsidized public flats and new private residential properties, the housing wealth effect essentially makes the upward mobility on the ladder contingent upon the house prices (Sing, Tsai, and Chen 2006). This suggests that household mobility decisions, as found in developed economies, are affected by price fluctuations in public flats. In fact, consumption spending in Singapore is found to react more to changes in HDB flat resale prices than private flats, and this relationship has sharpened post-Asian financial crisis (Edelstein and Lum 2004).

Thus, the resale market in Singapore presents us with an opportunity to examine the ambiguous relationship between housing and fertility through the so-called "wealth effect". Resale prices, given their sensitivity to market forces, can be used to signal the widening in the gap between the actual and desired income since the baseline cost of producing quality children has also increased. In other words, the price fluctuation in the secondary housing market may indicate diminishing levels of wealth, owing to market constraints, leading households to decide on a smaller family size. We could thus expect a negative relationship between HDB flat resale prices and fertility. On the other hand, if the argument concerning the effect of HDB flats on wealth formation is true, then such wealth effects could actually encourage bigger family sizes. This could mean that HDB flat resale prices can also have a positive association with aggregate fertility rates.

2.3 Data and Methods

This chapter employs a multiple time series analysis to tease out the relationship between housing prices, income, and fertility. Similar to Lee and Ng (2012), the present study uses cointegration analysis, which allows for the analysis of at least two nonstationary time series. Unlike earlier studies, this chapter conducts a unit root test to establish stationarity at first differences, an important condition for cointegration analysis. Without a unit root test and checking cointegration relations, the apparent co-movement of the time series may be spurious and no meaningful interpretation can exist. For example, Park (2005) uses the original model specified by Whittington, Alm, and Peters (1990), which is thought to be a classic case of spurious regression (Crump, Goda, and Mumford 2011).

This study will also use a vector error correction model specified as follows:

$$\Delta X_T = a + \sum_{j=1}^{p} \Gamma_j \Delta X_{t-j} + \delta \beta'^{X_{t-1}} + e_t$$

Where X_t is the 3 x 1 vector including a measure of fertility rate, income and housing price, and e_t is the vector of error terms and is assumed to be serially uncorrelated after the appropriate selection of the lag length p. β is the cointegrating vector representing the long-run relationship between the two variables. δ is the adjustment parameter vector representing the speed of convergence to the equilibrium path. Short-run and long-run Granger causality effects are also tested using the Wald test.

The series used in this chapter are taken from publicly available sources in Singapore via the Ministry of Finance Government Technology Agency (https://data.gov.sg/) and the Department of Statistics Singapore (http://www.singstat.gov.sg/statistics) (see Table 2.1 for summary statistics and variable definition). The measure of fertility rate used in the analysis is the TFR, which refers to the average number of livebirths each resident female would have during her reproductive years if she were subject to the prevailing age-specific fertility rates in the population in the given year. This measure broadly captures information about income, education and even female labor participation that approximates the cost calculations entailed by making

Table 2.1: Summary Statistics of Total Fertility Rate and Housing Development Board Flat Resale Index

Variable	Definition	Observations	Mean	SD	Minimum	Maximum
TFR	Total fertility rate	30	1.39	0.22	1.14	1.83
Index	HDB resale index	30	92.17	36.87	24.7	146.7
Income	Gross National Income per capita	30	50,223.33	17,712.68	22,901	80,778

HDB = Housing Development Board, SD = standard deviation, TFR = total fertility rate.

Source: Ministry of Finance, Department of Statistics Singapore.

fertility decisions (Lee and Ng 2021, Wong and Yeo 2003). Using the TFR meets the requirement of time series being I(1).

The main dependent variable is housing prices measured as the HDB flat resale index. Currently, prices at acquisition is a measure hard to generate and teasing out the subsidies would be difficult. The HDB flat resale index is computed by the HDB and captures the overall price movements of the HDB resale flats, calculated using resale transactions registered across towns, flat types, and models. The index in the fourth quarter is used with observations from 1990 to 2019. The HDB flat resale prices are much more indicative of market demand and supply since public homeowners are allowed to sell their heavily subsidized public housing units in the public resale housing market at market prices (Yuen et al. 2006). Thus, the HDB flat resale index here encapsulates important information about housing such as housing characteristics, floor level, and qualitative features of the flat such as access to facilities and living environment (Fan, Ong, and Koh 2006), which are important variables that shape fertility decisions.

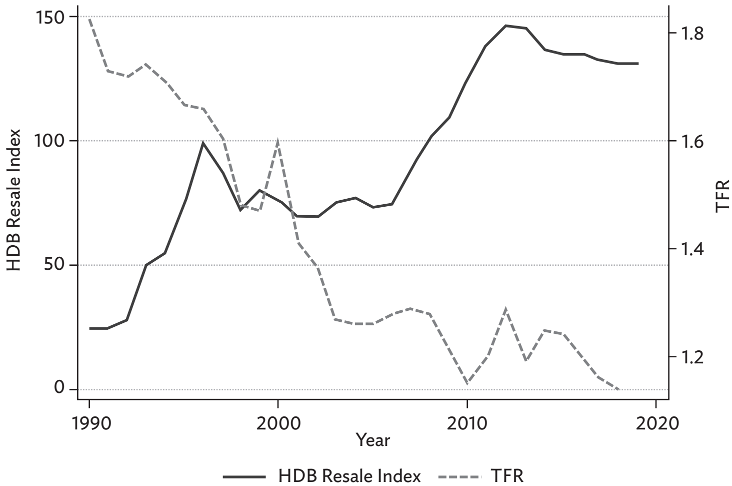
To control for other potential sources of wealth, a measure of income is included in the model. The gross national income (GNI) per capita at current prices is used as a proxy for the average income of Singaporeans. The GNI per capita is measured as the dollar value of a country’s final income in a year, divided by its population. We can expect a negative relationship between income and fertility, as income increases the opportunity cost of bearing children.

2.4 Results

By looking at the data, a co-movement between the three time series can be observed. Figure 2.1 indicates that the TFR decreased, while the HDB flat resale index increased for the same period. The TFR has been decreasing by 1.5% on average since 1990. There were only 6 years (1993, 2000, 2006, 2007, 2011, 2012 and 2014) in which the TFR posted a positive growth. The trend (in terms of the peaks and dips) is consistent with other measures of fertility, such as the gross reproduction rate. On the other hand, the HDB flat resale index and the GNI per capita grew at an average rate of 7% and 4.6% for the same period, respectively.

The co-movement of the time series can lead one to conclude that there is a cause–effect relationship, but it is important to first establish whether the time series has unit roots. A Perron unit root test was conducted using one lag for the first difference of the TFR, two lags for the GNI, and four lags for the first difference HDB flat resale index. The unit root test results show time series to be non-stationary at levels but stationary at the first difference (Table 2.2). This indicates that fertility

Figure 2.1: Total Fertility Rate and Housing Development Board Flat Resale Index (1990–2019)



HDB = Housing Development Board, TFR = total fertility rate.

Source: Author's computation.

Table 2.2: Unit Root Test

Variable	Perron-Stat	Unit Root Decision
TFR	−6.522***	I(1)
Index	−3.544**	I(1)
Income	−5.459***	I(1)

TFR = total fertility rate.

Note: *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

Source: Author's computation.

behavior follows a random walk process and that it might not be able to return to its former levels. This supports the use of the Johansen test for cointegration to derive long-run relationships between the time series.

At this point, a cointegration test is appropriate to determine the number of cointegrating equations. The trace test suggests only

Table 2.3: Results of the Johansen Tests for Cointegration

		TFR, Index, Income	
H_0	H_1	Trace Statistics	5% Critical Value
$r = 0$	$r = 1$	47.874	42.44
$r = 1$	$r = 2$	17.778*	25.32

TFR = total fertility rate.

Note: The lag length selection criterion is the Akaike information criterion (AIC). Includes a restricted trend in model. * statistically significant at 5%. An alternative test (Engle-Granger) reveals similar results for cointegration.

Source: Author's computation.

one cointegrating vector exists (Table 2.3). The null hypothesis of no cointegration is rejected, as the trace statistic is higher than the 5% critical value. This means that there is at least one cointegrating vector. Having a cointegrating vector at rank two is rejected since the critical value (25.32) is higher than the trace statistic (17.778). An alternative test based on the residuals using Engle-Granger (not reported) reveals similar results.

Using one cointegrating vector, the TFR coefficient is normalized to 1 using the error correction model with four lags. The estimated error correction term is reported in Table 2.4. The signs confirm a negative relationship between the HDB flat resale prices and fertility. A unit increase in the HDB flat resale index will result in a decrease in the total fertility rate of 0.0036, statistically significant at 1%. Similarly, a unit increase in income leads to a decrease in fertility of about −0.00002, significant at 5%. All variables are sensitive to disequilibrium. The variables have a tendency to come back together to the mean. However, the speed of adjustment is slow, as evidenced by a coefficient closer to 0 than $|1|$.

When short-run Granger causality is investigated, a feedback effect is found only between fertility rates and the HDB flat resale index, where resale housing prices Granger causes fertility rates. The error correction term is also statistically significant, suggesting that multiple time series have long-run effects on fertility. The HDB flat resale index does not have a short-run impact on the TFR or GNI per capita, but has a long-run Granger causality effect on the error correction term. On the other hand, income does not seem to have a short-run or a long-run Granger causal effect on fertility. The p-value is higher than the critical value of 0.5, which allows us to reject the null hypothesis of non-zero lagged values (Table 2.5).

Table 2.4: Estimates of Cointegration Equation and Adjustment Parameters for Total Fertility Rate

TFR	Index	Income
Cointegrating Equation		
1.00	−0.0036 (0.0012)***	−0.00002 (0.000)**
Adjustment Parameters		
−0.5061 (0.2322)**	85.2869 (35.4433)**	17,432.15 (12,397.27)

TFR = total fertility rate.

Note: Values given are coefficients (SE). Includes a restricted trend in model. Lag length selection criterion is the Akaike information criterion (AIC). *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

Source: Author's computation.

Table 2.5: Short-Run and Long-Run Granger Causality

	Short-Run			Long-Run
Variables	TFR	Index	Income	ECTt-1
TFR	–	9.07 (0.028)**	1.95 (0.582)	4.10 (0.042)**
Index	1.47 (0.688)	–	4.44 (0.218)	6.74 (0.009)*
Income	1.03 (0.793)	2.13 (0.546)	–	2.07 (0.150)

ECT = error correction term, TFR = total fertility rate.

Note: Values given are chi-squared (SE). Includes a restricted trend in model. Lag length selection criterion is Akaike information criterion (AIC). *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

Source: Author's computation.

Cointegration analysis assumes that the error terms are independent and normally distributed . Thus, there is a need to check auto-correlation and the normality of distribution of the residuals. As robustness checks, the residuals of the error correction regression are analyzed using the Jarque–Bera test for autocorrelation and the Lagrange multiplier test for normality. Table 2.6 presents the test statistics for autocorrelation with a null hypothesis of no autocorrelation at lag order 1. We do not reject the null hypothesis of no autocorrelation. Table 2.6 also displays the test statistics for all the equations jointly against the null hypothesis that there is univariate normal distribution. The high p-value (p = 0.648) indicates that we do not reject the null hypothesis of normality.

Table 2.6: Robustness Checks

Residual Diagnostics	
Langrange multiplier test for autocorrelation	
Equation-specific diagnostic	chi^2 = 5.234, p = 0.813
Jarque–Bera test for normality	
1st order	chi^2 = 4.211, p = 0.648

LM = Langrange multiplier.

Notes: The LM test statistic shown is for all equations. *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

Source: Author’s computation.

2.5 Discussion

This study provides evidence for the short-run and long-run links between housing and fertility decisions. It is consistent with previous studies in other Asian societies that established the negative relationship between house prices and fertility (Clark, Yi, and Zhang 2020; Yi and Zhang 2010). In particular, the chapter has found that the HDB flat resale price index, even when other measures of wealth are factored into the model, can negatively affect the aggregate levels of fertility. Given the use of the HDB flat resale index, it sought to confirm whether the wealth effects created by home ownership can increase the likelihood of having more children, as has been found in the US (Lovenheim and Mumford 2013). However, the Singapore case provides contrasting evidence. For households which have already been formed, the wealth effects generated by owning a public flat negatively shape fertility decisions.

Several factors may be behind the lack of a positive relationship between resale prices and fertility. First, the lack of a positive relationship could mean that house price inflation may not necessarily generate wealth effects. Phang (2004) found that house price inflation does not increase consumption owing to liquidity constraints and possible larger bequest motivations. This is exaggerated by the limited market for commercial loans in Singapore since the Central Provident Fund can be used for down payments (Phang 2001). The demand for greater flow of wealth from parents to children means that housing can be used for intergenerational wealth transfers rather than for residential mobility. Second, it could also mean that decisions to sell public flats are not only motivated by generating additional wealth, but also by social forces such as status seeking or perceptions of upward mobility (Ong and Sing 2002). For example, Tu, Kwee, and Yuen (2005) established that households with younger household heads, which have less access to alternative public housing units and more stable income, are more likely to move to private housing. Interestingly, household size negatively affects the likelihood to move because bigger families are probably less liquid given their higher non-housing consumption expenses (Tu, Kwee, and Yuen 2005). Third, the imposition of the minimum occupation period and the resale levy could be diminishing the wealth effect of price inflation on fertility. Considering the late age at marriage of Singaporeans, the 5-year occupation requirement may be functioning to de-couple the relationship between fertility and house prices observed in other contexts because of the difficulty of childrearing at a later age. The requirement also raises the age at which the upgrading can occur. Bank regulations concerning the maximum borrowing age significantly reduce the access to credit of households with older household heads. Thus, a mix of regulatory and market constraints to using the wealth generated from public house resale may be limiting the ability of house price inflation to encourage bigger family size.

Nonetheless, this study still provides evidence for the coupling of home ownership and fertility decisions. The relationship, though, may not be through wealth formation, as some studies have suggested. The negative relationship between the HDB flat resale index and fertility may be a confirmation of the assertion of economic theories regarding the increase in the cost of children. The findings of this study hold particularly for those households that had already been formed and had purchased their homes. For young homeowners in Singapore, increases in housing prices, given the constraints on resale, could have the effect of immediately dampening their fertility intentions because of the perceptions of foregone income. This is a possible mechanism in the short term, as shown by the bidirectional causality between price inflation and fertility rates, but such causality is not found between fertility and income.

2.6 Conclusion

The study confirms the theory that underpins the public and political discourse about the negative relationship of house prices and fertility in Singapore. House price is an important factor in making fertility decisions among Singaporeans. The cointegration analysis reveals a long-run effect of housing prices and income on fertility rates, which is consistent with the existing empirical studies (Lee and Ng 2012, Yi and Zhang 2010). Also, consistent with the theoretical assertions of Becker's new family economics and Easterlin's relative income hypothesis, an increase in house prices reduces the aggregate level of fertility. The results are robust even when different models of random walk are considered in the error correction regression. The subsequent tests for autocorrelation and normality of distribution suggest that the residuals are independent and can be used for cointegration analysis.

The study reponds to the call made by Zavisca and Gerber (2016) for more empirical work outside the US and Europe on the effects of housing on fertility. The study is also one of the first to systematically generate evidence on how housing prices can influence fertility decisions in Singapore. Previous studies may prove to be spurious owing to their inability to test for unit roots in time series. The findings of this study provide robust evidence for the popular "no flat, no child" belief prevalent among Singaporeans.

Policy makers in Singapore need to seriously consider this effect in crafting housing and population policies. The approach needs to be holistic and integrative so as to rethink the emphasis on home ownership within the framework of a normal family. Monetary incentives may prove inadequate if other aspects of family living in Singapore do not change significantly. The government needs to examine how housing affordability can be used as an instrument to drive fertility rates higher. It is important to acknowledge the finding that couples expecting house price inflation tend to correct their fertility by about 50% at the aggregate level. What this means is that the adjustment is slow, emphasizing short-run demand-smoothening measures as an immediate policy intervention to not only ease the price of HDB flats but also encourage early marriage, as well as childbearing and childrearing (Abeysinghe 2011). If little attention continues to be given to housing policies' effect on fertility, more direct pro-natalist policies may prove ineffective.

More broadly, housing policies should be folded into "reverse one-child policies", that incentivize larger families (Tan, Morgan, and Zagheni 2016). Although Singapore has adopted a priority scheme for families with three children, the current housing policy prioritizes younger couples, which essentially establishes housing as a precondition for marriage and childbearing—no flat, no child. These policies should be transformed to shape the tempo of family formation, by decoupling housing and marriage. Kohler, Billari, and Ortega (2006) suggested a mixture of housing-related financial incentives to decouple housing and marriage including mortgage reductions at the birth of each child. Building on Spain's housing and fertility crisis, Bernardi (2005) suggest interventions should take the form of promotion of "social and private renting sectors" that allows younger couples access to housing even before they are "financially ready" for investing in home ownership. Other policies can include subsidies for young single people in condominiums.

While the results are robust, there are, however, certain limitations to our analysis that make the findings indicative at best. The limited number of observations across time constrains the analysis in the sense that it does not include different cointegrating relations that could potentially exist if the time period under review was longer. Also, the use of lagged variables has been known to sometimes diminish the statistical power of the analysis. To help solve this, Singapore's government could provide the estimates of the HDB flat resale index pre-1990, but such estimations may be less accurate. It must be acknowledged that the analysis presented here is only a conditional or partial analysis, which is an inherent nature of cointegration analysis. Furthermore, data on women's wages and father's incomes would have completed the verification of the theoretical model, but adding other explanatory variables would have significantly reduced the efficiency and the strong restriction for variables to be I(1) will not allow for larger specification of the model. The restriction can be relaxed, as in the study by Lee and Ng (2012), but in that case the findings may turn out to be less robust and spurious, as the authors themselves admit. The short time series also limit the external validity of our findings, making the comparison of results with other studies difficult. Another limitation is the use of the GNI per capita as a measure of wealth derived from means other than housing. Although the GNI per capita has been used as a proximate measure of the level of development by the World Bank in classifying countries by income and by the United Nations Development Programme in measuring the human development index, it still remains a rough and imperfect measure. In particular, it may be a weak proxy for household income, depending on how it is conceptualized and measured (Nolan, Roser, and Thewissen 2016). Although imperfect, the GNI per capita performs better than the GDP per capita in the sense that it is closer to the measures of household consumption employed in surveys (Birdsall and Meyer 2015).

Furthermore, the chapter's findings could be better corroborated if survey data that can tease out the micro-behavior of households were used. More specifically, that would allow us to take into account the asymmetric appreciation of housing units and how it can result in a differentiated effect on fertility (Phang 2001). Future studies could extend the time series to improve validity of the findings. Housing affordability indices similar to the one proposed by Abeysinghe and Gu (2011) can be computed for HDB flats for a longer time frame. Also, studies abroad could examine whether the housing-fertility relationship is present in other economies that suffer from extremely low fertility rates, such as Taipei,China or the Republic of Korea. The impact on fertility in other economies with soaring housing prices like the PRC could also be a subject of future research.

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3

Consumption Profiles and the Aging of Populations: Insights from Virtual Married Households in Japan, Thailand, and the Philippines[1]

Maria Rebecca Valenzuela, Mikio Suga, and Yasuo Nakatani

3.1 Introduction

This chapter explores the use of household expenditure analysis to characterize the nature of population aging in Asia. The predicted declines in birth rates are now a stark reality for many economies in the region. Combined with the achievement of higher life expectancy rates, declining fertility rates have accelerated the aging of populations in the region, with predictions that the share of the population aged 65 years and over is expected to increase nearly two and half times in lower-middle and low-income Asia-Pacific countries in the next decades (OECD and WHO 2020). Notably, declining fertility rates have significantly altered household arrangements and consumption preferences. For example, as the need for extended family living has diminished—with fewer or no babies being born—grandparents and older relatives are much less required to assist new parents with caring

1 The National Survey of Family Income and Expenditure anonymous data used in this analysis were provided by the National Statistics Center, Japan. Thailand's Household Socio-economic Survey resampling data have been provided by the Statistical Information Institute for Consulting and Analysis and are a part of the international micro database maintained by the Institute of Statistical Mathematics in Tachikawa, Japan. Lastly, the Family Income and Expenditure Survey data were provided by the Philippine Statistics Authority.

for their young. The decline in fertility has also coincided with younger people becoming more geographically mobile, often creating more micro-size households of singles or couples living in dense city pockets. This has also increased the prevalence of older people living on their own, usually in bigger homes in less urbanized areas. Other related trends associated with declining fertility rates include delayed age of marriage, delayed parenthood, preference toward having a small family of just one or two children, or indeed, not having any children at all. All these accelerate the population aging process.

Given that governments need to plan to manage the demographic transition of their populations, we wondered about the extent to which the analysis of household expenditures could assist social planners and policy makers in understanding the nature of population aging and the drivers of fertility rate decline. In this context, we embarked on this study and sought answers to the following questions:

(i) When the structure or composition of households change, how do their consumption profiles change?
(ii) What do these observed changes in consumption mean for the aging of populations in the countries covered?

As we are interested in factors affecting fertility decisions, we focus our examination on how consumption profiles change when two single individuals are combined to form a married couple household. We ask:

- Is there a systematic rearrangement of expenditures that can be observed?
- How much money does a couple save by living together versus living apart?
- What percentage of the household's expenditure accrues to what spouse?
- What items in the consumption basket begin to take a larger share of the budget, and which ones are reduced?
- Finally, looking forward, what do these changes in consumption profiles and preferences mean for the aging of populations?

This chapter also makes an important methodological contribution to the literature. Conventionally, when using household expenditure data, individual welfare is analyzed by estimating consumer demand models. These models perform two key functions: (i) model how price and nonprice factors influence the consumption of goods and services in the household; and (ii) identify the consumption technology function that summarizes the extent to which each good is shared among the household members (in contrast to previous work that required goods to be purely private or purely public). There is a strong preference for this approach in the economics literature largely because it explicitly considers utility functions which satisfy "desirable" theoretical properties and empirically allows for a systematic method for incorporating demographic variables in the demand system. The most popular functional forms within this approach are (i) the Almost Ideal Demand System proposed by Deaton and Muellbauer (1980a, 1980b), and (ii) the Quadratic Almost Ideal Demand System model by Banks, Blundel, and Lewbel (1997).

While these demand-based models mitigate the need for strong restrictive theoretical assumptions of their predecessors, their empirical estimation has proved to be problematic. Specifically, studies have shown that they are generically econometrically unidentified. This means that the model parameters cannot be uniquely determined from the observable population that generates the data, which is why these models fail to adequately characterize the consumption sharing rule that applies to the members of the same household. Therefore, a vast volume of literature has evolved proposing several different approaches that try to circumvent this issue, including Browning, Chiappori, and Lewbel (2013), de Ree, Alessie, and Pradhan (2013), Nicholas, Ray, and Valenzuela (2010), Griffiths and Valenzuela (2004, 2006), and Hasegawa, Van Hoa, and Valenzuela (2004).

In this chapter, we propose an alternative approach for using expenditure data to make inferences about individual welfare. Specifically, we develop and introduce a statistical matching methodology to simulate family expenditure settings and analyze expenditures of synthetically created "virtual" households alongside those of real households. Our simulation model is more probability-based than economic theory-based, but recent studies have demonstrated the strong ability of this approach to produce economically sensible results (for example, Eurostat 2013, Conti, Marella, and Neri 2017, Suga and Nakatani 2020). We apply this approach to the micro record expenditure data from Japan (high-income country), Thailand (middle-income country), and the Philippines (low-income country). This will be the first study to undertake an integrated modeling of the link between aging population and consumption and/or demand structure for multiple countries in Asia.

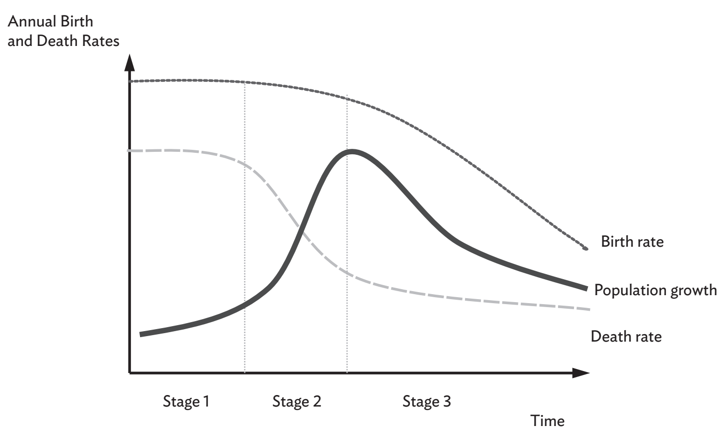
As will be seen, our empirical results are consistent with the consumer choice theory; they also provide insights into expenditure behavior that are not provided by the demand system approach. With regards to aging, our results show that policy settings and cultural environments are important determinants of shifts in expenditure preferences in restructured households, which, consequently, have an impact on the diverging rates and characteristics at which populations age. Lastly, our empirical results show that our methodology is a feasible alternative approach for conducting analysis of household demand.

The rest of the chapter has the following structure. Section 3.2 provides an overview of population aging in Asia and briefly discusses the trend in Japan, Thailand, and the Philippines—the three countries whose data we analyze in this chapter. This is followed by Section 3.3 describing the statistical matching methodology we introduce for constructing virtual households. Section 3.4 describes the data and presents some summary statistics. The statistical matching method is then applied to the data and subsequently analyzed in Section 3.5. The results are then discussed in the Section 3.6. Lastly, Section 3.7 summarizes and concludes.

3.2 Population Aging in Asia

Population aging is the term used to describe the changes in a country's population that occur as its median age increases due to the combined effects of declining fertility rate and rising life expectancy. In Figure 3.1, it corresponds to the Stage 3 segment of a population's demographic transition, where, by this time, older people take up a relatively high share of the composition. In Asia, the number of older people is rising at unprecedented rates, with as many as one in four persons predicted to be

Figure 3.1: The Demographic Transition Model



Source: Dowling and Valenzuela (2009).

over 60 years old by 2050 (UNESCAP 2017). On average, Asian citizens today live longer lives due to vast improvements in medical science and technology over the last few decades. At the same time, fertility rates have slowed mainly due to the increased uptake of the contraceptive pill and other forms of contraception, where this choice is driven by the higher opportunity costs of having children among younger, more educated couples, and the altered role of women in modern, less traditional households.

Life expectancies and fertility rates of countries in Asia, however, vary widely and individual economies are at different points of the demographic transition and aging process. Notwithstanding, there are some emerging trends by country groups. Generally, the high-income economies of Japan; Taipei,China; the Republic of Korea; Hong Kong, China; and Singapore are well advanced into the population aging process, with slow and/or negative population growths observed in recent years. This corresponds to Stage 3 in the demographic transition model depicted in Figure 3.1. Meanwhile, in Southeast Asia, Thailand and Malaysia are at the beginning of Stage 3, with their populations growing but at a rapidly declining rate; while the Philippines and Indonesia are in the middle of Stage 2, at which the populations continue to grow strongly.

Table 3.1 presents some statistics for the three countries covered in this study: Japan, Thailand, and the Philippines. Japan is the most populous, the most prosperous, and the also the most advanced in the aging process. A newborn in Japan today is expected to live to 84 years old, which is the highest life expectancy in the region. Data from the World Bank (2018) show that Japan's population shrunk by 2% in 2018, suggesting that the death rate is significantly lower than the already low birth rate. Japan is also noted to have a zero poverty rate and the lowest recorded inequality level in the group. In comparison, Thailand has less than half the population of Japan, with a per capita gross domestic product (GDP) that is just 16% of Japan's and a life expectancy that is 7 years shorter at 77. Furthermore, it has a 10% poverty rate and a level of income inequality that is 3.5 points higher than Japan's, using the Gini measure. The Philippines, on the other hand, is the second-most populous nation of the three, but is also the poorest, with an annual per capita GDP that is equivalent to 9% of that of Japan. The Philippines is also noted to have the highest poverty rate at 21.6% and a substantially higher Gini value of 44.4, indicating very high inequality levels compared to both Japan and Thailand.

The populations of Thailand and the Philippines have continued to grow in recent times, although the growth rates vary greatly—0.3% per year for Thailand and 1.4% per year for the Philippines. Given the smaller population size and higher life expectancy observed for

Table 3.1: Population Statistics: Japan, Thailand, and the Philippines (2018)

Country	Per Capita GDP ($)	Population Number (million)	Population Growth Rate (%)	Fertility Rate (total births per woman)	Life Expectancy (total years)	Head Count Ratio	Gini Index
Japan	41,150	126	−0.2	1.4	84	0	32.9
Thailand	6,600	69	0.3	1.5	77	10	36.4
Philippines	3,710	107	1.4	2.6	71	21.6	44.4

GDP = gross domestic product.
Source: World Bank (2018).

Thailand relative to the Philippines, it appears that the former is well ahead of the latter in the process of population aging.

Population aging is a part of the demographic transition process in which other related events are observed to take place as well. These include trends such as delayed marriage, higher rates of divorce, higher per capita incomes, higher educational attainment for women, and higher rates of labor force participation of women—all of which are observed in Asian countries with varying degrees of intensity. Several studies of developed countries in Europe suggest that these factors have influenced the decline in fertility rates there and may hint the same for Asia, but there is no consensus in the literature. Regarding fertility, for example, Becker (1960) was the first to suggest that the rise in income induced a fertility decline because the positive income effect on fertility was dominated by a negative substitution effect brought about by the rising opportunity cost of raising children. This proposition gained popularity soon after the paper was published and remains popular until today, although some recent studies have found the argument fragile from a theoretical and unsatisfactory from an intellectual viewpoint. The issue has not been settled in the economic literature.

Asian countries—including Japan, Thailand, and the Philippines—face significant challenges ahead as their populations age. For poor to middle-income countries such as Thailand and the Philippines, pension support for the elderly remains inadequate and it is often left to the family to take care of their aging family members. Furthermore, women are less likely than men to have adequate pension benefits or control over assets such as land in their old age, and yet, they are likely to outlive their spouses with less income to live on. Thus, a major challenge pertains to redressing the feminization of poverty among older women in the population.

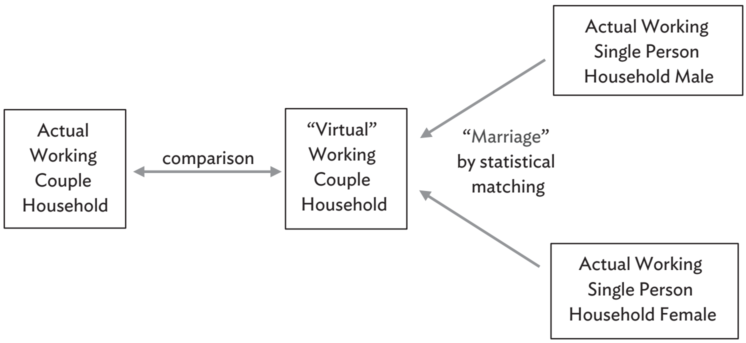
3.3 Statistical Matching Methodology

In recent years, there has been an increasing interest in statistical matching techniques applied to social surveys for providing more appropriate measures of households' economic well-being (see, for example, Donatiello et. al 2016; Conti, Marella, and Neri 2017; and López-Laborda, Marín-González, and Onrubia-Fernández 2020). Statistical matching is often employed to produce statistics on variables of interest that are collected in disparate surveys. It is applied mainly for the purpose of reducing survey costs through the use of the already existing data sources, as well as to minimize the response burden. International organizations like EuroStat and the World Bank have also considered statistical matching as a good tool for enhancing the information potential of the existing data sources.

Statistical matching—which is also known as data fusion, data matching, or synthetic matching—is a model-based approach for providing joint statistical information based on variables and indicators collected through two or more sources. In the standard approach, "similar" units from two or more statistical surveys are matched to enhance the complementary use of the data. The aim is to create a microdata file from different sources that have a set of variables in common but do not contain the same units or the same identifier. In our case, our matching occurs using information contained in a single survey—an approach that is uniquely designed for the study of changes in consumption behavior arising from changes in household composition. Here we use a non-parametric approach similar to the nearest neighbor matching methodology described and implemented in the study by D'Orazio, Di Zio, and Scanu (2006) and its predecessors Okner (1972), Ruggles and Ruggles (1974), and Rodgers (1984). Our aim is to create, using our set of matching criteria, synthetic households consisting of a single male and a single female who are statistically paired and considered the "closest" match to each of the actual couple households in the data, as depicted in Figure 3.2. In our empirical application, we match characteristics based on two criteria: income and age.

To implement the procedure, we follow Suga and Nakatani (2020) and describe the process using the following notation. First, let y denote income and a denote age, and let us use superscripts c and s to identify couple and single household types, respectively. Further, we let m and f refer to male and female household members, respectively—the lower subscript j refers to household identification number. For example, y_j^{cm} denotes the wage and salaries income of the male member of the j^{th} dual-income couple household. Similarly, y_j^{vf} denotes the wage

Figure 3.2: Creating Virtual Households



Source: Prepared by the authors.

and salaries income of the female member of the j^{th} virtual couple household. In our empirical applications, the wage and salaries income is continuous data and the age is discrete data.

Using information on incomes y and ages a, we can then define the distance functions d_{jk}^{m} and d_{jl}^{f} that are necessary to achieve the best possible matches in the procedure.

$$d_{jk}^{m} = w_y \cdot \left|y_j^{cm} - y_k^{sm}\right| + w_a \cdot \left|a_j^{cm} - a_k^{sm}\right| \qquad j = 1,\cdots,n^c, k = 1,\cdots,n^{sm} \quad (1)$$

$$d_{jk}^{f} = w_y \cdot \left|y_j^{cf} - y_k^{sf}\right| + w_a \cdot \left|a_j^{cf} - a_k^{sf}\right| \qquad j = 1,\cdots,n^c, k = 1,\cdots,n^{sf} \quad (2)$$

$$w_y \sim N(\mu_y, \sigma_y^2),\ w_a \sim N(\mu_a, \sigma_a^2),$$

Here, d_{jk}^{m} denotes the distance between the male in the couple household and any single male in the sample; and d_{jl}^{f} denotes the distance between female in the couple household and any single female in the sample; w_y and w_a represent the weights of income and age, respectively, in the distance function, and n is the number of households. Note that these distance values are calculated for all possible pairs of married and single males, and all possible pairs of married and single females, and are jointly determined by the absolute differences in incomes and ages of the two paired individuals. Note further that the weights w_y and w_a are normal random variables that follow the normal distribution with mean μ and variance σ^2. This implies that the distance values change stochastically and that the calculation results change with each simulation.

The best match is statistically determined by minimizing the distance functions d^m_{jk} and d^f_{jl}, where the minimum distance functions are expressed by the following equations:

$$\hat{d}^m_{j\hat{k}} = \min\left\{d^m_{j1}, \cdots, d^m_{jn^{sm}}\right\} \qquad j = 1, \cdots, n^c \tag{3}$$

$$\hat{d}^f_{j\hat{l}} = \min\left\{d^f_{j1}, \cdots, d^f_{jn^{sf}}\right\} \qquad j = 1, \cdots, n^c \tag{4}$$

Accordingly, $\hat{d}^m_{j\hat{k}}$ denotes the smallest distance between the j^{th} married male and the $\hat{k}^{\text{th}}$ single male, while $\hat{d}^f_{j\hat{l}}$ denotes the smallest distance between the j^{th} married female and the $\hat{l}^{\text{th}}$ single female. Thus, for each married couple in the sample, we assign the single male and single female whose distance values in (3) and (4) are the smallest from the j^{th} married male, and the j^{th} married female. This pair makes up the virtual household that corresponds to the j^{th} married couple. This procedure is similar to the nearest neighbor hot deck procedure in the conventional statistical matching setting where closeness is measured by means of a distance computed on a suitable subset of matching variables.

We can then proceed to conduct an expenditure analysis, for which we define the expenditure E^V_{ij} of the i^{th} item of the virtual household v, as follows:

$$E^V_{ij} = E^{sm}_{i\hat{k}} + E^{sf}_{i\hat{l}} \qquad i = 1, \cdots, n^E, j = 1, \cdots, n^c \tag{5}$$

By calculating the difference between the consumption expenditure of this virtual household and the consumption expenditure of an actual household, it is possible to estimate the influence of the change in household structure on item-specific consumption expenditure.

3.4 Data

In this chapter, we apply our statistical methodology to investigate the extent to which the analysis of household expenditures is able to help us understand the nature of population aging in Japan, Thailand, and the Philippines. Specifically, the chapter investigates behavioral changes in spending that can impact each country's fertility rates in the future. We first discuss our microdata sets.

For Japan, we used the 2004 wave of anonymized unit record data from the National Survey of Family Income and Expenditure (NSFIE). The NSFIE is conducted by the Statistics Bureau of Japan every 5 years since 1959 and aims to acquire comprehensive information concerning household consumption, through survey items such as income and expenditure, savings and liabilities, major durable goods owned and the status of dwellings, houses and land owned. It covers about 57,000 sample households and allows detailed analyses by location or area, by household type, and by characteristics such as income, age, and other labor force characteristics. For Thailand, we used expenditure data from the 2011 Household Socio-economic Survey conducted by the National Statistical Office. The survey covered 47,000 household samples in both municipal and nonmunicipal areas in every province of the country, and provides detailed information on income, expenditure, debt and asset of households, as well as their housing characteristics. In the survey, the expenditure data refer to expenditures on necessary items for daily life, and thus excluded savings and capital formation expenditure. For the Philippines, we used household unit records from the 2009 round of the Family Income and Expenditure Survey (FIES) implemented by the Philippines Statistics Authority. The FIES is designed to obtain details regarding expenditure, income and a wide range of demographic characteristics of private households in the Philippines on a nationwide basis. The information on demographic characteristics, income and infrequent expenditure items (e.g., vehicle and property purchases, household bills) were obtained through personal interviews, and details concerning all other expenditure by each household member, 15 years old or older, during a 2-week period, were recorded in personal diaries. The public-use files were representative of the Philippine population and the sample of households enumerated evenly over the respective 12-month period.

We choose an analytical sample from each of these three microdata sets. First, all households with one and two members are selected. To ensure the sharing of expenses and homogeneity, we further exclude all two-member households which do not consist of married or cohabitating couples. Furthermore, all individuals in the sample—married or single—need to be working. By "working", we mean earning an income, inclusive of wages or salaries and earnings from all entrepreneurial activities. To ensure even more homogeneity in the expenditure profiles, we also exclude outright homeowners (who do not pay rent) and those who regularly send remittances outside the household. The numbers of households analyzed in this study are summarized in Table 3.2.

Table 3.3 presents further summary statistics on income and age of individuals in the analytical samples. For Japan, we see that married and single males have incomes that are comparable (around ¥300,000 per month); while for females, we observe a large discrepancy between the incomes of married females and single females—with single females having an average income that is 50% higher than the average income of their married counterparts. Single females also appear older than the rest of the sample by about 5 years.

Table 3.2: Number of Households in the Analytical Sample, by Type and Country

Country	Date Source	Year	Dual income couple household	Single-person household	
				Male	Female
Japan	National Survey of Family Income and Expenditure	2004	608	782	571
Thailand	Household Socio-economic Survey	2011	213	218	209
Philippines	Family Income and Expenditure Survey	2009	91	88	45

Source: Prepared by the authors.

Table 3.3: Descriptive Statistics of Analytical Sample, by Country, Household Type and Gender

	Male		Female	
	Dual income couple household	Single-person household	Dual income couple household	Single-person household
Japan (2004)				
Mean income (¥)	301,837	297,207	148,929	220,494
	(118,793)	(114,261)	(96,630)	(104,199)
Mean age	30–34	30–34	30–34	35–39
Thailand (2011)				
Mean income (B)	9,297	9,993	7,758	9,217
Mean age	36.4	35.1	34.2	35.8
Philippines (2009)				
Mean income (₱)	6,170	9,166	5,467	9,060
	(5,436)	(8,810)	(6,194)	(15,120)
Mean age	42.45	38.70	40.93	50.13
	(13.32)	(12.95)	13.72)	(16.71)

Notes: Incomes are per month. Values in ( ) are the standard deviations.
Source: Prepared by the authors.

For Thailand, we also see that married and single males have incomes that are comparable (around B9,000 per month), and similar to Japan, there is a large discrepancy between the incomes of married and single females—with single females having an average income that is 70% higher than the average income of married females. In both male and female comparison groups, there are no large differences in the average ages.

For the Philippines, single males and single females appear to have similar income profiles, with each group earning an average of ₱109,000 per year in 2009. Similar to Japan, single Filipino females are older (by some 10 years) compared to married females and all the males.

3.5 Statistical Matching and the Creation of Virtual Households

The first step in performing a statistical matching approach using the nearest neighbor technique is to determine the weight of the distance function. Given completely available information (that is, no imputation required), we estimate the weight by regression analysis. Specifically, for the dual income couple households, we conducted a regression analysis with no intercept, such as expressed by the following formula below:

$$x_j^c = w_y \cdot y_j^c + w_a \cdot a_j^c + u_j \qquad j = 1, \cdots, n^c \tag{6}$$

Here, y_j^c denotes the total earned income of the j^{th} dual income couple household, a_j^c is the average age class of the j^{th} couple, and x_j^c is the consumption expenditure of the j^{th} dual income couple household, and u_j is the error term. Table 3.4 presents the estimation results of the regression analysis. All estimated parameters are statistically significant, and adjusted R squares are over 0.7 for all the country regressions.

To implement the statistical matching procedure, we take the following steps:

Step 1: Take the weight values and associated standard errors from the regression model estimated in the previous section.

Step 2: Generate uniform random numbers from 0 to 1.

Step 3: Calculate the value of the inverse function of the cumulative distribution function of the normal distribution with respect to the average (regression coefficient) and the standard deviation (standard error) specified as the probability and set this as the weight for each.

Step 4: Repeat Step 3 100 times to ensure strong matching results.

Table 3.4: Estimation Results of Regression Analysis

		Japan 2004	Thailand 2011	Philippines 2009
R square		0.738	0.894	0.906
Adjusted R square		0.736	0.890	0.893
Number of observations		608	213	224[a]
Weight of total earned income	coefficient	0.415	0.496	1.0670
	std. dev.	0.031	0.032	0.053
	t-value	13.37	15.403	20.153
Weight of average age of couple	coefficient	11,834	110.9	77.102
	std. dev.	1,797	16.6	209.89
	t-value	6.59	6.7	0.367

[a] The sample size of double-income-couple households in the Philippines was relatively small; therefore, single-person households were added to the pool without a loss of generality.

Source: Prepared by the authors.

We apply these steps to the chosen households from each survey to obtain a statistically paired single male and female, for every observed couple in the data set. We call the paired singles "virtual couple household."

3.6 Results and Analysis

In this section, we present results of our expenditure analysis for the various data sets.

Japan. Table 3.5 shows results obtained using the microdata set of the 2004 wave of Japan's NSFIE. Given that income is one of the two key matching criteria we used in the process, the total earned income of actual and virtual couple households appear very comparable, as expected. Regarding consumption, the total expenditures are significantly different—that is, the total consumption for actual couples is 9% smaller than that of virtual couples. This was also expected and can be attributed to well-known gains in economies of scale enjoyed by larger households. Item-specific gains in economies of scales are well captured in Table 3.5. The tabulated results show that large potential savings can be achieved in marriage for most items, including food (26%); culture and recreation (30%); clothing and footwear (18%); fuel, light, and water (17%); and housing (16%).

Table 3.5: Expenditures: Actual and Virtual Households, Japan (2004) (¥ per month)

Expenditure Item	Actual household	Virtual household		Difference	Difference rate (%)
		Mean	SD		
Earned income	462,809	464,058	67	–1,249	0
Total consumption	295,199	324,829	975	–29,629	–9
Food	57,457	77,221	130	–19,765	–26
Raw fish and shellfish	2,521	1,240	3	1,281	103
Raw meat	3,026	1,354	5	1,672	123
Fresh vegetables	3,795	2,278	2	1,517	67
Cooked food	6,547	12,113	18	–5,565	–46
Beverages	3,466	7,943	8	–4,477	–56
Eating out	17,989	28,767	78	–10,779	–37
Other foods	20,113	23,526	-	–3,413	–15
Housing expenditure	51,796	61,720	994	–9,924	–16
Fuel, light, and water charges	12,349	14,842	14	–2,493	–17
Furniture and household utensils	6,393	5,335	7	1,058	20
Clothing and footwear	13,750	16,745	18	–2,996	–18
Health care	8,434	8,582	16	–148	–2
Transportation and communications	52,139	52,932	73	–793	–1
Education	2	0	0	2	-
Culture and recreation	30,779	43,769	108	–12,990	–30
Other consumption expenditure	62,101	43,683	27	18,418	42
Tobacco	1,478	4,442	28	–2,964	–67
Pocket money	19,093	818	14	18,274	2,234
Others	41,530	38,423	-	3,107	8

SD = standard deviation.

Note: A shorter version of this table first appeared in Suga and Nakatani (2020).

Source: Prepared by the authors.

A closer inspection of the food category reveals a high variability in consumption changes across the various food items. For example, we find that actual married couples spend twice as much money on fresh perishable good—particularly raw meat and seafood—compared to virtual couples. Virtual couples meanwhile spend twice as much on cooked food, beverages, and eating out compared to their married counterparts. Put together, these capture the change in eating lifestyle that occurs when singles come together in marriage—that is, singles shift their food consumption from outside the home to inside the home, choosing to spend more time preparing food and cooking at home, once married.

Another point of interest is the item labeled "Other consumption expenditure", for which expenditure increased by 42% with marriage. A breakdown of this expense category reveals the presence of a large "pocket money" subitem for actual married couples, which is practically nonexistent in the budget of the singles matched into virtual households. This expense accounts for 32% of the total "Other consumption expenditure" for married couples, and is tricky to account for among singles without further information. A tobacco subitem shows a 67% drop in consumption with marriage and indicates the existence of strong incentives to stop smoking when a person's status shifts from being single to married. That said, tobacco constitutes less than 3% of the total outlay for this category, so the magnitude of changes in its consumption seen here is not sufficient to overturn the diseconomies of scale in consumption caused by pocket money and the "Others" item, which dominate this category of expenditure.

Thailand. The next set of tables present results using the 2011 wave of Thailand's Household Socio-economic Survey microdata set. Table 3.6 presents results for 11 broad commodity groups, excluding food. First, we see that actual couples spend 23% less in total nonfood consumption compared to virtual couples. Potential savings come from the significant reductions in the following major household expenditure items: housing expenses or rent (potential savings of about 44%), household operations expenses (about 30%), clothing expenses (about 65%) and personal care expenses (about 41%).

These observations are consistent with the expected gains in economies of scale when two singles form a single expenditure unit. In contrast, diseconomies of scale in marriage (or cohabitation) are observed in the items of medical and health care expenses (which increased by 43%) and transportation and communications (which increased by 18%). The observed diseconomies of scale in medical expenses require further investigation. As for transport and communications, the discrepancy can be explained by the limited ways in which transport fares and mobile

Table 3.6: Nonfood Consumption Expenditures of Thai Households (2011)

Expenditure Item	Actual household	Virtual household	Difference	Difference rate (%)
Total consumption	7,329	9,516	–2,189	–0.23
Housing (shelter)	1,775	3,223	–1,448	–0.45
HH operation, furniture, and equipment	773	1,107	–334	–0.30
Service workers in household	0	4	–4	–1.00
Cloth, clothes, and clothing material	222	636	–414	–0.65
Footwear	19	112	–93	–0.83
Personal care	530	913	–383	–0.42
Medical and health care	129	90	39	0.43
Transportation and communications	3,670	3,108	562	0.18
Education expenses	9	37	–28	–0.76
Recreation/religious activity expenses	187	281	–95	–0.34
Special ceremony expenses	15	6	9	1.50

HH = household.

Source: Prepared by the authors.

Table 3.7: Expenditure on Food, Thailand (2011) (B per week)[a]

Expenditure Item		Actual household	Virtual household	Difference	Difference rate (%)
1. Grains and cereal products	(cash)	92	95	–3	–0.03
	(in-kind)	9	7	2	0.29
2. Meat and poultry	(cash)	84	83	1	0.01
	(in-kind)	1	0	1	0.00
3. Fish and seafood	(cash)	55	27	29	1.07
	(in-kind)	2	1	2	2.00
4. Milk, cheese, and eggs	(cash)	25	44	–19	–0.43
	(in-kind)	0	0	0	0.00

continued on next page

Table 3.7 *continued*

Expenditure Item		Actual household	Virtual household	Difference	Difference rate (%)
5. Oil and fat	(cash)	17	8	9	1.13
	(in-kind)	0	0	0	0.00
6. Fruit and nuts	(cash)	63	84	–21	–0.25
	(in-kind)	3	5	–2	–0.40
7. Vegetables	(cash)	53	27	26	0.96
	(in-kind)	1	1	1	1.00
8. Sugar and sweets	(cash)	31	32	–1	–0.03
	(in-kind)	4	1	3	3.00
9. Spices and condiments	(cash)	17	11	6	0.55
	(in-kind)	0	0	0	0.00
10. Nonalcoholic beverages (consumed at home)	(cash)	9	11	–2	–0.18
	(in-kind)	0	1	–1	–1.00
11. Prepared food (consumed at home) (prepared products)	(cash)	63	130	–67	–0.52
	(in-kind)	2	3	–1	–0.33
11. Prepared food (consumed at home)	(cash)	285	440	–154	–0.35
	(in-kind)	7	13	–6	–0.46
12. Food and nonalcoholic beverages (consumed away from home)	(cash)	284	438	–154	–0.35
	(in-kind)	31	56	-25	–0.45
13. Alcoholic beverages (consumed at home)	(cash)	23	41	–18	–0.44
	(in-kind)	0	3	–3	–1.00
13. Alcoholic beverages (consumed away from home)	(cash)	8	24	–17	–0.71
	(in-kind)	0	1	–1	–1.00
Total		1,206	1,637	–431	–0.26

B = bhat.

[a] We report no variation in virtual household values, as Step 3 in the statistical matching process was applied once only for the Thai data.

Source: Prepared by the authors.

phone expenses can be shared between individuals, even when they live as a couple in the same household.

Table 3.7 presents detailed results for food expenditures in Thai households, both in cash and in-kind. Recall that, in total, actual couples spend 26% less on food consumption than virtual couples. A more detailed inspection of this expenditure category is warranted for greater insight.

A closer inspection shows that, for the virtual couples, the largest share of their food budget is taken by food and nonalcoholic beverages consumed away from home (comprising 28%) and the purchase of precooked and freshly cooked food consumed at home (comprising 8% and 29%, respectively). A small amount of the food budget is spent on grains and cereal products (6.2%), meat and poultry (5.4%), and fruits and nuts (5.5%). These items account for 74% of a virtual couple's budget, and the rest is spread over a wide range of smaller food and beverage items. In contrast, we can see that among married couples raw and perishable food is of greater importance. Expenditure on meat and poultry, for example, occupies a larger share in their household budget (5.4 in virtual vs 7.0 in actual). Also, the expenditure on raw fish and seafood, as well as on fresh vegetables, is twice as large both in value and share for actual married couples.

These results provide another evidence showing that consumption behavior on food—from eating out to home-cooking—is likely to happen with marriage, which is what we have observed from the Japanese data earlier. Thus far, we find that in Japan and Thailand, it is highly likely that when single individuals begin to live together as a couple (in marriage), the newly formed couple unit will tend to cook and eat at home more, and thus reduce their expenses for eating out.

Lastly, for Thailand, we return to the item of medical expenditure, for which we found large diseconomies of scale in marriage (Table 3.6). We inspect this expenditure item in greater detail and present some analysis based on Table 3.8.

We see that for virtual couples, 84% of the budget for medical expenditure goes to modern medicines (57%) and private clinic hospital expenses (27%). In contrast, for actual married couples, the budget share of these items is reduced to 31% and 22%, respectively. We further observe a substantial increase in the budget share of condoms and other contraceptives, from a small share of 4.4% for virtual couples to 23% for actual married couples. The expenditure share of vitamins in the married couple's budget also increases to 15.5% from a small percentage of 4.4% for virtual couples.

By looking at more detailed subcategories of expenditure, the diseconomies of scale observed in the broad category of medical and

Table 3.8: Expenditure on Medical and Health Care, Thailand (2011) (B per month)

Expenditure Item			Actual household	Virtual household	Difference	Difference rate (%)
Medical supplies	Modern medicine	(cash)	40	51	–11	–21.6
		(in-kind)	0	3	–3	–100.0
	Traditional/ herbal medicine	(cash)	3	0	3	–
		(in-kind)	0	0	0	–
	Contraceptives and condoms	(cash)	30	4	26	650.0
		(in-kind)	0	0	0	–
	Vitamins	(cash)	20	4	16	400.0
		(in-kind)	0	0	0	–
	First aid kits/ medical equipment	(cash)	1	0	0	–
		(in-kind)	0	0	0	–
	Public health center/public hospital	(cash)	1	0	1	–
		(in-kind)	0	0	0	–
Medical services (outpatients)	Private clinic/ hospital	(cash)	28	24	4	16.7
		(in-kind)	0	0	0	–
	Traditional healer/medical services	(cash)	0	1	–1	–100.0
		(in-kind)	0	0	0	–
	Private dental clinic	(cash)	6	0	6	–
		(in-kind)	0	1	–1	–100.0
	Optometry services and equipment	(cash)	0	0	0	–
		(in-kind)	0	0	0	–
	Other health services	(cash)	0	0	0	–
		(in-kind)	0	0	0	–
Medical services (in-patients)	Public health center/public hospital	(cash)	0	0	0	–
		(in-kind)	0	0	0	–
	Private clinic/ hospital	(cash)	0	2	–2	–100.0
		(in-kind)	0	0	0	–
	Other expenses	(cash)	0	0	0	–
		(in-kind)	0	0	0	–
Total			129	90	39	

B = bhat.

[a] We report no variation in virtual household values, as Step 3 in the statistical matching process was applied only once for the Thai data.

Source: Prepared by the authors.

health care can now be better understood. It is not surprising to see that individuals, once married, will want to control their fertility levels and thus spend money on condoms and other contraceptives. We do not see the level of expense among singles that would, perhaps, be expected in less traditional, western economies, because sex outside marriage is still a taboo in Thailand, or is, at least, not openly accepted. As regards the diseconomies of scale in vitamin consumption, the difference may reflect a higher consciousness concerning health among actual married couples compared to virtual couples.

Philippines. Expenditure analysis for the Philippines is presented in Tables 3.9–3.11. The results indicate that significant savings through economies of scale are achieved when two single individuals join up in marriage. From Table 3.9, we can see that actual couples spend 12% less in total consumption compared to virtual couples. A closer inspection reveals that for virtual couples, 52% of the budget goes to food, followed by gifts and contributions, which take up 12.6%, and transportation and communications, which take up another 10.4% of the budget. The remaining 25% of the budget is spread across the rest of the items. For actual couples, some differences are observed—food takes a slightly larger share of the budget (54%), while the share of transport and communications, and gifts and contributions are now both under 10 % (9.3% and 9.7% respectively). The gains in economies of scale appear strongest in the case of education expenses (some 96%), followed by house maintenance and repair (53%), gifts and contributions (32%), transportation and communications (21%), further followed closely by personal care and effects (19% less). In contrast, we observed diseconomies of scale in the medical expense area, where the potential increase is about 1% when two singles join together to form a couple household. Another expense item exhibiting similar trend is durable furniture and equipment, which has been observed to increase by 231%.

Similar to Japan and Thailand, food is an area of expenditure where Philippine households gain significant economies of scales. Table 3.10, however, indicates that not all food items make a positive contribution to these gains. When Filipino singles join up as a couple household, gains in economies of scale are made in grains and cereals (52%), in leafy vegetables (28%), and in hot beverages (28%). At the same time, however, we see diseconomies of scale in expenditures on meat (this expense is higher for actual married couples by 144%), on processed fruit (28%), and on fresh fruit (11%). These suggest a significant shift in consumption behavior, from buying foods for consumption outside the home to the purchase of raw foods for home cooking. This is confirmed

Table 3.9: Expenditure on Broad Commodity Groups, Philippines (2009)[a] (₱ per week)

Expense item	Actual household	Virtual household	Difference	Difference rate (%)
Food	4,762	5,248	–486	–9.3
Fuel, light, and water	720	832	–112	–13.5
Transportation and communications	825	1,044	–219	–21.0
Household operation expenditure	215	251	–36	–14.3
Personal care and effects	451	555	–104	–18.7
Clothing, footwear, and other wear	275	308	–32	–10.4
Education	5	153	–147	–96.1
Recreation	29	31	–2	–6.5
Medical care	320	125	195	156.0
Nondurable furnishings	32	37	–5	–13.5
Durable furniture and equipment	193	58	134	231.0
House maintenance and repair	20	42	–22	–52.4
Special family occasion	172	116	56	48.3
Gifts and contributions	861	1,267	–406	–32.0
Total	8,880	10,067	–1,186	–11.8

[a] We report no variation in virtual household values, as Step 3 in the statistical matching process was applied only once for the Philippine data.

Source: Prepared by the authors.

by the figures in the last panel of Table 3.10 where we show that married couples spend less on food outside the home and on meals at restaurants. We further note that this finding is consistent with those for Japan and Thai households.

Table 3.10: Expenditure on Food by Type, Philippines (2009)[a] (₱ per week)

		Actual household	Virtual household	Difference	Difference Rate (%)
Grains and cereals	(cash)	914	966	–52	–5.4
Grains and cereals	(in-kind)	91	94	–3	–3.2
Bread	(cash)	131	127	4	3.1
Bread	(in-kind)	14	2	12	600.0
Fruit	(cash)	341	313	28	8.9
Fruit	(in-kind)	50	57	–7	–12.3
Fresh fruit	(cash)	133	122	11	9.0
Fresh fruit	(in-kind)	15	18	–3	–16.7
Leafy vegetables	(cash)	55	83	–28	–33.7
Leafy vegetables	(in-kind)	17	18	–1	–5.6
Total meat	(cash)	545	401	144	35.9
Total meat	(in-kind)	16	25	–9	–36.0
Dairy	(cash)	318	241	77	32.0
Dairy	(in-kind)	4	7	–3	–42.9
Fish and marine	(cash)	471	411	60	14.6
Fish and marine	(in-kind)	23	12	11	91.7
Fresh fish	(cash)	384	323	61	18.9
Fresh fish	(in-kind)	22	11	11	100.0
Coffee, cocoa, tea	(cash)	115	143	–28	–19.6
Nonalcoholic beverages	(cash)	175	188	–13	–6.9
Food outside home	(cash)	1,054	1,332	–278	–20.9
Meals at restaurants	(cash)	93	166	–73	–44.0
Alcoholic beverages	(cash)	110	112	–2	–1.8

[a] We report no variation in virtual household values, as Step 3 in the statistical matching process was applied only once for the Philippine data.

Source: Prepared by the authors.

In Table 3.11, we demonstrate that Philippine actual couples appear unique in their spending pattern for medical and health items, which is higher by almost two-thirds than that of virtual couples. Furthermore, we see that married couples incur expenses related to hospital room charges, whereas this type of expenditure was non-existent in the case of singles. Expenditure on other medical charges also increases significantly.

We believe that these new hospitalization and other medical charges are most likely the costs associated with births or giving birth. This makes particular sense when compared to the case of Thai couples, who, instead, increase their expenditure on contraception aids upon

Table 3.11: Health Expenditure Items, Philippines (2009)[a]
(₱ per month)

Expenditure item		Actual household	Virtual household	Difference	Difference rate (%)
Total medical care		**320**	**125**	**195**	**156.0**
Total medical care	(cash)	218	88	130	147.7
Total medical care	(in-kind)	11	37	–26	–70.3
Drugs and medicines	(cash)	61	57	3	5.3
Hospital room charges	(cash)	121	0	121	-
Medical charges	(cash)	99	2	97	4,850.0
Dental charges	(cash)	5	6	–1	–16.7
Other medical goods and supplies	(cash)	13	6	8	133.3
Other medical goods and services	(cash)	2	0	2	-
Contraceptive pills	(cash)	3	2	1	50.0
Food supplements	(cash)	4	14	–10	–1.4
Drugs and medicines	(in-kind)	2	21	–19	–90.5
Hospital room charges	(in-kind)	0	13	–13	–100.0
Medical charges	(in-kind)	0	1	–1	–100.0
Dental charges	(in-kind)	0	0	0	-
Other medical goods and supplies	(in-kind)	0	0	0	-
Other medical and health services	(in-kind)	0	0	0	-
Contraceptive pills	(in-kind)	0	0	0	-
Food supplements	(in-kind)	0	0	0	-

[a] We report no variation in virtual household values, as Step 3 in the statistical matching process was applied only once for the Philippine data.

Source: Prepared by the authors.

marriage. Newly coupled/married individuals in the Philippines and Thailand are similar in the sense that they aim to control fertility after they start to live together. Unlike in Thailand, however, Philippine households face severe accessibility issues that prevent them from using contraceptive pills and/or condoms when they become sexually active. Pills and condoms are not freely available to couples in the Philippines, and their use is generally frowned upon by the Catholic society around them. In contrast, contraceptive aids in Thailand are much more accessible and affordable. These results and conclusions are very plausible and consistent with the relative fertility rates of the two countries—2.5 births per woman in the Philippines vs 1.5 births per woman in Thailand.

Lastly, in this section, we present our estimates of adult equivalence scales (AES). For actual couples, this is simply equal to the ratio of the total expenditure divided by two. For virtual couples, the equivalence scale is computed as the sum of the total expenditure of the single male and the total expenditure of a single female divided by two. AES indicate that additional resources are required by the household with a unit change in its composition, so that the members can maintain their standard of living. An AES value of 1.82 thus suggests that a shift from a one- to a two-member household will generate the need for an 8% increase in income so that neither the male nor female in the new couple household will suffer any loss of living standard. The results are found in Table 3.12.

Table 3.12: Estimates of Equivalence Scales, by Country

Country Data Source / Household Type	1 Adult	2 Adults
Japan 2004	1.0	1.82
Thailand 2011	1.0	1.57
Philippines 2009	1.0	1.48

Source: Prepared by the authors.

The fact that the AES values are <2 shows that there are significant economies of scale that can be gained from two singles in Japan establishing themselves as a joint household in marriage or cohabitation. For Thailand and the Philippines, the lower AES values indicate larger gains from economies of scale from marriage or cohabitation compared to Japan. Specifically, two singles joining up and establishing a new couple household are expected to gain from economies of scale, leading some to realize savings from reduced expenses. The numbers further indicate that there are larger gains to be had from economies of scale when singles in the Philippines marry or cohabitate than when two singles join up in Thailand.

3.7 Conclusion

Motivations to marry or cohabitate and form new households have changed over the years due to several demographic and social factors. Women today are more educated, and the workplace is much more welcoming to those who want to actively participate in the labor force. In addition, the age of marriage and preference for children have also changed over the last 2 decades in favor of career and adventure goals (e.g., travel). This is true for both young men and young women overall.

Despite these demographic changes, our results show that gains in economies of scale from marriage or cohabitation remain strong as ever. Our virtual household analysis shows that people change their expenditure behavior when they start living with someone else—even if this is at a later age in life—and that their consumption behavior can be predicted from the behavior of earlier cohorts. That is, married or cohabitating couples will tend to cook more and eat at home more than go out. Additionally, their housing costs will also be reduced by close to 50%, while clothing expenses will fall by around 65%. We have observed these trends in all the three countries we covered, with larger gains appearing in the two poorer countries compared to the highly developed economy of Japan.

The two most interesting findings in this study pertain to the observations that the consumption of contraceptives (in Thailand) and hospitalization (in the Philippines) increased with marriage or cohabitation. Increased use of contraceptives after marriage is not unexpected as many young couples choose to postpone having children—something we would expect to see for both Thailand and the Philippines. But as seen, we observe this in Thailand but not in the Philippines, where we see instead increased hospitalization expenses soon after marriage. It is highly likely that this rise in hospitalization expenditure represents the costs of giving birth in hospitals soon after marriage. The Filipino population remains largely Catholic to this day, and the use of contraceptives is still not openly encouraged in the country. Additionally, access to contraception is not as free and easy as in Thailand. That is probably why we observe a rise in the expenditure on contraception among married Thai couples and an increase in expenditure on hospitalization for married Filipino couples.

These findings result from the analysis of expenditure data using a statistical matching methodology never before used for multiple countries in Asia. Compared to the more economically preferred demand modeling approach, our application has shown that statistical matching is a strong alternative approach that can result in sensible findings. Further, our study has shown that this approach can provide deeper and more detailed insights into shifts in household consumption as the economy matures and its populations age in due course.

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4

Investigation of Japan's Value Chain through Research and Development and Innovation under Demographic Change: Implications for Digitalization in the Post-COVID-19 Era

Michael C. Huang and Masahiro Kuroda

4.1 Background and Motivation

4.1.1 Technology and Demographic Change

The rapid development of information and communication technology (ICT) has drastically reshaped the socioeconomic structure since the boom of internet services aimed at facilitating human prosperity in a human-centered society. The global economy in the 21st century has undergone a major transition from heavy manufacturing and chemical industries, of which tangible assets required massive capital investment. The main driver of economic growth has changed its shape from investment in tangible capital to investment in intangible capital of ICT. Such a trend during the global pandemic was evident in the extraordinary growth of Google, Apple, Facebook, Amazon, and Microsoft, due to their innovative service provision in systems that are reshaping e-commerce and work styles.

The advanced fusion of cyberspace and physical space is a balance between economic growth and solving social problems related to rapidly aging and shrinking populations. Meanwhile, the global coronavirus disease (COVID-19) pandemic has also, since 2020, speeded up the transition of lifestyle toward digitalization, which requires more input of electronic equipment, intangible investment, and a more flexible workforce.

Based on the latest results of the Population Census of Japan and the Vital Statistics of Japan (Figure 4.1), the National Institute of Population and Social Security Research (IPSS) in Japan has conducted a new national population projection exercise (Population Projections for Japan: 2015–2065), covering the whole population of Japan, including foreign nationals. This is the same framework as the Japanese national census. The population projection assumes future trends in fertility, mortality, and international migration by calculating variants based on alternative scenarios (i.e., births, deaths, and international migration by gender and age) and using the cohort component method. The cohort component method is used to forecast future demographic trends by gender and age. Assumptions are made based on actual statistics for each component using the demographic method.

Vital statistics of the total fertility rate:

$$Total\ fertility\ rate = \sum_{\substack{Sum\ for\ age \\ (15-49)}} \frac{\begin{matrix} Births\ by\ Japanese\ women + Births\ by \\ non - Japanese\ women\ in\ a\ relationship\ with\ Japanese\ nationals \end{matrix}}{Population\ of\ Japanese\ women}$$

International migration is affected by internationalization, changes in socioeconomic conditions, and policies and regulations concerning international migration. International migration also fluctuates significantly due to domestic and international socioeconomic events and disasters. Looking at international migration statistics involving foreign nationals, the number of net migrants in Japan has generally been increasing continuously, although there are irregular fluctuations. For this reason, data from years with large fluctuations were excluded from the estimation of net foreign migration since the 1970s because of the large temporary changes caused by socioeconomic events and disasters. The results were then projected as the long-term trend of the net migration numbers and used as the assumption for the period until 2035.

By using the regression method and single-country data for Japan for the period 1975–2011, population aging in Japan is related to economic growth as measured by real gross domestic product (GDP) per capita. An increase in the number of people aged 70–74 is associated with a lower economic growth rate, while an increase in the number of people aged 75 and above is associated with a higher rate of economic growth, implying the correlation between the demographic impact of the baby boomer. One possible approach to promote sustainable economic growth in the context of population aging is to devise a comprehensive policy that focuses on demographics (Oliver 2015).

Figure 4.1: Japan's Population Projection, 2015 and 2065 (10,000 people)

Source: National Institute of Population and Social Security Research website (http://www.ipss.go.jp/index-e.asp) (accessed 7 July 2020).

In addition, changes in society have necessitated the development of policy alternatives to address the identified challenges and the ex-ante and ex-post evaluation of policies. Stakeholders are advised by academia to identify social issues with the expectation of evidence-based impact assessment for rational policy design. The policy formation process can be developed in a cyclical manner (Plan-Do-Check-Action) to fulfill the institutional need to build the industrial strategy for the utilization of public research and development (R&D) investment under the critical circumstance of Japan's demographic change.

Under such concerns, the R&D investment policy design should envision the foresight of industrial transition for human resource, especially in the ICT and R&D fields for their high connectivity between tangible and intangible allocation. The process could thus improve the mutual understanding for ensuring the policy implementation and follow-up evaluations in order to respond to the social challenges appropriately.

4.1.2 Japan's Public R&D Policy

The Fifth Science and Technology Basic Plan (Cabinet Office 2016) in Japan advocates a shift from an information society to "Society 5.0," a human-centered society that combines economic development and solutions to social problems through a system that integrates cyberspace and physical space. This will require a significant investment in ICT products for renovating domestic infrastructure with efficient and effective realization of productivity in smart manufacturing and smart city development. Domestic production on multiple platforms of tangible and intangible assets could be stimulated through R&D investment as a positive shock. Examples could be referred to the "Big Tech" companies of Google, Apple, Facebook, Amazon, and Microsoft; along with the spillover generated by the rapid innovation of ICT, the production and service efficiency has been greatly accelerated while the formation of service platform contributed to the transition in global supply chains. Such a society would be one that is able to provide the right goods and services at the right time and in the right quantity to those who need them, precisely addressing the diverse social needs of all people, regardless of age, gender, region, or language, with easy access to quality services.

Furthermore, the Sixth Science and Technology Basic Plan (MEXT 2020) was formulated from the perspective of investment in science and technology; policy recommendations should be made to maximize Japan's social welfare through optimal public R&D investment by linking science, technology, and innovation policies.

In order to maximize national value through the power of digital transformation, all intellectual resources (research seeds, human resources, research data, etc.) held by the government, universities, companies, among others, should be grasped and shared as much as possible in order to achieve a breakthrough in productivity. The specific initiatives to strengthen research capabilities include "digital transformation of research as a whole and response to accelerating open science," "development of world-class infrastructure to support research," and "promotion of shared use, new international joint research, and international brain circulation" in the post-COVID-19 era.

To achieve these objectives, data-driven innovation is becoming mainstream. It is necessary to promote both the utilization of personal data and the protection of privacy, the development of cybersecurity infrastructure, the release of public data by the government, and the construction of a typical architecture for the public and private sectors in the area of their collaboration as the essential environmental infrastructure for this. It is desirable to promote the development of cyberinfrastructure to accelerate the platform efficiency while utilizing the use of data through intangible capital investment (Haskel and Westlake 2018). While tangible capital investment confronts various limitation of on-site operation and mobility, the improvement of system connectivity such as distant meeting and working require more input from the intra-firm ICT and R&D activity.

According to the Statistics Bureau of the Ministry of Internal Affairs and Communications (2019), Japan's R&D spending has steadily increased from $150 billion to $185 billion since 2009. The private sector accounts for most of the increase. On the other hand, the ratio of R&D expenditure to GDP has been hovering around 3.5%, which is relatively higher than that of other Organisation for Economic Co-operation and Development (OECD) countries (2.4%), except for the Republic of Korea (4.2%). However, government-led R&D spending as a percentage of GDP remains low at 0.5%, below the average for OECD countries (0.6%) and most developed countries (0.5%), including the Republic of Korea (1.0%), Germany (0.8%), and the United States (0.7%) (METI 2019).

Although the scale of public investment in R&D is much smaller than that of private investment compared to the amount of R&D spending, public R&D investment in basic science can generate more spillover effects and promote productivity growth in multiple sectors. Much of this R&D investment comes in the form of competitive research funding to research institutions and universities (Huang, Liou, and Iwaki 2020). This situation calls for the creation of a public–private platform in the field of public data release and collaboration. Increasing productivity is not simply a matter of aiming for greater efficiency. Unlike the results of private R&D investments, which are usually focused on protecting patents and ensuring profitability, publicly funded research results may be released and shared with society after a certain period of time (usually 5 years), requiring a more systematic consideration of policy cost-effectiveness (Kuroda et al. 2018).

Creating a knowledge-based society through industries of data-driven innovation platforms would require more capital and human resource input for intra-ICT and intra-R&D activity to improve the production efficiency to enable the provision of high value-added goods and services to sustain the economic growth with less material input under demographic change. The increasing number of creative people may contribute to the rise of wage and price transition in the business model and education system.

4.1.3 R&D Policy and its Spillover Effect on the Value Chain

Public R&D policy can be divided into three categories: R&D tax credits and direct subsidies, support for university research systems and the formation of highly qualified human resources, and support collaboration among research institutes. The importance of R&D investment in explaining economic growth is well documented, as modern governments increasingly recognize the benefits of supporting R&D investment. However, in times of fiscal crisis and economic austerity, government funding is increasingly scarce. Therefore, it is important to evaluate the investment outcomes through an evidence-based approach in order to make the best use of limited resources (Becker 2015).

Observations of the 17 OECD member countries over the past 2 decades reveal that public R&D investment, including grants, procurement, tax incentives, and direct implementation of research in public laboratories and universities, is the preferred policy instrument to accelerate the development of science, technology, and innovation. Government funding has a positive effect on R&D carried out by private enterprises, directly or indirectly raising the level of enterprise R&D. This observation suggests that the stimulative effect of government funding varies with its generosity, increasing up to a threshold of about 10% of firms' R&D and decreasing above that threshold (Guellec and Potterie 2003).

It may be debatable whether public R&D investment complements and acts as an "add-on" to private R&D investment, or whether it tends to replace and "crowd out" private R&D. The overall results of a 35-year cross-sectional survey of laboratories, firms, and industries have been criticized for being ambiguous, lacking empirical support, and not sufficiently specifying the nature of the "experiments" that researchers envision (David, Hall, and Toole 2000).

The value chain in the second half of the 20th century is closely related to technological change, which is also evident in the input–output table's intermediate goods complex. In the case of Japan, the relative share of electronics and machinery has increased substantially as the manufacturing sector developed (Kuroda and Nomura 2004), but the next driver of rapid development since the 2000s has been the area of information technology through platform economies with intangible services. The value chain in such innovation can refer to the system of bridging ideas in the market (Hansen and Birkinshaw 2007). It may be indicated by the sourcing of knowledge or the initiation of a new product or process in the form of transformation, as well as the process of exploitation that may result in improved performance by the innovative business (Roper, Du, and Love 2008).

In other words, innovation in both products and processes contributes positively to firm growth, while product innovation has a short-term effect on labor productivity. Therefore, modeling the entire innovation value chain can assist policy makers by highlighting the structure and complexity of converting knowledge into business value and highlighting the role of firm skills, capital investment, and other resources in the value creation process.

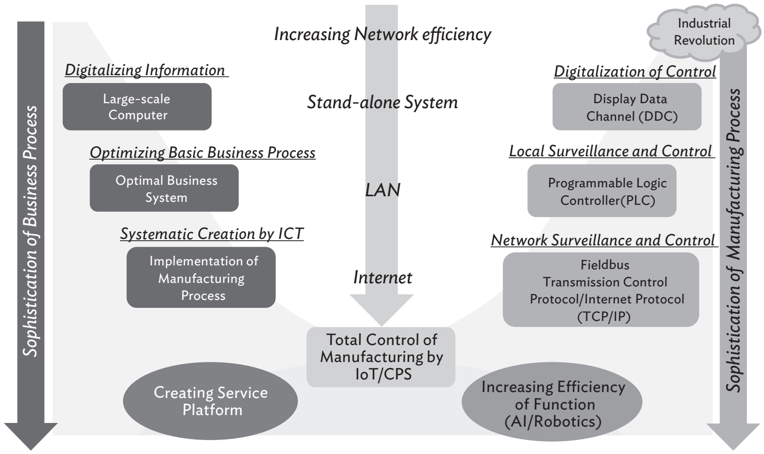
In the financing of R&D and innovation, conditional on the absence of underinvestment due to externalities and the "financing gap" in the financial markets, while small and medium-sized enterprises and new innovators experience a high cost of capital, and evidence that the cost of R&D capital for large firms is a mixed bag (Hall and Lerner 2010). On the other hand, countries with highly developed public stock markets can take advantage of spillover effects from public R&D investments. R&D subsidies can be considered a derivative means of encouraging firms' innovation efforts and making the way firms organize their innovation process more positive. It is not clear whether receiving public R&D subsidies affects the probability that a firm will form R&D alliances with other firms in the research institution or production network. Public support significantly increases the likelihood that a firm will collaborate with a public research institution, and it also increases the likelihood that a firm will enter into a private partnership, but only to a small extent and only if the firm possesses intangible knowledge assets (Busom and Fernández-Ribas 2008). The spillover effect generated by public R&D investment could accelerate the creation of innovation platform.

4.1.4 The Necessity of Evaluating Structural Change and R&D Policy Making

The main channels through which university research influences industrial R&D are through research literature and reports, public meetings and conferences, informal information exchange, and consulting. After controlling for industry, the influence of public research on industrial R&D is disproportionately large in large and emerging companies (Cohen, Nelson, and Walsh 2002). Technological change will accelerate access to healthcare through affordable and seamless marketing on cyber platforms (Biswas 2014).

In manufacturing, productivity in the production process could be consolidated through deepening the Internet of Things (IoT) and ICT technologies. How to reach to a high-level of the network efficiency by implementing the new research and development investment will be critical issues. Connectivity to remote prescribing of medical services via electronic devices may also accelerate the application of electronic machines, ICT, and the pharmaceutical industry as the world deregulates. These interactions and productivity gains deserve more attention through continuous observation. As shown in Figure 4.2, the innovation platform facilitates the production process with an automated feedback system for network efficiency.

Figure 4.2: Increasing the Importance of the New Design for a Digital Economy



AI = artificial intelligence, CPS = cyber-physical system, ICT = information and communication technology, IoT = Internet of Things, LAN = local area network.

Source: Center for Research and Development Strategy (CRDS), GRIPS SciREX Center.

In 2021, with the COVID-19 pandemic sweeping the world and the post-Abe era, the Suga administration, which took office in 2020, proposed the establishment of a digitization agency. Inevitably, the demand for electronics, machinery, and transportation equipment will increase significantly, forcing the government to formulate appropriate science, technology, and innovation (STI) policies and take more pragmatic measures to improve economic growth and welfare. It is now more difficult than ever to identify STI policies in response to these radical socioeconomic changes. It is essential to be able to assess policy makers' reflections on their policy engagement in a more quantitative manner. This will require connecting the conscience between scientists and policymakers for policy evaluation.

This requires redesigning STI policy to reconstruct the STI policy's planning and implementation and develop it as a science. This chapter includes three main sections. Section 4.2 examines the value chain transition along with the demographic change. Section 4.3 displays the simulation results, economic impact, and implications for the key sectors that will be subjected to the most significant changes. Section 4.4

provides policy recommendations for a new form of society in the post-pandemic era. Finally, Section 4.5 presents a conclusion with policy implications, research limitations, and future prospects.

4.2 Methodology

4.2.1 The Creation of SPIAS-e as Policy Simulator

Policy assessment is a vital process for allocating resources and priorities based on time series observation for a continuity analysis. The creation of a policy simulator could enable the assessment of the impact of policy instruments on the economic structure as alternative policy options and interpret the science linkage between public R&D investment and knowledge stock, and further, the knowledge capital service to be applied for production activity as an industry linkage. For this purpose, the SciREX Policy Intelligence Assistance System (SPIAS) was constructed, affiliated to an economic simulator (SPIAS-e)[1] and based on a recursive computable general equilibrium (CGE) model that illustrates the new business platforms reflecting the investment in R&D for facilitating capital service flow from three dimensions: (i) main product; (ii) intra-firm ICT activity; and (iii) R&D activity.

SPIAS-e provides a 50-year projection of productivity indicators resulting from public R&D investment. The system performs recursive CGE simulations based on time series data and demographic data obtained from the input-output table for Japan since 1995. The capital stock is estimated using the perpetual inventory method of tangible and intangible assets for each industrial activity. We have been able to show a theoretical framework that explicitly measures R&D activities in the conventional input-output framework and recursively measures how accumulated intangible assets (knowledge stock) generate efficiency in production activities. Here, it is assumed that each R&D investment is accumulated as an intangible asset and that the accumulated intangible asset generates capital service flows as technical knowledge (Kuroda et al. 2018).

Activity areas such as marketing, planning, research and development, procurement, operations and sales, and maintenance have different levels of process/productive efficiency set by technical parameters. These productivity parameters are adjusted through SPIAS and include research grants, academic outputs based on scientific

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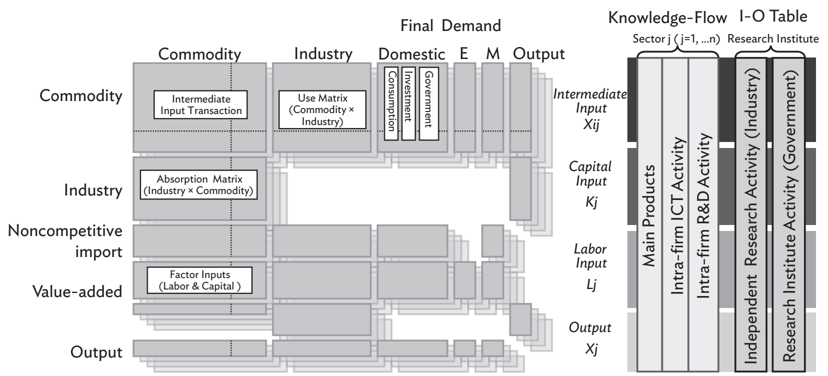
1 For details concerning the CGE model and formula, refer to Kuroda et al. (2018) and the SciREX website (https://scirex.grips.ac.jp/en/).

papers, patents, press releases, etc. In order to revitalize science and technology capabilities and capture social value, SPIAS was established as an independent research organization that divides the R&D activities of industry and government into five research areas: (i) life science; (ii) ICT; (iii) materials; (iv) environment and energy; and (v) others. In the process, changes in capital and labor services were observed, indicating a gap between income and capital formation. A graphical summary of the capital stock in the input–output table is shown in Figure 4.3.

Figure 4.3: Structure of Input–Output Data Layers and Production Activity by Sector



E = export, M = import, ICT = information and communication technology, I–O = input–output, R&D = research and development.

Source: Kuroda et al. (2018).

4.2.2 The Challenge of SPIAS-e and the Value Chain Transition

The SPIAS-e framework aims to identify societal challenges such as policy options design, mutual understanding acquisition, policy implementation, impact assessment, and evaluation. To support the development of science and technology to identify social issues, it is important for scientists to observe the current state of science and then accurately understand society's expectations for science and changes in the social structure. In order to discover social issues, an interdisciplinary collaboration between social and natural sciences is essential. This requires the formulation of policy alternatives to address the identified issues and the ex-ante and ex-post evaluation of policies.

In the scope of the model, factor inputs are the capitalization of intangible assets from R&D stock and ICT stock, measured by the quantity and price of capital services imputed from capital stock and cost of capital. The capital stock and cost of capital are measured consistently using the input-output tables for tangible and intangible assets in Japan (1995–2011). Intangible assets are estimated separately using the knowledge stock, including software and research outcomes. In addition, the capital formation matrix with flows and stocks of tangible and intangible assets is estimated annually. On the other hand, labor input is estimated by gender and age group by sector and activity.

Under such fragmentation, ICT and/or IoT may systematically capture the flow of capital services that facilitate the distribution and processing of information to improve manufacturing productivity in a changing demographic. Furthermore, information management may benefit from outsourcing and externalization, and a cross-cutting platform for information management may be established. The simulation results show the short- and long-term effects of ICT and/or IoT advancements on employment and production sectors. By quantifying the spillover effects across industries as process and product innovations, it is now possible to analyze productivity and competitiveness under economic and social structural changes.

4.3 Scenarios

In order to analyze the impact of the development of scientific and technological knowledge on the economy and society, it is important to establish the analytical tools to observe the impact both theoretically and empirically. Based on the theory and model building of Kuroda et al. (2018), we can observe the impact of the development of science and technology on the economy.

The sources of investment in R&D activities were provided by the government and the private sector. The investments were based on scientific and technological knowledge creation and were divided into several scientific fields. R&D activities were introduced by public research institutes, such as universities and affiliated research institutes, and private research institutes such as private independent research institutes, and in-house R&D activities belonging to private enterprises.

4.3.1 Compilation of R&D and ICT activity

The R&D and ICT products and services created by these agencies are accumulated in knowledge stocks as intangible assets in each agency. Knowledge stocks accumulated in these agents are assumed to have an impact through static and dynamic interdependency among sectors. We revised Japan's input-output table for 1995–2011, with the specification of the R&D and ICT activities explicitly. The following points describe the contents of R&D and ICT activities explicitly classified in the input–output table:

(i) Agents of the R&D and ICT activities are divided in several agents, which are (a) Intra-firm R&D and ICT activities by the market producer: R&D and ICT activities inside enterprises, except for independent public and private research institutes and information service producers; (b) R&D activities by private nonprofit organizations and public R&D institutions as special and independent corporations including research institutes in public and private universities; (c) R&D activities by independent private research institutes as market producers; and (d) ICT activities by independent industrial activities as market producers.

(ii) Capital formation in tangible and intangible investments is recorded in the capital formation matrices (capital flow matrices [commodity x activity]).

(iii) From the capital formation matrices, we can estimate capital stock by each activity, separately in the tangible and intangible assets by using a perpetual inventory method.

(iv) As regards the treatment of patent activity, we try to follow the concept of the current input–output. Consequently, the activity creating a patent entity is not classified separately from the main production; the patent entity is an auxiliary product of the main products, and the licensing fee transaction is treated as a transaction of property income among sectors.

The agents of the R&D and ICT activities are divided as follows:

(i) Intra-firm R&D and ICT activities by the market producer; R&D and ICT activities inside enterprises, except for independent private research institutes and information service producers.

(ii) R&D activities by private nonprofit organizations and public R&D institutions as special and independent corporations.

(iii) R&D activities by research institutes affiliated with public and private universities.

(iv) R&D activities by research institutes independent from market producers.
(v) R&D activities, except for educational activities by public universities and their affiliated hospitals.
(vi) R&D activities, except for educational activities by private universities and their affiliated hospitals as market producers.
(vii) R&D activities by nonprofit research institutes, which provide professional and related services for science and technology.

Intra-firm R&D and ICT activities are classified separately from the main production activity within the enterprise. The enterprise's knowledge services are counted as the capital formation of intangible assets which are accumulated by the capital formation investments in the intra-firm R&D and intra-firm ICT activities separately. On the other hand, tangible capital used in intra-firm R&D and ICT activities is counted as tangible capital formation investment and accumulated in tangible assets of these two activities. R&D activities by independent research institutes are divided into five natural science fields: life science, information, energy, materials, and other sciences including social science.

4.3.2 Scenario Setting

To visualize the change of social structure stimulated by the public R&D investment, we demonstrated a scenario by simulating the policy of promoting science and technology. In this scenario, we increased public R&D investment by 20% (compared with 2005) in all fields in both tangible (infrastructure) and intangible (research grant) capital accumulation.[2] The scenario is expected to reflect the structural changes with informative indicators to help interpret the social demand under Japan's demographic change. The volume of public R&D investment is demonstrated in Table 4.1.

[2] The amount of public investment is equivalent to $74 billion, while the public R&D budget for Japan in fiscal year 2018 was $193 billion (https://www.stat.go.jp/english/data/kagaku/1546.html). Given that the methodology is based on an input–output analysis and a CGE model, the estimated proportion could be reasonable.

Table 4.1: 5-year Public R&D Investment in Basic Science ($ million, $1 = ¥105)

Category	Intangible	Tangible	20% Investment	Sum
Life	20,528	3,991	4,904	29,424
Information	4,380	904	1,057	6,341
Materials	4,288	799	1,017	6,104
Energy	1,996	981	595	3,572
Others	13,129	10,747	4,775	28,651

Source: SPIAS-e.

4.3.3 Assumptions for Business-as-Usual for the Baseline Scenario

In the business-as-usual (BAU) scenario, the above propositions are exogenously assumed to provide an overview of the economic and social trend until 2050 from the year 2005. There are no positive science policies or economic policies by the government, although the population's structural changes by age and gender will be assumed exogenously. This will be the basic scenario to describe any additional policy options and discover the problems to be presumably realized in the future until 2050. The assumptions for the BAU path are stated as follows:

(i) Between 2005 and 2050, the level of government R&D expenditures will be nominally fixed at the 2005 level. In other words, there will be no policy-driven aggressive expansion of government R&D spending between 2005 and 2050.

(ii) The scientific knowledge stock accumulated by government R&D expenditures is assumed to affect the private sector's productivity growth as a public good.

(iii) Tax rates for personal income tax, corporate income tax, consumption tax, indirect tax, taxation, and property tax are fixed at 2005 levels.

(iv) Government expenditure is assumed to be endogenous and proportional to nominal GDP.

(v) Government capital formation in tangible and intangible assets is fixed at 2005 levels in nominal terms. This implies that the government does not intend to create positive effective demand.

(vi) The population structure is assumed to change in line with the medium-variable fertility projections of the IPSS.

4.4 Simulation Results

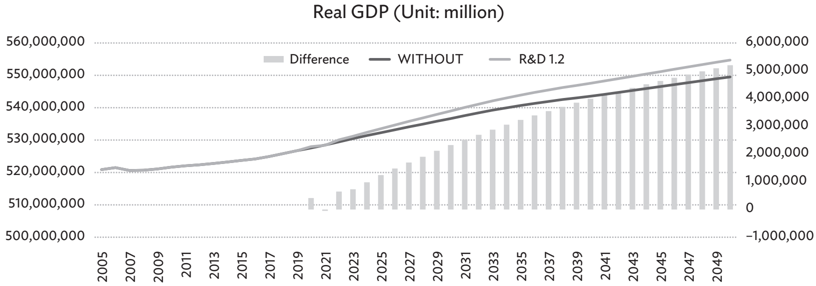
After making 1.2 times the public R&D investment in the SPIAS-e, we present the 50-year simulation results present in the process of capital accumulation that contributes to output, price change, and income based on the initial data setting sourced from the 1995–2011 input–output table and demographic changes. The simulation results calculated by SPIAS-e do not serve as a forecast of economic conditions. Instead, the various variables and projections illustrate a possible picture of Japan's development in a society of an aging and shrinking population. The growing dependence on ICT technology with electronic equipment and e-commerce in the post-COVID-19 era also implies that various reforms should be established to cope with changes in social structure as well as new service platforms. We thus demonstrate the simulation results of GDP, value-added breakdown, employment, and price change of tangible and intangible capital.

4.4.1 GDP and Value-added Breakdown

Public R&D investment increases productivity. Figure 4.4 shows the GDP growth from the BAU level after 2021 (after a 5-year investment) and how it continues to grow steadily (upper panel). Although the growth rate is 0.01%, the positive growth under the aging society's critical threats and shrinking population is already an encouraging sign for public investment. Although the level of change could be too small to have statistical meaning for evaluation, under the inevitable trend of Japan's shrinking population, the ability to maintain a real GDP growth could be regarded as both symbolic and noteworthy.

The breakdown of the change in value-added GDP (Figure 4.5) under the shrinking population shows that the operation surplus (OS) has increased less than the share of intangible capital depreciation (DEPKN) capital, which could be interpreted as traditional manufacturing being unable to create a huge surplus, as it used to be under the foreseen circumstances. Such a trend could imply that intangible capital accumulation could lead to more output if productivity growth were actualized in the long term. On the other hand, other kinds of capital depreciation provisions do not show significant change, indicating a low

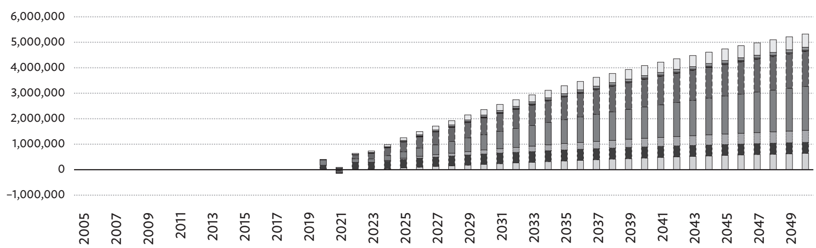
Figure 4.4: Projection of GDP and Growth Rate



GDP = gross domestic product, R&D = research and development.

Source: The authors.

Figure 4.5: Breakdown of Value-added and Composition



Abbreviation	Content
BCT	Household expenditure in t-period
YE	Total employees' income
YSEFW	Income of employer and family workers
OS	Operation surplus
DEPK	Tangible capital depreciation provision
DEPKN	Intangible capital depreciation provision
DEPKITE	Tangible capital depreciation provision on ICT activity
DEPKRDE	Tangible capital depreciation provision on R&D activity
DEPKPI	Tangible capital depreciation provision on main product activity
DEPKNITE	Intangible capital depreciation provision on ICT activity
DEPKNRDE	Intangible capital depreciation provision on R&D activity
DEPKNPI	Intangible capital depreciation provision on main product activity
TKAN	Indrect tax

ICT = information and communication technology, R&D = research and development.

Source: Authors.

level of integration. In addition, the income of employers and family workers has grown gradually, while the total employees' income has shown limited growth, implying that the income effect may be leaning to employers for capital intensity.

4.4.2 Employment

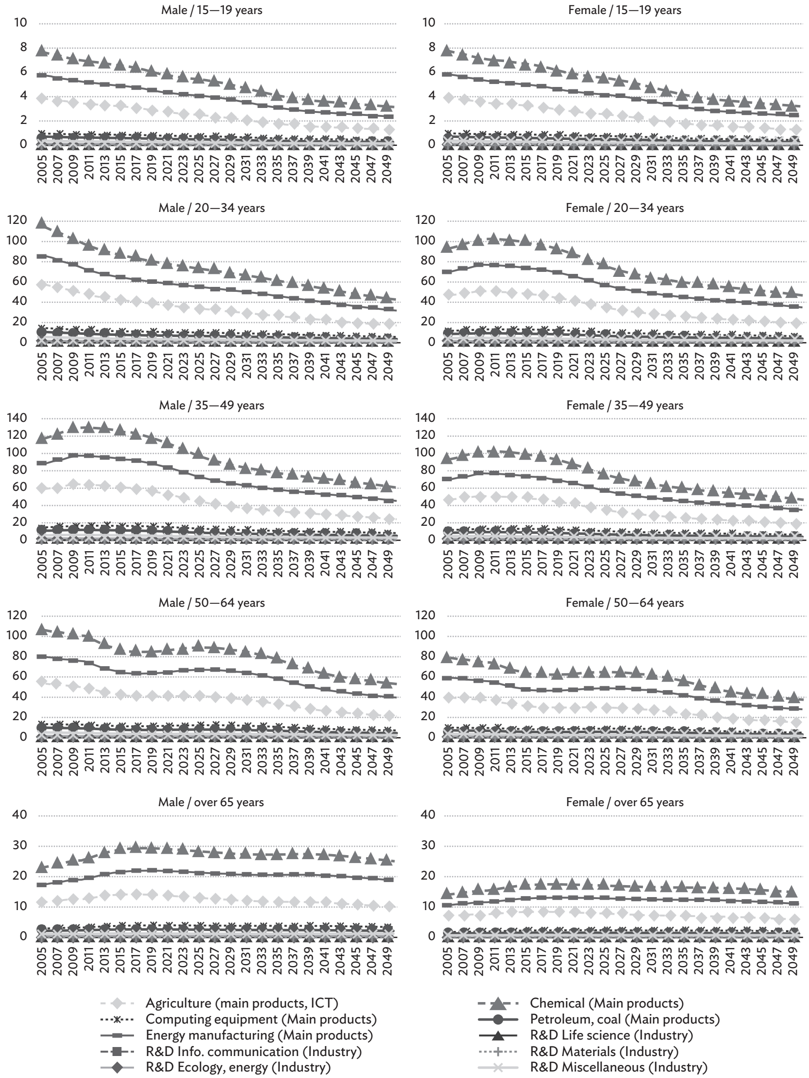
The simulation results for employment were categorized according to gender and five quantiles, while the data were sourced from the time series census to accommodate the 93 classifications. We sorted the 10 sectors with the most drastic change in employment to further investigate the sectoral transitions among the main products, intra-firm ICT activity, and intra-firm R&D. The general trends show that employment in younger generations declines steadily until the fourth quantile.

At the same time, no significant difference appears in gender. For the fifth quantile of senior citizens aged over 65, employment increases gradually, reflecting extended employment after the official retirement age. Most notably, such employment trends in intra-firm ICT and intra-firm R&D activity even show growth, implying that senior citizens could continue to contribute to ICT and R&D activities partially because of a lower physical barrier and knowledge accumulation.

Main Product

The decreasing trend was the most significant in the chemical, energy manufacturing, and agriculture sectors. Employment in these sectors could be the most affected by the shrinking population. On the other hand, private R&D sectors also showed the most significant decreasing trend. The employment is far lower than in the manufacturing sector and thus is not substantial in Figure 4.6.

Figure 4.6: Employment of Main Product Sectors (thousand people)



ICT = information and communication technology, R&D = research and development.

Source: Authors.

Intra-firm ICT Activities

The intra-firm ICT sectors represent the connectivity link between consumers and producers. The total employment may be far smaller than in the main production sectors, but it has implications for whether other sectors are able to respond to market demands quickly and effectively. We found that heavy machinery and transportation equipment dropped sharply, followed by precise machinery, transportation, and miscellaneous manufacturing. The sectors of petroleum, coal, semiconductor devices, and semiconductor manufacturing also showed a decrease, but the number was small (Figure 4.7).

Figure 4.7: Employment of Intra-firm ICT Sectors (thousand people)

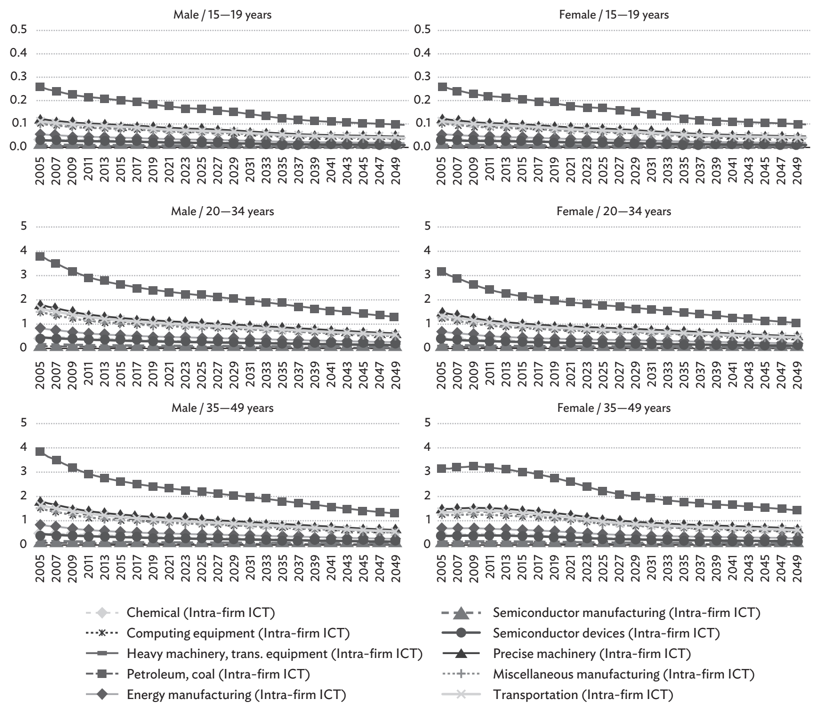


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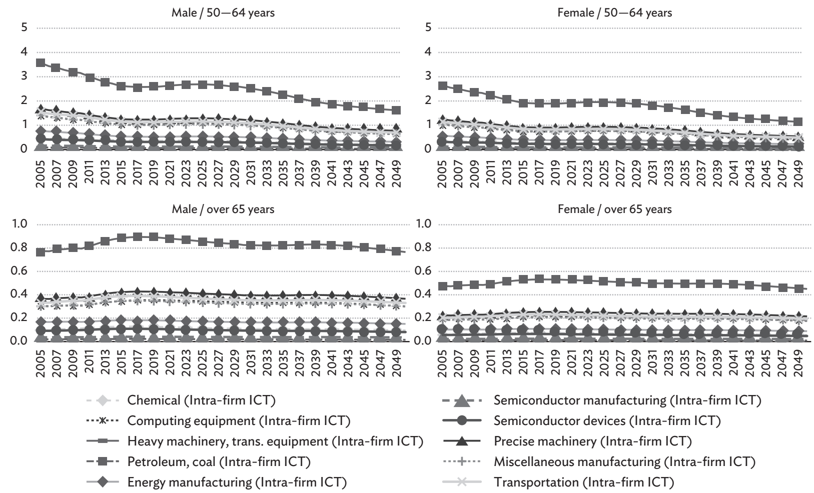
Figure 4.7 *continued*



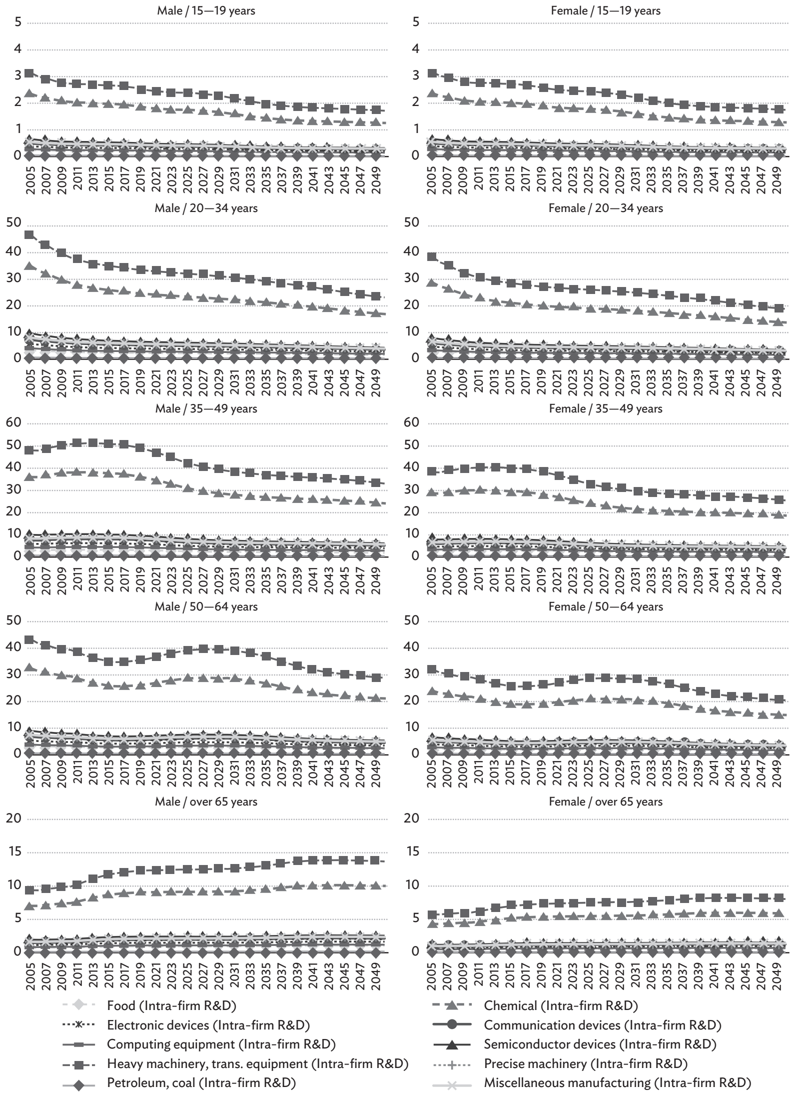
ICT = information and communication technology.

Source: Authors.

Intra-firm R&D Activity

The intra-firm R&D sectors present an innovative response to a changing society. Despite their decreasing direction, the trend was milder than in the other two sectors, implying that competitiveness comes from R&D and innovation activity. The heavy machinery, transportation equipment, and chemical sectors accounted for the largest share of employment. The employment trends of workers over the age of 65 actually showed an increase, indicating that experienced human capital is desirable regardless of age in R&D sectors. This provides empirical evidence that the official retirement age of 65 should not be imposed on R&D sectors, as in them accumulated skill is highly valued. The petroleum and coal sector had the smallest share but showed a positive trend (Figure 4.8).

Figure 4.8: Employment of Intra-firm R&D Sectors (thousand people)



R&D = research and development.

Source: Authors.

Price Change of Capital Goods

R&D and innovation are necessary to strengthen productivity so that the products can be made at a lower price, and this could result in higher social welfare. In the scope of the SPIAS-e model, the tangible and intangible capital goods were separated to provide insight into capital accumulation from the base year of 2005. We also selected the 10 most drastic price change indices for capital goods according to the main product categories, intra-firm ICT activity, and intra-firm R&D activity in tangible (Figure 4.9) and intangible capital (Figure 4.10).

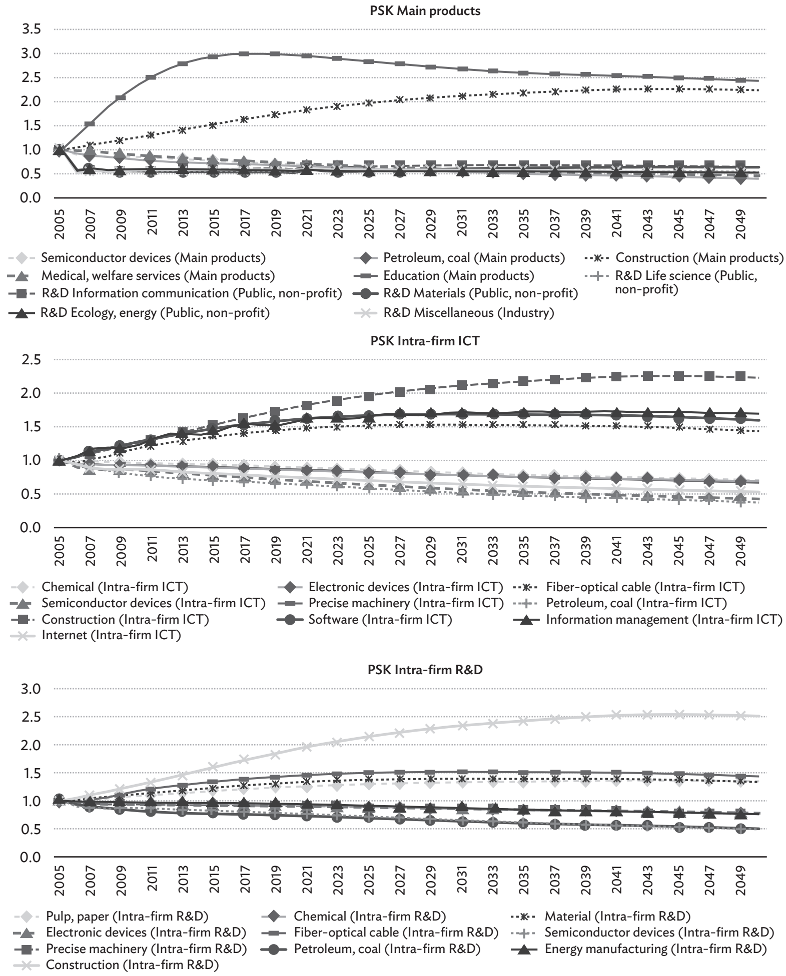
Tangible Capital

The prices in education and construction grew significantly for the main product, indicating that the cost of tangible capital formation for these two sectors was still high. Given the circumstances of a shrinking population, it is understandable that the cost of construction would remain high. In contrast, the capital price of the medical, materials, information communication, and R&D miscellaneous sectors was lower, implying that steady development could be sustained.

As for intra-firm ICT activity, similarly to the main product trend, the construction sector still showed a significant price growth. Intra-ICT is still an expensive input because people need to see the actual product to make a decision whether to purchase or not. Meanwhile, the price index increased steadily for the software and fiber-optic cable sectors, as there is a need to provide desirable ICT connectivity services between all sectors. It is interesting to see the volatility in information management, which is partly due to the time span of services. On the other hand, the price indexes in the petroleum, semiconductor, and internet sectors decreased, indicating mature development using ICT.

The price index for intra-firm R&D did not change significantly except for the construction sector. The slight growth trend in the sectors of pulp, paper, materials, and fiber-optic cable could mean that the traditional sector is also seeking innovative solutions. The energy sectors showed a mild decreasing trend, indicating their continuous support for R&D with more efficient performance. Overall, the price index's drastic fall shows that the value chain has gradually switched from main product to intra-ICT and intra-R&D activities.

Figure 4.9: Price Change of Tangible Capital Goods



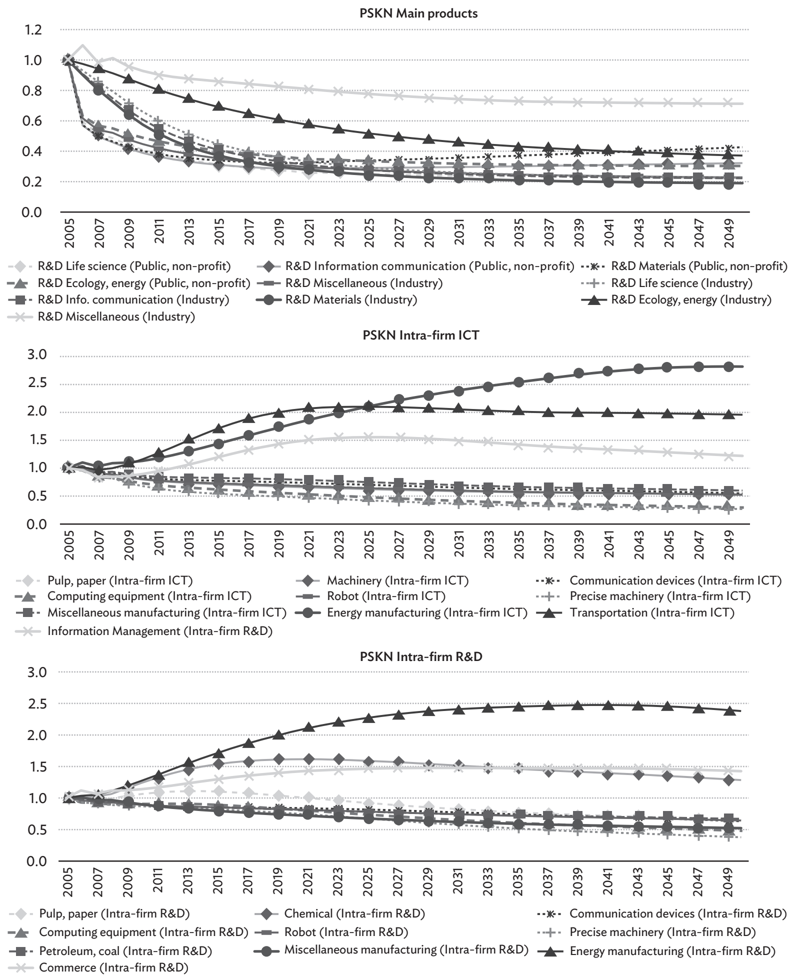
ICT = information and communication technology, PSK = price of tangible capital goods, R&D = research and development.

Source: Authors.

Intangible Capital

The main product price index shows a significant decrease for most sectors, indicating that the intangible R&D investment may provide the key element to increasing productivity, especially for research institutes and think tanks because their primary product is R&D activity.

Figure 4.10: Price Change of Intangible Capital Goods



ICT = information and communication technology, PSKN = price of intangible capital goods, R&D = research and development.

Source: Authors.

The price decrease in private R&D miscellaneous and private R&D ecology and energy was lower than for other R&D sectors, partly because of less interdependence with public R&D investment. In contrast, the substantial price index drop in public and private R&D information and communication, public R&D ecology and energy, and public R&D life science shows that public R&D investment could be operated effectively in these sectors for overall development projects.

For intra-firm ICT activity, the price index increased significantly in the sectors of energy manufacturing, miscellaneous manufacturing, and information management, indicating the importance of more efficient and effective resource management. However, the growing price index also reveals the concern that productivity in such sectors may not be competitive globally under the ever-increasing service trade liberalization. As for the sectors of precise machinery, computing equipment, robots, and communication devices, the maintenance of lower price indexes indicates Japan's comparative advantage in these sectors.

For intra-firm R&D activity, the price indexes of the energy manufacturing, chemical, and miscellaneous manufacturing sectors remained high, suggesting that the energy-related sectors are still the main concern for Japan due to the its low self-sufficiency even under the trend of a shrinking population. Meanwhile, the price indexes for the precise machinery, computing equipment, miscellaneous manufacturing, and robot sectors could stay at the lower level and become the growth engine to sustain the next generation of infrastructure development.

4.4.4 Disguised Unemployment

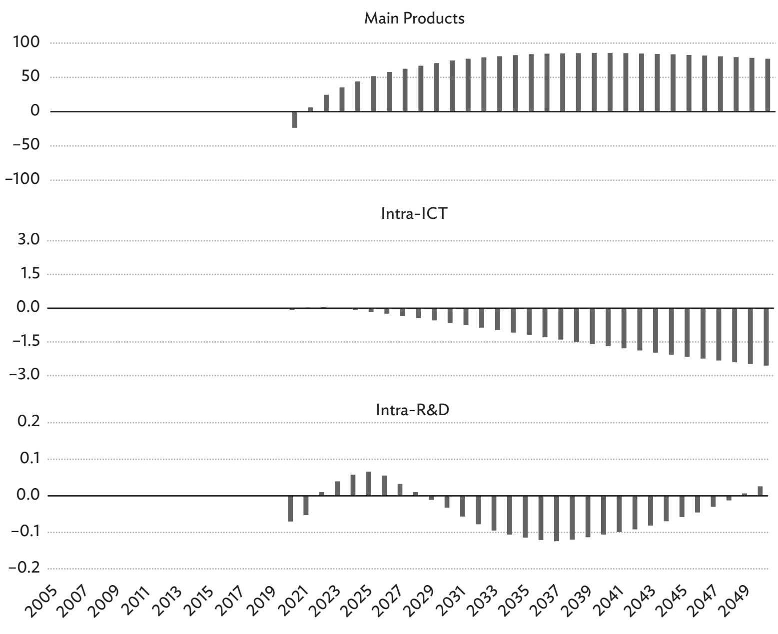
In the structural equations and the prescribed intertemporal equations of this model, full employment is assumed. The decline in labor supply due to an aging society and a shrinking population, especially the decline in working hours, may imply that many labor-intensive household chores will be done by the elderly with the help of ICT and robots. The decrease in working hours and the fact that human labor is even being replaced by ICT and robots through "work sharing" may be creating the phenomenon of "disguised unemployment."

Disguised unemployment is defined as unemployment in which people are visibly employed but are actually unemployed. In such a situation, more people are engaged in work than required, which could be derived from the following formula:

$$Disguised\ employment = Employment - \frac{Employment\ \times working\ hours}{\begin{array}{c}1{,}775\\(current\ annual\ working\ hours)\end{array}}$$

Based on our simulation results for the year 2029, there is a substantial demand for human resources for intra-firm ICT and intra-firm R&D. In the simulation results (Figure 4.11), the amount of disguised unemployment in the main product is growing, implying low productivity with inefficiency under the current regulations. By contrast, for intra-firm ICT and intra-firm R&D, the number becomes negative, especially after the year 2027, indicating that the human resources in these two categories are actually insufficient. Thus, ICT and R&D human resource development to accommodate the structural change in the next generation is not only desirable and but also urgent.

Figure 4.11: Disguised Unemployment (thousand people)



ICT = information and communication technology, R&D = research and development.

Source: Authors.

As of 2020, a full-time job still means that one must work 8 hours a day, 40 hours a week. However, the number of working hours is expected to decrease in response to the global COVID-19 pandemic as technology advances to increase production efficiency. Large-scale R&D inputs are expected to strengthen the cyberinfrastructure with the support of communication systems. With fewer working hours and more leisure time, humans will be free to think about the complex challenges of achieving a sustainable socio-economy based on a newer and more established service platform.

4.5 Concluding Remarks

4.5.1 Policy Implications

The policy simulator was not made for economic forecasting. Preferably, it could be utilized as a tool for the policy assessment regarding effectiveness of government investment in science, technology, and innovation. As regards the manufacturing sector, improved efficiency would increase production, and public and private R&D investment, and consolidate the knowledge stock for knowledge infrastructure that increases total factor productivity. The implication from the simulation results of structural change will motivate firms to allocate human resources and investment toward the different platforms. Furthermore, it will affect the policymakers to take appropriate action to accommodate the demands for reforms on workstyle and industrial policy. From our observation of the price indexes, we can conclude that the fall of the main product index indicates that effective production cannot be achieved without intra-ICT and intra-R&D activity, which contribute to maintaining its productivity.

Japan is facing looming challenges of digital transition and recession due to the global COVID-19 pandemic, a hyper-aging society, and a shrinking population. The solutions need to be holistic and fundamental. Our simulation results make possible an in-depth analysis of the factors of tangible and intangible R&D capital formation and the potential employment transition, showing that the sectors of intra-firm ICT activity have not been sufficiently connected with the main product and intra-firm R&D sectors. Such problems should be tackled well through deregulation and promotion of innovative sectors.

On the other hand, an increase in human resources, along with higher professional education and enhanced information, services, and private R&D sectors is evident. The evolution of industries may increase knowledge gaps that contribute to technological unemployment, and analytical frameworks will help create evidence-based policy-making systems. Given the trend of insufficient ICT professional human resource in a foreseeable future, public R&D investment is expected to reduce the income gap with higher production efficiency.

4.5.2 Research Limitations and Future Perspective

Due to the model scope, our study mainly interprets domestic production, neglecting the effects of external trade, although they can be observed from the production indicators. However, the export of tangible products is also vital for Japan to develop an overall global supply chain strategy, as well as a future platform and regulations for intangible goods. Therefore, it is essential to extend the model with wider analytical coverage or to link to other methods to capture the key indicators of external trades in order to make the assessment comparable for the global platform.

During the economic structure transition, the demand for electronic equipment and related infrastructure is expected to expand substantially. Furthermore, reform of working hours should be made more flexible to accommodate the new type of life-work balance. Leisure time and the generation of value-added are worth more attention.

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5

First Demographic Dividend, Digitalization, and Economic Growth: Bangladesh's Experience

Kazi Arif Uz Zaman and Tapan Sarker

5.1 Introduction

5.1.1 Background of the Study

Bangladesh is one of the most densely populated countries in the world with a total population of 165 million and about 1,265 people living per square kilometer (World Development Indicators 2020). Despite the population pressure, Bangladesh's economy has been rapidly growing in recent years and its gross domestic product (GDP) is expected to grow by 6.8% in 2021 (ADB 2020). While Bangladesh is experiencing rapid demographic changes accompanied by age structural transitions, this also creates a window of opportunity for potential demographic dividends over the next 3 to 4 decades (Navaneetham and Dharmalingam 2012, CRI 2017). Currently, about 45% of its population is aged below 24 years and 70% is aged below 40 (UN DESA 2019). The economic and social implications of such a demographic transition have been widely analyzed in the literature both theoretically and empirically. The earlier literature refers to the grander process of economic and social transformation, and the modernization that resulted from the demographic dividends enjoyed by Europe and the West throughout the middle of the twentieth century (Willekens 2016, Van de Kaa 2010). Theories imply that such a change in age structure eventually induces higher living standards and educational levels while the society becomes increasingly urban, with the industrial and services sectors of the economy used to surpass agriculture both in production and in social relevance (Reher 2011). Consequently, a larger consumer society begins to emerge, and the women start to enter into the labor market in greater numbers. Cutler et al. (1990) explain that a lower dependency ratio owing to demographic transition would enable the countries to invest more resources, which would lead towards economic growth. Many scholars recognize human capital development as the core factor to reap the benefits of demographic transition (Striessnig 2019; Ahmad and Khan 2019; Mason, Lee, and Jiang 2016). Bloom, Canning, and Fink (2007) emphasize the institutional and infrastructural improvement in forms of health care, schooling, roads and transport to facilitate the human development process that could employ a productive young labor force to maintain higher economic growth. Olaniyan, Soyibo, and Lawanson (2012) argue that the education system in the country must emphasize the right relevance of entrepreneurship and private sector employment.

Consequently, scholars argue that demographic transition is evidenced to be a powerful stimulus for migration, especially from the underdeveloped to the developed regions (Goldscheider 2019, Bruni 2019). However, with technological advancement, specifically with the massive digitalization in many developing countries, the pattern of migration in the international job market has been evolving with a newer dimension. More online jobs are now offered globally than ever and the colossal pool of the technologically skilled young population of the developing countries is getting access to those jobs. Digitalization not only drives the technological innovation and business process reengineering to support the country's industrial and service sector to fuel economic growth but also acts as a driver for large-scale employment generation using digital platforms (Bukht and Heeks 2017). In order to take advantage of lower cost, risks, and time, many large organizations from developed economies such as the United States, United Kingdom, Japan, and Australia have been outsourcing information technology (IT) jobs to developing and emerging digital economies like Bangladesh (Zaman 2019). Despite the huge untapped potential, there are very few attempts to explore the economic impact resulting from the demographic composition and adoption of digitalization and technological advancement in the context of developing countries like Bangladesh.

Bangladesh set ambitious goals in 2008 through its *Vision 2021* to lift the country from a low-income to a resourceful and modern middle-income economy by 2021 through massive socioeconomic progress, infrastructure setups, technological innovation, and human resources development (Government of Bangladesh 2012). The government at that time incorporated digitalization as the core effectual driving force for this ambitious attainment. The "Digital Bangladesh" concept was espoused to facilitate *Vision 2021* through efficient and colossal use of information and communication technology (ICT). The national ICT Policy 2009 was adopted to facilitate the emergence of a knowledge-driven economy that would come up and compete within the context of future global challenges. The demographic dividend remains one of the key factors that encourage the government to set the targets to implement Digital Bangladesh. There are still some hurdles that need to be overcome to reap the benefits of such digitalization in a larger context. Some of the key areas to improve are ensuring equitable inclusion of ICT in all economic sectors (Basher 2014), adopting robust ICT physical infrastructure, and e-governance (Sarker et al. 2018), establishing secured uninterrupted high-speed connectivity (Islam et al. 2019), providing mass e-literacy and increasing the supply of institutional skilled and trained ICT human resources (Bhuiyan et al. 2020). Nevertheless, the current "tech-savvy" generation and young labor force have to play a pivotal role to reinforce the digitalization process and inclusion to make Bangladesh one of the world's leading digital economies in the coming years. Therefore, understanding the links between demographic dividend, digital innovation, and the economic growth of Bangladesh is of utmost importance, and hence, it is considered central to this study.

5.1.2 Research Objectives

The Global Connectivity Index 2019 reveals that Bangladesh, along with Ukraine, South Africa, and Algeria were the top four economies with remarkable improvement and the fastest growth in the adoption of the digital economy between 2015 and 2019 (Huawei 2019). Despite this noteworthy success and advancement, the digital economy of Bangladesh still lacks formal institutional, legal, and policy support in a few key areas. For instance, the overseas payment system infrastructure, internet connectivity, speed, price of using the internet, proper institutional training, etc., are some of the issues that need adequate attention from the policymakers to sustain the growth of this sector. The government's commitment is visible, however, the potential of digitalization is still untapped by some margin. Other than a few reports in newspapers, no in-depth research work has been done in this field. The digital economy is a relatively new concept and its implication on reaping the demographic dividend is not comprehensively addressed in the literature. So, there is a large scope to be explored in this arena with meticulous and scholarly economic analysis. This study, therefore, attempts to fill the gap in the literature and potentially produce some useful recommendations for designing future policies to support strengthening digital economies (primarily for Bangladesh, which could also be replicated in other developing countries with similar demographic contexts) through using the long-lasting demographic dividends.

Considering the challenges and prospects, this study specifically attempts to explore the impact of the adoption of digitalization and technological innovation in enhancing economic growth in Bangladesh, especially to assess the role of the young labor force. For such analysis, the labor force aged between 20 and 39 is considered the young labor force. The research questions are, therefore, set as (i) how the demographic transition is fostering the digitalization process in Bangladesh, (ii) whether the adoption of digitalization and technological innovation makes the young labor force more productive than the older-age working groups, and (iii) how the digitalization and demographic transition lead toward faster economic growth of Bangladesh. To examine these research questions, the study investigates all relevant determinants and externalities of the digital economic growth of Bangladesh from the perspective of utilizing the demographic dividend's advantage.

5.2 Demographic Dividend, Digitalization, and Economic Growth: Conceptual Framework

Any demographic transition does not automatically result in dividends, i.e., economic benefit for the country. It largely depends on the government's policies to provide the abundant young population with proper education, health, and good governance, and facilitate other economic factors that may increase their productivity and job opportunities. Under the current context, digitalization could be a significant economic factor that would drive this transformation.

The conceptual framework and nexus between demographic dividend, digitalization, and economic growth can be analyzed by using endogenous growth models. Unlike the neoclassical growth models (which consider savings and capital accumulation as the drivers of economic growth, leaving the technology as an exogenous growth factor), endogenous growth theories advocate technological progress as the core determinants for sustained long-term growth, which is an endogenous factor of the models. Endogenous growth theories imply that investment in human capital, innovation and knowledge has positive externalities and spillover effects of a technology-based economy, which lead toward economic development (Romer 1990).

Using a simplified Cobb-Douglas production function, the output is defined as:

$$Y = AL^{\alpha}K^{\beta} \qquad (1)$$

where, Y, L, K refer to output, labor, and capital of an economy. A indicates the total factor productivity, while α and β are the output elasticities of labor and capital, respectively.

For a constant return to scale, $(\alpha + \beta)$=1, which would make equation (1) as follows:

$$Y = A\left(\frac{K}{L}\right)^{1-\alpha}.L \tag{2}$$

Output per capita can then be decomposed with three factors as shown in equation (3).

$$\frac{Y}{P} = A\left(\frac{K}{L}\right)^{1-\alpha}.\frac{L}{P} \tag{3}$$

Now, as the demographic dividend gets dominant, $\frac{L}{P}$ factor increases. Considering all other things being equal, it would increase the per capita income, i.e., $\frac{Y}{P}$ of the economy.

It may seem that in the demographic dividend phase an increase in the workforce would result in lower capital per labor (i.e., $\frac{K}{L}$). However, as the per capita income increases, a positive spillover effect is generated on the savings, as well as on investment that helps accumulate more capital in the economy. Eventually, it may be the case that $\frac{K}{L}$ would not decline due to the demographic dividend state of the economy; rather it would also create the opportunity to invest more in human capital that would add future dividends from a skillful generation of workforce.

Besides, under the demographic advantage situation, there would be a huge number of young entrants into the labor market. To sustain growth within such a competitive environment and with the scarcities of capital and financial endowments, the role of technology remains pivotal. To make use of the technologies viable, affordable, and low-cost, the digitalization process would be of utmost significance. It would push the technology frontier (measured by the total factor productivity A) upward.

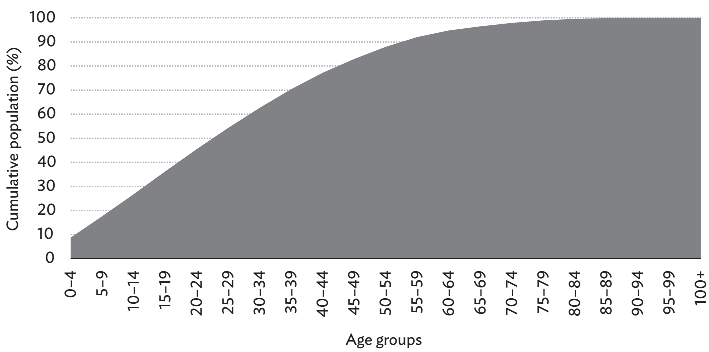
Therefore, it is implied that a demographic dividend scenario would instigate the rise of all three factors A, $\frac{K}{L}$, and $\frac{L}{P}$, which would eventually increase the economic output per capita.

5.3 Demographic Dividend and Digitalization in Bangladesh

5.3.1 Age Structure and the First Demographic Dividend in Bangladesh: Trends and Potentials

The detailed age structure of the population depicted in Figure 5.1 indicates that currently the population of Bangladesh is largely dominated by young people. For instance, in 2019, 36.2% of the total 164.7 million population was aged below 20, 54.3% below 30, and 70.4% below 40. It also implies that 96.43 million people (58.5%) belong to the working-age groups of 20–64 years.

Figure 5.1: Age Structure of the Population in Bangladesh, 2019

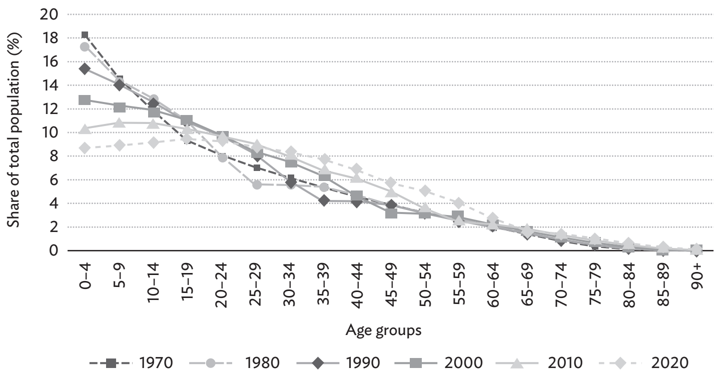


Sources: UN DESA (2019), authors' compilation.

Figure 5.2 illustrates the transitions of different age groups since 1970. Over time the curve has become flatter and skewed towards the working-age groups. This would indicate that the demographic transitions are intensifying and the likelihood of demographic dividends increasing.

Key indications that a society is moving toward a demographic dividend are declining fertility and declining mortality rates. As Figure 5.3 illustrates, the fertility rate in Bangladesh was 6.9 births per woman at the time of independence in 1971, but dropped to 5.3 in 1985,

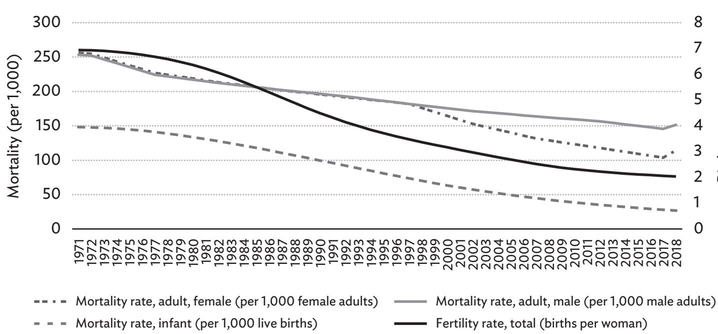
Figure 5.2: Chronological Transition of Different Age Groups (1970–2020)



Sources: UN DESA (2019), authors' compilation.

and then fell sharply to 2.04 in 2018. Also, infant mortality decreased remarkably from 148.2 (per 1,000) in 1971 to 26.7 in 2018. Adult male and female mortality rates also declined markedly over this period. These indicate that Bangladesh is well placed to attain its first demographic dividend now.

Figure 5.3: Trends of Fertility and Mortality Rates in Bangladesh (1971–2018)



Sources: World Bank (2020), authors' compilation.

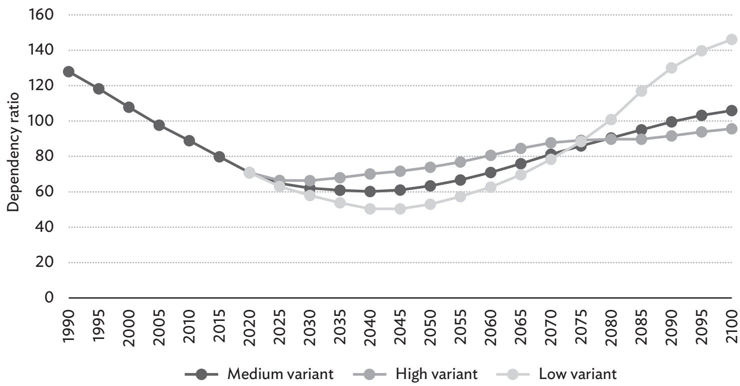
One global standard measure of demographic transition is the *dependency ratio*, which refers to the ratio of the nonworking age population to the working-age population. The Population Division of the Department of Economic and Social Affairs of the United Nations (UN DESA) regards ages below 20 and above 65 as the nonworking age population. Therefore, the age group between 20 and 65 is considered as the working population.

$$Dependency\ Ratio = \frac{Population\ aged\ 0-19\ and\ 65+}{Population\ aged\ 20-65}$$

The lower the value of this dependency ratio, the economy is assumed to gain higher dividends out of it, as, proportionately, a greater number of people are expected to engage in economic activities as compared to the non-working population. Figure 5.4 depicts the trends of the dependency ratio in Bangladesh under three different scenarios (i.e., high, low, and medium fertility variants) between 1990 and 2100, as projected by UN DESA in its *World Population Prospects 2019*. The medium fertility variant refers to the historical long-term fertility trend, while the high and low fertility variants refer to the upper and lower values of 95% prediction intervals. UN DESA's projection is the most comprehensive and globally acknowledged, encompassing all historical data from each country's official censuses and surveys and follows the consequential trends in fertility, mortality, and international migration. Although there is no specific threshold of this dependency ratio, anything less than 100 can be considered as a good indication for an economy. Bangladesh, in this connection, seems to have entered the phase of the first demographic dividend in the early 2000s. A notable decline in dependency ratio is observed between the 1990s and 2000s, which is largely attributed to a marked drop in the fertility rate (as illustrated in Figure 5.3), supported by a massive birth-control campaign by the government and nongovernment organizations. It was complemented by a fall in the infant mortality rates in the same period.

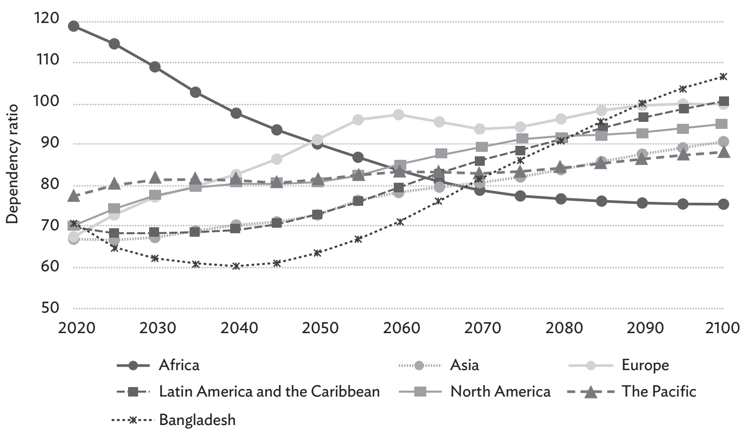
As Figure 5.4 shows, the dependency ratio with medium and low fertility variants has been falling and the trend is expected to continue until 2040, when the ratio would come to its lowest at 60.2 (for medium fertility variant) and 50.4 (for low fertility variant). It would go up thereafter, as the projection reveals. Under the medium fertility variant, the ratio is expected to cross 70 in 2060, 80 in 2070, and 90 in 2080. This implies that Bangladesh has got the opportunity to optimize the gains of the first demographic dividend at least for the next 4 to 5 decades, which would be a crucial factor for the country to attain the

Figure 5.4: Trends of Dependency Ratio in Bangladesh (1990–2100)



Sources: UN DESA (2019), authors' compilation.

Figure 5.5: Dependency Ratio in Different Regions, Medium-fertility Variant (2020–2100)



Sources: UN DESA (2019), authors' compilation.

high-income status by 2041, as targeted. Of course, that can only be attained with a proper strategic framework that would carefully plan and facilitate the optimal and efficient deployment of the country's human and other resources.

Now, in a global context, economies enjoying the first demographic dividend would compete with each other in extracting the gains. Despite some challenges from other regions of the world, Bangladesh would still enjoy the highest potential benefits as compared to the rest of the regions until 2070, as illustrated in Figure 5.5. After that, Africa, the Pacific, and other parts of Asia will take over as regions reaping the highest benefits.

5.3.2 Digitalization in Bangladesh: Trends and Potentials

Digital Infrastructure and Ecosystem

Fostering economic activities through digitalization requires establishing the digital infrastructure for businesses and operations, the transaction of e-money, digital payment, and online-based platforms for providing and facilitating services for the businesses.

Throughout the last decade, Bangladesh has experienced rapid growth in internet connectivity and mobile phone penetration. The country has also fostered the development of a support system for digital

Table 5.1: Fixed Broadband Subscriptions (per 100 inhabitants)

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018
Afghanistan	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.05	0.04
Bangladesh	**0.28**	**0.31**	**0.40**	**1.00**	**2.00**	**3.13**	**4.17**	**4.57**	**6.34**
Bhutan	1.27	1.91	2.39	2.88	3.47	3.83	2.24	2.24	1.43
Cambodia	0.25	0.15	0.20	0.22	0.43	0.54	0.62	0.83	1.02
India	0.89	1.07	1.18	1.17	1.22	1.29	1.41	1.33	1.34
Malaysia	7.44	8.75	10.05	9.97	10.25	10.12	8.86	8.64	8.55
Maldives	4.25	4.64	4.55	4.90	4.56	5.09	6.16	7.36	10.37
Myanmar	0.05	0.04	0.04	0.05	0.05	0.06	0.17	0.21	0.24
Nepal	0.22	0.35	0.85	1.16	0.93	1.12	0.82	1.82	2.82
Pakistan	0.44	0.64	0.81	0.85	1.03	0.90	0.81	0.88	0.85
Sri Lanka	1.13	1.76	1.72	2.05	2.73	2.99	4.24	5.78	7.27
Thailand	4.84	5.77	6.66	7.62	7.95	9.07	10.47	11.86	13.24
Viet Nam	4.17	4.32	5.32	5.68	6.54	8.26	9.72	11.91	13.60

Sources: International Telecommunication Union (2020), authors' compilation.

entrepreneurs which functions to attract the huge young population to utilize the advantages of digitalization and technologies.

Table 5.1 compares the trend of fixed broadband in 12 South Asian and Southeast Asian countries, including eight South Asian Association for Regional Cooperation (SAARC) countries. It reveals that, despite the lower number of broadband subscriptions per 100 inhabitants, the growth of broadband users in Bangladesh has been the fastest among all the mentioned countries. Bangladesh stood third among the SAARC countries after Maldives and Sri Lanka in terms of fixed broadband subscriptions, which amounted to 6.34 per 100 people in 2018. Among the top user countries, Viet Nam has the highest subscription of 13.6%, followed by Thailand with 13.2%, and Maldives with 10.4%. During the 2010–2018 period, Bangladesh experienced the highest (22.6 times) growth in fixed broadband subscriptions among all peer countries. In this growth rate, Bangladesh is followed by Nepal, with 12.8 times and Sri Lanka, with 6.4 times.

Table 5.2 shows that Bangladesh attained 100% mobile cellular telephone subscriptions in 2018. Although it lags most of its peer countries in terms of subscriptions, the rate of growth in mobile subscriptions in Bangladesh was remarkable—118% during the 2010–2018 period. Among the peer countries, only Myanmar and Nepal had higher growth than Bangladesh over this period.

Table 5.2: Mobile Cellular Telephone Subscriptions (per 100 inhabitants)

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018
Afghanistan	35.00	45.81	49.23	52.08	55.16	57.27	61.05	65.93	59.12
Bangladesh	**46.03**	**56.52**	**64.36**	**76.30**	**82.10**	**84.08**	**86.08**	**94.53**	**100.24**
Bhutan	57.52	69.84	79.95	76.64	86.86	92.84	94.80	98.00	93.26
Cambodia	56.95	94.61	129.26	134.86	133.90	134.33	126.32	116.01	119.49
India	60.94	71.49	68.32	69.20	72.86	76.41	85.15	87.32	86.94
Malaysia	120.03	127.96	142.16	145.93	150.43	145.70	141.65	136.12	134.53
Maldives	135.17	139.41	141.11	150.43	153.06	162.62	170.79	181.33	166.36
Myanmar	1.17	2.44	7.25	13.18	55.53	77.82	95.36	89.82	113.84
Nepal	34.04	49.39	61.54	79.36	85.56	101.85	117.81	130.63	139.45
Pakistan	55.28	59.39	64.16	66.79	69.51	63.13	67.03	69.51	72.56
Sri Lanka	85.68	89.81	94.16	98.32	106.42	114.31	122.72	133.47	142.65
Thailand	106.74	114.71	125.32	137.72	141.87	149.81	173.51	175.60	180.18
Viet Nam	126.83	143.26	146.63	136.34	148.45	129.83	128.79	126.87	147.20

Sources: International Telecommunication Union (2020), authors' compilation.

Along with fixed broadband and mobile subscriptions, the advancement toward digitalization is fostered by the mass-scale use of the internet in Bangladesh. According to the Internet World Stats, Bangladesh is ninth in the world in terms of internet users. The latest data reveal that 94.2 million people in Bangladesh used the internet in 2020. Although the penetration (i.e., percent of the population using the internet) remains lower at 57.2%, the annual average growth rate in internet users was high at 49.5% per annum during the 2000–2020 period.

Table 5.3: Top 20 Internet Users by Country (2020)

	Country	Total users in 2020 (in million)	Population using internet (%)	Annual average growth in internet users (2000–2020) (%)
1	People's Republic of China	854.0	59.3	1.9
2	India	560.0	40.9	5.8
3	United States	313.3	94.7	0.1
4	Indonesia	171.3	62.6	4.5
5	Brazil	149.1	70.2	1.5
6	Nigeria	126.1	61.2	33.1
7	Japan	118.6	93.5	0.1
8	Russian Federation	116.4	79.7	1.9
9	**Bangladesh**	**94.2**	**57.2**	**49.5**
10	Mexico	88.0	66.5	1.7
11	Germany	79.1	94.4	0.1
12	Philippines	79.0	72.1	2.0
13	Turkey	69.1	81.9	1.8
14	Viet Nam	68.5	70.4	18.0
15	United Kingdom	63.5	93.6	0.2
16	Iran	67.6	80.5	14.2
17	France	60.4	92.6	0.3
18	Thailand	57.0	81.7	1.3
19	Italy	54.8	90.6	0.2
20	Egypt	49.2	48.1	5.7
Top 20 Countries		**3,241.3**	**61.9**	**0.6**
Rest of the World		**1,332.9**	**52.0**	**0.6**
Total World		**4,574.2**	**58.7**	**0.6**

Sources: Internet World Stats at https://www.internetworldstats.com/top20.htm. The source compiles data from each country's agencies, surveys, and also from standard global data sources like the International Telecommunication Union; authors' compilation.

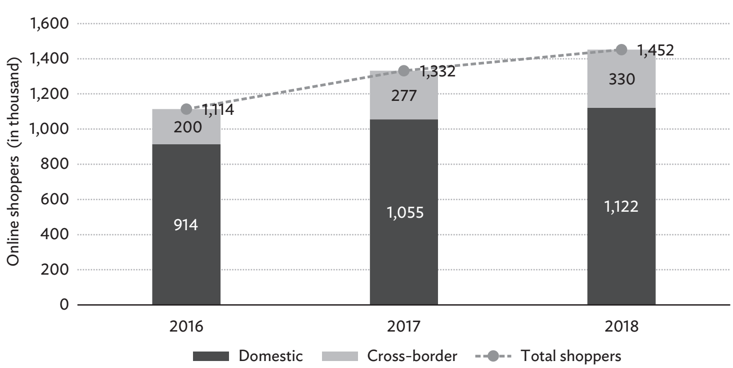
E-commerce and Digital Entrepreneurship

E-commerce is one of the core embedded parts of a digital economy. It refers to economic activities involving goods and services offered online. Over time, new avenues of e-commerce are opened to provide various products and innovative online services that connect mass consumers and suppliers in a virtual marketplace. Thus, in a way, it facilitates large-scale digital entrepreneurship, especially among the young population.

Globally, e-commerce and cross-border online businesses have been rising at a good pace. According to UNCTAD (2019), over 1.45 billion people shopped online in 2018, which was 9% higher than in 2017 and 30.3% higher than in 2016, as shown in Figure 5.6. The global value of e-commerce transactions amounted to $25.6 trillion in 2018, an increase of 8%compared to2017. The United States, Japan, and the People's Republic of China have the highest e-commerce sales and a share of 55.4%in global sales. Category-wise, business-to-business (B2B) accounts for around 83% of the total e-commerce sales, while business-to-consumer (B2C) comprises the rest.

In Bangladesh, e-commerce is at its early stage; sales have been increasing but are yet to reach the full potential. Of the internet users, only 8% are internet shoppers, as per 2017 data (UNCTAD 2019). However, as the digitalization process is shaping up, more infrastructure and regulatory support is provided by the government and concerned organizations. E-commerce has been, thus, facilitated on a broader scale and Bangladeshi people are getting more accustomed to online purchasing, rather than conventional physical visits to the shops. As the

Figure 5.6: Global Online Shoppers (2016–2018)



Sources: UNCTAD (2018), authors' compilation.

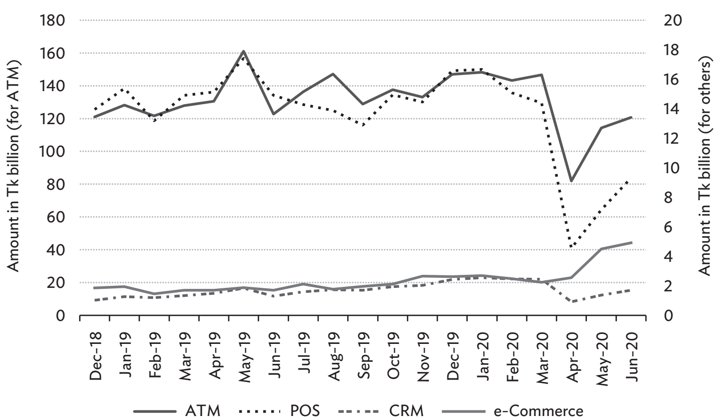
people are becoming more financially educated and able to handle smart devices and digital payment systems, the prospect of e-commerce seems to be immense.

As Figure 5.7 depicts, the volume of e-commerce sales in Bangladesh using credit or debit cards has been gradually increasing. The rate has increased remarkably during the period of the COVID-19 lockdown. As of June 2020, the total volume of e-commerce sales using cards reached Tk914 million, equivalent to $58 million. Although the use of cards in automated teller machines (ATM), points of sale (POS), and cash recycling machines (CRM) was increasing at a good rate up to December 2019, COVID-19 seems to have impacted their use at the beginning of the epidemic until April 2020; afterward, their use has increased again.

Banking plays a significant role in supporting digitalization through online payment systems, along with internet banking. Internet banking is experiencing a rising trend, as shown in Figure 5.8. Transactions through internet banking amounted to Tk38.0 billion in December 2018. This gradually increased, hitting Tk74.2 billion in June 2020. During this period, online banking customers also increased from 1.97 million to 2.74 million.

Besides the banks, mobile financial services (MFS) play a major role in transforming the digital payment system. There is still a kind of

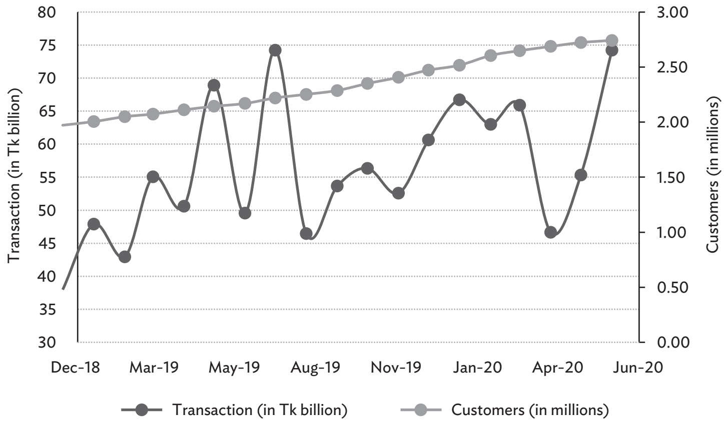
Figure 5.7: ATM, POS, CRM, and e-Commerce Transaction Statistics by Cards



ATM = automated teller machine, POS = point of sale, CRM = cash recycling machine.

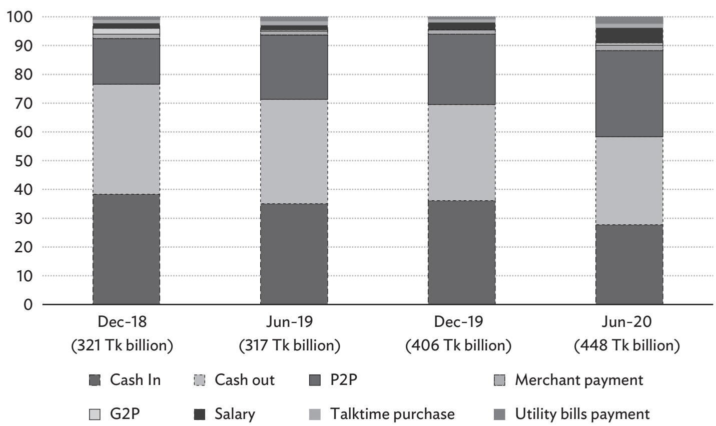
Sources: Bangladesh Bank (2020), authors' compilation.

Figure 5.8: Internet Banking Trend in Bangladesh



Source: Bangladesh Bank (2020), authors' compilation.

Figure 5.9: Transaction Shares of Mobile Financial Services Activities



G2P = government-to-person, P2P = person-to-person.

Sources: Bangladesh Bank (2020), authors' compilation.

oligopolistic market of MFS, but the market is under constant regulation and monitoring by the central bank. As a result, MFS activities have been growing fast, accelerating the digitalization process. According to Bangladesh Bank's statistics, MFS supports an array of financial activities: cash in, cash out, merchant payments, person-to-person (P2P), government-to-person (G2P), salary disbursement, talk-time purchase, and utility bills payment. Total transactions through MFS increased from Tk321 billion in December 2018 to Tk448 billion in June 2020, an increase of around 40%. Figure 5.9 illustrates that over time, shares of P2P, salary disbursements, utility payments, merchant payments, and talk-time purchases have increased while the shares of cash in, cash out, and G2P have decreased. In June 2020, cash out, P2P, and cash in had the highest shares with 30.0%, 29.3%, and 27.2%, respectively. Contrarily, G2P, talk-time purchase, and merchant payments have the lowest shares with 0.8%, 1.4%, and 1.8%. respectively.

Professional Settings (freelancing and IT-skilled jobs)

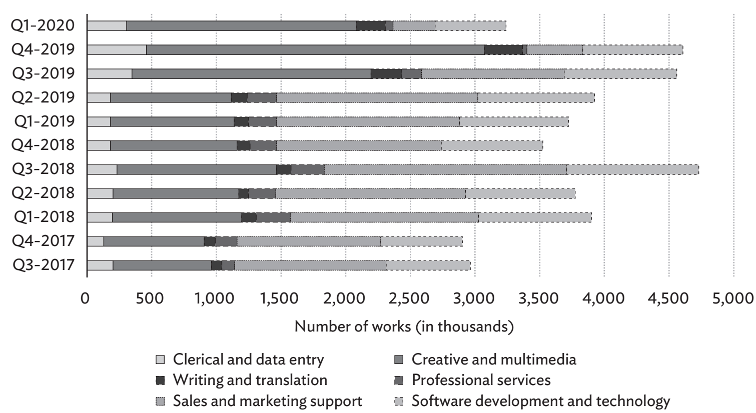
Digitalization not only energizes entrepreneurship and extends business opportunities of an economy, but also opens up the colossal horizon of the online job market for the technologically skilled labor force both at home and abroad. This is especially crucial for countries such as Bangladesh, which has a large number of young individuals entering the labor market each year.

The global online outsourcing market has been expanding and countries with higher labor costs are hiring low-cost laborers in developing countries to perform several types of jobs online. The jobs comprise software development, creative and multimedia, sales and marketing support (especially in the health and education sectors), data entry, tax preparation, search engine optimization, etc. (Chakravorti, Tunnard, and Chaturvedi 2015; Van Ark 2016). As a result, online freelance jobs are becoming popular, especially among the tech-savvy young generation, students, women, and the unemployed. Thus, freelancing has become a solution to the unemployment problem of countries with large labor force such as Bangladesh. The fast-tracked digitalization comprising mass-scale internet access both in urban and rural areas and accompanied by the initiatives taken by the government and nongovernment organizations to promote freelancing has fueled the recent settings of the rising online job markets. As a result, Bangladesh has already emerged as the second-largest supplier of online labor after India, with a global share of 16% of freelance workers (Oxford Internet Institute 2020). According to the ICT Division of the Ministry of Posts, Telecommunications and Information Technology of the Government of Bangladesh (2019), there are around

650,000 registered freelancers in the country, out of which about 500,000 are actively delivering on a regular basis. Although the number of freelancers is a small share of the total labor force in Bangladesh, the untapped potential in the global market may encourage more young laborers to enter these online jobs. On average, these freelancing jobs add $100 million to the economy per annum, which is expected to rise at a good rate in the near future. The government has already taken various measures, including the establishment of tech cities to support these freelancing jobs on a large scale.

Figure 5.10 reveals different types of outsourced IT work performed by Bangladeshi freelancers from the third quarter (Q3) 2017 to Q1 2020. It indicates a seemingly growing trend of outsourced work (by Bangladeshi freelancers) until the end of 2019. COVID-19 may have an adverse impact, as the work volume decreased in the first quarter of 2020.

Figure 5.10: IT Outsourcing Data, Bangladesh

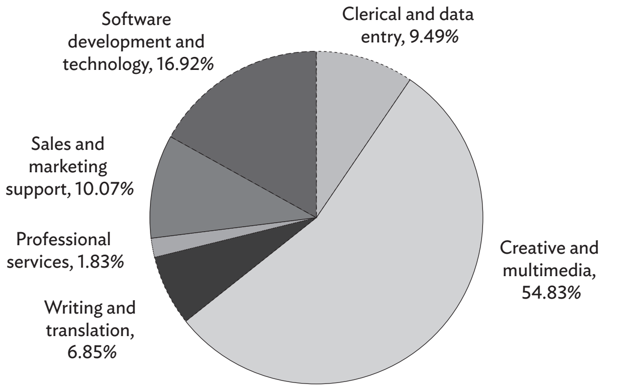


IT = information technology.

Sources: Oxford Internet Institute (2020), authors' compilation.

In terms of job category, it is evident that, over time, Bangladeshi freelancers have come to work more in creative and multimedia jobs, while the share of sales and marketing support jobs has declined. In the latest available quarter's data (i.e., Q1 2020), freelance jobs in

Figure 5.11: Share of Various Freelance Jobs by Bangladeshi Workers (Q1 2020)



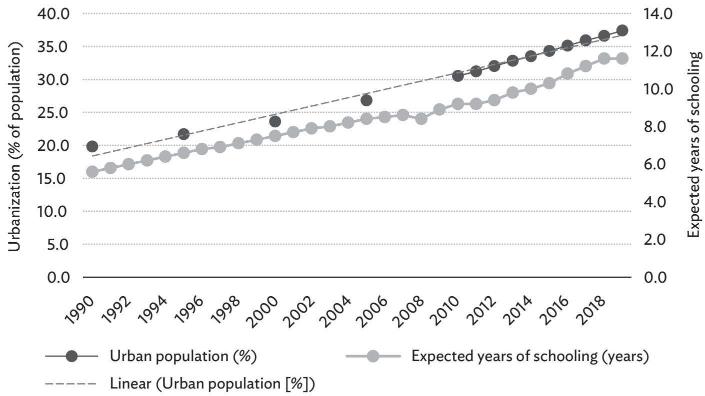
Source: Oxford Internet Institute (2020).

the category creative and multimedia comprise 54.8% of the total freelancing outsourcing jobs. As shown in Figure 5.11, that category is followed by software development and technology with 16.9%, sales, and marketing support with 10.1%, and clerical and data entry with 9.5%.

5.3.3 Key Factors Facilitating Demographic Transition and Digitalization

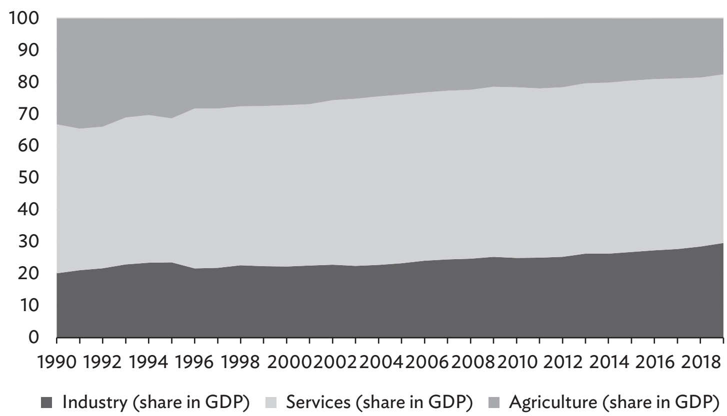
Some key factors are pivotal in facilitating both the demographic transition and digitalization, such as faster urbanization, education, and structural transformation (i.e., moving away from agriculture toward industry and service sectors). Figure 5.12 shows that the urbanization rate has almost doubled from 19.8% in 1990 to 37.4% in 2019. Furthermore, the expected years of schooling (i.e., the total years of schooling a child of school-entrance age can expect to receive in their life in the prevailing context of age-specific enrolment rates) also rose from 5.6 years in 1990 to 11.6 years in 2019, revealing that the young population with higher level of education has been gradually emerging to reap the demographic advantages for Bangladesh in the coming years.

Figure 5.12: Trends Regarding Urbanization and Expected Years of Schooling (1990–2019)



Sources: UNESCO (2020), UN DESA (2019).

Figure 5.13: Economic Structural Changes in Bangladesh (1990–2019)



GDP =gross domestic product.

Source: World Bank (2020).

Figure 5.13 depicts a significant structural change in Bangladesh's economy over the 1990–2019 period. During this time, the share of agriculture declined from 33.1% to 17.5%, while the industry sector's share increased from 20.2% to 29.6%, and the service sector's share from 46.7% to 52.9%.

5.4 Methodology

This study uses two distinct methodologies to examine three research questions. To understand how the demographic transition (reflected through higher labor participation over time) is fostering the digitalization process in Bangladesh; and how digitalization, in aggregate, leads towards faster economic growth, a three-stage least squares (3SLS) simultaneous equation model is adopted. To determine whether the young populations' adoption of digitalization and technological innovation makes them more productive than the older age groups, this study applies labor elasticities of productivity measures, as explained in section 5.4.2.

5.4.1 The Three-Stage Least Squares Model

For establishing the causal link to estimate the impact of the first demographic dividend on the economic growth of Bangladesh through digitalization channels, a system of equations using the simultaneous equation estimation modeling approach seems appropriate. As the demographic dividend and digitalization are found as the endogenous variables to the economic growth, to comprise the cross-equation error correlation owing to the unobserved characteristics normally encountered among the dependent variables, a 3SLS approach can be used.

In this connection, an ordinary least squares estimation (OLS), two-stage least squares (2SLS), or seemingly unrelated regression (SURE) would most likely generate biased and inconsistent estimations of parameters because of the unaccounted correlation among the endogenous dependent variables and the error terms of these equations. A 3SLS overcomes these limitations as its estimates are calculated by assessing a set of linear (or non-linear) equations with cross equation constraints, but also with a consideration of the diagonal covariance matrix of the error terms across these equations (Zellner and Theil 1962). Hence, a 3SLS model should result in more efficient parameter estimates than other simultaneous equation estimation models, such as the SURE and 2SLS.

The 3SLS estimation approach consists of three consecutive stages:

(1) Initially, the 2SLS estimates are obtained by regressing each endogenous variable (i.e., the first demographic dividend and digitalization in this study) on all exogenous variables. The regression-predicted values are used as instruments to estimate the 2SLS parameter estimates using the OLS.
(2) In the second stage, the optimal instrument, or weighting matrix is computed by using the estimated residuals. The contemporaneous (cross-equation) variance-covariance matrix of the error terms is determined by using the 2SLS parameter estimates to compute residuals.
(3) In the last stage, the contemporaneous (cross equation) variance–covariance matrix of the disturbances obtained from the previous stage is used to obtain the transformation of the original variables; and the generalized least-squares (GLS) method is applied to estimate the 3SLS model parameters.

For this study, structural equation and system equations are considered as follows:

$$lnGDP_t = \gamma_0 + \gamma_1 lnCapital_t + \gamma_2 lnProductivity_t + \gamma_3 Internet_t + \gamma_4 Dep\_ratio_t + \epsilon_t \quad (4)$$

$$Internet_t = \alpha_0 + \alpha_1 labor_{rate_t} + \alpha_2 urban_{rate_t} + \alpha_3 lnProductivity_t + \alpha_4 Mobile\_penet_t + \alpha_5 Rural\_electricity_t + \varepsilon_{1t} \quad (5)$$

$$Dep\_ratio_t = \beta_0 + \beta_1 HDI_t + \beta_2 urban\_rate_t + \beta_2 labor\_female_t + \varepsilon_{2t} \quad (6)$$

where, GDP_t : GDP at constant 2010 $ at time t

$Capital_t$: Gross capital formation at constant 2010 $ at time t

$Productivity_t$: Labor productivity measured in income per worker at time t

$Internet_t$: Internet users per 100 people at time t

Dep_ratio_t : Dependency ratio (i.e., population aged below 19 and above 65/ population aged (20–64) at time t

$labor\_rate_t$: Labor participation rate at time t

$urban\_rate_t$: Urban population to total population at time t

$Mobile\_penet_t$: Mobile penetration (per 100 population) rate at time t

$Rural\_electricity_t$: Percent of rural population having access to electricity at time t

HDI_t : Human Development Index score (developed by the UNDP) at time t *labor_female*$_t$: Rate of female participation in the labor force at time t

α, β, and γ are the parameters of estimates

ε, and ϵ : Error terms

Here, the first demographic dividend (presented by the dependency ratio) and digitalization (presented by the internet user population) are regarded as the endogenous variables to the economic growth (presented by the GDP). The rest of the variables are exogenous to the model.

Hence, the estimation process follows the following stages:

(1) OLS is applied to equation (5) and (6) and the predicted values of $\widehat{Internet_t}$ and $\widehat{Dep\_ratio_t}$ are obtained

(2) The values of $\widehat{Internet_t}$ and $\widehat{Dep\_ratio_t}$ are substituted into the right-hand side of the structural equation (i.e., equation (1)); and OLS is applied to this transformed equation. Structural parameters of the models (i.e., α and β values) are estimated using 2SLS, which are subsequently used for the estimations of the error terms of equations (5) and (6) if the sample size is n, then the variance-covariance of the estimated error terms are calculated as follows:

$$\widehat{\sigma_{\varepsilon_1}}^2 = \frac{\sum_{i=1}^{n} \varepsilon_{1i}^2}{n}$$

$$\widehat{\sigma_{\varepsilon_2}}^2 = \frac{\sum_{i=1}^{n} \varepsilon_{2i}^2}{n}$$

$$\widehat{\sigma_{\varepsilon_1\varepsilon_2}} = \widehat{\sigma_{\varepsilon_2\varepsilon_1}} = \frac{\sum_{i=1}^{n} \varepsilon_{i1}\varepsilon_{i2}}{n}$$

Hence, the matrix of variance-covariance of the error terms is as follows:

$$\begin{vmatrix} \widehat{\sigma_{\varepsilon_1}}^2 & \widehat{\sigma_{\varepsilon_1\varepsilon_2}} \\ \widehat{\sigma_{\varepsilon_2\varepsilon_1}} & \widehat{\sigma_{\varepsilon_2}}^2 \end{vmatrix} = \begin{vmatrix} \frac{\sum_{i=1}^{n} \varepsilon_{1i}^2}{n} & \frac{\sum_{i=1}^{n} \varepsilon_{i1}\varepsilon_{i2}}{n} \\ \frac{\sum_{i=1}^{n} \varepsilon_{i1}\varepsilon_{i2}}{n} & \frac{\sum_{i=1}^{n} \varepsilon_{2i}^2}{n} \end{vmatrix}$$

(3) Finally, the GLS method is applied to get the final estimations of all equations using the transformed value derived from the above variance-covariance of the error terms.

5.4.2 Labor Elasticities of Productivity

To estimate whether or not the adoption of digitalization raises the productivity of the young labor force higher than that of the others, this study adopts the productivity sharing approach to calculate the labor elasticities of productivity separately for the working groups (i.e., millennials aged 20–39, and others aged 40–65).

Labor elasticity of the young working population's productivity at time t is calculated as,

$$\epsilon_{y,t} = \frac{\%\ change\ in \frac{Y}{L}\ between\ time\ t\ and\ (t-1)}{\%\ change\ in\ the\ number\ of\ laborers\ aged\ (20-39)\ between\ time\ t\ and\ (t-1)} \qquad (7)$$

Similarly, the labor elasticity of the others' productivity at time t is calculated as,

$$\epsilon_{o,t} = \frac{\%\ change\ in \frac{Y}{L}\ between\ time\ t\ and\ (t-1)}{\%\ change\ in\ the\ number\ of\ laborers\ aged\ (40-65)\ between\ time\ t\ and\ (t-1)} \qquad (8)$$

5.5 Description of Data

For empirical analysis, data on required variables are collected from various sources for the period 1990-2019. Data on GDP in constant 2010 $, gross fixed capital formation (in constant 2010 $), labor force participation rate (i.e., number of laborers as the percentage of total population ages 15–64), labor force participation rate of the female (i.e., number of female laborers as the percentage of the total female population aged 15–64), urbanization rate (i.e., the urban population as the percentage of the total population), mobile cellular subscriptions, and access to electricity of the rural population (the percentage of rural population) are extracted from the World Bank's World Development Indicators dataset. Data from the Human Development Index (HDI) score are collected from the United Nations Development Program's website. Data on productivity (measured in 2010 constant $ per worker), and population and labor by age group are extracted from the International Labour Organization modeled estimates of the United Nations Department of Economics and Social Affairs (UN DESA). For the data on internet users, two datasets are used: World Development Indicators and Internet World Stats.

5.6 Results and Findings

5.6.1 Summary Statistics

Table 5.4 shows the summary statistics of the variables used for modeling. The phenomenal economic growth has been evident from the data as Bangladesh experiences fivefold growth (i.e., from $42.4 billion to $210.0 billion) over the 3 decades between 1990 and 2019. Notably, the pace of growth increases over time. In the first decade of the referred period, a 150% growth was achieved while in the second and third decades, the growth was 163% and 182%, respectively. This has significant implications for this study in terms of perceiving the plausible nexus between the faster digitalization and economic growth in recent years.

The capital accumulation also experiences a remarkable tenfold increase from $6.3 billion to $65.3 billion during the 1990–2019 period. The share of capital in the GDP also increases over this time from around 15% to 31%. The higher standard deviation refers to the higher variability among the data on capital during this period.

Table 5.4: Summary Statistics of the Variables (1990–2019)

Variable	Mean	Std. Dev.	Min	Max
GDP (in billion $)	98.00	48.30	42.40	210.00
Capital (in billion $)	24.80	17.20	6.31	65.30
Labor force participation rate (in %)	59.01	0.80	58.53	61.41
Labor force participation rate, female (in %)	29.88	3.83	25.41	38.39
Productivity (in $)	1,946.90	609.50	1,262.69	3,301.06
Urban population (% of total population)	27.32	5.51	19.81	37.41
Access to electricity in rural (% population)	32.64	25.11	2.50	85.00
HDI score	0.50	0.07	0.39	0.62
Dependency ratio	1.00	0.17	0.72	1.28
Internet users (% population)	6.52	13.58	0.00	57.75
Mobile penetration (in %)	30.42	38.18	0.00	107.47

GDP =gross domestic product, HDI = Human Development Index.

Source: Authors' compilation.

The labor force participation rate was relatively stable at around 60% during the reference period with a very small standard deviation. Despite this steady participation rate, the number of workers aged 15–64 increased rather rapidly, from 33.2 million in 1990 to 67.7 million in 2019, reflecting the faster demographic transition. Interestingly, the female participation rate increased from 25.4% to 38.3% during the 1990–2019 period. Workers' productivity steadily increases from $1,263 per worker to $3,301 per worker. The variability of productivity data is also relatively lower.

The transition from the rural to urban areas should have notable implications both on digitalization and the economic growth of the country. The urbanization rate has doubled from 19.8% to 37.4% during the 1990–2019 period. Also, the variability of urbanization is on the low side, implying the process remained steady over time. Yet, the rising urbanization does not imply that the living standard of the rural population has been degraded; rather, they are also enjoying the fruits of the faster economic growth of the country. In the last 3 decades, there have been revolutionary attainments in enhancing access to electricity in rural areas in Bangladesh. In 1990, only 2.5% of the rural population had access to electricity, but that jumped to 85.0% in 2019. As is evident, the variability of this variable remains much higher.

Bangladesh has also achieved great success in socioeconomic indicators in recent times. Its life expectancy, education levels, and standard of living have improved markedly, which is evident in the HDI score. The HDI score gradually increased from 0.39 in 1990 to 0.62 in 2019. In this, the influence of the dependency ratio, which dropped from 1.28 to 0.72 during this period, may have been reflected.

As mentioned earlier, the digitalization process has been accelerating in Bangladesh, especially throughout the past decade. The number of internet users spiked from 3.7 million (i.e., 2.5 persons per 100 people) in 2010 to 94.2 million in 2019 (i.e., 57.8 persons per 100 people). Mobile subscribers also rose from 67.9 million (i.e., 46 per 100 people) in 2010 to 175.4 million (i.e., 107 persons per 100 people) in 2019.

5.6.2 Estimations of the 3SLS Model

Table 5.5 highlights the findings from the 3SLS model, adopted for this study to link the impacts of the first demographic dividend and digitalization on the economic growth of Bangladesh.

Economic Growth Determinants

Estimations reveal that the country's economic growth is significantly influenced by both digitalization and the demographic transition. The 3SLS model results show that for an increase in 1 percentage point of internet users per 100 people, the GDP would increase by 0.001%. The coefficient is statistically significant at a 99% confidence level. This is quite evident as digitalization, particularly in recent times, has played a noteworthy role in excavating new opportunities in various sectors of the economy, especially in the service sectors. In addition, the demographic structure, represented by the dependency ratio, also suggests that the higher the working-age population (i.e., lesser dependency ratio), the higher the economic growth. The result indicates that a 10-basis point decrease in the dependency ratio would increase the GDP by 7.2%, on average.

Alongside these, economic growth was also positively impacted by two key endowments of the growth model, i.e., accumulated capital and labor productivity. Our result shows that a 1% increase in capital formation would increase the GDP by 0.25%, on average. The estimation also suggests that a 1% increase in labor productivity would result in a 0.58% growth.

Table 5.5: Results of the 3SLS Estimations

Dependent Var.	Explanatory var.	Coefficient	Standard error	P-value
lnGDP				
	lnCapital	0.245***	0.070	0.00
	lnProductivity	0.579***	0.039	0.00
	Internet	0.001***	0.0002	0.00
	Dep_ratio	−0.723***	0.257	0.01
Internet				
	Labor_rate	9.029***	1.603	0.00
	Urban_rate	−7.238*	4.235	0.09
	lnProductivity	128.717*	85.146	0.10
	Mobile_penet	14.867*	9.111	0.10
	Rural_electricity	0.117	0.230	0.61
Dep_ratio				
	HDI	−2.471***	0.134	0.00
	Urban_rate	−0.004*	0.002	0.10
	Labor_female	0.007***	0.001	0.00

3SLS = three-stage least square, HDI = Human Development Index.

***Result is statistically significant at 99% confidence level; **Result is statistically significant at 95% confidence level; *Result is statistically significant at 90% confidence level.

Source: Authors' estimation.

The model also explains the key driving forces of two endogenous variables, i.e., digitalization and the dependency ratio.

Determinants of Digitalization

Digitalization, represented by the number of internet users per 100 population, is positively influenced by the labor rate participation, workers' productivity and mobile penetration. Presumably, more people in the labor force would prompt the usage of digital services since they are capable of defraying the cost of using the internet and other digital platforms. Our estimation implies that a 1 percentage point increase in the labor participation rate would lead to an increase in internet users by 9.0 percentage points. The estimation is significant at a 99% confidence level.

Findings also reveal that a 1% increase in labor productivity would increase the usage of the internet by 1.29 percentage points. The estimation result is significant at a 90% confidence level. This may be the case for two reasons: i) higher labor productivity is linked with higher use of technology, and ii) higher labor productivity leads to a higher income of workers, who then can spend more on digital services and the internet.

The result implies that a 1 percentage point increase in mobile penetration would lead to an increase in internet users by 14.9 percentage points. The estimation is significant at a 90% confidence level. The mobile phone is the most convenient pivotal instrument for using the internet. The mobile penetration is already at a higher side, with 107 mobile subscriptions per 100 people. The use of the internet will pick up the trend and smooth out in the future.

Rural peoples' access to electricity is used as a proxy for rural development. Findings show that it is also estimated to have a positive association with digitalization, though the coefficient is not statistically significant.

The result implies that the urbanization rate has negatively impacted the use of the internet; i.e., more people migrate from rural to urban areas, so the internet usage rate goes down. Our estimation reveals that a 1 percentage point increase in the urbanization rate would lead to a decrease in internet users by 7.2 percentage points. The estimation is significant at a 90% confidence level. It may be plausible, as migration to a new environment costs a lot and life in urban areas is usually competitive and expensive. To cut down the cost, migrants with low incomes may not feel inclined to use the internet, which remains among the costlier in the SAARC region. The average cost of a 1 gigabyte internet package in Bangladesh is around $0.70, higher than in neighboring India, Sri Lanka, and Pakistan, as shown in Table 5.6.

Table 5.6: Average Cost of 1 GB of Internet Data in 2020

Global rank	Country	Average price of 1GB (in $)
1	India	0.09
8	Sri Lanka	0.51
10	Viet Nam	0.57
12	People's Republic of China	0.61
17	Pakistan	0.69
19	**Bangladesh**	**0.70**
28	Myanmar	0.78
31	Nepal	0.86
47	Malaysia	1.12
49	Bhutan	1.16
51	Thailand	1.23
66	Cambodia	1.50
67	Afghanistan	1.55
134	Maldives	3.88

GB = gigabyte.

Sources: https://www.cable.co.uk/mobiles/worldwide-data-pricing/, authors' compilation.

Determinants of the Dependency Ratio

Three exogenous variables are tested as the determinants of the dependency ratio, which proxies the demographic transition in this 3SLS model.

The HDI is found to have a significant impact on the dependency ratio. The result implies that a 10-basis point increase in the HDI score would decrease the dependency ratio by 0.24 percentage points. The estimation is significant at a 99% confidence level. It would be rational to consider that, with the progress in life expectancy, education, and social indicators, people would focus on maintaining their standard of living. As a consequence, the birth rate will drop in one timeframe, and, eventually, the dependency ratio will drop in the next time period.

Urbanization is found to have a negative effect on the dependency ratio, implying that as more people move from rural to urban areas, the share of the working population should increase. Since life in urban areas is more competitive and expensive to support their livelihoods, a larger proportion of people will join the work force bringing the dependency ratio down. The impact is, however, minimal according to the estimation shown in Table 5.6. It indicates that an increase in 1 percentage point in urbanization would result in a 0.4 basis point decline in the dependency ratio. The estimation is significant at a 90% confidence level.

The female participation rate in the labor force, however, is found to have a positive association with the dependency ratio. This is an interesting aspect of the demographic transition. On one side, if a female joins the labor force, the probability of having children usually goes down as making a good balance between the family (i.e., child-rearing) and employment becomes difficult. On the other, a woman's entrance into the labor market may also mean that the family can support more children. This has implications for the dependency ratio, which rises as female participation in the labor market increases. The estimation presented in Table 5.6 implies that an increase in 1 percentage point of the female participation rate in the labor force would result in a 0.7 basis point increase in the dependency ratio. The estimation is significant at a 99% confidence level.

Model's Robustness

The model's robustness is also tested, and the findings are presented in Table 5.7. It shows that all the three equations have very high R-square values, which indicates that the model is well-fitted for the variables used. The values of Chi-square are also high enough to affirm the robustness of the model. Root mean square errors (RMSE) represent the variance of the residuals. The lower the value of the RMSE, the more accurately the model is able to predict the responses. With this in mind, it is worth noting that the RMSE values of our model are very low for the economic growth and demographic transition equations. Hence, the model seems to fit well in every aspect.

Table 5.7: Robustness of the Model

Equation	Observations	Explanatory Variables	RMSE	R-sq	chi^2
lnGDP	30	4	0.006568	0.9998	155144.3
Internet	30	5	3.673195	0.9244	369.11
Dep_ratio	30	3	0.00686	0.9983	17786.63

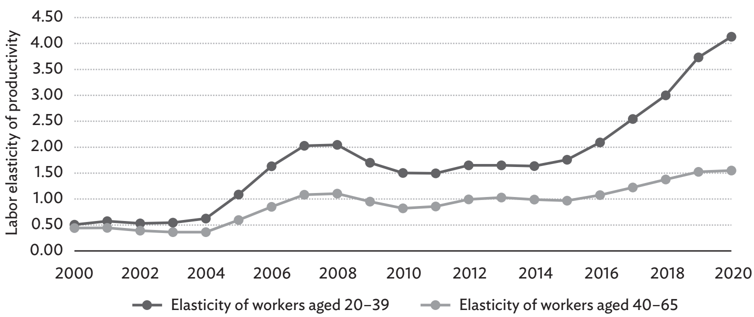
RMSE = root mean square errors.

Source: Authors' estimation.

5.6.3 Calculation of the Elasticities

Labor elasticities of productivity are calculated to see whether the adoption of digitalization leads to a higher productivity among young workers than among the working population of other ages. Using equations (7) and (8), the elasticities of the two groups are calculated. Results depicted in Figure 5.14 shows that between 2000 and 2019, the labor elasticity of productivity of young workers recorded a rising trend against the seemingly constant elasticity of workers from the age group 40–65. After 2012, the elasticity of the young gained a marked momentum and leaped from 2.93 to 6.63 over the 2012–2019 period. During the same period, the elasticity of the other group hovered between 1.76 to 1.71.

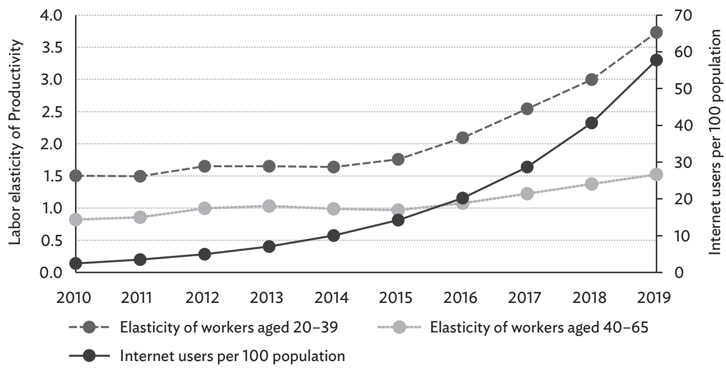
Figure 5.14: Labor Elasticities of Young Workers (aged 20–39) and Other (aged 40–65)



Sources: World Development Indicators (2020), ILO (2020).

Nevertheless, the question arises how the different uses of the internet can be distinguished based on the age groups and how the pattern could be linked with the level of labor productivity. The analysis would be easy if the data on age-specific productivity were available. Since such data are not explicitly available, this study takes an indirect approach to establish the link. The correlations between the aggregated internet penetration and the labor elasticity of productivity are calculated for the two age groups of workers. The higher the correlation, the higher the assumed impact of digitalization on productivity for that segment of the labor forces. From earlier analyses, it is evident that the process of digitalization has picked up pace in Bangladesh mostly in the very recent years. The number of internet users per 100 population increases from 10.0 to 57.8 just over the 5 years from 2014 to 2019. The elasticity also rises sharply for young workers aged 20–39 at the same time, as illustrated in Figure 5.15. The correlation between the labor elasticity of productivity and internet users per 100 population is found higher for the labor force aged 20–39 (correlation coefficient of 84.8) than the other age group (correlation coefficient of 74.8) also for the entire period 2000–2019, indicating that a close association exists between digitalization and the productivity of young people.

Figure 5.15: Digitalization and Labor Elasticities of Productivity (young workers vs other ages)



Source: Authors' calculation.

5.7 Summary, Policy Suggestions, and Conclusion

This study has been comprehensive in its approach to understanding the links between the first demographic dividend, digital innovation, and the economic growth of Bangladesh, a country that has attained reasonable success in all these segments (i.e., digitalization, demographic transition, and economic growth). With its conceptual framework and empirical evidence, the chapter explains how the digitalization process can be accelerated with the involvement of the young labor force and the government's support in developing the digital infrastructure and regulations. Furthermore, this study reveals the marked improvement in the productivity of young workers is due to a rapid adoption of digital technologies. Finally, it uses the 3SLS simultaneous equation estimation model to explore how and to what extent the digitalization and demographic transition lead towards faster economic growth in Bangladesh.

Bangladesh entered the period of the first demographic dividend in the early 2000s. The dependency ratio started falling since then and the trend, according to the UNDP, will continue until 2040, when the ratio will come to its lowest point. Data reveal that despite some challenges from other regions of the world, Bangladesh would still be able to extract higher probable gains from its demographic transition than the rest of the regions until 2070, under the assumption that a proper strategic planning framework is put in place and the country's human and other resources efficiently deployed.

Also, the digitalization process in Bangladesh has accelerated significantly in recent years, and has encompassed everything from mass-scale digital infrastructure for businesses and operations, the transaction of e-money and digital payment systems, to online-based platforms for providing and facilitating services for the businesses. Despite the comparatively lower number of broadband subscriptions per 100 inhabitants, the growth of broadband users in Bangladesh has been the fastest among all the peer nations. In Bangladesh, digitalization is fostered by the growing use of the internet, as the country was positioned ninth in the world in terms of internet users in 2020. Yet, there is still enormous untapped potential since the internet penetration is only about 57%.

E-commerce is becoming popular and Bangladeshi people are becoming accustomed to the new digitalized business ecosystem. The use of ATMs and POS has been gradually increasing. Increased transactions through internet banking and MFS also play crucial roles intaking the digital payment system to the next level of comfort.

Digitalization not only encourages entrepreneurship and extends business opportunities in an economy, but also creates massive amounts of online jobs for a technologically skilled labor force. Online freelance jobs are becoming increasingly popular in Bangladesh, especially among the tech-savvy young generation, students, women, and the unemployed. Thus, freelancing has become a big solution to the unemployment problem in Bangladesh. The country is already the second-largest supplier of online labor in the world after India, with a global share of 16%.

Our estimations using the 3SLS model have shown that economic growth is significantly influenced by both digitalization and the demographic transition. The results reveal that in Bangladesh with an increase of 1 percentage point in internet users (per 100 people), the GDP would increase by 0.001%, while a 10-basis point decrease in the dependency ratio would increase the GDP by 7.2% on average. The key driving factors for digitalization are the labor participation rate, workers' productivity and mobile penetration. The urbanization rate, however, appears to be an adverse factor in terms of the rise in internet users. Presumably, migrants from rural to urban areas who have a low income find it challenging to cope with the new competitive, expensive environment and, hence, may not be able to use the costlier internet service in cities. In our study, rural development is also found to have a positive impact on digitalization.

Our estimations imply that the HDI score and the urbanization rate have significant negative impacts on the dependency ratio, while female participation in the labor force has a positive impact on it. Based on the findings, the study identifies several policy areas that need to focus on overcoming the challenges of digitalization and maximize the untapped potential of digitalization and demographic dividends in attaining higher economic growth.

Infrastructure: Local governments in Bangladesh have been playing a pivotal role in expanding the necessary public services through Union Digital Centers (i.e., the smallest tier local government), thereby strengthening the e-government policies (Government of Bangladesh, ICT Division 2019). To reinforce the process, more community digital centers, telecenters and hubs at the rural grass roots level could be established to provide constant multifaceted support through skilled manpower. Post offices can be renovated with state-of-the-art technologies to ease the monetary and financial transactions and to provide courier services, which may be crucial for e-commerce development as well.

Payment system modernization: Cashless transaction is a prime precondition of a modern digitalized payment system. Encouraging people to use cards instead of cash in their daily transactions may require substantial incentives for the users. Lowering the costs of operation on debit and credit cards is of utmost importance in this respect. More MFS should be allowed to enter into the market so that the current oligopolistic market turns into a competitive one that would be able to reduce the transaction costs and extend the market base with new products and services. The establishment of more ATMs, POS, CRMs, and CDMs should be allowed, considering the efficient distribution at different locations. Modernization of the payment system will not only bring benefits to the common people, but can also be used to facilitate government activities such as online tax collection, improved financial management of projects, as well as promote a conducive investment environment. Recently, the National Board of Revenue has commenced online filing of tax returns amid the COVID-19 pandemic (bdnews24.com 2020), a procedure which could be eased further in the future.

Easing of regulations: Rather than being too strict, regulatory frameworks, legislation, and policies on e-commerce, digital payments, freelance jobs and inward remittances should be eased to attract more people and investments toward digitalization. For instance, the limits on transactions using cards, MFS accounts, or internet banking should be meticulously extended over time. Because of the lower limits and procedural constraints, sometimes, certain levels of transactions are hampered.

Security and safety measures: Alongside the easing of regulations, proper security and safety measures should also be ensured, since otherwise people may not put their trust in the digital system. Banks and MFS should incorporate proper safekeeping measures concerning debit and credit card transactions, internet banking, e-wallets, among others, Bangladesh Bank (Bangladesh's central bank) could also intervene with conducive regulations.

E-commerce support: To sustain the progress of e-commerce, adequate logistics, transportation, and supply chains are required. A comprehensive government policy in this connection could be framed so that more young entrepreneurs and workers can create jobs in these sectors. To expand the network of businesses including e-commerce, express roads and highways and faster rail lines need to be developed throughout the country.

Entrepreneurship development: The government should provide adequate financial support at concessional rates in the form of venture capital or loans for small and medium-sized enterprises to meet the capital requirements for new ventures and e-commerce businesses. Bangladesh Bank could also facilitate large refinance schemes for new ICT-based entrepreneurs. The government could also allow tax rebates and offer other fiscal supports to develop the base of digital commerce and businesses.

Education and skill-based training: Digital financial education has a big role to play in influencing the behavioral patterns of the people regarding digitalization. The potential benefits of digitalization are only attainable through proper guidelines and edification. The government has already placed ICT as a core subject at the school level. However, more skill-based training and knowledge-sharing sessions can be arranged for the young population to groom them for becoming a self-employed entrepreneur or working as an expert freelancer. More ICT cities and high-tech parks should be established in all districts of Bangladesh to support the knowledge as well as the employment of young people.

This study has significant implications for identifying the determinants as well as the potentials of the digitalization and demographic transition towards the economic progress of Bangladesh. It empirically reveals that both digitalization and the demographic transition would play a momentous role not only in creating enormous employment opportunities for the young and educated labor force but also in sustaining the existing high economic growth trajectory of Bangladesh. Furthermore, the study provides an adequate economic analysis as an input for the government and policymakers. The outcome could be linked to a roadmap for attaining sustainable development targets for developing countries by using the channel of millennials' adoption of digitalization and technological innovation.

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6

Promoting Sustainable Development through Realizing the First Demographic Dividend Opportunity in the Digital Economy: The Nepal Experience

Shristi Tandukar, Tapan Sarker, and Sima Rani Dey

6.1 Introduction

Nepal, being among the 48 least-developed countries, with robust economic growth of 7.1% in the fiscal year (FY)[1] of 2018–2019 is rigorously putting effort into fulfilling the criteria to be upgraded into a developing country in the coming years. For the last few decades, Nepal has been undergoing remarkable demographic changes and has entered into a demographic transition that provides it with a "window of opportunity" for higher economic growth. For Nepal, the first demographic dividend became available in the 1980s and is expected to last until 2030 (Kannan and Dharmalingam 2012). Furthermore, the working-age population (those who are between the ages of 15 and 64 years) is increasing rapidly in Nepal. However, limited opportunities have impelled the working-age population to migrate to other countries for better living and employment opportunities. Therefore, the period of this demographic dividend being temporary, it is necessary that Nepal act smartly within the time frame and systematically utilize its human resources for future prosperous economic development.

1 Nepal's fiscal year is the 12-month period beginning 16 July and ending 15 July.

The rise of the new techno-economic paradigm has triumphed in the world economy, influencing almost every sector of business, trade, and services via the process of digitalization. Combined with the increasingly sophisticated tools of connectivity and networking tools used in digital technologies, it has enhanced the modes of communication significantly. In the case of Nepal, during the last few decades, the trend of technological advancement has built an innovative pathway to the digital economy for sustainable development. However, Nepal is struggling to keep up with the rapid pace of the digital revolution, and its development remains insufficient, compared to the pace of global digitalization. Scholars posit that such transformations often start with simple digitization initiatives; however, planning the social architecture is central to drive the initiatives (Kar et al. 2019).

E-business allows physical spaces and flows to be reconfigured and reconstituted, generating new forms of environmental problems through the dispersal of land uses and the amplification of new travels, rather than substituting them. Furthermore, digital technology is capable of creating environmental harm and diminishing environmental sustainability at various levels which include increasing electronic waste streams, besides, improving the energy efficiency of production and the product-to-service shift in consumption, or rebound effects in transport (Hilty et al. 2006). The goal of reducing environmental impacts brings out the importance of defining a new business paradigm that takes into account collaborative consumption to support environmental policies and encourage sustainable behavior (Toni, Renzi, and Mattia 2018).

This study is an attempt to identify and assess the opportunities, inter-linkages, and complexities associated with the first demographic dividend in Nepal. More specifically, this research explores the influence of the emerging digital economy on the demographic dividend with a focus on managing environmental sustainability. An appropriate study in this sector is indispensable to capture the optimum advantage of the first demographic dividend during the nascent stage of the digital economy. Also, until now, very little research has been done in the area of environmental sustainability, which means that there is a need to investigate to what extent the use of digital platforms can help reduce the material and energy needs in the period of the first demographic dividend. Against this backdrop, this study will strive to provide useful insights into the inter-linkages and relationships between the demographic dividend, the digital economy, and the environment. Existing regulatory frameworks tend to evolve slower than the digital revolution blooms. In light of that, this chapter will further offer assistance in identifying policy interest and implications for government policies with the goal of contributing to seizing the maximum advantage of the first demographic dividend for a sustainable digital economy.

The remainder of the chapter proceeds as follows. We present a review of the literature in Section 6.2, which also includes a conceptual framework underpinning the measurements of variables of interest for the study. Section 6.3 introduces the data and methodology of the study. Section 6.4 presents and discusses the results. Section 6.5 explains the role of government in sustainable development. Section 6.6 briefly discusses the policy implications and economic impacts of the novel coronavirus (COVID-19) pandemic during the demographic transition. The final section concludes this study.

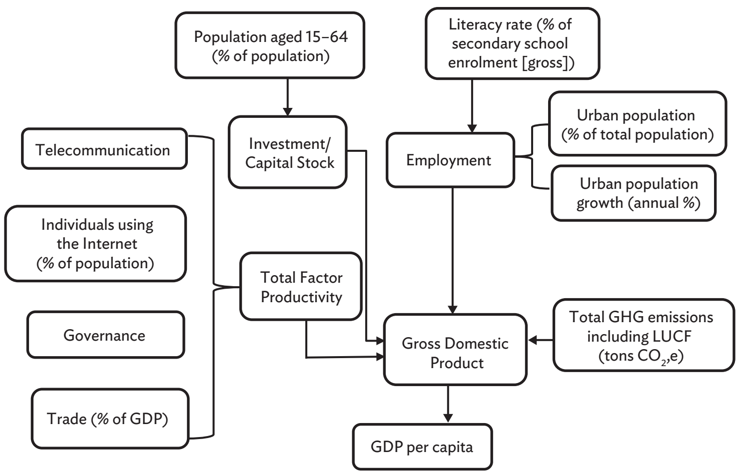
6.2 Literature Review

Lee and Mason (2011) were among the first who pinpointed the average life cycle income and consumption patterns varying with age structures, from the data provided by country teams participating in the global National Transfer Accounts (NTA) project. They used an economic "life cycle method" to predict the preferable age structures which might differ from the actual pattern among countries (Lee and Mason 2011). Cincotta (2015) posits that politics play an important role and function most fluently during the course of the demographic dividend. However, it is important to note that a demographic dividend does not continue endlessly and that the window of opportunity for it is often short. For this reason, it is important for each country to understand that to achieve a demographic dividend there is a need to acknowledge the size and distribution of its population, its current and projected age structure, and the pace of population growth (Ross 2004). The pace and timing of demographic transition differ from one country to another. Although demographic transitions began in the developed world, in regions such as Africa, Asia, and Latin America they are still underway (Bongaarts 2009). Labor supply, savings, and human capital are considered three mechanisms that deliver the demographic dividends. According to Bloom, Canning, and Sevilla (2003, 41–42), "the demographic transition has significant effects on investments in human capital, effects of which are the least tangible, but maybe the significant and far-reaching and the mechanisms are heavily dependent on the policy environment". Moreover, the demographic structure in the next decades in the South of the world has a significant window of opportunity to implement structural reforms, with the increase in working-age population associated with improvements in saving rates, capital accumulation, and sustained growth (Attanasio, Kitao, and Violante 2006). Extensive literature has studied the economic consequences of demographic transition for the developed world, in contrary to the developing economies, which have minimal research.

A national transformation across diverse institutions is a prerequisite for each nation in order to embrace digital transformation both in urban and rural areas. Such a transformation also requires a great deal of innovation in planning, process re-engineering, and execution. However, it is important to note that societies need to overcome the economic, social, and digital divide to achieve sustainability, particularly when there is a trend of high population growth (Dwivedi, Weerakkody, and Janssen 2012). According to Kar et al. (2019), a digital nation is more connected and can share information and intelligence dynamically, which can help deliver services and improve the quality of life. However, it requires an integrated infrastructure in which data sources and software functionality are shared. It is important to note that the use of these technologies can also have adverse impacts on society, especially when it is misused (Chatfield and Reddick 2018). Digitalization can enhance the likelihood of social and environmental sustainability challenges and threats (OECD 2017). These include the carbon footprint associated with increased electricity generation demand, cyber security vulnerabilities, and social discrepancies illustrated by the widening gap in relation to access to information and communications technology (ICT), also referred to as the "digital divide". A recent study by Aebischer and Hilty (2015) observed that there is a positive trend in achieving energy efficiency of information and communication technology (ICT), which has doubled every 1.57 years. The study further highlights that overall, energy used for ICT has also increased as the demand for ICT has grown over the years.

Demography can influence different dimensions of sustainable development, including economic development (Janowski 2015). Considering the sharing economy as a model for sustainable development can help encourage the emergence of consumers who are fascinated by sharing, thereby enhancing affordability and promoting environmentally friendly options in the society (Hasan and Birgach 2016). Few scholars note the paradoxical implications of the role of demography in promoting sustainable practices. They posit that while it can influence the patterns of consumption and production, it can also reinforce the prevailing unsustainable economic paradigms by creating unregulated markets (Janowski 2015; Hasan and Birgach 2016). The adoption of a circular economy paradigm also carries the potential for digital transformation as it often requires a rigorous management approach combined with technical skills and effective tools for redefining the business model. Such a model can benefit from the use of efficient and digitized production units aimed at new market segments, such as green consumers, architects, and designers. It has been found that such actors in the supply chain are more sensitive to socially responsible behavior and inclined to use innovative digital distribution channels to lower the production costs, thereby offsetting the high cost of internalizing environmental and social externalities (Garcia-Muiña et al. 2019).

Figure 6.1: Demographic Dividend–Digitalization–Sustainable Environment Nexus



GDP = gross domestic product, GHG = greenhouse gas, LUCF = land-use change and forestry.

Source: Authors' depiction.

Drawing on the above literature, we propose a conceptual framework underpinning the study. Figure 6.1 shows the various channels in which the first demographic dividend, digitalization, and sustainable environment in an economy are interrelated. The represented variables of digitalization are increasing the total factor productivity, the demographic dividend variables are playing a significant role in stimulating the economic growth through capital accumulation and employment generation, and environmental indicators are also contributing to boost the economic productivity. Therefore, maintaining a balanced ratio of these three indicators is essential to ensure growth sustainability.

6.3 Data and Methodology

6.3.1 Data Description and Properties

This study analyzes the first demographic dividend, digital economy, and sustainable environment nexus of Nepal using a range of indicators. The percentage of the working population and literacy rate represent the demographic indicators depicting the dependency ratio and human capital status to represent the demographic dividend. Further, the use of mobile phones and the internet resembles the extent of the digitalization of Nepal's economy. Broadly, urbanization and greenhouse gas (GHG) emissions are approximating the environmental concerns. Apart from the above-listed variables, other variables could have a substantial impact on the studied nexus and economic growth in general. From this point, we included trade openness, the human development index, and governance indicators to avoid the bias (omitted variable bias and simultaneity bias) of our result estimation. Most of the studied variables were attained through the World Bank's World Development Indicators (World Bank 2019).

The study analyzes the economic variables of the demographic dividend as the dependent variable, with the indicators of the digital economy being telecommunications, internet access as independent variables, and for the environment, GHG emissions and urbanization as explanatory variables, to understand the convoluted relationship of the demographic dividend, the digital and sustainable economy. Multiple linear regression analysis is employed to explore the sustainability of the digital economy in the demographic transition period in the country, while also exploring the environmental issue. It should be noted that this research is one of the few studies conducted in this sector to associate the digital economy with the demographic dividend and grasp the optimum advantage from the phase of demographic dividend in Nepal alongside the practice and socioeconomic role of environmental sustainability in the digital economy.

Data are accessible for the majority of the variables incorporated into the model from 1999–2019 and the detailed scenario of the key indicators used for the analytical purpose are found in Table A6.1 (Appendix 6.1). Few data are extrapolated for the later periods of inspected time to tackle the issues of missing data, particularly the governance and emissions data. Important details regarding variable definitions and sources are discussed in Table 6.1.

Table 6.1: Variable Definitions and Sources

Variables	Definitions	Sources
Population aged 15–64 (% of the total population)	Total population between the ages 15 to 64 as a percentage of the total population. The population here is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.	World Development Indicators
School enrolment, secondary (% gross)	Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.	World Development Indicators
Urban population (% of the total population)	Urban population refers to people living in urban areas, as defined by national statistical offices.	World Development Indicators
Urban population growth (annual %)	Urban population refers to people living in urban areas as defined by national statistical offices.	World Development Indicators
Mobile phone subscriptions (per 100 people)	Mobile phone subscriptions are subscriptions to a public mobile telephone service that provide access to the public switched telephone network using cellular technology. The indicator includes (and is split into) the number of postpaid subscriptions, and the number of active prepaid accounts (that have been used during the last three months). The indicator applies to all mobile telephone subscriptions that offer voice communications.	World Development Indicators
Individuals using the internet (% of the population)	Here, internet users are individuals who have used the internet (from any location) in the last 3 months. The internet can be used via a computer, mobile phone, personal digital assistant, game console, digital TV set, etc.	World Development Indicators
Human Development Index	A composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent standard of living. See Technical note 1 at http://hdr.undp.org/sites/default/files/hdr2020_technical_notes.pdf for details on how the Human Development Index is calculated.	United Nations Department of Economic and Social Affairs (UN DESA) (2019)
Governance	A simple average of aggregate indicators of three broad dimensions of governance. The dimensions are regulatory quality, rule of law, and control of corruption.	Kaufmann, Kraay, and Mastruzzi (2010)

continued on next page

Table 6.1 *continued*

Variables	Definitions	Sources
Trade openness	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	World Development Indicators
Total GHG emissions including LUCF (tons CO_2,e)	Total greenhouse gas emissions are measured in tons of "carbon dioxide-equivalents."	Climate Watch (2020)

GHG = greenhouse gas, LUCF = land-use change and forestry.

Source: Authors' compilation.

6.3.2 Data Limitations

While there are limitations in the available data on the studied variables, it should be noted that the present study includes an empirical estimation with a short span of 20 years (1999–2019).

6.4 Results and Discussion

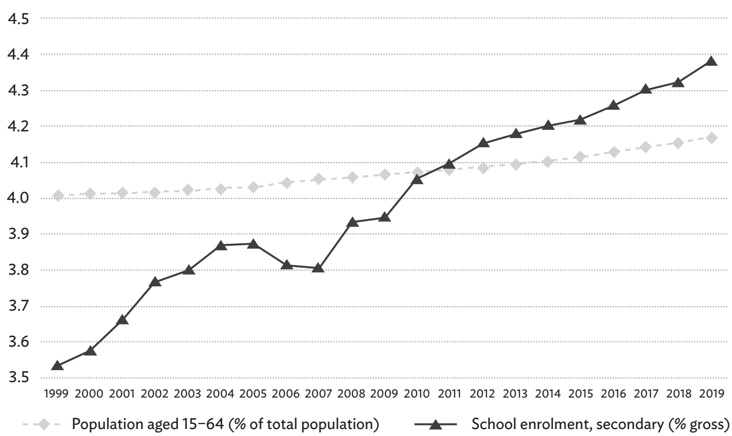
6.4.1 Nepal in the Nexus of Population Aging and Demographic Transition

According to the traditional demographic transition theory, demographic changes take place in a particular sequence and distinct phases. In the case of Nepal, demographic changes have occurred concurrently and outside traditional transition theory parameters. Also, the country has experienced rapid demographic changes at much lower levels of development (National Planning Commission and UNICEF 2017). While Nepal continues to rank among the least-developed countries globally, the country has experienced fertility and mortality declines, similar to many middle-income countries.

A report published in collaboration with the National Planning Commission of Nepal and UNICEF in 2017 highlighted a range of countries that were able to take advantage of their demographic windows of opportunity to secure significant economic and societal benefits. The report particularly focuses on the East Asian economies such as Taipei,China; Hong Kong, China; Singapore; Thailand; and Malaysia, which have experienced social sector investments combined with a favorable sequence of fertility and mortality decline in the

1970s and 1980s. These economies invested in education, health, and labor market opportunities for women, which has underpinned their substantial economic growth. However, demographic transitions in the contemporary developing world seem considerably shorter. The analysis presented in this study highlights the need for strategic early investments for a smart economy in Nepal to strengthen the ability to contextualize and tailor policy and programmatic interventions and act on the limited window of time. Other factors such as poverty, political instability, and the lack of the right policy environment were identified as the main reasons for the emigration of Nepal's youth to Middle East countries during the demographic window of opportunity (Chalise 2018).

Figure 6.2: The First Demographic Dividend of Nepal



Sources: Authors' depiction using data from World Development Indicators (WDI).

Figure 6.2 exhibits Nepal's experience of the first demographic dividend in the last 2 decades using logarithmic transformations. Both dividend indicators are showing an upward pattern and, more specifically, the literacy rate is experiencing a sharp increase, which is indicating the existence of positive investments in Nepalese human capital. Nepal, being a least-developed country, has had a consistent and remarkable growth in the literacy rate, which indicates that these demographic indicators can positively influence Nepal's economy.

6.4.2 Nepal to Enter Stage III of the Demographic Transition

While Nepal has a universal primary education, it experiences poor educational quality and a high level of school dropouts. Early marriage is seen as one of the reasons, particularly among girls and women. Furthermore, migration patterns within the country have important implications for dependency ratios, productivity, and savings. For instance, migration to and from regions often influences regional disaggregation within the country. Such trends also impact the pattern of international migration. In 2018, the working-age population was 63.86% of the total population, 66.57% of the female population, and 60.65% of the male population. Currently, Nepal is in the lower end of Stage II, which is characterized by a low birth rate and low death rate, attempting to approach Stage III of the demographic transition with fertility slightly prevailing over mortality. According to the United Nations Population Fund (UNFPA) (2017), the country can enjoy the advantage of the first demographic dividend if the right social and economic policies are in place. However, this will require strategic investments, including in the digitalization of services.

Nepal's demographic window of opportunity has some similarities with those experienced by East Asian economies such as Japan, Malaysia, Indonesia, and Taipei,China, where it lasted for around 50 years (Amin et al. 2017). Regarding the aging transition, Oizumi (2013) posits that Nepal's projected duration would coincide with Japan's, which is about 26 years and is considered to be among the fast aging transitions in the world. According to the 2017 UNFPA report, Nepal's first demographic dividend seems to end in 2047 having started in 1992. As more children survive and parents have fewer children, parental investments turn to quality education and health, for which infrastructure support and effective policies are necessary. It is important to note that such investments in the productivity of the future workforce can ease dependency burdens by making the dependent (elderly) population more self-sufficient in the future. The experiences of the Republic of Korea; Taipei,China; Indonesia; Malaysia; Viet Nam; Thailand; and the People's Republic of China, economies that established productive engagement in the workforce, are relevant for ensuring faster uptake of technology. On close analysis of these developed and developing economies, Nepal, although a least-developed country, represents a unique case, where the demographic dividend can prove to be advantageous via policy prescriptions for sustainable development for two reasons. First, the demographic transition in Nepal is taking place at a relatively low stage of development; and second, the fertility decline is well underway, with the average fertility rate at 2.3 births per woman, as compared to 6.3 in 1976. With the declining fertility rate, Nepal's dependent population has started shrinking. This is freeing more people to work and contribute to economic development. The first demographic dividend generally results in rapid economic growth because of a decline in the country's birth rate (UNFPA 2017).

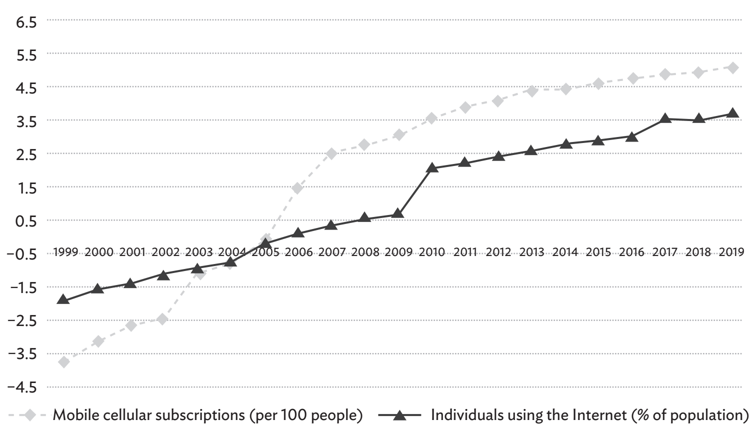
6.4.3 Digital Economy in the Period of the "Window of Opportunity"

Information technology has accelerated substantial transformation in the economy from public to private businesses, enabling the virtualized existence of versatile business relationships and partnerships with improved market access, and revamping the value chain of production and distribution by enabling faster results and less costly product designs. According to the *Digital Economic Report 2019* (UNDP 2019), the world presently is characterized by a yawning gap between the under-connected and the hyper-digitalized countries. In the least-developed countries, only one in every five people uses the internet, as compared to four out of five in developed countries. In the past decade, global exports of ICT, including digital services, grew considerably faster, constantly reshaping the existing market, reflecting the acceptance of digitalization by the world economy. It is envisioned that the proliferation of digital economy firms and platforms will eventually become an inevitable and crucial part of the global economy (Yaraghi and Ravi 2017). In the least-developed countries, these frontier technologies are estimated at 16% of total services exports, a proportion that has more than tripled between 2005 and 2018 (Korovkin 2019). However, the enhancement of the digital world does not only have a broader scope in developed countries but has also proved to be a boon to developing and least-developed countries.

E-commerce is still a new concept in Nepal, but it is growing rapidly. As of May 2017, there were more than 56,286 registered websites in the country, including 40,000 commercial websites belonging to 166,781 registered companies. Nepalese investors are limited in number, so firstly, to break monopolistic business practices, and secondly, to shift the country toward industrialization, Nepal encourages foreign direct investment (FDI) in the limited arena of necessity. The total number of companies registered with the Department of Industry in FY2017–2018 was 497, followed by 439 in FY2018–2019, and around half of that number (277) in FY2019–2020 due to COVID-19, with a total of 5,052 projects of FDI for the entire industry of 8,247 in the period until FY2019–2020. In spite of the fact that COVID-19 can adversely affect the business and investments, many businesses and organizations in Nepal have started leveraging digital marketing to upgrade their business globally through virtualization. The growth of e-commerce in Nepal is inhibited by a lack of a supporting ecosystem, such as digital payment options. However, this is changing slowly with the emergence of fintech startups such as eSewa and Khalti, which are expected to change the payments landscape (Ministry of Communication and Information Technology 2017). As per the data, agriculture occupies 24.26% of the country's gross domestic product (GDP), and ICT services such as smart irrigation projects, digitization of land records, and e-Haat Bazar, an online platform for farmers and associated businesses. Similarly, since the COVID-19 pandemic, smart classrooms, online learning platforms, mobile learning apps, and biometric and e-attendance systems have brought about a remarkable reform in Nepal's traditional education system. However, due to the lack of connectivity or the low quality of internet services in rural parts of the country, people are deprived of the advantages that connectivity can bring. Similarly, in urban areas and cities too, fluctuating internet connection is another challenge that needs to be resolved in near future.

Figure 6.3 highlights the digitalization scenario of Nepal using logarithmic transformations. Both indicators of the first dividend are showing an upward pattern, which is a representation of Nepal's

Figure 6.3: The Digitalization Scenario of Nepal



Source: Authors' depiction using World Development Index data.

adaptability to information and communication technology. The increased use of mobile phones per 100 people is also facilitating the use of the internet.

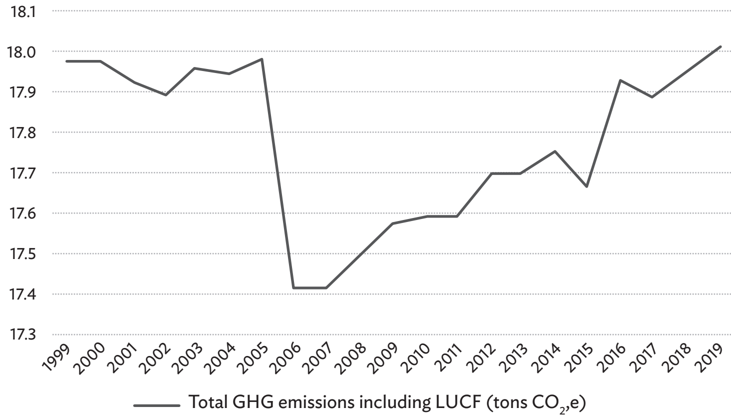
The Global Information Technology Report 2016 (WEF 3016) ranks Nepal 118 out of 139 low-income group countries in the Network Readiness Index, which is a gradual advancement from the past positions of 118 out of 143 in 2015, 123 out of 148 in 2014, and 126 out of 144 in 2013. The position is based on the environment sub-index (political and regulatory environment, business and innovation environment), readiness sub-index (infrastructure, affordability, and skills), usage sub-index (individual, business, and government), impact sub-index (economic and social impact). According to a World Bank report (2016), every 10% increase in penetration of broadband could result in an increase of 1.21% in high-income economies and 1.38% in low- and middle-income economies, which indicates the high significance of ICT for the economy of a country.

The digital economy, being a broad concept, also brings a complex paradigm with it, enhancing the scope for research. Also, there is neither a widely accepted definition of the digital economy nor exact tools to measure it. Another challenge for national digital strategizing, especially in the context of developing economies, is the "digital gap", observed due to the inability of the least-developed countries to compete in the speed of digitalization with developed countries. A simple instance could be the unavailability of a proper international payment gateway, which hinders a least-developed country's access to global trade and markets. Besides the development of infrastructure, it is also necessary to increase digital literacy to reap the benefits from digitalization and reduce the prevailing digital divide in Nepal.

6.4.4 Environmental Sustainability and Digital Economy During the Demographic Transition

Both technological and management perspectives are vital when addressing the smart ecosystem needs (Janssen and Helbig 2018). Consequently, researchers often focus on issues related to governance and implementation of technology-enabled transformation initiatives in achieving environmental sustainability (Chatterjee et al. 2018). Although the potential of the Information Age to save material and energy cannot be doubted, it might nonetheless be too early to presume an optimistic scenario regarding the environmental impacts of the emerging digital economy by thinking that moving businesses online will reduce waste such as paper, retail space, and transportation requirements, and will only necessitate more energy-intensive computers (Sui and Rejeski 2002).

Figure 6.4: Emissions Pattern of Nepal



GHG = greenhouse gas, LUCF = land-use change and forestry.

Source: Authors' depiction using Climate Watch data.

Figure 6.4 shows the emissions pattern of GHGs of Nepal. The graphed variable is transformed into a natural log. Nepal's GHG emissions are revealing an upward pattern now, although they were depressed from 2006 to 2015. One of the primary reasons for this downward trend in 2006 was the political instability in the country after the royal massacre and the civil war, which hampered the overall economy.

Even though limited industrialization seems to have a minimal impact on the environment, the lack of proactive measures might lead to serious environmental issues. The increasing scope of the digital economy in the country should be envisioned together with environmental sustainability. In the context of the sharing digital economy, the arguments about the welfare, employment, and income aspects of development propose platforms that present three-dimensional (3D) printed goods, which can assure new forms of sustainable, resource-efficient, and optimized production in the sharing economy (Cohen and Munoz 2016). On the other hand, 3D printing technology can lower manufacturing inputs and outputs via low-volume, customized, and high-value production processes performed at a low cost. This also leads to energy saving, as the technology only consumes materials that end up in final products without producing too much process-related waste. Consequently, it reduces CO_2 emissions over the entire life cycle of its products and per unit of the GDP, which is an effective catalyst for environmental sustainability and sustainable development (Gebler, Uiterkamp, and Visser 2014). The current environmental problems are the consequence of the present production and consumption pattern, so the environmental dimension of the digital economy deserves special attention for its sustainability (Sui and Rejeski 2002).

Table 6.2: Summary Statistics

	N	Mean	SD	Min	Max	Variance
Population aged 15–64 (% of total population)	21	58.71	2.95	55.08	64.65	8.7
School enrolment, secondary (% gross)	21	55.64	13.76	34.27	80.18	189.39
Urban population (% of total population)	21	16.51	2.15	12.86	20.15	4.63
Urban population growth (annual %)	21	3.36	1.23	1.76	6.08	1.52
Mobile phone subscriptions (per 100 people)	21	48.14	53.99	0.02	156.02	2914.97
Individuals using the internet (% of population)	21	10.03	12.59	0.15	39.96	158.44
Human Development Index	21	0.51	0.05	0.44	0.58	0.00
Governance	21	−0.65	0.13	−0.8	−0.37	0.02
Trade Openness	21	48.68	4.53	41.83	55.8	20.48
Total GHG emissions including LUCF (tons CO_2,e)	21	5.36e+07	1.03e+07	3.64e+07	6.64e+07	1.05e+14

GHG = greenhouse gas, LUCF = land-use change and forestry, N= sample size, SD = standard deviation.
Source: Authors' calculation.

Table 6.2 presents the summary statistics of the modeled variables separately. The means of Nepal's dividend variables are 58.71, 1.03, and 55.64, respectively. The means of mobile phone subscriptions and internet use are 48.14 and 10.03. The means of emissions variables are significantly small to report, and the means of the percentage of urban population and population growth are 16.51 and 3.36.

6.4.5 Ordinary Least Squares Regression Results

This section presents the multiple regression outputs of studied variables relevant to the demographic dividend, digital economy, and environment. In total, representations of three models are discussed in Tables 6.3–6.6). Trade openness, the Human Development Index, and the governance indicator are also included in all the models so that the issue of the omitted variable bias can be taken care of.

Table 6.3: Ordinary Least Squares Regression Results

	(1)	(2)	(3)
	Population aged 15–64 (% of total population)	**Population aged 15–64 (% of total population)**	**Population aged 15–64 (% of total population)**
Mobile phone subscriptions (per 100 people)	0.0548** (0.0137)	0.0249** (0.00673)	0.0253* (0.0105)
Total GHG emissions including LUCF (tons of CO_2,e)	−2.21e-08 (1.76e-08)		
Urban population (% of total population)		1.073*** (0.225)	
Urban population growth (annual %)			0.535* (0.232)
Constant	58.11*** (8.383)	46.40*** (3.520)	38.27*** (6.877)
Governance	−1.982 (1.824)	−0.131 (1.134)	−0.0600 (1.588)
Human Development Index	−2.300 (16.53)	−4.25 (9.220)	40.79* (15.41)
Trade (as % of GDP)	−0.0198 (0.0336)	0.0127 (0.0228)	−0.0735 (0.0394)
Observations	21	21	21
R^2	0.985	0.993	0.988

GDP = gross domestic product, GHG = greenhouse gas, LUCF = land-use change and forestry.

Standard errors in parentheses.
*$p<0.05$, **$p<0.01$, ***$p<0.001$

Source: Authors' calculation.

Table 6.4: Ordinary Least Squares Regression Results

	(1) Population aged 15–64 (% of total population)	(2) Population aged 15–64 (% of total population)	(3) Population aged 15–64 (% of total population)
Individuals using the internet (% of population)	0.128***	0.0790***	0.0911***
	(0.0212)	(0.0155)	(0.0214)
Total GHG emissions including LUCF (tons of CO_2,e)	−8.21e-09		
	(1.10e-08)		
Urban population (% of total population)		0.824**	
		(0.209)	
Urban population growth (annual %)			0.346
			(0.191)
Governance	−0.650	0.127	−0.0936
	(1.231)	(0.888)	(1.153)
Human Development Index	27.62***	4.570	42.96***
	(6.357)	(7.531)	(8.549)
Trade (% of GDP)	0.0103	0.0230	−0.0372
	(0.0243)	(0.0176)	(0.0332)
Constant	42.75***	40.92***	36.32***
	(3.132)	(1.736)	(3.535)
Observations	21	21	21
R^2	0.991	0.995	0.992

GDP = gross domestic product, GHG = greenhouse gas, LUCF = land-use change and forestry.
Standard errors in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$
Source: Authors' calculation.

These three models are developed assuming the interaction of the first dividend, digitalization, and environmental variables. The working population as a dependent variable is regressed on digitalization (mobile use and internet access) and environmental variables (GHG emissions, urban growth, and urbanization) in Tables 6.3 and 6.4. School enrolment as a dependent variable is regressed on digitalization (mobile use and internet access) and environmental variables (GHG emissions, urban growth, and urbanization) in Tables 6.5 and 6.6.

In total, four tables present the different scenarios of the selected variables for Nepal. In Table 6.3, the increasing working population tends to be more technology-friendly, which is evident in all the models where mobile subscriptions per 100 people have come out statistically significant. GHG emissions do not come out as significant in any of the models. Urbanization variables representing environmental issues are also found significant in models 2 and 3. In Table 6.4, the other indicator of digitalization, Internet use, indicates a positive and significant impact on the demographic dividend in all the models, which supports the notion that people belonging to the working age group (15–64) are being more digitally savvy over the years. Among the environmental variables, urbanization is only found significant in terms of influencing the demographic dividend in Model 2.

Table 6.5: Ordinary Least Squares Regression Results

	(1)	(2)	(3)
	School enrolment, secondary (% gross)	School enrolment, secondary (% gross)	School enrolment, secondary (% gross)
Mobile phone subscriptions (per 100 people)	0.0450	0.138*	0.261***
	(0.0545)	(0.0482)	(0.0503)
Total GHG emissions including LUCF (tons of CO_2, e)	0.000000220**		
	(6.99e-08)		
Urban population (% of total population)		2.539	
		(1.611)	
Urban population growth (annual %)			–2.752*
			(1.109)
Governance	–1.698	–8.138	–15.81
	(7.259)	(8.134)	(7.588)
Human Development Index	232.9**	11.48	–64.17
	(65.76)	(66.13)	(73.62)
Trade (as % of GDP)	–0.278	–0.262	–0.0253
	(0.134)	(0.164)	(0.188)
Constant	–65.50	8.627	76.27*
	(33.36)	(25.25)	(32.85)
Observations	21	21	21
R^2	0.989	0.985	0.987

GDP = gross domestic product, GHG = greenhouse gas, LUCF = land-use change and forestry.

Standard errors in parentheses.
*p< 0.05, **p< 0.01, ***p< 0.001

Source: Authors' calculation.

In Table 6.5, when the literacy rate is taken as the proxy for the demographic dividend, mobile subscriptions per 100 people disclose a significant impact on the literacy rate in models 4 and 5. The scenario for the urbanization variables is more or less the same as in Table 6.3, and the GHG emissions variable is found to be significant. The estimation outcome of Table 6.6 is very much similar to the results of Table 6.4. Internet use also reveals a positive and significant impact on secondary schooling in all the models, and GHG emission is also found to be significant. Also, urbanization growth has become significant in Model 3.

In summary, the empirical output of the study indicates that the percentage of internet users comes out significant with any combination

Table 6.6: Ordinary Least Squares Regression Results

	(1)	(2)	(3)
	School enrolment, secondary (% gross)	School enrolment, secondary (% gross)	School enrolment, secondary (% gross)
Individuals using the internet (% of population)	0.219*	0.365*	0.705***
	(0.0955)	(0.136)	(0.116)
Total GHG emissions including LUCF (tons of CO_2,e)	0.000000195**		
	(4.94e-08)		
Urban population (% of total population)		1.791	
		(1.829)	
Urban population growth (annual %)			−3.271**
			(1.029)
Governance	−3.448	−4.758	−10.37
	(5.551)	(7.772)	(6.225)
Human Development Index	226.5***	108.2	43.73
	(28.66)	(65.92)	(46.16)
Trade (% of GDP)	−0.273*	−0.173	0.217
	(0.110)	(0.154)	(0.179)
Constant	−62.32***	−27.86	19.83
	(14.12)	(15.20)	(19.09)
Observations	21	21	21
R^2	0.992	0.984	0.990

GDP = gross domestic product, GHG = greenhouse gas, LUCF = land-use change and forestry.

Standard errors in parentheses.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Source: Authors' calculation.

of environmental variables in all the models of the demographic dividend. This outcome indicates that a lower dependency ratio exhibits positive externalities in the form of having young generations with advanced technological knowledge and keeping emissions at a sustainable level. So, population growth means an increase in the size of the working population, and literate young people exhibit a greater tendency of using the internet and new technologies to keep themselves updated in the new, digitalized world. The same scenario was evident in the case of urbanization, which implies that the pace of urbanization in Nepal is satisfactory and also contributing to the dependency on ICT through mobile use among young people. As for GHG emissions, they were found to be significant. This may be because of the higher prevalence of greenhouse gases in the environment (Figure 6.4).

6.5 Role of Regulatory Bodies Policies to Transform the Strategic Opportunities into Sustainable Outcomes

6.5.1 Significance of E-governance in the Digital Economy

E-governance plays a crucial role in enhancing the digital economy in the country. If the government goes digital, that will influence other sectors of the economy. Nepal is gradually improving its online portals. The development of e-government in various phases of digitalization, transformation, engagement, and contextualization contributes to greater government efficacy and promotes environmental sustainability (Janowski 2015). No matter how the state's digital governance responds and how it is shaped by political and institutional realities, the fact remains that adaptive governance approaches are essential to address the socioeconomic sustainability challenges posed within differing manifestations of digitalization (Linkov et al. 2018).

As part of its efforts to develop e-governance, Nepal's government has established a data center called the Government Integrated Data Centre, with every government body implementing the policy of least possible paperwork and going digital. Furthermore, ICT infrastructure needed for the National e-Payment Gateway has already been prepared. Also, the construction of a data recovery center in Hetauda in central Nepal is underway to keep the information intact from potential losses due to natural calamities and emergencies. The introduction of the Digital Nepal Framework is also one of the efforts by the government to track the progress of the digital economy and plan a substantive strategy for the coming years. With the budget announcement for FY2020–2021, the government distinctly showed an interest in developing ICT infrastructure. It has allocated Rs7.13 billion for the ICT sector in the coming fiscal year. The new budget prioritizes a cashless economy and, consequently, also focuses on enhancing cybersecurity.

The level of penetration of a government digital infrastructure scheme and e-services in Estonia suggest that the individual choice of opting for a universal digital identity is affected by socio-demographic and macro-level characteristics (Tammpuu and Masso 2019). Their findings support the notion that the demographics are not the only reason for choosing e-residency by individuals, and that other country-level factors such as professional interests, business interests, education, cultural ecosystems, and information security, also play a significant role. Furthermore, the enhancement of e-government, besides functioning as an important intermediary variable for environmental sustainability, in small island developing countries, also contributes to the sustainability of production and gaining a competitive advantage in the global online market (Lee 2017). In countries like India and Bangladesh, the governments have taken up initiatives such as "Digital India" and "Digital Bangladesh" to transform the government and governance using ICT across the countries. Similarly, governments are also communicating with their people via social initiatives such as "REACH" in Singapore, "Mann Ki Baat" in India, and "MyGov" in Australia. (Kar et al. 2019). According to the World Bank's *World Development Report 2016*, Nepal, Rwanda, and Uganda scored highly among low-income countries on administrative e-governance systems, suggesting that governments are more intensive users of information technology than firms.

6.5.2 Status of Regulatory Policies and Their Importance for Sustainability

Human behavior still plays a significant role in solving environmental problems and most environmental policies require considerations for shifts toward sustainable behavior (Toni, Renzi, and Mattia 2018). Without complementary developments, such as regulations and the improved skills and institutions to help implement these regulations, the accelerated growth opportunities that the digital technology may offer could be replaced by unexpected risks (World Bank 2016).

Environmental policies seem to focus merely on the manufacturing industry as the source of pollution rather than on services and consumption; on the details of the law rather than the dynamics of the system, although problems concerning production tend to be industrial and local, while problems regarding consumption increasingly tend to evolve into universal issues of a global scale. If the digital economy is a complex system and the relationship between the internet and the environment is best captured from the theory of complexity, this shall have serious policy implications (Elliott and Kiel 1999). There are numerous policies relating to information technologies, including the ICT policy, which was revised in Nepal after the country promulgated its new constitution in 2015. The government seems to be willing to take the initiative for the development of ICT through the concept of e-governance, but for that to be successful, periodic policy updates, data security, and skilled human resources are necessary. Besides the ICT policy, other government policies include the National Broadband Policy announced in 2016, which put forth a framework for stimulating broadband access and availability across the country. The National Broadcasting Act and Regulations, the Radio Act and radio communication license regulations, as well as the cybersecurity policy of 2016, are critical for the development of the ICT sector. It should be noted that the handling and regulation of digital data are complex, as they touch on human rights, trade, economic value creation, as well as law enforcement and national security, which points to the necessity of research in this sector.

With the number of young entrepreneurs increasing, digitalization has a significant role, especially if blended with environmental awareness for sustainable development. However, the skewed distribution of access, affordability, and availability dimensions need to be addressed through macro policies so that Nepal's younger generations can compete in the international arena without hindrance by the regulatory and governance framework. For instance, in terms of the availability of a secure international payment gateway, the government has the prerequisite task to provide a safe platform for the young to thrive in the global market.

6.6 Impact of the COVID-19 Pandemic: Challenges and Opportunities

The series of lockdowns and restrictions in business operations have resulted in colossal health and economic crises not limited to any specific country. Governments are increasing provisions for the welfare of citizens and giving various concessions to businesses to offset the damage, relying on a set of predictions to get back to normalcy.

Demographic indicators such as age and family structure or co-residence patterns mix with other socioeconomic aspects to determine the impact of the COVID-19 pandemic. It is evident that older populations and people with pre-existing medical conditions have a higher risk of morbidity and mortality from COVID-19. Nepal is experiencing a demographic transition, but due to the limited infrastructure and living standard of people, the demographic dividend it is currently enjoying can turn into a demographic burden, considering the lack of proper health facilities. Recent evidence shows that people from minority ethnic groups and living in economically deprived areas have a higher chance to fall seriously ill and die from COVID-19. People with different demographic and socioeconomic characteristics respond differently to the disease, as the ability to cope, recover, and adapt varies greatly across population subgroups in accordance with their socioeconomic status and capability, including the institutional and geographical contexts.

In Nepal, manufacturing businesses highly depend on raw materials from India and the People's Republic of China, and travel restrictions due to the pandemic have had a tremendous impact on its economy: service industries have been shut down, banks are facing challenges in maintaining their liquidity, and the crisis has overall resulted in a large unemployment rate, increased risk of market volatility, and a massive downfall of the economy. Businesses take a holistic view of potential risks and postpone investments. However, the priority now lies in eradicating the disease, as the number of cases tends to rise each day with the liberalization of restrictions. Policy regulators, mainly the Ministry of Finance, the Central Bank, the federal and local governments, and the entire central government, are deliberately implementing numerous monetary and fiscal policies to mitigate the market risk, financial, and non-financial risks, while prioritizing the health sector, which still seems to be unable to produce an adequate response to the current situation brought about by COVID-19.

Nepal is desperately attempting to upgrade itself from a least-developed country status, but it seems that that goal may be postponed in the coming years due to the economic crisis caused by the pandemic. However, the "work from home" trend brought by the pandemic may, along with the upward trend of digitalization, help widen the scope of Nepal's digital economy, as the empirical results of our regressions seem to indicate. The contribution of the demographic dividend to enhancing the scope of the digital economy has also raised the consciousness concerning environmental sustainability. As learning initiated by developed European countries suggests, by innovative environment-friendly concepts we can pave a fresh path to control environment depletion and achieve the United Nations' Sustainable Development Goals. Besides adversely affecting the economy, environmental destruction has provided numerous lessons to humanity and impelled us to think more about sustainability. It is especially emerging economies that need to prepare beforehand and start well on that path, rather than be forced later to revise their development plans.

6.7 Conclusion and Policy Implications

The pace of urbanization is observed as satisfactory, with the literacy rate increasing among working Nepalese people, who have a greater tendency to utilize new technologies effectively. As developing countries are emerging markets for global digital platforms and their users contribute significantly to the generation of value and profits, firms that invest in ICT are generally more productive, competitive, and profitable. However, small business owners in developing countries and especially in the least-developed countries, lack the resources, skills, and awareness to harness digital connectivity for their business operations, especially in the sectors of forestry and agriculture because of the significant generational gap. In this context, Nepal needs to double its pace of digital development to improve its economy, make it an integral part of the global market and remove the tag of a low-income country.

Despite Nepal being an agricultural country, among the emissions variables used in this study, methane gas was observed to be a significant factor affecting the GHG emissions. This necessitates unconventional economic thinking and policy analysis for the optimum utilization of resources. For instance, systematic and sustainable industrialization and green bonds that potentially may evolve into a major contributor to the country's GDP can be used as emerging tools to step up environment-friendly investments, e-commerce, etc. An effective national digital strategy needs to be implemented, not limited by the cultural and ideological challenges of the decentralized information environment, to blend the digital economy with the green economy to take the optimum advantage of the first demographic dividend.

The declining dependency ratio, rising life expectancy along with the gradually peaking working-age population or the young population indicates that the country is reaching the peak point of its demographic bonus that can be used to induce economic growth, provided that a strategic public policy is formulated and implemented. Without a good economic and human development policy, sound institutions, proper investment, and saving incentives, as well as systematically developed health facilities, a demographic opportunity might turn into a demographic burden, even without the challenges posed by the pandemic. Thus, we may say that the COVID-19 pandemic has served to warn the country to make stronger efforts for a pragmatic change in its strategies of development, by prioritizing the necessities in the socioeconomic and technology sectors such as agriculture, education, tourism, urban infrastructure, health, energy, finance, and disaster management, to create an enabling environment and allow the government and enterprises to unlock the potential to achieve exponential growth. Even though Nepal is still in the initial stage of digitalization, motivating improvements in its digital economy have been observed in recent years, which can help carry out successful digitalization that can contribute to the optimal utilization of the demographic window of opportunity paired with environmental sustainability. The impact of digitalization varies with countries and as a result, individual governments require policy space to modulate the digital economy for fulfilling various legitimate public policy objectives (UNCTAD 2019). The continuous rapid pace of technological change requires sustainable and qualitative investment measures, including foreign investments and cross-border trade. Besides the size of investments, balancing the supply chain of education, enhancing work skills, and building strong institutions, technology and infrastructure development also contribute to entrepreneurship, private sector participation and facilitate the creation of a robust financial ecosystem. Extensive use of disruptive technologies such as artificial intelligence, robotics, the internet of things, and intelligent waste management, public transport management, municipality mobile applications, electronic health records, mobile health units, or the national payment gateway, as well structural reforms for raising the employment of young people will enable Nepal to reap the benefits of its demographic dividend and cope with the concomitant environmental impact of digitalization. Also, a proper broad-based policy gap analysis is necessary to ensure that the ICT sector is grounded on sound policy frameworks, with public and private partnerships for endorsing automation and digitalization. Improvements should be suggested, if necessary, in order to incorporate the use of emerging new technologies in laws and regulations to get the best out of ICT.

For ensuring digital transformation in the least-developed countries such as Nepal and to contribute to more inclusive outcomes, national efforts should be complemented by more international assistance. Such assistance could be directed at optimizing the country's demographic transition. Foreign institutions could integrate the digital dimension into their aid policies and strategies, with the assistance aimed at reducing the digital divides and safeguarding the environment for value addition. They could help to build capacity in the private and public sectors in Nepal and support the enforcement of relevant laws and regulations to transform the country's economy into a data-driven green, digital economy.

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Appendix 6.1

Table A6.1: Key Indicators and Variables Incorporated in the Study (1999–2019)

Year	Working age pop.	School enrolment (%)	Urban pop. (%)	Urban pop. growth (%)	Mobile cellular subscriptions (per 100 people)	Individuals using the internet (%)	HDI	Governance	Trade (%)	GHG emissions (tons CO_2e)
1999	55.079	34.27134	12.857	6.078335	0.023394	0.146669	0.439	−0.37	52.566	63,930,000
2000	55.269	35.7619	13.397	5.93153	0.042713	0.204652	0.446	−0.47	55.710	64,270,000
2001	55.430	38.96552	13.947	5.704944	0.070998	0.240015	0.447	−0.45	55.799	60,970,000
2002	55.642	43.43044	14.24	3.62176	0.088495	0.312956	0.457	−0.45	46.230	59,420,000
2003	55.891	44.65308	14.538	3.497629	0.326412	0.382811	0.462	−0.46	44.247	63,110,000
2004	56.154	47.94606	14.841	3.403277	0.459406	0.449844	0.469	−0.72	46.147	62,300,000
2005	56.427	48.14908	15.149	3.325134	0.882969	0.826551	0.475	−0.69	44.062	63,970,000
2006	56.949	45.33157	15.462	3.28883	4.439006	1.141389	0.486	−0.61	44.761	36,410,000
2007	57.394	44.99971	15.781	3.246689	12.39035	1.41	0.491	−0.65	44.579	36,470,000
2008	57.796	51.03944	16.105	3.103007	15.75005	1.73	0.502	−0.7	46.036	39,490,000
2009	58.217	51.79061	16.434	2.832563	20.82271	1.97	0.514	−0.76	47.079	42,970,000
2010	58.698	57.63132	16.768	2.493196	34.04098	7.93	0.529	−0.8	45.984	43,660,000
2011	59.043	60.26435	17.108	2.111827	49.38563	9	0.535	−0.8	41.828	43,780,000
2012	59.503	63.7488	17.458	1.834271	61.53811	11.1493	0.548	−0.78	43.658	48,140,000
2013	60.046	65.35344	17.815	1.757324	79.36417	13.3	0.554	−0.75	48.145	48,590,000
2014	60.598	66.87903	18.182	1.998324	85.56218	15.44	0.56	−0.69	52.255	51,280,000
2015	61.106	67.84369	18.557	2.442467	101.8546	17.58162	0.566	−0.68	53.095	47,230,000
2016	62.076	70.77675	18.942	2.960308	117.8146	19.68876	0.569	−0.79	48.751	61,250,000
2017	62.998	74.07729	19.336	3.392323	130.6294	34	0.574	−0.71	51.363	58,756,000
2018	63.858	75.27547	19.74	3.721818	139.4464	33.69671	0.579	−0.63	55.084	62,511,800
2019	64.647	80.17992	20.153	3.907939	156.0244	39.96096	0.583	−0.673	54.925	66,402,440

GHG = greenhouse gas, HDI = Human Development Index.

Source: Prepared by authors.

7

Demographic Transition for Economic Development in Taipei,China: Literature Review and Policy Implications

Chin-Peng Chu and Kuo-Chun Yeh

7.1 Introduction[1]

Taipei,China, an island economy with 23 million inhabitants, is currently enjoying the demographic dividend of economic growth resulting from a shift in its population age structure, but an increasingly aged population could be bad for its economy in the future. A decade ago, officials from Taipei,China sent out a warning that population decline is irreversible (Wang et al. 2009). The school-age population and working-age population would decline, and the proportion of middle-aged and older workers would rise. As Table 7.1 indicates, the age structure of developed economies naturally gets older, but what is worrying is the speed of the progression. An aging population places a significant burden on society. The dependency ratio, the number of dependents compared to the working-age population, has been increasing in Taipei,China since 2012. In 2020, there were 40 dependents to be supported by every 100 members of the working-age population. With the rapid growth of the elderly population, the number of dependents is projected to increase to 102.0 by 2070 (National Development Council 2020). Besides, Taipei,China has the lowest fertility rate in the world (1.07 children born per woman) ranking last (227 out of 227) (CIA 2021), while the aging trend heralds the possible collapse of its social insurance system. In 2020, there were approximately 4.5 people of working age supporting one elderly

1 This chapter is based on the ADBI working paper (Chu and Yeh 2021).

Table 7.1: Demographic Facts and Projections in Taipei,China

Year	Population ('000)	Fertility rate	Dependency ratio	Potential support ratio	Age 65+ ratio	Median age
1985	19,310	1.88	53.0	12.9	5.1	25.1
2018	23,590	1.09	37.9	5.0	14.5	41.6
2070	15,814	1.20	102.0	1.2	41.6	58.2

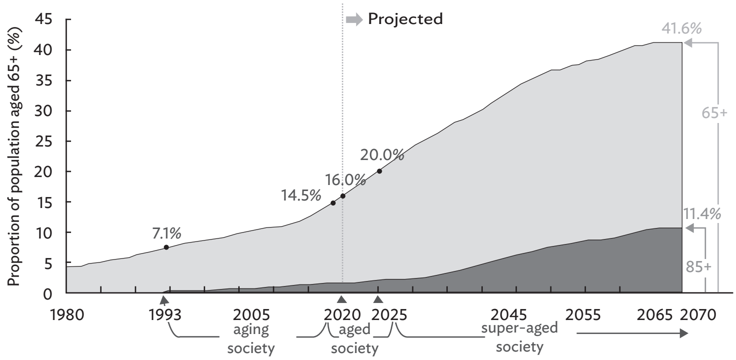
Note: Medium-variant projections after 2017.

Sources: National Development Council (2018, 2020); authors' compilation.

person. By 2070, the number will have fallen to 1.2 people of working age supporting one elderly person. As a result, the island has been struggling with a shortage of human resources for home care and manufacturing jobs. Exactly 261,457 foreign nationals worked in the personal care industry in 2019, mostly from Indonesia and the Philippines (Chang 2020). The prospects regarding the fertility rate are also not optimistic, failing to meet the requirement of maximized consumption.

Population dynamics is a foundation element of development, while age structure change is the key determinant. To understand future demographic development trends, the National Development Council has biennially prepared long-range population projections since 2006. Figure 7.1 depicts the concern by the authority (National Development Council 2018, 2020). Taipei,China became an aging society in 1993 (7.1%), reached the second stage in March 2018 (14.5%), and is projected to become a super-aged society in 2025 (20%). The newest population projection, available from 18 August 2020 (National Development Council 2020), is almost the same as the previous version, except for the following. First, as the Ministry of Interior (2020) indicated, the natural rate of population growth becomes negative 2 years earlier (2022–2020) due to the novel coronavirus disease (COVID-19) pandemic. Second, the super-aged society is forthcoming 1 year earlier (2026–2025). Third, the population bonus (ratio of age 15–64 to total population >66.7%) will be extended for a year (2026–2027), which also implies that the demographic dividend will disappear in 2028. By 2070 the super-aged ratio will be, all other things being equal, 41.6%, which will be higher than the United Nations' recent estimations for Japan (38%), Singapore (36%), and the People's Republic of China (30%) in 2050–2075 (UN DESA 2019). Dramatic population aging has been upgraded as a security concern, involving issues from sustainable economics to financial and social stability.

Figure 7.1: Speed of Population Aging



Sources: Medium-variant projections by the National Development Council (2018, 2020); authors' compilation.

For the purpose of an international comparison, let us first note that the World Health Organization (WHO) defines the aging, aged, and super-aged societies as those where more than 7%, 14%, and 20% of the population are aged 65 years or above, respectively. As Table 7.2 indicates, the population of Taipei,China is aging at a rapid rate. Its aged society is expected to transition into a hyper-aged society within 8 years, which is not only sooner than developed economies such as Japan (11 years), Canada (14 years), the United States (16 years), France (29 years), Germany (37 years), and the United Kingdom (51 years), but also emerging markets like the People's Republic of China (10 years) and the Republic of Korea (9 years).

Economists have observed Taipei,China's rapid aging for a long time. For example, Angus Deaton, the 2015 Nobel Prize winner in economics, noticed that fast population aging was relevant to life cycle saving because of Taipei,China's rapid transition over the last several decades from high to low population growth (Deaton and Paxson 1994), and then made a long-run program to track the causes and consequences (Deaton and Paxson 1997, 2000). It is worth noting, however, that population decline can bring some advantages, such as an improved quality of life. Also, in densely populated areas, the pressure on the environment would be alleviated. Besides, an opportunity for economic transformation could be achieved by the so-called "senior industries," for example, remote home health care and medical services, medical equipment,

Table 7.2: From Aging, Aged, to Super-aged Societies: An International Comparison

Economy	Population aged 65+ (%)		
	7%	14%	20%
Taipei,China	1993	2018	2025
Republic of Korea	1999	2017	2026
Singapore	1999	2018	2026
People's Republic of China	2000	2025	2035
Japan	1970	1994	2005
United States	1942	2013	2029
United Kingdom	1929	1975	2026
Germany	1932	1971	2008
France	1964	1990	2019
Canada	1945	2010	2024

Note: Taipei,China's ratio in 2020 was 15.1%.

Sources: UN DESA (2019); National Development Council (2020); Huang, Lin, and Lee (2019); authors' compilation.

pharmaceuticals, mobility aids, health-preserving food, cosmetics, and toiletry products. The market for these goods is expected to be $150 billion in 2025 (Tsai 2008). However, it also has to deal with the negative economic impact of rapid population aging by itself, which explains why its population conundrum will haunt the economy for years to come. Increasing education and job opportunities for women, together with changing family values, have led to the prevalence of late marriage and delayed childbearing, causing an aging society.

We should not neglect the ideas that come from beyond economics. For instance, sociologists prefer to discuss the issue of population aging by focusing on social welfare and long-term care. First, the imbalanced age distribution makes the island increasingly rely on foreign labor and brides to fill the gap in labor shortage and elderly care, respectively. However, these are not without costs. Second, the opportunity to have a grandparent and grandchild living under the same roof becomes more frequent as life expectancy extends. Grandparenting also creates tensions within the family (Tsai 2008). Third, the elderly will become clients of physical and mental health services, long-term care services, personal social services, and the public pension system, which in turn puts pressure on the health insurance system, residential care institutions, and public pension system covering various income-related social insurance schemes (Lin 2010).

The authorities are fully aware of the causes and consequences of an aging society. However, that does not mean that the government has sufficient time and tools to stop the worsening trend. This chapter introduces the current situation, the official strategies and evaluations by referring to the existing empirical literature. Policies on retirement, pension systems, health care, human capital accumulation, capital flows, and financial markets that target the aged population are discussed, accompanied by policy suggestions.

By using relevant data and literature to examine the state of the research, this chapter contributes to the evaluation of the impact of population aging on economic growth and volatility according to estimation and simulation, and then offers advice for policies that the government could implement to deal with the prospective problem of population aging. The structure of the chapter is as follows. Section 7.2 describes the impact of population aging on economic growth. Section 7.3 introduces simulated results concerning the impact of population aging on macroeconomic and financial situations based on a model by Gertler (1999). Section 7.4 concludes with the relevant policies and provides a new scientific perspective on the aging problem.

7.2 Impact on Economic Growth

In economics, the first question is the impact of an aging society on economic growth. Numerous studies have explored the impact of population aging on productivity and economic development. It makes sense to predict a negative relationship between an aging workforce and economic growth (e.g., Bloom, Canning, and Finlay 2010 for the case of Asia; Maestas, Mullen, and Powell et al. 2016 for the United States (US); Aiyar, Ebeke, and Shao 2016 for Europe). However, some studies have found that aging workers may not necessarily cause a decline in productivity (e.g., Börsch-Supan and Weiss 2016), and it may depend on other factors, such as the relative value of the death and birth rates (Prettner 2013) and foreign labor immigration. A few studies stress the potential of immigration to prevent population decline, maintain the support ratio, and slow down population aging (e.g., Felbermayr, Hiller, and Sala 2010; Boubtane, Dumont, and Rault 2016; Borjas 2019), but do not cover problems related to social welfare and public order.

Due to the differences in population structure between economies, it is necessary to conduct a case study on the impact of population aging and human resources aging specifically for Taipei,China. However, data limitations and a rapid rate of aging make statistical estimation difficult.

Huang, Lin, and Lee (2019) used quarterly data from 1981 to 2017 to examine the impact of Taipei,China's aging society on its economic growth rate. They utilized the old-age dependency ratio (ODAR, %) calculated as population aged 65 years and above divided by population aged 15–64 years; aging workforce (*AgeWorker*, %), which is the ratio of workers aged 55–64 years to the total workforce; and the average real gross domestic product (GDP) per worker (*WGDP*) as proxies for population, workforce aging, and economic productivity, respectively. In relation to that, Taipei,China has been implementing welfare and care policies targeting the elderly since the launch of the Senior Citizens Welfare Act in 1980.

The number of workers serving in elderly long-term care, nursing, and care institutions divided by total nursing staff (*ElderCare*, %) can be taken as a proxy for healthcare policies for tackling with an aging society. Therefore, the interaction terms *ElderCare×OADR* and *ElderCare×AgeWorker* are included in the model to observe the mitigating effect of policies related to an aging population and workforce. Furthermore, the ratio of foreign workers with residency (*ForWorker*, %) can capture the foreign personnel's effect on Taipei,China's economic development, which is why its interaction terms, *ForWorker×OADR* and *ForWorker×AgeWorker*, are included to observe the similar mitigating effect of the foreign labor policy. The ratio of the workforce to college or higher educational attainment (*WHEDU*, %) is a traditional variable explaining income growth, but its interaction terms *WHEDU×OADR* and *WHEDU×AgeWorker* can be used to measure whether an investment in human capital can mitigate the negative effects of aging.

Other determinants related to aging and economic growth have been controlled, so we can mainly focus on the effect of the important variables and their interaction terms, as listed above. The controlled variables include the youth dependency ratio (*YADR*, %), the ratio of employed population to working-age (15–64 years) population (*Employ*, %), the ratio of gross investment to GDP (*Invest*), and the *WGDP* of the previous year.

The unit root tests including augmented Dickey–Fuller (ADF), Phillips–Perron (PP), and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) are implemented in the above variables in the level and first-order difference forms, respectively. Most variables are nonstationary at level but become stationary after being transformed into difference forms. Thus, the empirical results shown in Table 7.3 are made by the first-order differential for the natural logarithm.

Table 7.3 recompiles Huang, Lin, and Lee (2019), but updates the explanations as follows. First, most controlled variables related to traditional economic theory in Columns (1), (2), and (3) are statistically significant with expected signs.

Second, the old-age dependency ratio ($OADR_t$) has a significantly negative effect, but the significantly positive coefficient for the interaction term *ElderCare×OADR* highlights that expanding long-term care for the elderly can significantly mitigate the negative impact of a high old-age dependency ratio. Besides, the aging workforce ($AgeWorker_t$) is positively significant, meaning that senior workers do not handicap but, rather, support economic development. That is, a rapid increase in $OADR_t$ creates a social burden, while $AgeWorker_t$ is still considered to improve productivity. To mitigate the burden caused by $OADR_t$, the government has implemented related heath and elderly care policies, as represented by $ElderCare_t$.

Third, although we cannot find any evidence to support the benefits of the ratio of foreign workers with residency ($ForWorker_t$), its interaction term with $OADR_t$ is significantly positive. That is, introducing immigration and a foreign labor force can only partially help Taipei,China deal with the concerns of population aging.

From the above initial assessment, we can infer that in the case of Taipei,China, an aging workforce ($AgeWorker_t$) is not bad for economic growth. The old-age dependency ratio ($OADR_t$) has a significantly negative effect on economic development, but it can be mitigated with appropriate policies related to foreign labor immigration and elderly long-term care. Also, higher education attainment still works to support economic growth in the long run.

A lot of issues related to an aging society and long-run development need to be explored. Typically, it is assumed that economic growth is supported by a constant or a growing population and driven by people discovering new ideas. It is necessary to analyze what happens to economic growth in higher-income economies where fertility rates are already below the replacement level (Jones 2020). For example, Glover and Short (2020) observe that in the US the share of income paid to workers (labor's share) has declined concurrently with the aging demographics. They hypothesize that an aging workforce has contributed to the decline in labor's share, because employers of older workers may have substantial monopsony power due to the decline in labor market dynamism that accompanies aging. This is manifested as a rising wedge between a worker's salary and marginal product over their life. The decline in labor's share in the US and globally has raised concerns regarding its impact on income, distribution of income and wealth inequality. This implies that Taipei,China, which has a flexible labor market, as well as the US, should not only consider economic growth but also the problem of income distribution.

Table 7.3: Impact of Population Aging on Income Growth (Q1 1981–Q4 2017)

Variable	(1)	(2)	(3)
c	0.21 (0.56)	0.20 (1.52)	0.23 (1.04)
$WGDP_{t-1}$	−0.43** (−2.34)	−0.23* (−1.80)	−0.27** (−2.21)
$Invest_t$	1.07** (2.09)	0.88* (1.88)	1.14 (1.55)
$Employ_t$	−1.39* (−1.80)	−1.01** (−2.25)	−1.21* (−1.78)
$OADR_t$	−3.67** (−2.12)	−3.01** (−2.79)	−2.88* (−1.74)
$YADR_t$	−0.85 (−1.05)	−0.15 (−1.31)	−1.21* (−1.78)
$AgeWorker_t$	1.05* (1.68)	1.27** (2.46)	0.95* (1.95)
$ElderCare_t$		0.48 (1.25)	0.58 (0.89)
$OADR_t \times ElderCare_t$		1.12** (2.40)	0.80* (1.67)
$AgeWorker_t \times ElderCare_t$		0.10 (0.86)	−0.73 (−1.03)
$WHEDU_t$	1.53** (2.34)	1.33** (2.38)	0.82* (1.94)
$OADR_t \times WHEDU_t$		0.29 (1.20)	
$AgeWorker_t \times WHEDU_t$		0.57 (0.27)	
$ForWorker_t$	0.44 (0.58)	0.45 (1.63)	1.00 (1.05)
$OADR_t \times ForWorker_t$			1.26** (2.20)
$AgeWorker_t \times ForWorker_t$			0.92 (1.00)
Obs.	148	148	148
Adjusted R^2	0.46	0.52	0.64

Note: The dependent variable is the first-order differential for the natural logarithm of real GDP per worker (WGDPt). The same applies to all other independent variables. The year dummy has been controlled. ***, **, and * indicate significance at the 1%, 5%, and 10% levels (two-sided), respectively. t-values are presented in parentheses.

Sources: Huang, Lin, and Lee (2019); Directorate-General of Budget, Accounting and Statistics; Ministry of Health and Welfare; authors' compilation.

7.3 Impact on Economic and Financial Stability

Life cycle theory predicts that an aging society would cause a current account deficit and capital inflow because there exists a large old population that has a relatively low saving rate. Many papers confirm that demographic changes indeed influence international capital flow, but few studies have discussed the responses of net foreign assets to technology shocks in a small open economy facing population aging.

Gertler (1999) introduces two stages of the human life cycle: work and retirement. Each individual is born as a worker facing a random transition probability from work to retirement and then to death. Using an appropriate parameter setting yields a realistic average length for each state. The main feature of Gertler's model is that an individual changes their consumption behavior and considers different discount rates in accordance with the life state. In other words, the worker and the retiree have different preferences and budget constraints. As Gertler suggests, this model can be easily extended to a small open economy by adding the net foreign asset position into the market clearing condition. This implies that the economy can borrow from or lend abroad at international interest rates.

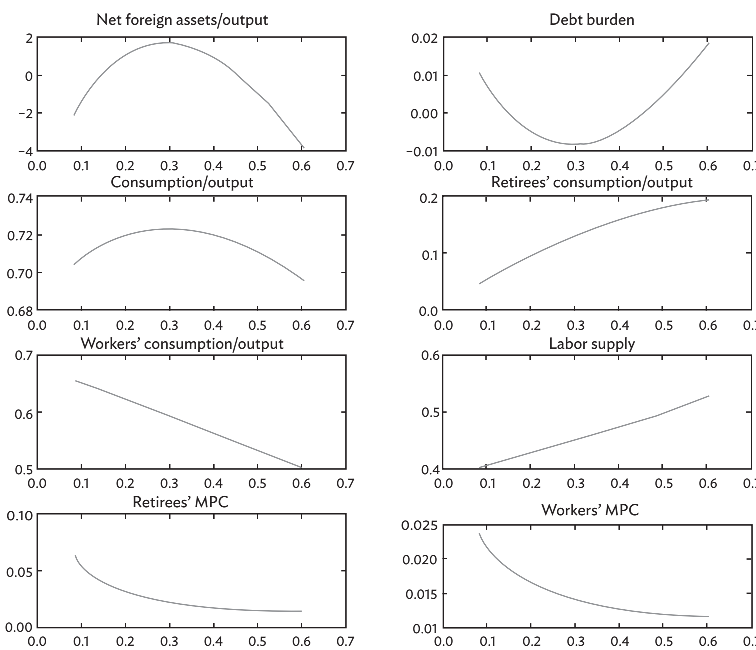
Tseng (2010) and Yeh (2010) extend the tractable overlapping generation model of Gertler (1999). We add a stochastic technology shock and assume the agents can borrow from or lend abroad. The economy is a small open economy, so the domestic interest rate equals the international interest rate. The two kinds of agents in the model are households and firms, where we distinguish workers and retirees by their marginal propensity to consume (MPC).

The details of the modeling and calibration for Taipei,China are shown in Appendix 7.1, based on Tseng (2010) and Yeh (2010). Our model consists of 20 equations, including 19 endogenous variables and one exogenous technology shock. All the quantity variables should be detrended because the growth rates of both the labor-augmenting technology and the population are deterministic. The parameters of the prototype model are solved with quarterly frequency. For simplicity's sake, here we present only the important implications concerning the impact of aging on financial situations. The mathematic derivations are shown in Appendix 7.1.

Demographics can be represented by three parameters: population growth rate, the probability of survival, and the probability of remaining in the workforce. A decrease in the birth rate and an increase in longevity are two factors that cause population aging. In this model, a decrease in the birth rate is represented by the decline in the population growth rate. An increase in life expectancy is represented by an increase in the survival rate. Both rising survival rates and falling population growth rates increase the old-age dependency ratio. Various combinations of parameters can yield the same old-age dependency ratio. Besides, these two factors may impact macroeconomic variables differently. In the following paragraphs, we show how a declining population growth rate and an increasing survival rate influence the long-run values of macroeconomic variables.

Figure 7.2 varies the survival rate from 0.9765 to 0.9943, meaning the retirement life expectancy varies from 10 years to 40 years. Meanwhile, the old-age dependency ratio varies from 21.77% to 69.47%. The horizontal axis represents the old-age dependency ratio. As can be seen, the rising survival rate increases net foreign assets at first and

Figure 7.2: Long-run Effect of Increasing Longevity



Note: The horizontal and vertical axes refer to the old-age dependency ratio and percentage change (in decimal).

MPC = marginal propensity to consume.

Sources: Tseng (2010), Yeh (2010).

then augments the holding of international debt. The net foreign assets position will be negative when the old-age dependency ratio is high. Meanwhile, the debt burden also increases. This result seems strange because the traditional life cycle theory suggests that an increasing old-age dependency would bring about capital inflows, decreasing net foreign assets. In other words, the life cycle theory is valid only for the latter part of the simulation.

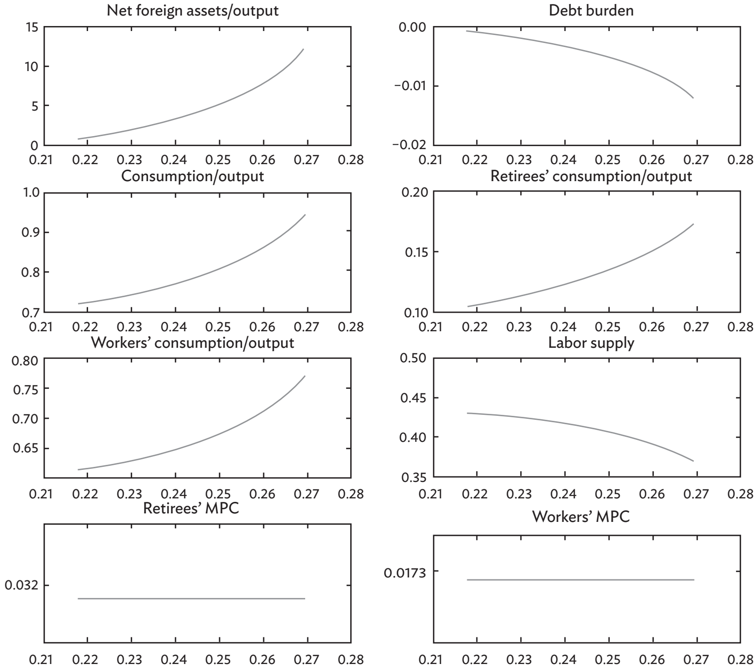
However, this would not be a strange phenomenon if we understood the entire story. Workers increase savings when they expect a longer life expectancy. In the simulation, workers' savings are sufficient to compensate for the consumption of retirees at first. Although the old-age dependency ratio increases, net foreign assets rise. As the number of older people grows, workers' savings become insufficient to compensate for retirees' consumption. Therefore, net foreign assets start to decline and even become negative in the simulation. Also, an increase in longevity lowers workers' MPC and retirees' MPC. This implies that individuals try to save more and consume less with a longer life expectancy.

Figure 7.3 assumes that the population growth rate changes from 0.01 to –0.01 and shows the long-run effect of a falling population growth rate. The horizontal axis of Figure 7.3 represents the old-age dependency ratio. The long-run effect of a falling population growth rate is quite different from the long-run effect of increasing longevity. Although both falling population growth rates and increasing survival rates can increase the old-age dependency ratio, their effects on net foreign assets differ. The net foreign assets will increase when the population growth rate goes down. This implies that a decrease in population growth causes capital outflow. This happens because the lower population reduces the long-run growth rate of the domestic economy. In this situation, there is an incentive for domestic agents to hold foreign assets. Unlike an increase in longevity, a decrease in population growth brings about capital outflow. Besides, MPC is unaffected by decreasing fertility.

From the above discussion, we see that an aging population may either increase or decrease net foreign assets, depending on the size of the old-age population and the population growth rate. Both aging factors can increase the old-age dependency ratio, but the effects differ. The old-age dependency ratio cannot be reasonably simulated by changing just one of the population structure parameters. Calibrating population projection data is a reasonable way to choose population structure parameters.

In the subsequent analysis of dynamic properties, demographic assumptions are chosen to match the population projections. We take the year 2010 as the younger economy and 2025 as the older economy. The reason we choose 2025 as the older economy is that Taipei,China's

Figure 7.3: Long-run Effect of Decreasing Fertility



Note: The horizontal and vertical axes refer to the old-age dependency ratio and percentage change (in decimal).

MPC = marginal propensity to consume.

Sources: Tseng (2010), Yeh (2010).

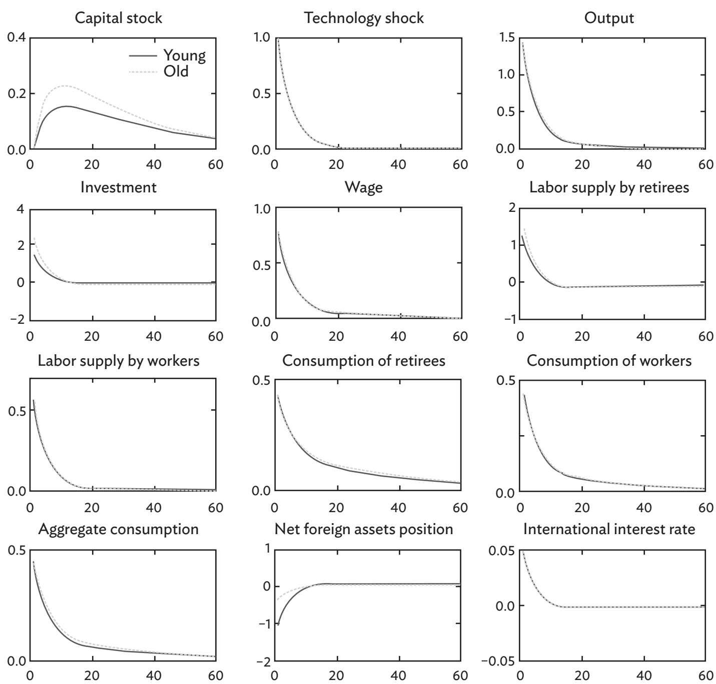
population is expected to become a super-aged society in the year 2025–2026 (20.7%), as mentioned above.

Life expectancy at birth in 2010 was 79 years, so we calibrate a 14-year retirement life. Meanwhile, the population growth rate in 2010 corresponds to 0.03%. The old-age dependency ratio implied by the model is 25% in the younger economy. The older economy closely matches the population projection of Taipei,China. Comparing 2010 and 2025, the population growth rate is projected to decrease by –0.4%, while life expectancy is projected to increase by 3 years. In the older economy, the old-age dependency ratio implied by the model is 33%, close to the old-age dependency ratio of 31% projected for the population in 2025.

Figure 7.4 shows the demographic structures of the younger and older economies calibrated by the population projections of Taipei,China. It indicates an impulse response to the positive technology shock both in the younger and older economies. The solid line represents the younger economy, while the dashed line represents the older economy. It is no accident that output, consumption, and investment respond positively to a positive technology shock. Labor supply also responds positively to the shock because the shock increases wage levels.

Meanwhile, the net foreign asset position responds negatively to a positive technology shock because an economy increases imports when a domestic positive technology shock occurs. The increase in imports

Figure 7.4: Responses to a Technology Shock under Alternative Demographic Structures



Note: The horizontal axis is on a quarterly basis. The vertical axis refers to a percentage change (in decimal).

Source: Tseng (2010).

causes a current account deficit and brings about capital inflow, thus increasing domestic international debt.

Most variables respond similarly under alternative demographic structures, except investment, capital stock and net foreign assets. The responses of investment and capital stock are larger in the older economy because it is mainly retirees who depend more on returns from nonhuman wealth. With a longer life expectancy, individuals would invest more and accumulate more capital stock, preparing for retirement. Unlike investment and capital stock, the response of net foreign assets is smaller in the older economy, mainly because, logically, a longer life expectancy encourages saving behavior. Individuals prefer to increase consumption less than in the younger economy when they face a positive technology shock, so the increase in foreign debt is relatively small in the older economy.

In sum, the demographic structure indeed affects the net foreign asset position in the long run. An increase in longevity first enhances and then erodes net foreign assets. This finding supports the traditional life-cycle theory that an aging society attracts capital inflow. Besides, the demographic structure also changes the size of the response to technology shocks. High old-age dependency ratios cause investments to strongly respond to technology shocks because individuals prefer to save more for retirement in aging societies. However, the correlations among macroeconomic variables show that the transmission mechanism of technological shocks is only slightly affected by the demographic structure. This implies that the aging of the population has a minor influence on the dynamics of macroeconomic variables.

A lot of issues related to an aging society and macroeconomic stability have not been explored here. For instance, housing prices may affect fertility, early-life child health, and the aging speed (e.g., Daysal et al. 2020). A case study by Lin (2020) indicates the social housing policy since 2018 has created higher birth and marriage rates. Thus, it is important to monitor the trend of East Asian housing prices since the quantitative easing in 2009 and the COVID-19 shock.

7.4 Conclusion and Policy Recommendations

From the empirical study and simulations for Taipei,China's economic growth and volatility, we conclude that the situation is not as bad as might be expected. An aging workforce is necessarily not bad for economic growth, and while the old-age dependency ratio has a significantly negative effect on economic development, that can be mitigated with appropriate policies concerning foreign labor immigration and elderly long-term care. Higher education attainment also works to support economic growth in the long run. Furthermore, an increase in longevity first enhances and then erodes net foreign assets, and high old-age dependency ratios cause investments to strongly respond to technology shocks because individuals prefer to save more for retirement in aging societies. Nonetheless, population aging has a minor influence on the dynamics of the macroeconomic variables.

While numerous developed and developing economies are facing the challenge of an aging population, Taipei,China is aging at a faster rate than other developed and emerging economies. According to the estimation by Central Intelligence Agency (2021), the ranking of Taipei,China's fertility rate is the lowest in the world (227 out of 227). The above empirical results provide some policy implications to improve health care and increase the supply of the eldercare workforce and foreign personnel contributing toward countering the negative impact of an aging population on economic growth. That is, it is necessary to implement policies to improve elderly long-term care and properly relax restrictions on the foreign workforce. Social welfare support must also become an important aspect of the social security framework. Economic development strategies must be adjusted to the reality of the falling fertility rate and an increasingly elderly population. In response to the aging of human resources, the government should allocate resources to help labor-intensive and low-skilled industries transform into more innovation-oriented and knowledge-intensive ones.

Taipei,China's government has implemented the following four main policies (National Development Council 2018). The first is to raise the fertility rate and enhance childbearing and child-rearing. A 4-year program for the period 2018–2022 has been approved for responding to the low birth rate, aiming for a fertility rate of 1.4 in 2030.

Second, the government should attempt to raise labor productivity by catering to future industry needs, promoting economic development and upgrading and transforming the industrial structure. Some new policies have been promoted, such as the "5+2 Industrial Innovation Plan," the Industrial Innovation & Transformation Fund, the Act for the Recruitment and Employment of Foreign Professionals, and the New Economic Immigration Bill, currently being planned.

Third, the government must create a friendly society for older people. Given the speed of Taipei,China's population aging, creating a society that is friendly to older people is a task that should not be delayed. The Ministry of Labor has drafted the Act for Employment of Middle-aged and Older People to help them secure employment, and more such action is needed.

Last but not least, the government must implement the “Long-Term Care Plan 2.0” and support it with other relevant policies in fields such as industry, finance, land-use, social and medical care, retirement, housing, and pluralistic social development, to deal with the demographic changes. It is worth noting that in 2008, the government implemented the first 10-year long-term care plan, and since 2015 the Ministry of Health and Welfare has been promoting the Ten-year Long-term Care Plan 2.0. The government initiated this second plan to establish a system to help the elderly who have low income and disabled people in need. The objectives of the policy are to combine and integrate public and private resources at all levels for medical care, long-term nursing care, and preventive healthcare in order to perfect community care systems and mechanisms and create affordable, accessible, and good-quality long-term care services.

The Ministry of Health and Welfare (2019) is responsible for the Long-term Care Plan 2.0. In addition to extending the target groups and services, the launch of benefit and payment systems is expected to encourage companies and citizens to provide long-term care (LTC) services, enhance service functions and assist more people in need. In 2018, the Ministry of Health and Welfare care management system recorded a 70.9% increase (from 71,777 to 180,660) over the previous year in first-time applicants for LTC services.

The Long-term Care Plan 2.0 has four major features, beginning with providing resources:

(1) To promote a comprehensive community-based care service, the government established the so-called “ABC scheme” aimed at establishing 472 integrated community service centers (A), 2,922 long-term care service institutions (B), and 1,603 care service grocery stores (C). Although established at the end of November 2018, the number of total A, B, and C reached 3,827 in 2019, which was ahead of the Long-term Care Plan 2.0 schedule.

(2) It also promotes dementia care services and, as part of that effort, set up a support center for people with dementia and their families in 2017. The ministry also announced the Dementia Plan 2.0 in June 2018, which envisaged the establishment of support centers and integrated dementia care centers. More hospitals on the island are participating in the government’s plan for LTC discharge-friendly medical care institutions. To streamline discharge planning services and connect health care with LTC services, a pilot plan for diversified rehabilitation services was launched in August

2018. This helps people with the activities of daily living and also reduces the cost of care and the physical burden of family members who provide the care. Family Caregivers Support Innovation Plans have been initiated since 2019.

(3) To significantly improve home caregiving staff's working conditions, the Long-term Care Plan 2.0 supports to raise salaries and encourage job retention. As of August 2018, 50% of home care workers receive a monthly salary of over NT35,000 (Ministry of Health and Welfare 2019).[2]

(4) A pilot plan in collaboration with the Ministry of Labor has been launched to expand respite care services for families with foreign caregivers. Since 1 December 2018, two kinds of families have been able to apply for respite care services and related benefits if the foreign caregiver is temporarily unable to provide care services: one is the families employing foreign home-caregivers to take care of individuals who meet the disability levels of 7–8 as assessed by LTC management centers and are living alone (only live with their foreign caregivers), the other is those whose primary caregiver is over 70 years old.

Needless to say, a lot of issues related to an aging society, macroeconomic development and stability have not been explored. The government still needs to deal with population aging as a matter of security, be alert to new developments, and take necessary precautions.

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[2] Exchange rate: $1.00 = about NT$1:28.

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Appendix 7.1: Modeling and Calibration

Derivations of this appendix are from Tseng (2010) and Yeh (2010), which are based on Gertler (1999). As in the Gertler (1999) life cycle model, the population is a composite consisting of workers and retirees. Individuals have an infinite life expectancy and two sequential states during their lifetime: work and retirement. Each individual is born as a worker and faces the constant probability of remaining in the workforce in the next period. ω denotes the probability of remaining in the workforce in the next period, while 1-ω is the probability of becoming a retiree in the next period. The length of the working period can be denoted as 1/ (1-ω).

A1. Households

When an individual becomes a retiree, we assume he or she survives in the current period, but faces the constant probability of staying alive in the next period. γ denotes the probability of surviving in the next period. Similarly, 1-γ represents the probability of death in the next period and 1/ (1-γ) is the average length of retirement.

We use N_t as the number of workers in period t and assume (1-$\omega + n$) N_t new workers are born in each period. This implies that the law of motion for workers is:

$$N_{t+1} = (1-\omega+n)N_t + \omega N_t = (1+n)N_t$$

Thus, the workforce growth rate is 1 + n. Further, the law of motion for retirees can be shown as:

$$N_{t+1}^r = (1-\omega)N_t + \gamma N_t^r$$

$$\frac{N_{t+1}^r}{N_t^r} = (1-\omega)\frac{N_t}{N_t^r} + \gamma\frac{N_t^r}{N_t^r}$$

We assume that the demographic structure is constant. The stationary population structure implies workers and retirees have the same rate of population growth. The ratio of retirees to workers can be represented as:

$$\frac{N^r}{N} = \frac{1-\omega}{1+n-\gamma} = \Gamma$$

where Γ is the old-age dependency ratio. This ratio increases by the survival rate and the retirement rate and decreases by the rate of population growth.

In this model, we can distinguish workers and retirees by their marginal propensity to consume (MPC). The MPC varies with the life cycle state because the effective discount rate of workers differs from that of retirees. In the following, we will show that workers tend to have a higher effective discount rate than retirees. The difference in discount rates would make the MPC vary with life states. In general, the MPC of retirees is higher than that of workers because workers have a higher effective discount rate. The reason workers have a higher effective discount rate is because they might retire in the future, so the expected future wage for them is lower. A high effective discount reduces the value of the discounted stream of wage incomes, decreasing consumption, and increasing savings. Therefore, this model captures workers' life cycle behavior of saving for retirement.

A1.1 Workers and Retirees

The preference of our agents is expressed as:

$$V_t^z = \left\{[(C_t^z)^v(1-L_t^z)^{1-v}]^\rho + \beta^z E_t(V_{t+1}^{\varkappa}|z)^{\frac{\rho}{\varkappa}}\right\}^{\frac{1}{\rho}}$$

$$\begin{cases} \beta^\omega = \beta \\ \beta^r = \beta_\gamma \end{cases}$$

$$E_t\{V_{t+1}|z\} = \begin{cases} \omega V_{t+1}^w + (1-\omega)V_{t+1}^r & \text{if } z = w \\ V_{t+1}^r & \text{if } z = r \end{cases}$$

where z represents different cohorts. The superscript r stands for retirees, while the superscript w stands for workers. Individuals have one unit of time per period. They can spend their time on work or leisure. Note that retirees form a part of the labor force in our model. However, the productivity of retirees is assumed to be lower than that of workers. Let C_t denote consumption and β a subjective discount factor. The discount factor of retirees differs from that of workers because retirees face the probability of death. On the other hand, retirees' discount rate is greater than workers'. The parameter ρ refers to intertemporal substitution. The parameter κ relates to risk aversion. $E_t\{V_t|z\}$ is the conditional expectation of the value function for the next period. It depends on the current life state.

To keep the model tractable, we assume there is no aggregate risk. Nevertheless, the lifetime of individuals is idiosyncratic. Workers face the uncertainty of wage loss caused by retirement. Retirees face uncertainty about their time of death. These uncertainties make derivation and aggregation difficult. We need more assumptions to mitigate uncertainty to keep the model simple. For instance, $\kappa = 1$, and retirees earn R_t^f/γ from their nonhuman assets to fully compensate for the risk of death.

A1.2 Decision of the Representative Retiree

The representative retiree maximizes the following recursive utility function:

$$\max_{\{A_{t+1}^{rjk}, L_t^{rjk}\}} V_t^{rjk} = \left\{\left[\left(C_t^{rjk}\right)^v \left(1 - L_t^{rjk}\right)^{1-v}\right]^\rho + \beta\gamma E_t\left(V_{t+1}^{rjk}\right)^\rho\right\}^{\frac{1}{\rho}}$$

subject to

$$A_{t+1}^{rjk} = \frac{R_t^f}{\gamma} A_t^{rjk} + W_t \vartheta L_t^{rjk} - C_t^{rjk}$$

The superscript jk represents the retiree who was born at j and retired at k. W_t denotes the real wage. A_t^r is the nonhuman wealth held by the retiree. R_t^f is the gross international interest rate. ϑ is the relative productivity of the retiree to that of the worker, capturing the productivity decline when the individual retired. One can obtain the labor supply and the Euler equation for consumption from the first-order conditions:

$$E_t C_{t+1}^{rjk} = \left[\beta E_t R_{t+1}^f \left(\frac{W_t}{E_t W_{t+1}}\right)^{\rho(1-v)}\right]^{\frac{1}{1-\rho}} C_t^{rjk}$$

By combining the first-order conditions with the budget constraint, the consumption equation can be shown as follows:

$$C_{t+1}^{rjk} = \varepsilon_t \theta_t \left[\frac{R_k^f}{\gamma} A_t^{rjk} + H_t^{rjk}\right]$$

where $\varepsilon\theta$ is the retiree's marginal propensity to consume out of wealth (MPC), θ the worker's MPC, and ε the ratio of the retiree's MPC to the worker's MPC. Thus, consumption is the product of MPC and wealth. H_t is human wealth. Human wealth is derived from the discounted stream of wage incomes:

$$H_t^{rjk} = \frac{\sum_{q=0}^{\infty} W_{t+q} \vartheta L_{t+q}^{rjk}}{\prod_{z=1}^{q} R_{t+z}^{f} \,/\, \gamma}$$

$$H_t^{rjk} = W_t \vartheta L_t^{rjk} + \frac{\gamma}{E_t R_{t+1}^{f}} E_t H_{t+1}^{rjk}$$

We obtain the dynamic equation of the retiree's MPC after deduction:

$$\varepsilon_t \theta_t = 1 - \frac{\varepsilon_t \theta_t}{E_t \varepsilon_{t+1} \theta_{t+1}} \gamma \left(E_t R_{t+1}^{f}\right)^{\frac{\rho}{1-\rho}} \beta^{\frac{1}{1-\rho}} \left(\frac{W_t}{E_t W_{t+1}}\right)^{\frac{\rho(1-v)}{1-\rho}} \quad (1)$$

A1.3 Decision of the Representative Worker

The representative worker maximizes the following recursive utility function:

$$\max_{\left\{A_{t+1}^{wj}, L_t^{wj}\right\}} V_t^{wj} = \left\{\left[\left(C_t^{wj}\right)^{v} \left(1 - L_t^{wj}\right)^{1-v}\right]^{\rho} + \beta E_t \left[\omega V_{t+1}^{wj} + (1-\omega) V_{t+1}^{rj}\right]^{\rho}\right\}^{\frac{1}{\rho}}$$

subject to

$$A_{t+1}^{wj} = R_t^{f} A_t^{wj} + W_t L_t^{wj} - C_t^{wj}$$

The superscript j represents the worker who was born at j. A^{w} is the nonhuman wealth held by the worker. Similarly, we derive the labor supply and the Euler equation for consumption from the first-order conditions:

$$\omega E_t C_{t+1}^{wj} + (1-\omega)(\varepsilon_{t+1})^{-\frac{1}{\rho}} E_t C_{t+1}^{rj} \left(\frac{1}{\vartheta}\right)^{1-v}$$

$$= \left[\beta E_t R_{t+1}^{f} \ \ \omega + (1-\omega)(E_t \varepsilon_{t+1})^{-\frac{1-\rho}{\rho}} \left(\frac{1}{\vartheta}\right)^{1-v} \left(\frac{E_t W_{t+1}}{W_t}\right)^{(v-1)\rho}\right]^{\frac{1}{\rho-1}} C_t^{wj}$$

By combining the first-order conditions with the budget constraint, the consumption equation can be shown as follows:

$$C_t^{wj} = \theta_t \left[R_t^{f} A_t^{wj} + H_t^{wj}\right]$$

where θ is the worker's MPC and H^{w} the human wealth of the worker. Human wealth is derived from the discounted stream of wage income:

$$H_t^{wj} = W_t L_t^{wj} + \omega \frac{E_t H_{t+1}^{wj}}{E_t R_{t+1}^{f} \Omega_{t+1}} + (1-\omega)(E_t \varepsilon_{t+1})^{\frac{\rho-1}{\rho}} \left(\frac{1}{\vartheta}\right)^{1-v} \frac{E_t H_{t+1}^{rj(t+1)}}{E_t R_{t+1}^{f} \Omega_{t+1}}$$

where $H^{rj(t+1)}$ is the value of human wealth for the individual who worked at period t and retired in the next period.

Ω_t can be shown as:

$$\Omega_t = \omega + (1-\omega)(\varepsilon_t)^{\frac{-(1-\rho)}{\rho}} \left(\frac{1}{\vartheta}\right)^{1-v} \tag{2}$$

Ω_t augments the interest rate for the worker and distorts the worker's decision rule. $\Omega_t > 1$ since the ratio of the retiree's MPC to the worker's MPC is greater than 1, $\varepsilon_t > 1$. Therefore, the worker's discount rate is higher than the infinitive horizon model's discount rate. Ω_t arises from life cycle behavior and captures the attitude of the worker who faces the potential probability of retirement. For instance, if the relative productivity of the retiree in terms of the worker is falling, Ω_t would increase, depressing the worker's current consumption. This implies that the worker would save more for retirement.

Finally, the worker's decision rule also yields the dynamic equation of the worker's MPC:

$$\theta_t = 1 - \left(E_t R_{t+1}^{f} \Omega_{t+1}\right)^{\frac{\rho}{1-\rho}} \beta^{\frac{1}{1-\rho}} \left(\frac{E_t W_{t+1}}{W_t}\right)^{\frac{(v-1)\rho}{1-\rho}} \frac{\theta_t}{E_t \theta_{t+1}} \tag{3}$$

A1.4 Aggregation

To obtain the aggregate function, we define the law of motion of nonhuman assets held by retirees as follows:

$$A_{t+1}^{r} = R_t^{f} A_t^{r} + W_t \vartheta L_t^{r} - C_t^{r} + (1-\omega)\left[R_t^{f} A_t^{w} + W_t L_t^{w} - C_t^{w}\right]$$

where the first term is the assets accumulated by retirees at time t, and the second term is the assets held by the workers who worked at time t and retired in the next period.

We define λ as the ratio of retirees' assets to society's assets.

$$\lambda_t = \frac{A_t^{r}}{A_t}$$

where the nonhuman asset A_t is the sum of capital stock and net foreign assets.

$$A_t = K_t + F_t \tag{4}$$

The assets held by workers at time *t + 1* is:

$$A_{t+1}^{w} = \left[R_t^f A_t^w + W_t L_t^w - C_t^w\right]\omega$$

We can simplify the law of motion of the assets held by retirees in the following manner:

$$\begin{aligned} \curlyvee_{t+1} A_{t+1} = \omega\big[(1-\varepsilon_t\theta_t)\big(R_t^f \curlyvee_t A_t + H_t^r\big) \\ + W_t\vartheta L_t^r - H_t^r\big] + (1-\omega)A_{t+1} \end{aligned} \tag{5}$$

Next, multiplying the individual's labor supply by the population of each life state yields the aggregate labor supply function and aggregate human wealth:

$$L_t = L_t^w + \vartheta L_t^r \tag{6}$$

$$L_t^r = \Gamma \mathrm{N}_t - \frac{1-v}{v}\frac{C_t^r}{\vartheta W_t} \tag{7}$$

$$L_t^w = N_t - \frac{1-v}{v}\frac{C_t^w}{W_t} \tag{8}$$

$$H_t^r = \frac{\sum_{q=0}^{\infty} W_{t+q}\vartheta L_{t+q}^{rjk} N_{t+q}}{\Pi_{z=1}^{q}(1+n)R_{t+z}^f/\gamma}$$

$$= W_t\vartheta L_t^{rjk} N_t + \frac{\gamma}{(1+n)R_{t+1}^f}\frac{\sum_{q=0}^{\infty} W_{t+q+1}\vartheta L_{t+q+1}^{rjk} N_{t+q+1}}{\Pi_{z=1}^{q}(1+n)R_{t+1+z}^f/\gamma}$$

$$H_t^r = W_t\vartheta L_t^r + \frac{\gamma}{(1+n)E_t R_{t+1}^f} E_t H_{t+1}^r \tag{9}$$

$$H_t^w = W_t L_t^w + \omega \frac{E_t H_{t+1}^w}{(1+n) E_t R_{t+1}^f \Omega_{t+1}}$$
$$+(1-w)(E_t \varepsilon_{t+1})^{\frac{\rho-1}{\rho}} \left(\frac{1}{\vartheta}\right)^{1-v} \frac{E_t H_{t+1}^r}{(1+n) E_t R_{t+1}^f \Omega_{t+1}} \tag{10}$$

Note that the population growth rate 1 + n increases the discount rate of aggregate human wealth because increasing the population reduces the share of wages earned by the current generation. The term 1 + n ensures that the income streams of the current generation can be separated from those of the future generations.

Finally, eliminating the superscript jk from individual consumption, one obtains the aggregate consumption:

$$C_t = C_t^r + C_t^w \tag{11}$$

$$C_t^r = \varepsilon_t \theta_t \left[R_t^f \leftthreetimes_t A_t + H_t^r\right] \tag{12}$$

$$C_t^w = \theta_t \left[R_t^f (1 - \leftthreetimes_t) A_t + H_t^w\right] \tag{13}$$

A2. Firms

We assume that firms are perfectly competitive. Firms employ labor L_t and capital K_t to produce output Y_t. The production function follows the Cobb-Douglas form:

$$Y_t = Z_t (X_t L_t)^{1-\alpha} K_t^{\alpha} \tag{14}$$

where Z_t is the exogenous total factor productivity and follows an AR(1) process. $X_{t+1} = (1 + x)\, X_t$ is the labor-augmenting technical progress. Firms choose optimal inputs to maximize their profit. Note that all the capital stock is held by the firms. The depreciation of capital stock is the only cost of holding capital.

$$\max_{\{L_t, K_{t+1}\}} \mathfrak{R}_t = \sum_{s=0}^{\infty} \left(R_t^f\right)^{-s} \Pi_{t+s}$$

$$\Pi_t = Y_t - W_t L_t - I_t$$

$$I_t = K_{t+1} - (1 - \delta) K_t \tag{15}$$

where I_t and δ are an investment and the depreciation rate, respectively. The firm's optimal problem implies the following wage equation and the interest rate equation.

$$W_t = (1 - \alpha) \frac{Y_t}{L_t} \tag{16}$$

$$R_t^f = \alpha \frac{Y_t}{K_t} + (1 - \delta) \tag{17}$$

A3. Market Clearing and the World Interest Rate

This is a small open economy model. Agents can lend to or borrow from abroad at international interest rates. The market-clearing condition equals the national income identity of an open economy:

$$Y_t = C_t + I_t + TB_t$$

where TB_t is the trade balance. To include net foreign assets in the market clearing condition, we define net foreign assets as the payment received from foreign countries in exchange for domestic goods. The evolution of net foreign assets can be represented as a sum of compound interest and trade balance in the previous period:

$$F_{t+1} = R_t^f F_t + TB_t$$

We rewrite the market clearing condition as:

$$K_{t+1} + F_{t+1} = y_t - C_t + (1-\delta)K_t + R_t^f F_t \tag{18}$$

where F_t is the net foreign asset position. $F < 0$ implies the net holdings of international debt and $F > 0$ the net holdings of international bonds.

We have enough equations to generate the steady-state value by assuming the domestic interest rate equals the international interest rate, which is given exogenously given. However, one more equation is needed to describe the dynamics of net foreign assets when their level deviates from the steady-state. We use the debt-elastic interest rate approach to complete the model. We assume that the international gross interest rate is an increasing function of the economy's detrended international debt:

$$R_t^f = R^* - \varphi\left(\frac{F_t}{X_t N_t} - f\right) \tag{19}$$

where R^f is the constant world interest rate, $\varphi > 0$ is the risk premium parameter, and f is the steady-state value of the detrended net foreign asset position.

A4. General Equilibrium and Steady-state Values

Here, we discuss the steady-state property under alternative demographic structures. The model consists of 20 equations. There are 19 endogenous variables from equations (1)-(19) and one exogenous shock Z_t. All the quantity variables should be detrended because the growth rates of both labor-augmenting technology and the population are deterministic. Y, K, C, F, H, A are detrended by XN, W by X, and L by N. Detrended variables are denoted by lower case letters.

The parameters of the prototype model are described in Table A7.1. The model is solved with quarterly frequency, so all parameters are displayed in quarterly terms. Note that we modify the survival rate and the probability of remaining a worker to generate a realistic length for each life state. We assume that the working age is 15–64 years and that the retirement life expectancy is 10 years. Therefore, ω and γ can equal $1.023^{-0.25}$ and $1.1^{-0.25}$, which generates an old-age dependency ratio of 21.77%. Other parameters are based on Gertler (1999), except for the risk premium, which follows the small open economy model.

Sims' optimization program csolve.m can solve for the steady-state values. Table A7.1 also lists the steady-state values of the prototype model.

tb/y is the ratio of the trade balance to output, which can be shown as:

$$\frac{tb}{y} = \frac{-(R^* - 1 - x - n)f}{y} = \frac{-f}{y/(R^* - 1 - x - n)}.$$

This ratio measures the burden of a foreign debt imposed on the economy. The higher the ratio, the greater the likelihood the debt is unsustainable. *tb/y* can be used to check the foreign debt burden under alternative demographic structures.

Table A7.1: Values of the Parameters and Steady-state Values of the Prototype Model

Parameter	Value	Definition
σ	0.25	Intertemporal elasticity of substitution
φ	0.01	Risk premium parameter associated with debt position
β	$1.04^{-0.25}$	Subjective discount factor
ω	$1.023^{-0.25}$	Probability of remaining a worker
α	1/3	Capital share, while 1-α is labor share
δ	$1.1^{0.25}-1$	Capital depreciation rate
ρ	–3	$(\sigma-1)/\sigma$
ν	0.4	Utility weight on consumption
ϑ	0.6	Labor productivity of retirees
γ	$1.1^{-0.25}$	Probability of remaining a retiree
x	$1.01^{0.25}-1$	Labor-augmenting technology growth rate
n	$1.01^{0.25}-1$	Population growth rate
Γ	0.2177	Old-age dependency ratio $\Gamma = (1-\omega)/(1+n-\gamma)$
R^*	$1.04^{0.25}$	World interest rate
c/y	0.718	Share of consumption in output
k/y	9.813	Share of capital in output
f/y	0.859	Share of the net foreign asset in output
tb/y	–0.004	Share of trade balance in output
λ	0.139	Share of assets held by retirees
Ω	1.012	Weighting term on workers' discount rate
θ	0.017	Marginal propensity to consume out of wealth (workers)
$\varepsilon\theta$	0.032	Marginal propensity to consume out of wealth (retirees)
l^w	0.401	Participation rate of workers
l^r	0.052	Participation rate of retirees

Sources: Tseng (2010), Yeh (2010).

8

Demographic Change and Its Economic Impacts in Sweden

Sang-Chul Park

8.1 Introduction

The last half a century has witnessed swift demographic changes in developed countries followed by increased attention to these changes and their causes and consequences for their economies. Population aging is regarded as a natural consequence of lower mortality and fertility. Having already started in the most developed countries, this process will affect all countries in the world. At the same time, all nations are keen to estimate the impacts of population aging on their economic growth, since that is the most important factor for them in conducting their economic policies. Unfortunately, however, this is still largely unknown.

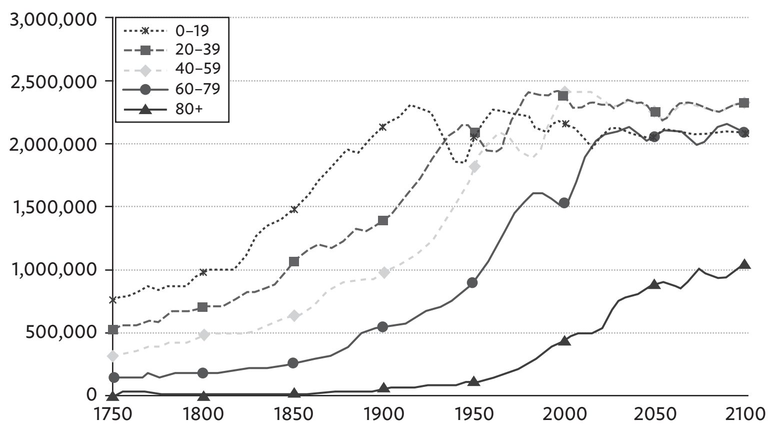
Sweden established a public agency responsible for producing population statistics in 1749. These statistics were created by surveying population records kept by parish priests of the Swedish Lutheran Church. These detailed data of high quality enable us to analyze how mortality and fertility have changed. They also tell us about how Sweden developed from a poor agricultural country in the 18th century to a rich and highly industrialized country in the 20th century (Hofsten and Lundström 1976; de la Croix, Lindh, and Malmberg 2009).

Given how old the statistical data are, it is possible to estimate a demographically based statistical growth process in the long term. The data indicate a simultaneous shift in the most productive age and in life expectancy—the peak productivity shifted from about 30 years old when the country's life expectancy was around 50 years old in the middle of the 18th century to above age 30, as the life expectancy rose. The statistical data thus accounts not only for the recent changes in per capita income, but also for the long-term process of Swedish economic development from the mid-19th century. Such a long-term economic development enables us to forecast population change and income growth over the period 2000–2100 using a demographically based statistical growth model (de la Croix, Lindh, and Malmberg 2009).

There is no doubt that the long-term trend of decline in mortality and fertility has led to a total transformation of the age structure in Sweden. Declining mortality and fertility changed the age structure from a population dominated by children and young adults (0–19 age group), which increased rapidly from 1750 to 1910, to an older population. Other age groups, such as 20–39, 40–59, and 60–79, also increased in the period of 1750–1950, 1750–1970, and 1750–1990, respectively. The age group 80 and over started to increase in the 20th century and is estimated to grow continuously to 2100. As such, each age group experienced or is expected to experience a downturn in the period of 1910–1940, 1945–1960, 1960–1980, 1985–2000, and 2010–2020, respectively (Malmberg and Sommestad 2000; de la Croix, Lindh, and Malmberg 2009) (Figure 8.1).

In Europe, Sweden has frequently been referred to as a forerunner in recent demographic changes, particularly in changes concerning the family. During the 1960s and the 1970s, Sweden led the second demographic transition with declining levels of fertility and marriage formation and increasing levels of divorce. However, Sweden has succeeded in increasing its fertility since the 1980s and gained attention

Figure 8.1: Changing Age Structure in Sweden By Age Group (1750–2100)



Source: Adopted from de la Croix, Lindh, and Malmberg (2009).

for achieving turnarounds in trends related to marriage in recent years. Additionally, the divorce level has also been stabilized. The recent trend of reversals in fertility, marriage, and divorce that started at the turn of the century is linked to a gender regime that is regarded as the second step in the gender revolution aiming at gender equality (Lesthaeghe 2010; Ohlsson-Wijk, Turunen, and Andersson 2017; Andersson and Kohler 2015; Goldscheider, Bernhardt, and Lappegård 2015).

A demographic transition means that a country is moving from a state of high mortality and high fertility to a state of low mortality and low fertility. During the process, the question arises whether the transition will cause economic growth and whether economic growth will in turn affect population change. Therefore, analyzing and understanding the correlation between child mortality, fertility, the peak of productivity age, life expectancy, and economic growth is an important research task (Ranganathan, Swain, and Sumpter 2015).

This chapter focuses on the correlation between the Swedish demographic transition and economic growth from a long-term perspective and analyzes how the demographic change and the country's economic growth have interacted over a long period of time. It will also offer a forecast of the demographic change, economic growth, and population aging for the period until the end of the 21st century. In order to answer these questions, various research methods such as critical analysis of the literature, inference, and quantitative and qualitative analyses based on statistical data and correlations between various factors will be employed.

8.2 Theoretical Debates

The industrial revolution contributed to generating a substantial economic growth in Western Europe and North America, which coincided with the era of demographic transition. The relationship between economic growth and demographic change is clear. Cutler, Deaton, and Lleras-Muney (2006) point out that there is evidence of the impact of economic growth on child mortality. That is, cross-country analysis reveals a strong negative correlation between a country's income per capita and child mortality. Also, Filmer and Pritchett (1999) explain that economic growth enables more capital investment in the health care system, which helps prevent deaths among children. On the other hand, Heckman and Walker (1990) point out that a decline in child mortality also impacts economic growth and show that the return to human capital investment is the highest before the age of five.

Exogenous child mortality decline, generally speaking, leads to a fertility decline because women give birth to fewer children when they know that the probability of their children's survival is high. However, there are various specific factors that affect fertility decisions, such as the mother's health, a sequential fertility choice, gender, and health of the already existing children. Economic growth also directly influences fertility decisions. For example, Barro and Becker point out that raising children can be regarded as an opportunity cost for women. That is, if wages for women increase, they will be motivated to work more and will have less opportunity to spend on childbearing and child-rearing, which results in a lower fertility. This is the so-called Barro–Becker Model, that has been highly influential and adopted by many other scholars (Barro and Becker 1989). Empirically, the model is confirmed by the Swedish fertility data. Based on the data, a conclusion can be drawn which two-thirds of fertility decline can be explained by the decline in child mortality, while the remaining one-third can be accounted for by an increase in women's wages (Barro 1991, Rutstein and Medica 1978; Kalemi-Ozcan 2002, Strulik 2004).

Kögel and Prskawetz, and Tamura developed the quality–quantity trade-off model. It shows that an endogenous shift from an agricultural to a manufacturing economy has implications for the relationship between mortality and fertility. In this model, industrialization processes in all countries coincided with fertility and mortality declines. However, it is extremely difficult to quantify the impact of fertility decisions at the individual level on a country's economic growth (Kögel and Prskawetz 2001, Tamura 2002). Despite that fact, Kalemi-Ozcan was of the opinion that the fertility choice in the conditions of uncertainty of child survival explains the demographic transition in a wide range of countries (Kalemi-Ozcan 2002). Strulik (2004) also found that child quality expenditure can create economic take offs and result in a sustainable economic growth. On the contrary, its absence may cause economic stagnation with high fertility. Furthermore, Galor (2005) explained that the quality–quantity trade-off model can be endogenously triggered by technological progress that leads to an increase of investment in education.

Durlauf, Johnson, and Temple (2005) and Brock, Durlauf, and West (2007) advocated the econometrics approach. They focused on economic growth and regarded demographic transition as a factor that impacts economic growth. In their approach, increased life expectancy with exogenous child mortality decline plays an important role as a covariate in economic growth. However, their approach has a limitation in that ignores nonlinearity and complex interactions that are essential features of the impact of demographic transition on economic growth.

Overall, there are three traditions or schools of thought in the analysis of the interaction between demographic trends and economic growth. One consists of building theoretical models to prove the correlation between demographic transition and economic growth either qualitatively or quantitatively. The other empirically analyzes a study between demographic variables and the growth in per capita income and extrapolates economic growth on the basis of demographic projections. Despite the differences, both approaches agree that a decline in child mortality can have a positive impact on economic growth. This study adopts both of these traditions as an eclectic approach, and distances itself from the econometrics approach (Lagerlof 2003; Boucekkine, de la Croix, and Licandro 2003; Bloom and Williamson 1998; de la Croix, Lindh, and Malmberg 2009; Ranganathan, Swain, and Sumpter 2015).

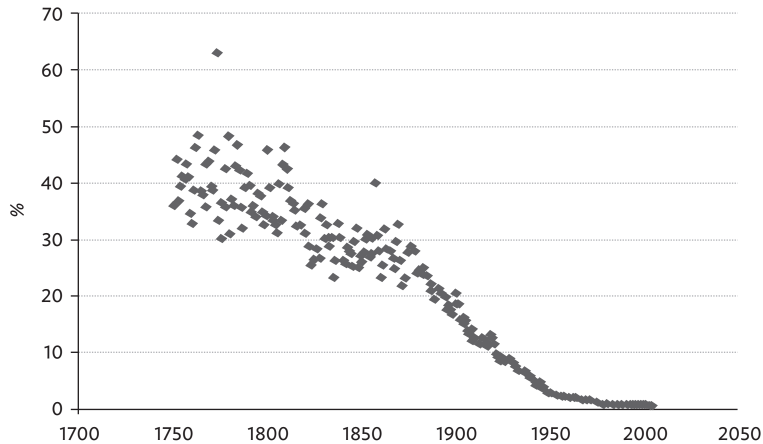
8.3 Demographic Trends and Economic Growth in Sweden

8.3.1 Demographic Trends

Child mortality in Sweden has declined continuously since 1750. Until 1750, the rate was 40% per year, but declined to 25% in 1870, and continued falling to 0.5% in 2000. During the century from 1750 to 1850, it declined substantially, although it was still high compared to the modern period. Sweden's child mortality rate further declined to 20% in 1900. The trend continued in the 20th century, when, between 1900 and 1950, it fell substantially from 20% to about 3%. By 2000, the country's child mortality rate was further reduced to 0.4%, and in 2018 it reached 0.27%, one of the lowest in the world. Such a rapid decline of child mortality caused an acceleration in the population growth, since, as demonstrated by previous studies, the pattern of population growth is closely related to the pattern of the child mortality decline (de la Croix, Lindh, and Malmberg 2009; UNICEF 2020) (Figure 8.2).

Along with the improvements in child mortality, adult survival began to improve substantially. From a long-term point of view, the survival of all age groups, from age zero to over age 80, began to increase uninterruptedly from the year 1850. This continued until the 1920s and 1930s, when the survival rate of the age group 0–19 started to decrease because of a decline in the fertility. Other age groups followed this pattern later. In 1850, the male survival rate from age 10 to age 65 was 40%. It increased to 60% in 1900, about 75% in 1950, and 87% in 2000. Life expectancy at age 65 also increased, from about 10 years in 1850 to almost 19 years in 2000. This means that it took more than a century for the expected remaining years of life for people who have reached age 65 to almost double. The male and female life expectancy in 1751–1790

Figure 8.2: Trends in Sweden's Child Mortality, % (1750–2005)

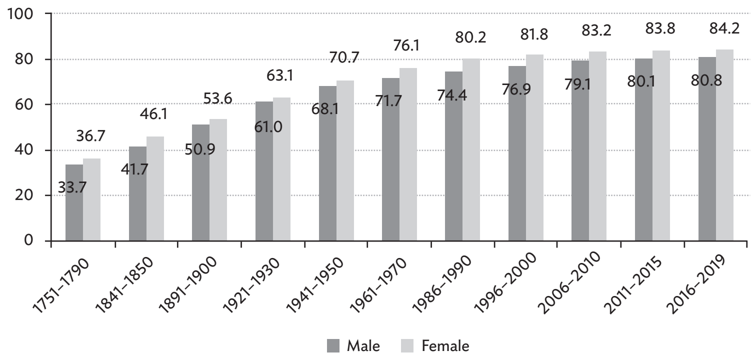


Source: Adopted from de la Croix, Lindh, and Malmberg (2009).

were 33.7 and 36.7 years, respectively, increasing to 80.8 and 84.2 years in 2016–2019, respectively. Furthermore, the fertility rate in 1750 was five children per woman and remained continuously high at 4.5 until 1850. Later, it declined to four in 1900 and dropped extremely low to 1.5 in the 1930s. After the Second World War, it started to increase again, reaching 2.5 in 1950, but then again went on a downward trend, falling to 1.5 in 2000. However, from thereon, Sweden's total fertility rate recovered, increasing again to 1.98 in 2010, and then easing off to 1.9 in 2020. The fertility rate increase after 2000 is attributed to the success of the country's family policy. Looking at the entire period under review, the fertility rate in Sweden was on average higher than the 2.1 replacement rate estimated by the United Nations as necessary to keep a population stable (de la Croix, Lindh, and Malmberg 2009; United Nations 2017; Statista Research Department 2020; SCB 2020) (Figure 8.3).

As a result, the total population of Sweden increased during the whole period. In 1750, the total population was 1.78 million, and the number increased continuously to 3.5 million in 1850, 5.1 million in 1900, and 8.9 million in 2000. It then exceeded 10.1 million in 2017, and is estimated to further increase to 13 million in 2060. Thus, the total population of Sweden increased nearly six times between 1750 and 2019. Since the 1950s, foreign immigrants such as laborers and political

Figure 8.3: Life Expectancy in Sweden (1750–2019)



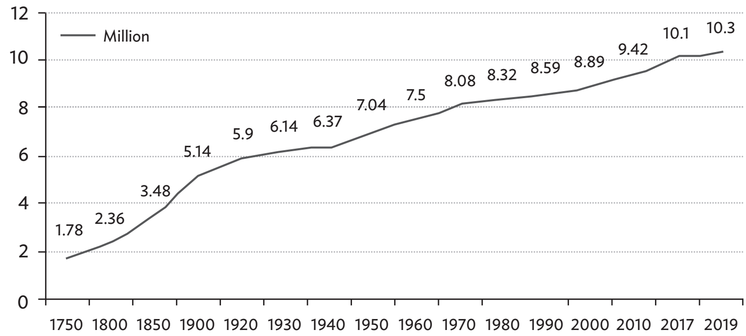
Source: SCB (2020).

dissidents have also contributed to the increase in the total population to a certain extent along with abovementioned factors. The share of the population with a foreign background in Sweden's total population was 20% in 2019 (de la Croix, Lindh, and Malmberg 2009; SCB 2020) (Figure 8.4).

The child mortality rate per thousand births and the total fertility rate have declined coincidently from 1800 to 2020. These were 38.1 deaths and 4.1 births per woman in 1800, but declined to 4 and 1.6 in 2000, respectively. Furthermore, child mortality has since declined continuously to 0.2 deaths in 2020, while fertility has increased slightly to 1.9 in the same year. This shows that the mortality and fertility declines are correlated and that they have influenced the increase in the total population and life expectancy during the entire period under review (www.statistica.com 2020a, 2020b) (Figures 8.4 and 8.5).

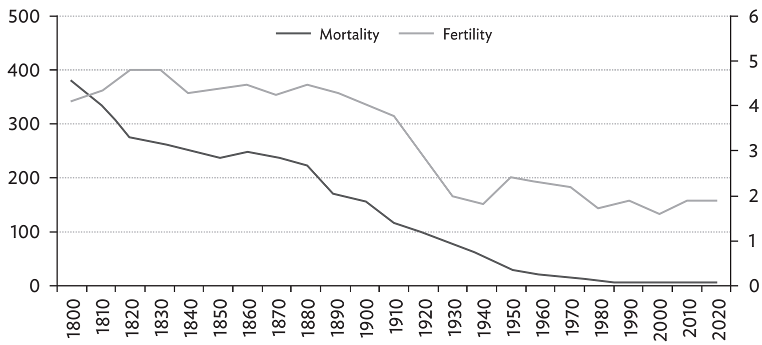
As Figure 8.5 shows, between 1800 and 2020, rapid fertility declines took place between 1880 and 1910, between 1920 and 1940, and between 1960 and 1980. These trends were correlated with various factors, such as a rapid industrialization process, the Second World War, and changes in social norms, among others. During the 1960s and the 1970s, Sweden was at the forefront of the second demographic dividend with declining levels of fertility and marriage formation, and increasing levels of divorce. From the 1970s, childbearing started to be postponed to higher ages due to a change in the life course stages: finishing tertiary education, finding

Figure 8.4: Population Growth in Sweden (1750–2019)



Source: SCB (2020).

Figure 8.5: Child Mortality and Fertility (1800–2020)



Source: www.statistica.com (2020).

jobs, and realizing other personal goals became priorities that caused the fertility decline. At the same time, parenthood came to be regarded as being in conflict with a self-realization in other areas of life because it incurs economic costs, requires time, and selflessness. Despite that, as different from other developed nations, since the 1980s Sweden has not experienced declining fertility. In fact, the country's fertility level and marriage formation have turned around, while the divorce level has stabilized (Ohlsson-Wijk, Turunen, and Andersson 2017; Andersson and Kohler 2015).

8.3.2 Patterns of Economic Growth

With a population of slightly over 10 million, Sweden is regarded as a small country. However, it possesses high quality statistical data. Swedish industrial statistics have been published annually since 1858, while the United Kingdom's Census of Production first appeared in 1907 and is published every second year. Furthermore, Sweden's annual official agricultural statistics started in 1802, which is even earlier than the year in which the publishing of industrial statistics began. It is true that Sweden's historical national accounts provide one of the most detailed statistics in the world. Having such valid data, it is academically valuable to investigate and analyze the pattern of Sweden's economic growth (Edvinsson, Jacobsson, and Waldenstrom 2013).

It is generally accepted that the central economic variable in national accounting is the gross domestic product (GDP), which is regarded as a significant monetary variable and a part of the quantity equation. In general, the GDP can be calculated in three different ways, by focusing on production, expenditure, or income. However, it is not easy to extrapolate Sweden's GDP for the period between 1750 and 1899, although some scholars have tried to do so, by applying classification and methods from the period preceding the system of national accounts and by utilizing the post-1950 data from Statistics Sweden for forward or backward extrapolation of the pre-1950 series (Krantz and Schon 2012, Bounfour and Edvinsson 2005, Edvinsson 2011, Heikkinen and Nummela 2015).

According to these historical estimates of per capita GDP, Sweden experienced a stagnation in per capita income up to the 1820s, although it rose slightly after the Napoleonic Wars. After that, a clear trend of increase is observable until the 1850s, which exceeds the average growth rate of per capita income by over 1%. However, the economic crisis that took place in and around the 1870s caused substantial emigration, with around 10% of the total population fleeing to the United States. That, however, provided the strength for generating a high income growth rate of over 2% in the early 20th century. At the same time, the production side, such as investments and foreign trade, also increased continuously and coincidently (Krantz and Schön 2007; de la Croix, Lindh, and Malmberg 2009; Heikkinen and Nummela 2015).

From the 1870s to the beginning of the First World War in 1914, the national income rose at an average of 2.8% per year, which helped the country's GDP to more than double. During that period, the industrial growth was higher than the national income growth. The average annual growth of industrial production, gross investment, and foreign trade amounted to 4.4%, 5.0%, and 3.2%, respectively. Particularly, investments in machinery increased from SKr10 million in 1870 to SKr90 million in 1914, which formed the cornerstone for Sweden's transition from an agrarian to an industrialized country at the beginning of 20th century. As a result, industry came to play a more important role in the national income than agriculture at the time of the outbreak of the First World War. In 1914, more than 30% of the population was dependent on industry, while agriculture employed about 50% of the population, as compared to over 80% in 1850 (Jörberg 2012) (Table 8.1).

Table 8.1: Swedish Economic Growth (1870–1914)

Factors	Annual Growth Rate (%)	Absolute Figures (in millions)	
		1870	1914
National Income	2.8	800	3,300
Industrial Production	4.4	320	2,200
Gross Investments	5.0	50	450
Investments in Machinery	4.0	10	90
Exports	3.1	140	790
Imports	3.2	150	800

Source: Adopted from Jörberg (2012).

After the First World War, the economic growth further increased and remained high up to 1975—a period which is regarded as the golden age of Sweden's economy. The country's economic development since 1800 can be divided into seven periods with different growth trends and forces at work. These are: the period of emergence (1800–1840), the transformation period (1840–1870), the industrialization period (1870–1910), the high economic growth period (1910–1950), the mature period (1950–1975), the downturn period (1975–2000), and the sustainable development period (2000–2019). Among these periods, the high economic growth period, the mature period, and the sustainable development period are characterized by high economic growth of 2.2%, 3.6%, and 3.4%, respectively. It is interesting to note that the mature period and the sustainable development period enjoyed higher economic growth than other periods (Krantz and Schön 2007, World Bank 2020, SCB 2020, https://www.theglobaleconomy.com/Sweden/capital_investment/) (Table 8.2).

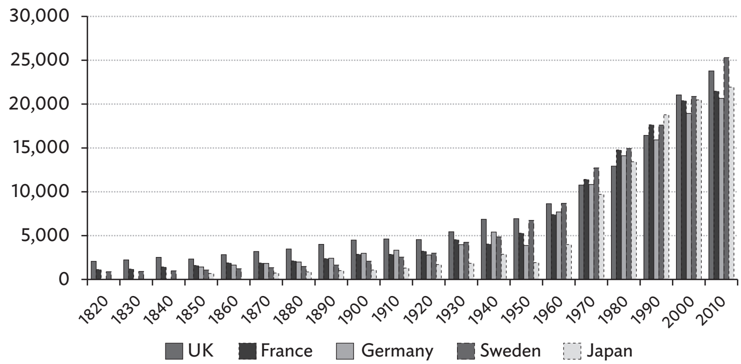
Table 8.2: Annual Growth Rates in per Capita Production, Total Investments, and Trade (1800–2019)

Period	Per Capita Production	Total Investments	Trade
1800–1840	0.6	0.3	0.7
1840–1870	1.2	3.0	4.6
1870–1910	1.7	3.0	3.3
1910–1950	2.2	4.2	2.0
1950–1975	3.6	5.5	6.5
1975–2000	1.4	2.1	4.3
2000–2019	3.4	1.2	4.2

Sources: Krantz and Schön (2007), World Bank (2020), SCB (2020), www.theglobaleconomy.com (accessed 6 August 2020).

Apart from short periods, such as the two world wars and oil crises, the average growth of per capita income has remained at those levels. During the stagnation period in the 1820s, the per capita income was around $1,000 in 1996 dollars—that increased to as much as $25,000 in 2000. Another estimation by the Organisation for Economic Co-operation and Development (OECD), put Sweden's per capita income in 1820 at $888 in 1990 dollars—and at $25,306 in 2010. In 1820, the Swedish income per capita was one of the lowest in Western Europe, but became the highest in 1960. Sweden kept that position until 2010. This means that its income per capita increased to between 25 to 28 times its subsistence level from 1820 to 2010. Expressed in current US dollars, Sweden's per capita income reached the highest level of $61,690 in 2014, but declined to $55,840 in 2019 due to the currency devaluation and an increase in its population and number of immigrants. Most of the immigrants that have entered the country since 2015 are political dissidents from the Middle East, North Africa, and Central Asia. During the nearly 200 years under review, the Swedish per capita income increased rapidly, and from the 1950s the country managed to catch up with most Western European countries. Japan's per capita income in the 1990s was higher than Sweden's, but Sweden overtook Japan in that category in the 2000s (de la Croix, Lindh, and Malmberg 2009; Bolt, Timmer, and van Zanden 2014; OECD 2016; World Bank 2020) (Figure 8.6).

Figure 8.6: Per Capita GDP in Selected Countries, 1820–2010 (in 1990 $)



GDP = gross domestic product, UK = United Kingdom.

Source: Adopted from Bolt, Timmer, and van Zanden (2014).

8.4 Analysis of Demographic Changes and Economic Growth

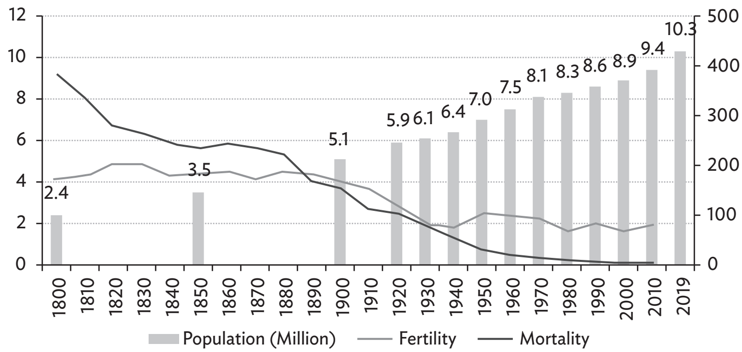
8.4.1 Correlation between Mortality, Fertility, Life Expectancy, and Population

As discussed above, Sweden's mortality rate was very high in the 19th century, amounting to 38.1%. However, it has declined continuously to 0.2% in 2020. The country's fertility has declined from 4.1 to 1.9 during the same period. The Swedish population has also increased from 2.36 million in 1800 to 10.3 million in 2019. Furthermore, the average life expectancy increased from 35.2 years to 82.5 years during the same period.

Among the four factors (mortality, fertility, population, and average life expectancy), mortality and fertility exhibit the same pattern of decline during the period under review, and are closely correlated as shown in Figure 8.5, except for the period since 1950. During the 1940s and 1950s, mortality declined continuously, while fertility increased after the Second World War that caused the baby boom phenomenon. A similar pattern took place since the 1980s. During that period mortality declined continuously, but fertility either increased slightly or stabilized, owing to changes in values and social norms, gender equality, etc. Sweden's trend is unique among developed economies, since most of the economically developed countries have experienced difficulties in increasing fertility since the 1980s, despite the fact that their governments have implemented various policies to boost fertility (Lesthaeghe 2010).

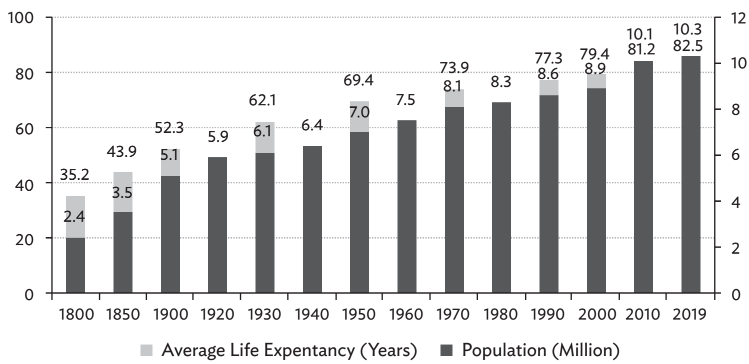
It is certain that mortality and fertility have had an impact on the growth of the total population and the increase of average life expectancy. First, mortality and fertility have been on the downward trend, while the population size and average life expectancy show an upswing pattern. Therefore, the correlation between mortality and fertility is positive, while the correlation between mortality and population, as well as between fertility and population are negative. As explained, low mortality and fertility have contributed to increasing average life expectancy in all age groups since 1800. Therefore, their correlation also looks negative. However, the correlation between population and average life expectancy is positive because they both exhibit the same pattern of growth continuously since 1800. This means that an increasing average life expectancy can play a significant role in increasing the total population despite the fertility decline that lasted until the 1980s (and later rebounded). Overall, the total number of new births has been higher than the total number of deaths, which has generated a natural increase of population since 1800 (Figures 8.7 and 8.8).

Figure 8.7: Correlated Trend between Mortality, Fertility, and Population (1800–2019)



Sources: SCB (2020), www.statistica.com (2020).

Figure 8.8: Correlated Trend between Population and Average Life Expectancy (1800–2019)



Source: SCB (2020).

8.4.2 Correlation between Economic Growth, Total Factor Productivity, and Population

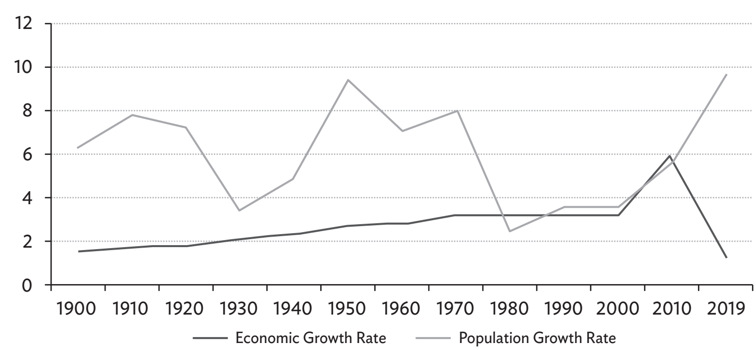
As mentioned above, there are three different ways to measure GDP: by production, expenditure, and income. Although Swedish statistical data have been highly qualified, the old data for the period from 1750 to 1899 are extrapolated by applying classifications and methods from the period before the system of national accounts. Therefore, there is a large gap in the per capita income for year 1800 calculated by several different scholars: the results vary from $888 to $1,500 in 1996 dollars. Because of such a high gap in the calculated value of the per capita income in 1800, the author believes that it is important to use the official statistical data on GDP from 1900 that has been calculated by Statistics Sweden (SCB) and the Swedish Central Bank (the Riksbank) in order to analyze the correlation between economic growth and population (de la Croix, Lindh, and Malmberg 2009; Bolt et al. 2014).

Sweden's GDP has been increasing sharply since 1900, except in 1917–1918, 1921, 1931–1932, 1940–1941, during the 1990s crisis, the global financial crisis (in 2008), and the COVID-19 pandemic in 2020. These economic downturns mostly coincide with the First World War, the Great Economic Depression, and the Second World War. Sweden also faced severe economic difficulties caused by the currency crisis in the early 1990s—the worst crisis since the Great Depression in 1929–1930. In the 21st century, the 2008 global financial crisis impacted Sweden's economy strongly and the current COVID-19 pandemic may generate negative economic growth again in 2020 (Rojas 2005, Park 2020, IMF 2020).

Overall, the Swedish economy has continuously expanded, with relatively high economic growth from the 1950s to the 2010s, and has shown an upswing pattern during the entire period under review, except for the abovementioned specific periods of domestic and international economic crises. However, it is not easy to find a close correlation between economic growth and population from 1900 to 2019, except for the periods between 1950 and 1970 and between 1990 and 2010. The high population growth and the high economic growth during the period 1950–1970 are closely correlated and their trends are well matched. However, a relatively high economic growth was generated during the 1930s, while the population growth rate declined to a considerable extent at that time. Therefore, the two factors are not well matched during this period. Moreover, they exhibit a pronounced negative relationship in the period from 2010 to 2019, since in that period the population grows while the economic growth rate declines (Swedish Central Bank 2020, SCB 2020).

Furthermore, Sweden's high economic growth continued to the 1980s, while population growth became lower than in the 1970s. Also, economic growth slowed down parallel with population growth in the 2010s. This means that other factors, such as education and technological development, can also affect economic growth and more strongly than population, as several traditional economists, such as Solow and Romer, have pointed out. Thus, overall, population growth may contribute to generating economic growth, but only during certain periods and not always. Therefore, it is wise to conclude that the relationship between economic growth and population varies from period to period. Accordingly, while it is true that the first and second demographic dividend exists in the Swedish context too, it also true that it does not last long term (Solow 1956, Romer 1990, Jones 2019, Swedish Central Bank 2020, SCB 2020) (Figure 8.9).

Figure 8.9: Correlation between Economic Growth and Population (%)

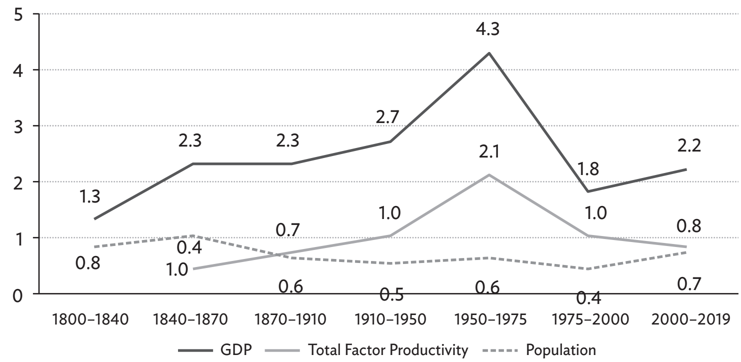


Sources: Swedish Central Bank (2020), SCB (2020).

In that sense, it is important to understand what determines long-term economic growth and improvement in living standards. According to Romer's theory, long-term economic growth is determined endogenously, and the equilibrium growth rate might be lower than the optimal rate due to externalities. He highlighted that production is characterized by increasing returns to scale. In order to maximize production, entrepreneurial researchers hunt for new ideas because of financial rewards that can be earned by innovating. Therefore, investment in education and research and development (R&D) are crucial to motivate the young generation to create technological innovation that ultimately leads to the long run economic growth. This means that rapid growth in total factor productivity (TFP) based on education, R&D, and technological innovation is vital for further economic growth because it is not merely dependent on the inputs of capital and labor once a national economy enters into the mature phase (Romer 1990, Stiglitz 2001, Park 2016, Jones 2019).

The correlation between economic growth and TFP can also be applied to the Swedish context. The economic growth rates from 1840 to 2019 are more closely correlated to those of TFP than population growth rates, except in the period of 2000 to 2019. As a result, the correlation between GDP growth and TFP in Sweden is positive in most of the periods, while the correlation between GDP growth and population varies from period to period. This means that TFP is more important for a nation to generate a sustainable economic growth in the long term than population growth that is mostly valid for Swedish case (World Bank 2020, SCB 2020, FRED Economic Research 2020) (Figure 8.10).

Figure 8.10: Correlation between Growth Rates of Economic Growth, Total Factor Productivity, and Population, 1800–2019 (%)



GDP = gross domestic product.

Note: The statistics for total factor productivity are available for the period from 1840 onward.

Sources: Krantz and Schön (2007), World Bank (2020), SCB (2020), FRED Economic Research (2020).

8.5 Policy Implications for Asian Economies

Sweden has managed its economic and population growth properly for more than the last 200 hundred years. Although Sweden was a latecomer of the First Industrial Revolution in Europe, it completed its industrialization process rapidly in the early part of the 20th century and surpassed most of the Western European countries in terms of the per capita income in the 1950s, becoming one of the highest income nations in the world alongside the United States and Switzerland in the 1970s. At the same time, since the end of the Second World War, Sweden has built a unique universal welfare system based on the social democratic philosophy of the welfare state. It is known as the "Swedish Model," and provides citizens with social security and social services from the cradle to the grave. There is no doubt that the Swedish welfare system has, to a large extent, contributed to generating the country's sustainable economic growth by investing in public sector education, R&D, health care, care for the elderly and children, among others.

In Sweden, together with a rapid industrialization process, child mortality and fertility have been continuously declining, resulting in the increase of population and average life expectancy in the last 200 years. It is also valuable to point out that the immigrants since the 1950s have contributed to maintaining a reasonable fertility rate, although the Swedish immigration policy has been limited since the 1950s and allowed mostly political dissidents from the Middle East recently compared to other Western European countries. These factors have influenced the country's economic growth in the period under review as a whole, as well as in some particular intervals during the period. Swedish demographic changes as the first demographic dividend and their economic impacts provide valuable policy hints both for developed and developing Asian economies.

Firstly, all developed Asian economies, such as Japan, the Republic of Korea, Singapore, and Taipei,China, have been experiencing low mortality and fertility that cause an aging society, population decline, and sluggish economic growth at least since the 2000s. Sweden also experienced these phenomena in the 1970s, and the government tried to overcome such negative trends. The Swedish universal welfare system, which particularly focused on the family policy, contributed to increasing the country's fertility in the 1980s. Since then, the country's fertility has stabilized with the average birth rate of 1.9 in 2019, which is one of the highest among OECD member nations and mitigates the difficulties accompanying the aging society. At the same time, child mortality declined continuously to 0.2 in 2020. As a result, the total population increased continuously to 10.3 million in 2019. Certainly a large number of immigrants mostly as political dissidents were accepted in the 2010s that contributed to increasing the total number of population in recent period to a certain extent. Simultaneously, the average economic growth from 2001 to 2019 stood at 2.2% despite the global financial crisis in 2008—that is the highest economic growth among developed countries, including Japan.

Moreover, the social policy that has focused on gender equality since the 1970s has empowered Swedish women to develop professional careers, which contributed to supplying the female labor force properly to the labor market and generating further economic growth even after the country entered the period of a mature economy. The education policy providing easy access to life-long education to all citizens has enabled Sweden to increase the quality of its labor force, which has contributed to the strengthening of the competitiveness of Swedish companies in the global market. It has led to a sustainable economic growth that can overcome various economic crises such as the global financial crisis or the economic recession in the COVID-19 pandemic era.

Overall, Sweden has dealt appropriately with the important demographic factors: mortality, fertility, population, life expectancy, and an aging society, and has managed to generate continuous economic growth, while many developed nations, particularly those in Asia, are facing serious difficulties such as declining population, rapid aging, and sluggish economic growth, mainly due to low fertility, high life expectancy and weak consumption power. Therefore, the Swedish approach to maintaining stable fertility, increasing population, and generating decent economic growth implies policy lessons for developed Asian nations regarding how to tackle their own problems properly.

Second, most Asian developing economies have experienced a rapidly increasing population and economic growth. However, no one can guarantee that this path can be continued in the future. On the one hand, increasing population is regarded as positive for their economic growth because their labor markets can count on an abundant supply of cheap labor. On the other hand, however, the low quality of the labor force cannot contribute to generating high economic growth continuously because such laborers cannot produce high-value added products, while their wages increase continuously. Therefore, it is important that Asian developing countries adopt Swedish lessons and focus on increasing their TFP based on education, R&D investment, technological innovation, etc. In fact, all developed Asian nations have been able to achieve further economic development by increasing their TFP. In addition, Asian developing countries need to improve their basic social security systems to provide their citizens with a better environment and opportunities for proper education. By doing that, they would enable all their citizens to have a better access to higher vocational education and the labor market, and thus contribute to further economic growth in their countries.

Lastly, some Asian developing countries, such as the People's Republic of China and Mongolia will be facing an aging society right before they become developed economies. They must be well prepared in order to avoid the negative economic impacts of an aging society that all the developed Asian economies are experiencing at present. They therefore should explore how Sweden has managed to maintain stable fertility rates, while also creating sustainable economic growth in the conditions of an aging society.

8.6 Conclusion

With slightly over 10 million inhabitants in 2020, Sweden is regarded as a small country, although its population increased fourfold from 2.4 million in 1800 to 10.3 million in 2019. Sweden was one of the poorest countries in Europe in the 19th century, but toward the end of the 20th century its income per capita increased from $888 to $1,500 (in 1996 dollars) in 1800, to over $25,000 (in 1996 dollars) in 2000. Sweden has been one of the nations with the highest income per capita in Europe since the 1960s. Its income per capita has varied from about $55,000 to $62,000 in the 2010s, which was one of the highest incomes per capita in the world. Along with the per capita income, its GDP has also expanded continuously, reaching $531 billion in 2019.

Population growth is mainly based on declining mortality and fertility, as well as increasing average life expectancy. Sweden's child mortality rate per 1,000 live births has declined from nearly 40 in 1800 to 0.2 in 2020, while the fertility rate has declined from 4.1 to 1.9 per woman during the same time period. The decline in mortality was mostly caused by increasing productivity in agriculture, which enabled a better environment for nurturing children and helped increase their survival rate. The declining child mortality and women's education have had a direct impact on lowering fertility because women realized that the child survival rate had improved. At the same time, industrialization played an important role in providing Swedish women with the opportunity to work and participate in the labor market. Moreover, the declining child mortality and fertility rates have led to an increase in average life expectancy. It is clear that these three factors are closely correlated to the increase in the total population of Sweden (Boucekkine et al. 2003).

However, the correlation between economic growth and population is not clear cut. Certainly, population growth is a positive factor for a national economy because the domestic market expands and labor becomes readily available. This phenomenon in which the proportion of effective workers is larger than the proportion of effective consumers is known as the first demographic dividend. However, on the other hand, an increase in population may not lead to a higher economic growth if productivity is not increased to the proper level. Education and technological development can contribute to increasing productivity, which further results in economic growth. This is the so-called impact of TFP. In the case of Sweden, a high population growth rate does not always match with a high economic growth, but the TFP is highly correlated with the economic growth in most of the periods under review. This means that a growing population is a significant factor in terms of generating economic growth based on expanding the domestic market and providing proper labor supply. At the same time, however, improving education and investing in technological development for increasing productivity may be more important than a population increase because they contribute to generating sustainable economic growth.

Lastly, it is also noteworthy that the problem of declining fertility can be improved by various policies such as those concerning family, labor, economic, and social issues. Rapidly declining fertility may harm economic growth because a declining population and an aging society can negatively affect the purchasing power in the domestic market as well as social costs in the welfare system. Therefore, it may be wise to keep the fertility rate at the proper level continuously, while the mortality rate declines and average life expectancy increases, in order to maintain sustainable economic growth. These are the major policy implications for Asian economies on how to deal with their future properly.

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9

Labor Supply of Older Workers in Thailand: The Role of Co-Residence, Health, and Pensions[1]

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9.1 Introduction

During the last few decades, the composition of the Thai population has changed dramatically with reduced fertility and aging of the population. In 1964, the average number of children per woman was 6.3, decreasing to 1.6 in 2014 (Institute of Population and Social Research 2014). At 1.45 in 2020, Thailand ranks 183rd out of 199 countries worldwide in its fertility rate, lower than neighboring countries including the Philippines (2.88), Malaysia (2.01), and Brunei Darussalam (1.85) (World Population Review 2020). In contrast, Thai life expectancy continues to increase, from 59 in 1964 to 75 in 2015. The proportion of elderly persons (over 60 years old) has increased from 5.5% in 1980 to 12.9% in 2010 and is estimated to reach 32% in 2040 (National Economic and Social Development 2013). Among the Association of Southeast Asian Nations (ASEAN) countries, Thailand ranks second in the percentage of elderly people, after first-placed Singapore (United Nations Department of Economic and Social Affairs 2015).

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The global labor market is transforming and faces challenges due to demographic changes (ILO 2019). Recent studies have suggested that population aging has an impact on the composition of the workforce and labor force participation (LFP), i.e., that shifts in the population age structure will lead to a new direction of the future labor force (Kühn, Milasi, and Yoon 2018; Abeliansky et al. 2020). For several decades, there has been widespread attention to aging populations in developed countries, but population aging has recently started occurring in developing countries too, where it is often more severe (Kaushal 2014). The aging of the population is accompanied by a higher probability that older people stay in the labor force, which suggests that they tend to contribute more to the labor market (Schmidt and Sevak 2008). Therefore, understanding the labor supply of older people has become increasingly important for policy makers and future development.

Thailand's aging society faces many challenges. Developing countries usually have different retirement systems for elderly persons from developed countries (Giles, Wang, and Cai 2011). Pension systems in developing countries, including Thailand, usually can be categorized as formal, in which employees in the formal sector have a mandatory retirement age and receive a pension after retirement, and pension systems in informal sectors, in which employees depend on family support and usually keep working after retirement age. The majority of older workers in Thailand are in the informal sector.

According to the World Bank (2012), elderly persons are the poorest age group in Thai society. In 2010, Thailand's overall poverty rate was 7.7%, while it was 10.9% for elderly persons. Moreover, most elderly poverty occurs in the informal sector. The monthly subsistence level in Thailand ranges from B5,000 to B6,000 per person (Tankulrat 2015, Hempornwisan and Akarachanon 2014). In 2007, over 80% of the elderly population had an income of approximately B6,000 or lower, and 42% reported that their income was insufficient or barely sufficient at the time (National Statistical Office 2007). Financial support from their children is the most important source of income for elderly Thai persons, while a small proportion comes from pensions and allowances (UN DESA 2013).

In Thailand, approximately two-thirds of older people reside with or live near their children, and the co-residence rate is higher in urban areas than in rural areas (Survey of Older Persons in Thailand, SOPT 2014). However, co-residence has declined from 77% in 1986 to 55% in 2014, but that is not the case with monetary and nonmonetary filial support, which suggests that the trend toward smaller families correlates with the probability of receiving financial support from adult children (Knodel and Teerawichitchainan 2017).

Studies on the labor supply of older people in developed countries have focused on different factors because of different economic conditions and social security systems, while studies of developing countries have generally used cross-sectional data and have mainly focused on descriptive analysis or have suffered from data limitations in estimation. Although the concern with the aging population has also been addressed by many studies in Thailand, empirical evidence is still lacking.

In this study, we use both Labor Force Survey (LFS) and Socio-Economic Survey (SES) panel data to study the determinants of the labor supply of older people. LFS data from 1985 to 2017 provide an overview of the basic changes related to the LFP of older people, while SES panel data from 2005 to 2012 enable us to estimate the determinants of LFP, allowing us to better control for the factors that may be associated with older people's preference for work, which includes their own and their spouse's pension, self-reported health status, co-residence, and income sources from other people or the government.

We find strong evidence that pensions and poorer health status reduce the LFP of older people in Thailand. The majority of older workers are located in the informal sector, with less education and lower accessibility to social security. While health status is significant across all analyses, pensions have less impact on lower-status workers, indicating that even if they receive a pension, they may still be too poor to retire. Moreover, we find that co-residence decreases the LFP of older persons only in the case of those in rural areas, those at an older age, and those with primary education who usually suffer from poverty and require more assistance from others than their counterparts.

The remainder of this chapter is organized as follows. Section 9.2 provides the background of the study. Section 9.3 presents a literature review, and Section 9.4 describes the data. Section 9.5 provides an overview of older workers in Thailand, and Section 9.6 analyzes the determinants of older people's LFP. Section 9.7 concludes the chapter with policy recommendations for Thai policy makers.

9.2 Background

The current Thai pension system is based on the three-pillar old-age income security system recommended by the World Bank (1994). The first pillar is a universal program that has the main objective of protecting general households against poverty, the second pillar is occupational pension programs, while the third consists of voluntary programs. The pension system comprises the old-age allowance, a pay-as-you-go scheme, and a government pension system. The target population can be separated into three categories covered by the three-pillar system: government officers, workers in the formal sector, and workers in the informal sector. Table 9.1 presents the pension programs under the three-pillar system.

Table 9.1: Thai Pension Programs under the Three-pillar System

	Program	Target Population	Type	Program Sponsor
Pillar I	Old-age allowance	Formal and informal workers	Universal	Individual
Pillar II	Old civil service pension	Government officers	Mandatory	Government
	Government pension	Government officers	Mandatory	Government
	Social Security Fund (Article 33, 39)	Formal workers	Mandatory	Employer
	Social Security Fund (Article 40)	Informal workers	Voluntary	Individual
Pillar III	Retirement Mutual Fund	All workers	Voluntary	Individual
	National Savings Fund	Formal and Informal workers	Voluntary	Individual
	Provident Fund	Formal workers	Mandatory if listed	Employer

Sources: World Bank (1994, 2012).

Funding structure and pensionable age differ under each pension scheme. Introduced in 1992, the old-age allowance was expanded in 2009 and has been paid to the entire Thai population over the age of 60 (approximately $20 to $30 per month), except for government employees. Its aim is to assist poor older people, especially those working in the informal sector. The government pension fund was introduced in 1997, covering government officials with at least 25 years of service, and is payable at age 60. The pension coverage for the private sector workforce under the social security system was established in 1999, which required at least 15 years of contributions and set 55 as the payable age. The pensionable age of the provident fund is 55, but members can take a lump-sum payment before age 55 without any tax privileges. The

National Savings Fund was introduced in 2011 to assist informal and unemployed workers, with a pensionable age of 60. The retirement mutual fund that provides tax incentives for saving is pensionable at the age of 55 (Ratanabanchuen 2019).

According to the Survey of Older Persons (SOPT) undertaken in 2014, although the Thai government has expanded the pension system, it still makes up a minor portion (below 8%) of older people's income. About 97% of older people have more than one source of income, with support from their children accounting for the largest share, but one that has decreased over time. The second-largest share of income is employment income, with an increasing trend from 1994 to 2014. In addition, income from interest, savings, or rent also shows a growing trend. The old-age allowance accounted for only 3% of the income of elderly persons in 2007 and has increased to nearly 15% in 2014. Asked about their reasons for working, over 50% of older Thai people mentioned the need for an income, while the second-largest proportion (around 30%) of older people mentioned their desire to maintain good health. As for reasons for not working, the majority of older people suggest that they are too old, and the second-most commonly given reason is the need to take care of home and family (NSO 2003).

Informal workers account for more than half the Thai labor force, but they have much more limited access to social security than the other two groups (Fujioka and Thangphet 2009; ILO 2020). The government has put much effort into revising the pension system to cover more informal workers in recent years, including the recently introduced universal pension allowance and two voluntary programs[2] for informal workers. Currently, the old-age allowance, the Social Security Fund, the Retirement Mutual Fund, and the National Savings Fund cover informal workers (Table 9.1). The primary program that helps poor older people is the old-age allowance. It appears to have a significant impact on the reduction of poverty among the elderly. However, given its universality, most of the advantages are absorbed by those who are not poor, which casts doubt on its efficiency in helping older people.

9.3 Literature Review

Population aging and decreased fertility highlight the significance of understanding the determinants of the labor supply of older people. Studies in developed countries have provided several explanations for

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[2] The new voluntary programs include the National Savings Fund and the Social Security Fund (Article 40), which were introduced in 2011.

the labor supply of older people, including their financial status, health status, wages, social security income and pensions, and related tax rates (e.g., Gruber and Wise 1999, Kostol and Mogstad 2014, Blau and Gilleskie 2006). In the United States (US), Haider and Loughran (2001) suggested that the labor supply of older workers consisted mainly of the most educated, richest, and healthiest individuals, who treated their work as leisure. Similarly, Maestas (2010) found that 24% of retirees return to the labor market and that these returners have higher pre-retirement incomes and education. Schmidt and Sevak (2008) found a positive relationship between wages and marginal tax rates with the LFP of older Americans. Researchers have demonstrated that pension reform has a significantly positive impact on senior employment (Engels, Geyer, and Haan, 2017 for Germany, Manoli and Weber 2016 for Austria). Many studies also focus on the role of financial wealth on the labor supply of older people, including the effects of inheritances, lottery wins, and stock markets (e.g., Imbens, Rubin, and Saerdote 2001; Brown, Coile, and Weisbenner 2010; Coronado and Perozek 2003). Meanwhile, studies have provided strong evidence of the effect of social security, medical care, and health factors on the labor market behavior of older people (e.g., Krueger and Pischke 1992; Blau and Gilleskie 2001; Bound, Stinebrickner, and Waidmann 2010; Vere 2011; French and Jones 2011).

In developing countries, because of differences in pension systems and cultural norms, the explanations are quite different. One of the main factors that affects the labor market participation of older people in developing countries is poverty. Barrientos, Gorman, and Heslop (2003) found a high level of old-age poverty in developing countries, including Thailand, due to the lack of accessibility to markets, public services (including healthcare and education), and social networks. Households, as the key to older people's support in developing countries, play an especially important role in low-income and rural areas. Giles, Wang, and Cai (2011) have suggested that, unlike developed countries, given the lack of pension support and the absence of mandatory retirement age, workers in the informal sector in developing countries expect to work until late in their lives. In Latin America, the working hours of people over age 65 are similar to those aged 50 to 59, but older people receive much less payment (del Popolo 2001). Kaushal (2014) found that pensions have a relatively small negative effect on the employment of older people in India, in contrast to rich and middle-income countries that documented a large negative effect. Besides, most older people in developed countries do not live with their adult children, but co-residence is a traditional norm in developing countries. Caregiving in the intergenerational family can go both ways. On the one hand, an adult child provides care for their parents. On the other hand, parents help with the housework and caring for the grandchildren. Connelly, Maurer-Fazio, and Zhang (2014) used the People's Republic of China's (PRC) population census to study the determinants of labor participation of older people and found that co-residence reduces labor participation of older PRC citizens in rural but not in urban areas. However, because of data limitations, they do not control for health status and pensions.

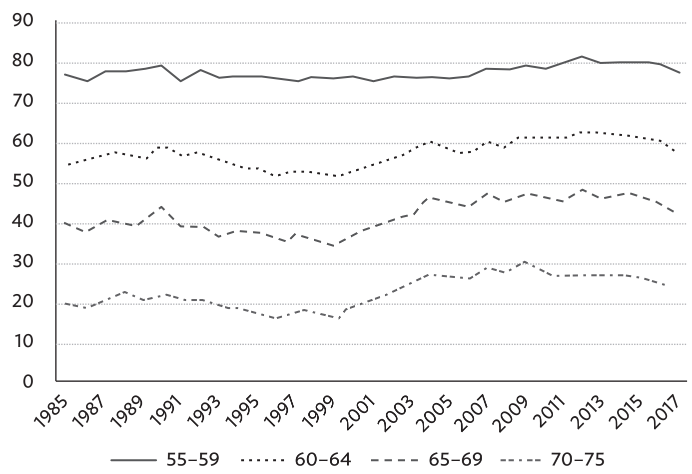
Many studies in Thailand have addressed the concerns regarding the aging population, but empirical analysis of their labor supply is lacking, and the studies are limited by their cross-sectional design. Fujioka and Thangphet (2009) provided a descriptive analysis of the elderly population in Thailand and highlighted the significance of this group in the labor market. In addition, it has been suggested that the recent increase in older people's labor participation in Thailand may be due to their improved health (Fujiaka and Thangphet 2009). In 2002, the universal health coverage scheme was implemented, which covered those in the informal sector who had not benefited from the public health scheme previously. Using the 2007 Survey of Older Persons in Thailand and the logit model, Adhikari, Soonthorndhada, and Haseen (2011) analyzed the factors determining the LFP of elderly Thai individuals, which suggested that women living with children and those with poor health are more likely to withdraw from the labor force. Keeratipongpaiboon (2012) estimated the determinants of older people's employment decisions using a standard probit model that considers household types, health, and pensions in Thailand. However, with the limitation of the cross-sectional data, their results suffer from an estimation bias.

More recently, Paweenawat and Vechbanyongratana (2015) studied the impact of older people's allowances on their labor participation using the standard probit model and suggested that social pensions have a negative impact on LFP in Thailand, and the impact is higher for low-income households. Sadangharn (2017) investigated elderly employment in the Thai automotive industry through interviews, which drew attention to the recruitment method, health, pensions, and working conditions for older workers. A recent study by Wattanasaovaluk (2020) found that the incidence of experienced older workers returning to the workforce increased with their skill level. However, to the best of our knowledge, no one has provided a detailed overview of the employment of older people and estimated the determinants of LFP among older people, considering the effect of co-residence, health, and pensions by exploring panel data in Thailand.

9.4 Overview of Older Workers in Thailand

Using the Labor Force Survey (LFS) from 1985 to 2017, we provide an overview of the employment of older people in the Thai labor market, including LFP, wages, working hours, and work status. Figure 9.1 shows the labor force participation rate for older people by four age groups. Nearly 80% of the sample aged 55 to 59 in the LFS is in the labor force. After the official retirement age of 60 is reached in the public sector, over 57% of those between ages 60 and 64, over 40% of those aged 65 to 69, and over 20% of those 70 to 75 years of age remain in the labor force. After the 1997 Asian financial crisis, the labor force participation rate increased by around 6% for each of the age groups over 60.

Figure 9.1: Labor Force Participation Rate of Older Thai People (%)



Source: Prepared by the authors.

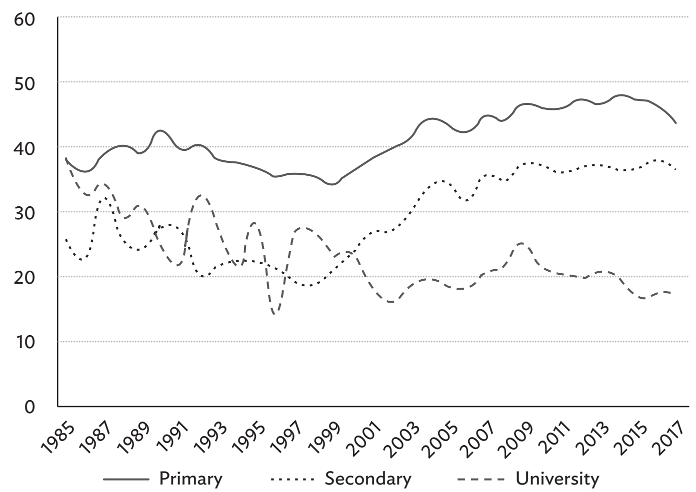
This trend has been consistent with that found in developed countries. In the US, the LFP of older people has increased significantly since 1996, from 17.5% in 1996 to 26.8% in 2016 (US Bureau of Labor Statistics). From 1990 to 2015, an average increase of 20% in the rate of LFP was found among older people (55–64) (Regina 2018).

Geppert et al. (2019) found that the labor participation of older people in most Organisation for Economic Co-operation and Development (OECD) countries has increased in the last 2 decades, mainly because of rising life expectancy and improved education.

LFP among older people in developing countries is usually higher than that of developed countries because of insufficient income security and social welfare in the former. In developing countries, especially low-income ones, the proportion of older people in the labor market is high, as they make a significant contribution to their households, but their remuneration decreases as they age (Barrientos, Gorman, and Heslop 2003). Thailand shows a higher rate of LFP among those over 60 than certain other economies in Southeast Asia, including Singapore, Indonesia, and Brunei Darussalam (Arifin and Anata 2009).

Figure 9.2 shows that older persons with primary-level education have the highest labor force participation. After 2000, there was a clear gap in LFP between each education level, which may suggest that less-educated workers tend to work longer to support themselves. In Figure 9.3, we separate LFP by gender. At over 20%, older male participants have a much higher participation rate than women.

Figure 9.2: Labor Force Participation Rate of Older Thai People by Education Level (%)



Source: Prepared by the authors.

9.5 Data

In this study, we used two datasets, both from surveys conducted by the National Statistical Office of Thailand. To mitigate the issue of seasonal migration of the workforce, only the third quarter of the year is used for analysis (Sussangkarn and Chalamwong 1996). The sample is restricted to individuals aged 55 to 75. We provide an overview of the trends of older workers' labor market behavior by using the LFS from 1985 to 2017. While the LFS contains many observations and offers a long time span for the basic analysis, it lacks comprehensive information relating to the labor supply of older people, such as pensions and health status.

Therefore, to estimate the determinants of older people's labor force participation, we use the 2005, 2006, 2007, 2010, and 2012 waves of the SES on individuals aged 55 to 75. The SES data are nationally representative panel data and contain more information that would affect the labor supply of older people than if we used only the LFS. Besides information on individuals' health status, household type, and pension, the SES also asked about the sources of their income ("Did you receive money in-cash or in-kind from the following sources?"), including job compensation, monetary assistance from other people, and assistance from the government, which allows us to provide more insights on labor force participation.

Table 9.2 shows the summary statistics of the SES data. On average, 57% of the sample between the ages of 55 and 75 participated in the labor force. About 60.5% of the sample lives with their adult children. Most older people obtain only primary-level education (78.1%), and only 3.5% of those receive a pension. Health status is assessed using a five-point scale. The description details of the variables are shown in Table 9.3.

Table 9.2: Summary Statistics of the Socio-economic Survey (2005–2012)

	Observation	Mean	Std.	Min	Max
Labor force participation	10,406	0.577	0.494	0	1
Pension	10,406	0.035	0.183	0	1
Health	10,406	2.744	0.777	1	5
Co-residence	10,406	0.605	0.489	0	1
Age	10,406	63.538	6.075	55	75
Education levels:					
Primary level	10,406	0.781	0.413	0	1
Secondary level	10,406	0.091	0.287	0	1
University level	10,406	0.128	0.334	0	1
Gender	10,406	0.448	0.497	0	1
Married	10,406	0.725	0.447	0	1
Urban	10,406	0.355	0.479	0	1
Income source:					
Job compensation	10,406	0.002	0.050	0	1
Assistance from other people	10,406	0.348	0.476	0	1
Assistance from government	10,406	0.288	0.453	0	1
Income from house /land/asset lending	10,406	0.041	0.198	0	1
Income from interest /dividend/share/bond	10,406	0.090	0.287	0	1
Spouse information:					
Spouse pension	6,317	0.040	0.195	0	1
Spouse work	6,317	0.591	0.492	0	1

Source: Prepared by the authors.

Table 9.3: Description of Variables

Variable	Description
LFP	A dummy that equals 1 if individual i participates in labor force at time t
Pension	A dummy that equals 1 if individual receives pension
Health	Categorical variable that equals 1 if self-report heath status is very good, 2 if good, 3 if fair, 4 if poor, and 5 if very poor.
Co-residence	A dummy that equals 1 if individual currently lives with their adult child
Age group	The group dummies of 55 to 59, 60 to 64, 65 to 69 and 70 to 75
Edu	Three education degree dummies, including primary level, secondary level and university level
Gender	A dummy that equals 1 if individual is male
Marital	A dummy that equals 1 if individual is married; 0 includes single, widowed, divorced, and separated
Area	A dummy that equals 1 if individual resides in urban area, 0 in rural area
Income source	Includes five dummies:
	Equals 1 if individual receives job compensation
	Equals 1 if individual receives assistance from other people
	Equals 1 if individual receives assistance from government
	Equals 1 if individual receives income from house/land/asset lending
	Equals 1 if individual receives income from interest/dividend/share/bond
Spouse pension	A dummy that equals 1 if individual's spouse receives pension
Spouse work	A dummy that equals 1 if individual's spouse participates in labor force

LFP = labor force participation.

Source: Prepared by the authors.

9.6 Determinants of Older People's Labor Force Participation

9.6.1 Methodology

The theory of older people's labor supply assumes that individuals maximize their utility subject to a budget constraint, which is related to their health, wealth, and other individual or household characteristics (Giles, Wang, and Cai 2011; Connelly, Maurer-Fazio, and Zhang 2014).

We examine the determinants of older people's labor force participation by employing both a standard logit model and a fixed-effect logit model. While the standard logit model provides some evidence on the determinants by controlling for older people's individual and household characteristics that reflect their preference in labor force participation, unobserved heterogeneity, such as ability, may still bias the estimation results. Therefore, we also apply the fixed-effect model to account for additional endogenous bias.

With the binary outcome of labor force participation, we first employ the standard logit model to estimate the determinants of labor force participation for older people in the form of:

$$\begin{aligned} \text{LFP}_{it} = \beta_0 &+ \beta_1\text{Pension}_{it} + \beta_2\text{Health}_{it} + \beta_3\text{Co-residence}_{it} \\ &+ \beta_4\text{Agegroup}_{it} + \beta_5\text{Edu}_{it} + \beta_6\text{Gender}_{it} \\ &+ \beta_7\text{Marital}_{it} + \beta_8\text{Area}_{it} + \beta_9\text{Income\_source}_{it} + \varepsilon_{it} \end{aligned} \tag{1}$$

where LFP_{it} is an indicator that equals 1 if individual i participates in the labor force in period t, and 0 otherwise. The model accounts for the availability of pensions, individual health status, co-residence status or not, education levels, gender, marital status, residence areas, and sources of income. We expect that without pensions, declining health and aging are negatively correlated with older people's labor force participation. We also expect that co-residence status and residence areas will affect their decision to work.

Because most older workers are in the informal sector that does not report wages, we do not include wages in the regression. However, we include education levels and income sources as proxies for their wealth. As suggested by Giles, Wang, and Cai (2011); education levels reflect the returns and accumulated wealth of elderly persons.

To correct for unobserved heterogeneity, we further employ the fixed-effect logit model (FE-logit). The probability that older people choose to work is as follows:

$$\Pr\left(\text{LFP}_{\text{it}} = 1 | \text{x}_{\text{it}}, \gamma, \alpha_{\text{i}}\right) = \Lambda\left(\alpha_{\text{i}} + \text{x}_{\text{it}}\, \gamma\right) \tag{2}$$

where x_{it} is a set of covariates, which is the same as equation (1). α_{i} is the individual specific effects, the unobserved heterogeneity in individual preferences for labor force participation, which is allowed to be correlated with the regressors x_{it}. $\Lambda(\theta)$ is equal to $\exp(\theta) / [1 + \exp(\theta)]$. However, we have lost many observations under fixed effects.[3] Furthermore, as the LFP of older people may be affected by the LFP or pension of their spouse, additional controls for spouse pension and spouse labor force participation with loss of observations are added as a robustness check.

9.6.2 Results

Basic Analysis

Table 9.4 presents the basic results of the standard logit model, fixed-effect logit model, and random-effect logit model. The magnitudes of the coefficients under each model are different. After correction for potential endogeneity from the standard model, the results show a smaller magnitude under a fixed-effect model, indicating an upward bias. We find strong evidence that age growth, pension, health status, marital status, job compensation, and assistance from other people have a significant impact on the LFP of older people—findings which are robust across the three models.

Pensions and worse health status have a negative influence on the LFP. After we control for age, education, and other related individual characteristics, older people are 36.4% less likely to participate in the labor force if they receive pensions, and those with very poor health are 26.7% less likely to participate in the labor force than those with very good health under the fixed-effect model. The negative effect of co-residence on LFP is not statistically significant under the fixed-effect model. Both job compensation and assistance from other people have been shown to have a significantly negative impact on LFP: job compensation reduces the probability of LFP by 42.6%, and assistance from other people reduces it by 7.9%.

In Thailand, informal workers have until recently received much less access to social security than formal sector and government employees. Those without pensions usually occupy a lower status with less education and wealth, and they tend to remain in the labor force into old age to support themselves. Similar results have been found in studies in other developing countries with different magnitudes. For example, de Carvalho Filho (2008) found that old-age benefits increased

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3 The random-effect (RE-logit) results which take into account unobserved heterogeneity and assume that the regressors are completely exogenous, where α_i is distributed independently of x_{it} (Verme, Barry, and Guennouni 2016), are also presented in the results section. The Hausman test shows strong rejection of the null hypothesis that random effect provides consistent estimates.

Table 9.4: Determinants of Labor Force Participation of Older Thai People (Marginal Effects)

	Overall			With spouse control	
	Logit	FE logit	RE logit	FE logit	RE logit
Pension	−0.410***	−0.364***	−3.519***	−0.170**	−2.662***
	(0.027)	(0.099)	(0.307)	(0.070)	(0.310)
Health status (Base group: very good)					
Good	−0.0775***	−0.129***	−0.657***	−0.0673**	−0.564***
	(0.020)	(0.039)	(0.191)	(0.029)	(0.216)
Fair	−0.124***	−0.160***	−0.929***	−0.0815***	−0.741***
	(0.020)	(0.037)	(0.188)	(0.028)	(0.211)
Poor	−0.262***	−0.238***	−1.832***	−0.135***	−1.689***
	(0.022)	(0.044)	(0.210)	(0.031)	(0.233)
Very poor	−0.358***	−0.267***	−2.497***	−0.124***	−2.061***
	(0.052)	(0.069)	(0.467)	(0.044)	(0.460)
Co-residence with adult children	−0.124***	−0.0303	−0.910***	−0.0249	−0.698***
	(0.009)	(0.027)	(0.104)	(0.020)	(0.102)
Age (Base group 55–59):					
Age 60–64	−0.130***	−0.0820***	−1.200***	−0.0520**	−0.633***
	(0.012)	(0.028)	(0.112)	(0.023)	(0.121)
Age 65–69	−0.281***	−0.139***	−2.408***	−0.0863***	−1.509***
	(0.013)	(0.039)	(0.134)	(0.031)	(0.137)
Age 70–75	−0.420***	−0.185***	−3.516***	−0.101***	−2.100***
	(0.013)	(0.051)	(0.155)	(0.036)	(0.156)
Education (Base group primary level):					
Secondary level	−0.0605***	−0.0691	−0.471***	−0.0244	−0.478***
	(0.016)	(0.042)	(0.177)	(0.028)	(0.169)
University level	−0.0383***	−0.0107	−0.305**	0.0136	−0.350**
	(0.013)	(0.034)	(0.140)	(0.029)	(0.139)
Gender	0.186***	0.142	1.837***	−0.989	1.603***
	(0.009)	(0.247)	(0.125)	(42.820)	(0.109)
Married	0.0687***	0.110**	0.802***	0.0393	0.167
	(0.010)	(0.048)	(0.120)	(0.042)	(0.139)
Urban	−0.0944***	−0.0244	−0.803***	0.00458	−0.429***
	(0.009)	(0.044)	(0.112)	(0.027)	(0.102)

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Table 9.4 *continued*

	Overall			With spouse control	
	Logit	FE logit	RE logit	FE logit	RE logit
Source of income:					
Job compensation	−0.317***	−0.426**	−2.757***	−0.0815	−2.734***
	(0.094)	(0.170)	(0.818)	(0.109)	(1.061)
Assistance from other people	−0.0896***	−0.0794***	−0.688***	−0.0402***	−0.579***
	(0.009)	(0.021)	(0.087)	(0.015)	(0.094)
Assistance from government	0.0141	−0.101***	−0.00692	−0.0469***	0.146
	(0.010)	(0.026)	(0.085)	(0.017)	(0.097)
House/land/asset lending	−0.103***	−0.0175	−0.538***	−0.0109	−0.562***
	(0.021)	(0.038)	(0.195)	(0.028)	(0.217)
Interest/dividend /share/bond	0.0735***	0.0262	0.496***	0.00474	0.385**
	(0.016)	(0.029)	(0.145)	(0.021)	(0.155)
Spouse pension	–	–	–	0.016	0.143
	–	–	–	(0.038)	(0.266)
Spouse work	–	–	–	−0.00916	2.102***
	–	–	–	(0.010)	(0.089)
Observations	10,406	3,444	10,406	1,851	6,317

FE = fixed effect, RE = random effect.
Source: Prepared by the authors.

the retirement rate by 38% in Brazil, while Bloom et al. (2008) suggested that pensions were associated with a 5% reduction in LFP, using cross-country data.

Many of the informal workers are in the agricultural industry, which requires manual labor (Mu and van de Walle 2011 for the PRC; Rendall 2013 for Brazil, Mexico, India and Thailand). Health status acts as a leading factor in older people's decision to work. Consistent with previous empirical studies in both developed and developing countries, unhealthy people leave the labor force earlier than healthy people (e.g., McGarry 2004, Kalwji and Vermeulen 2008). A decreased level of work strongly associated with health and aging is also found in Thailand (Knodel et al. 2015). Keeratipongpaiboon (2012) suggested that health plays a significant role in older people's choice to work, where healthy individuals are 26.9% more likely to work than unhealthy ones.

We next run a regression by adding controls for the spouse's pension and spouse's LFP. For those who have spouses, pensions and health have a smaller negative effect than for the overall sample, but spouses' pensions and work do not show a significant impact on the LFP under the fixed-effect model.

Subgroup Analysis

While the marginal effects from Table 9.4 reflect the effect of each determinant of LFP, it is possible that the results are driven by the composition of the sample that has not been adequately controlled in the estimation. Therefore, we separated the analysis of LFP behavior by subgroups, including gender, residence area, age, and lower education level. Table 9.5 shows the results for men and women. Pension and health status negatively affected women's LFP more than men's. Under the fixed-effect logit model, men who are receiving pension payments are 21.5% less likely to participate in the labor force than those who are not, while women with pensions are 35.3% less likely to do so than those without pensions.

Under the traditional norm, women are expected to take care of household chores and childcare, indicating that they are more likely to leave the labor market than men (Johnson and LoSasso 2006; Maurer-Fazio et al. 20110; Liao and Paweenawat 2021). As shown in Figure 9.3, more older men participate in the labor force than older

Table 9.5: Comparison of the Determinants of Labor Force Participation of Older Thai People by Gender (marginal effects)

	Men		Women	
	FE logit	RE logit	FE logit	RE logit
Pension	−0.215**	−3.983***	−0.353**	−2.596***
	(0.100)	(0.402)	(0.143)	(0.566)
Health status (Base group: very good)				
Good	−0.0449	−0.349	−0.156***	−0.889***
	(0.037)	(0.285)	(0.050)	(0.263)
Fair	−0.0740**	−0.794***	−0.177***	−1.042***
	(0.037)	(0.281)	(0.048)	(0.259)
Poor	−0.125***	−1.782***	−0.244***	−1.916***
	(0.044)	(0.325)	(0.046)	(0.283)
Very poor	−0.157***	−3.214***	−0.231***	−1.956***
	(0.058)	(0.762)	(0.086)	(0.604)
Co-residence with adult children	−0.0106	−0.538***	−0.0425	−1.183***
	(0.027)	(0.178)	(0.030)	(0.130)

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Table 9.5 *continued*

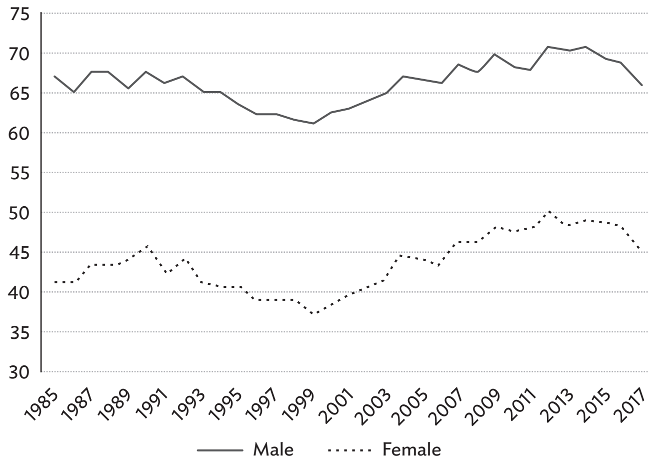
	Men		Women	
	FE logit	**RE logit**	**FE logit**	**RE logit**
Age (Base group 55–59):				
Age 60–64	−0.184***	−1.974***	−0.0293	−0.908***
	(0.059)	(0.223)	(0.030)	(0.132)
Age 65–69	−0.199***	−3.381***	−0.0858**	−1.997***
	(0.066)	(0.255)	(0.041)	(0.163)
Age 70–75	−0.204***	−4.405***	−0.140***	−3.109***
	(0.071)	(0.282)	(0.049)	(0.193)
Education (Base group primary level):				
Secondary level	−0.0392	−0.41	−0.0623	−0.628**
	(0.036)	(0.259)	(0.051)	(0.263)
University level	0.0151	−0.542**	−0.025	−0.234
	(0.046)	(0.262)	(0.035)	(0.165)
Married	0.0703	1.309***	0.0925*	0.642***
	(0.061)	(0.247)	(0.052)	(0.135)
Urban	−0.066	−1.019***	−0.0102	−0.700***
	(0.050)	(0.194)	(0.048)	(0.140)
Source of income:				
Job compensation	−1.772	−6.059***	0.0169	−0.00296
	(69.630)	(1.314)	(0.166)	(0.966)
Assistance from other people	−0.0737**	−0.888***	−0.0548***	−0.611***
	(0.029)	(0.154)	(0.020)	(0.107)
Assistance from government	−0.0943**	−0.151	−0.0730***	0.0299
	(0.040)	(0.143)	(0.026)	(0.107)
House/land /asset lending	0.0142	−0.314	−0.0655	−0.698***
	(0.034)	(0.304)	(0.051)	(0.261)
Interest/dividend /share/bond	−0.0262	0.273	0.0564	0.630***
	(0.030)	(0.233)	(0.036)	(0.188)
Observations	1,298	4,660	2,140	5,746

FE = fixed effects, RE = random effects.

Source: Prepared by the authors.

women, and the gender gap in LFP is stable over time. According to the NSO (2005), there is a large gender gap in the share of those who engage in household work among those over 60: 21.8% of women and only 1.9% of men.

Figure 9.3: Labor Force Participation Rate of Older Thai People by Gender, 1985–2017 (%)



Source: Prepared by the authors.

Table 9.6 shows the results for rural and urban areas. Older people in rural areas usually earn less over their lifetimes and have less access to pensions than those in urban areas (Ravallion and Chen 2007). Health status has a greater impact on older people's LFP in rural than in urban areas. In Thailand, the percentage of working elderly persons is much higher in rural than in urban areas regardless of year, indicating a higher tendency to work among older people in agriculture (Knodel et al. 2015). Pension status affects urban residents more than rural residents, suggesting that even when they receive pensions, older people in urban areas are more likely to leave the labor market than those in rural areas.

Interestingly, the significantly negative impact of co-residence is evident in the rural but not in the urban sample. Similarly, Connelly, Maurer-Fazio, and Zhang (2014) found that co-residence had a large and significantly negative impact on the LFP of older people in the rural areas of the PRC, but not in urban areas. The main source of income for older people in Thailand is the support they receive from their working children. This is especially true for poor and informal workers without social security. Those who live together with their children usually have a lower likelihood of participating in the labor force as they tend to provide childcare and share housework with their children. Monetary

Table 9.6: Comparison of the Determinants of Labor Force Participation of Older Thai People by Residence Area (marginal effects)

	Rural		Urban	
	FE logit	RE logit	FE logit	RE logit
Pension	−0.257**	−2.910***	−0.368**	−4.910***
	(0.122)	(0.412)	(0.188)	(0.537)
Health status (Base group: very good)				
Good	−0.126**	−0.446*	−0.125**	−1.186***
	(0.049)	(0.231)	(0.054)	(0.368)
Fair	−0.166***	−0.830***	−0.149***	−1.354***
	(0.046)	(0.225)	(0.054)	(0.367)
Poor	−0.271***	−1.854***	−0.158***	−1.952***
	(0.049)	(0.250)	(0.057)	(0.412)
Very poor	−0.261***	−2.329***	−0.201**	−2.795**
	(0.081)	(0.526)	(0.091)	(1.105)
Co-residence with adult children	−0.0582*	−0.688***	−0.0211	−1.528***
	(0.033)	(0.121)	(0.037)	(0.218)
Age (Base group 55–59):				
Age 60–64	−0.0670*	−1.152***	−0.0741**	−1.542***
	(0.037)	(0.139)	(0.037)	(0.210)
Age 65–69	−0.150***	−2.476***	−0.0563	−2.591***
	(0.047)	(0.164)	(0.041)	(0.259)
Age 70–75	−0.211***	−3.527***	−0.05	−3.836***
	(0.058)	(0.187)	(0.053)	(0.305)
Education (Base group primary level):				
Secondary level	0.0628	−0.342	−0.0890*	−0.646**
	(0.079)	(0.262)	(0.046)	(0.278)
University level	−0.0345	−0.343**	0.0268	−0.182
	(0.041)	(0.168)	(0.054)	(0.270)
Married	0.148**	0.885***	0.022	0.604***
	(0.061)	(0.143)	(0.050)	(0.234)

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Table 9.6 *continued*

	Rural		Urban	
	FE logit	RE logit	FE logit	RE logit
Source of income:				
Job compensation	−0.0143	−0.877	−1.64	−4.468***
	(0.218)	(1.193)	(36.100)	(1.281)
Assistance from other people	−0.0541**	−0.473***	−0.116**	−1.393***
	(0.022)	(0.102)	(0.051)	(0.186)
Assistance from government	−0.109***	−0.0983	−0.0656*	0.219
	(0.030)	(0.100)	(0.037)	(0.171)
House/land /asset lending	−0.0729	−0.779***	0.0203	−0.214
	(0.051)	(0.243)	(0.045)	(0.357)
Interest/dividend /share/bond	0.0288	0.468**	0.0146	0.628**
	(0.039)	(0.186)	(0.031)	(0.254)
Observations	2,304	6,707	984	3,699

FE = fixed effects, RE = random effects.

Source: Prepared by the authors.

transfers from adult children to their parents are, in part, a compensation for the childcare they provide (Park 2013). Liao and Paweenawat (2020) suggested that intergenerational co-residence increased the maternal labor supply in Thailand because of grandparents' assistance in childcare. The lack of social security in rural areas also explains why older people depend more on their children and are less likely to leave the labor market with greater financial needs. In addition, the health status of older people and co-residence with adult children may be correlated. Poor health may be a good indicator that could increase the probability of co-residence and lower the LFP of older people. According to Knodel and Chayovan (2011), Thai parents who are not in good health strongly prefer to live with and receive care from their children.

Considering that the mandatory retirement age for workers in the public sector in Thailand is 60 (Labor Protection Act), Table 9.7 provides the results for all people over 60 and those among them who have primary-level education. Those who only have primary-level education are more likely to be poor and participate in the labor force to earn a living. Similarly, as suggested by the United Nations Population Fund (UNFPA 2017), poorer Thai people over 60 are more likely to work than the wealthier ones, which suggests that poorer elderly persons are more likely to remain in the labor force out of obligation than out of choice.

Table 9.7: Determinants of Labor Force Participation of Older Thai Workers over the Age of 60 and Those among Them with Lower Education (Marginal Effects)

	Over 60		Over 60&Primary level	
	FE logit	RE logit	FE logit	RE logit
Pension	−0.223*	−3.295***	0.11	−1.771***
	(0.121)	(0.364)	(0.185)	(0.664)
Health status (Base group: very good)				
Good	−0.135***	−0.705***	−0.104*	−0.664**
	(0.051)	(0.227)	(0.056)	(0.262)
Fair	−0.157***	−1.026***	−0.153***	−1.089***
	(0.054)	(0.224)	(0.058)	(0.258)
Poor	−0.214***	−1.912***	−0.202***	−2.012***
	(0.069)	(0.248)	(0.069)	(0.285)
Very poor	−0.289***	−2.555***	−0.254**	−2.423***
	(0.111)	(0.547)	(0.105)	(0.593)
Co-residence with adult children	−0.0683*	−1.070***	−0.0702*	−1.158***
	(0.036)	(0.126)	(0.040)	(0.142)
Gender	0.0248	1.502***	0.0503	1.518***
	(0.280)	(0.152)	(0.290)	(0.168)
Married	0.093	1.017***	0.0674	1.124***
	(0.058)	(0.143)	(0.060)	(0.160)
Source of income:				
Job compensation	−0.188	−0.988	−0.266	−1.318
	(0.184)	(0.941)	(0.272)	(1.317)
Assistance from other people	−0.0844**	−0.770***	−0.109***	−0.934***
	(0.034)	(0.103)	(0.042)	(0.116)
Assistance from government	−0.134***	−0.471***	−0.138***	−0.444***
	(0.048)	(0.092)	(0.049)	(0.104)
House/land /asset lending	0.00275	−0.471**	0.0284	−0.451*
	(0.044)	(0.230)	(0.051)	(0.256)
Interest/dividend /share/bond	0.02	0.456***	0.0538	0.675***
	(0.035)	(0.176)	(0.047)	(0.212)
Observations	2,347	6,965	1,757	5,446

FE = fixed effects, RE = random effects.

Source: Prepared by the authors.

Our results show that the impact of pensions is negatively significant for those over 60, but not for those with primary-level education. Not only does a very small proportion of older people of low economic status receive pensions, but even when they do, their pensions still may not be sufficient to live on. That is why their decisions regarding labor force participation are not affected by pensions but rather by their health status and co-residence status, which may mean that the government support for the poor is inadequate. According to SOPT (2014), older Thai people who reported the government allowance as their primary source of income were more likely to say that their income was inadequate, while those who reported employment or their children as their primary sources of income were much less likely to feel that their income was inadequate. Both of the samples show that co-residence reduces the LFP of older people, whereas lower education levels have a stronger effect. Those over 60 who have primary-level education and co-reside with adult children are 7% less likely to work.

9.7 Conclusion

In this chapter, we have examined the labor supply of older people in Thailand and the impact of pensions, health, and co-residence status on their labor force participation using LFS and SES data. We first shed light on the trends in the labor market behavior of older Thai people by utilizing the LFS from 1985 to 2017. We then turned to SES panel data from 2005 to 2012 to estimate the determinants of older people's labor force participation. Our estimates suggest that older Thai people who receive a pension and whose health status is relatively poorer are less likely to work. Women's LFP is more affected by pension and health status than men's. Pension status has less impact on those living in rural areas than on those living in urban areas, and is not significant for those with lower education. The results underscore that older people of lower economic status, especially those in the informal sector, may be suffering from inadequate government support, which makes them remain in the labor market to earn a living. Furthermore, older people's LFP is negatively affected by co-residence, which suggests that the lack of public support and other social assistance tends to make them depend more on their children.

Thailand, as well as other members of the United Nations, adopted the Sustainable Development Goals in 2015, which include as their objective to improve the well-being of old people. While notable progress has been made, further improvement is required. Compared to developed countries, where most workers are covered by social security such as pensions, health insurance, and other benefits, in developing countries, social security usually covers workers in the formal sector, with a large proportion of the labor force not covered (Giles, Wang, and Cai 2011). In developed countries, over 90% of the labor force has access to the pension system, in which the provision of voluntary and mandatory pension programs is well structured and funded (Dethier 2007). In OECD countries, different methods have been applied to ensure that older people can achieve the necessary minimal standard of living. For example, the United Kingdom and Australia use a means-tested public scheme, while the US has an earnings-related scheme (Dethier 2007). Because of various obstacles, such as fiscal and structural constraints, it is difficult to directly apply the models prevailing in developed countries to developing nations.

On the basis of our analysis in this study, we highlight several issues related to employment among Thailand's elderly population. First, our results suggest a strong association between pensions and the labor supply of elderly persons. A high share of older workers in rural areas seems to be an indication of the "ceaseless toil" of older, rural people (Davis-Friedman 1991), which raises concern about the insufficiency of social pensions for older people, especially in the informal sector and in rural areas.

The Thai government has taken steps to help increase older people's income in recent years, such as through the Older Persons Act (2003), the implementation of the Old Age Allowance (2009), and the National Savings Fund (2015). However, except for the universal program, all other pension programs available for informal workers are on a voluntary basis. The benefits are low and hardly have a significant impact on older workers (Paweenawat and Vechbanyongratana 2015). Similarly, the voluntary social program within the three pillars system remains undersubscribed (NSF 2017). In fact, the majority of older Thai people in the informal sector still cannot afford to join those programs. Until the end of 2017, the National Savings Fund had only approximately 546,000 members (NSF 2017). Although it is too early to assess the impact of the program, preliminary evidence in Thailand, as well as past evidence from other countries with similar programs suggest that it primarily helps wealthier persons in the informal sector (World Bank 2012).

Thus, the government should pay more attention to increasing pension coverage and benefits to address older people's income insecurity. The universal allowance for older people should relate to the national subsistence level and the poverty line. As suggested by Knodel and Teerawichitchainan (2017), "civil social networks and community-based organizations can support the expansion of the National Savings Fund." The implementation of voluntary social programs should be facilitated by encouraging workers in the informal sector to get more involved. The government needs to provide more incentives to encourage working-age people to participate in voluntary programs, in which, through savings, they can obtain a higher income as they age. Considering the high poverty rate among the elderly (World Bank 2012), in addition to social programs, enabling the supplementation of their income through public programs is required. For example, different study programs and additional community activities could help improve their skills and income and contribute to sustainable development.

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10

Re-Allocating the Workfare Income Supplement to Improve Retirement Adequacy Outcomes of Low-wage Workers[1]

Damien Huang and Christopher Gee

10.1 Introduction and Context

Singapore first introduced a form of income supplement through the Workfare Bonus Scheme (WBS) in 2006 by providing cash bonuses to older, low-wage Singaporean workers to reward regular and productive work (Ministry of Finance 2006). Subsequently, the Workfare Income Supplement (WIS) was introduced in the 2007 budget as a permanent fourth pillar of Singapore's social security system to augment the income of the bottom 20% of full-time workers. The World Bank's three-pillar model of a state pension, occupational pension and private savings has thus been complemented by a fourth government-aided savings scheme.

These savings are particularly important in the context of an aging population in Singapore, which the United Nations 2019 *World Population Report* cites as the second fastest aging country in the world from 2019 to 2050. The increase in Singapore's population aged 65 and above is more than 20.9 percentage points, just slightly lower than that of the Republic of Korea at 23 percentage points (UN DESA 2020). With national healthcare expenditure already a major fiscal expansionary driver, growing at 11% per annum between 2013 and 2018 (Ministry of

[1] The authors acknowledge the significant contributions to this chapter by Kevin Chee, an intern with the Institute of Policy Studies from 2 December 2019 to 24 January 2020.

Health 2020), in the future committing funds toward purely welfare programs may place further strain on the government's budget. At the same time, the government reports that only about 53% of the active Central Provident Fund (CPF) members in the current cohorts meet the required retirement sums (Teo 2018).

The prudent move would thus be to encourage more savings while working with effective financial vehicles with low risk (Gee et al. 2014). The WIS provides the means for lower-income individuals to do so without burdening their already stretched household budgets. Also, fiscal expenditure would be more efficiently utilized by encouraging work through automatic participation in the WIS on top of compulsory savings through the CPF. This would reduce the burden the future increase in social spending and help meet retirement income needs.

Since its introduction, the WIS has served to increase take-home pay, improve employability, and supplement wages and retirement savings (Zaqy 2019). The WIS was paid quarterly to workers aged 35 and older, with the amount disbursed based on individual income levels. The age of 35 was selected as the policy threshold since it is the age by which individuals normally stop pursuing further education. The WIS is split into a cash and a CPF component, fully funded from government operating expenditure on an annual basis. While not the only policy available to alleviate poverty, the WIS is a uniquely effective policy, as it targets only those who work, and thus avoids the criticism that is usually directed at welfare programs, that they may serve to discourage work.

The aim of this chapter is to look closer at the design of the WIS, particularly its scheme parameters. We use simulations to project the differences in scheme parameters to see and compare outcomes in retirement savings. We also discuss the role that nonnumerical parameters have in policy design and the need to tailor these administrative and operational parameters specific to local contexts using Singapore as an example.

The rest of this chapter is set out as follows: Section 10.2 tracks the changes and enhancements in the WIS during its 13-year history and gives a brief introduction of the broader CPF system within which WIS is nested. Section 10.3 discusses some literature on similar programs and documents current policy debates in Singapore. Section 10.4 details the model and simulation. Section 10.5 expands on the WIS scheme by discussing its operational and administrative parameters and trends in labor. Section 10.6 offers lessons for other countries based on Singapore's experience and Section 10.7 concludes with some outstanding questions for future scholars.

10.2 Introduction to the Central Provident Fund and the Workfare Income Supplement Scheme

10.2.1 Central Provident Fund

The CPF in Singapore, a defined contribution retirement system set up in 1955 by the British colonial government, was adopted by Singapore's government in 1965 upon independence. Proportional contributions from employees' salaries are denominated by age and capped at S$6,000, a recent, once-in-a-generation increase from S$5,000 after the protests in 2014 (Ministry of Manpower 2014, Sim 2014, Straits Times 2014), which resulted in the recommendations of a government panel (CPF Board 2015) to allow CPF members more flexibility in withdrawing from their retirement savings, even in cases where they did not meet the minimum thresholds previously determined.

Contributions to the CPF from salaried employees (but not self-employed persons) are determined in accordance with the age groups to which they belong (Table 10.1). Reduced rates for workers above 55 were implemented in 2005, with the justification that this improves the employability (CPF Board 2012) of older workers.

Contributions are then split into three main accounts: Ordinary, Special, and Medisave, by allocation rates (Table 10.2). The Ordinary Account is generally used to finance housing and investment, while the Special Account has more restrictions as the main retirement savings account. At age 55, a "new" Retirement Account is created, taking monies

Table 10.1: Central Provident Fund Contribution Rates

	Contribution Rates from 1 Jan 2016 (for monthly wages >=$750)		
Employee's Age (years)	**By Employer (% of wage)**	**By Employee (% of wage)**	**Total (% of wage)**
55 and below	17	20	37
Above 55 to 60	13	13	26
Above 60 to 65	9	7.5	16.5
Above 65	7.5	5	12.5

Source: CPF Board Website (https://www.cpf.gov.sg/employers/employerguides/employer-guides/paying-cpf-contributions/cpf-contribution-and-allocation-rates) (accessed 29 October 2020).

first from the Special Account and then from the Ordinary Account to form the so-called Full Retirement Sum for each specified cohort (previously the Minimum Sum). Any excess above the pre-announced retirement sum can be withdrawn. The 2015 recommendations also included the Basic Retirement Sum (BRS) and the Enhanced Retirement Sum (ERS), set at 0.5 times and 1.5 times of the Full Retirement Sum, respectively. The former allows for lower-income households to pledge a portion of their remaining lease in the 99-year public housing toward their retirement, while the latter allows higher income individuals to set aside more for their retirement.

The Medisave Account is specifically set aside for healthcare use and is a part of a multi-tiered system made up of copayments, government subsidies, national insurance (MediShield), and private insurance components. The Medisave Account can be used to pay for copayments as well as national insurance up to certain limits.

Table 10.2: Central Provident Fund Allocation Rates from 1 January 2016
(for monthly wages >=$750)

Employee's Age (years)	Ordinary Account (% of wage)	Special Account (% of wage)	Medisave Account (% of wage)
35 and below	23	6	8
Above 35 to 45	21	7	9
Above 45 to 50	19	8	10
Above 50 to 55	15	11.5	10.5
Above 55 to 60	12	3.5	10.5
Above 60 to 65	3.5	2.5	10.5
Above 65	1	1	10.5

Source: CPF Board Website (https://www.cpf.gov.sg/employers/employerguides/employer-guides/paying-cpf-contributions/cpf-contribution-and-allocation-rates) (accessed 29 October 2020).

While the entire CPF system and its administrative rules are too complicated to be discussed at length, interested readers can refer to Asher and Rajan (2002), Asher (2002), Asher and Newman (2003), and Asher and Bali (2014) for earlier histories, with more recent changes summarized in the CPF Advisory Panel report in 2015 (CPF Board 2015).

10.2.2 Workfare Income Supplement Scheme

When the WIS scheme first began, there were four eligibility criteria: the recipient must be a Singapore citizen above 35 years old, earning a gross monthly salary of S$1,500 or less, staying in a property that does not exceed S$10,000 in annual value (which covers more than 80% of all housing in Singapore) and must have worked at least 3 months in any 6-month period in the calendar year, or at least 6 months in the calendar year. The S$1,500 benchmark is based loosely on the gross monthly income of workers over 35 at the 30th percentile in 2007 (See Appendix 10.4 for the income interpolation formula). It is higher than the targeted bottom 20th percentile due to the phase-out schedule (The peak of the schedule is set at the 20th percentile).

The workfare quantum is then determined based on workers' age and gross monthly income with a cash-to-CPF ratio of 1:2.5, and with payments made twice a year. Payouts are also split between the recipient's CPF account and a cash component that helps defray the cost of living.

WIS Changes over the Years

There have been four main policy reviews of WIS since its inception in 2007, which involved raising the WIS payouts workers receive and the income ceiling eligibility of the WIS. The income ceiling changes are summarized in Table 10.3.

Two additional qualifying criteria were also added. In 2013, the annual assessable income of one's spouse for the preceding year of assessment not exceeding S$70,000, and property ownership (of two or

Table 10.3: Illustration of WIS Ceiling Changes over Time

Year of Review (Implementation)	Income Ceiling of WIS (S$)
2007 (2007–09)	1,500
2010 (2010–12)	1,700
2013 (2013–16)	1,900
2016 (2017–19)	2,000
2019 (2020 onwards)	2,300

WIS = Workfare Income Supplement.

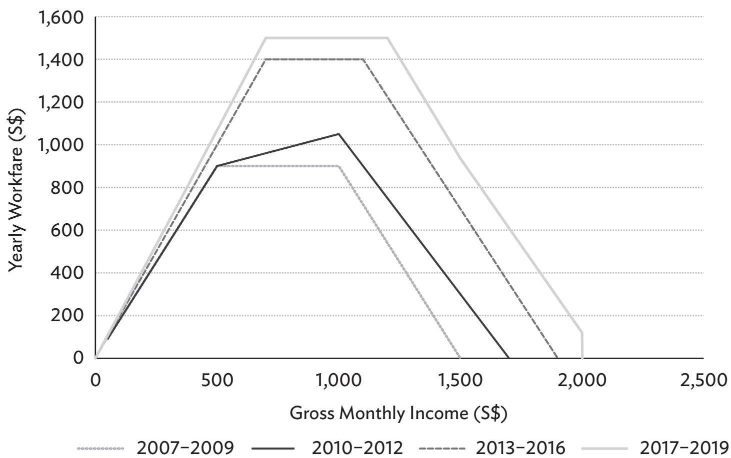
Source: Ministry of Manpower website on Workfare (https://www.mom.gov.sg/employment-practices/schemes-for-employers-and-employees/workfare) (accessed 23 July 2021).

more properties, including those owned by spouses). The annual value of the recipient's residence was also updated from S$10,000 to S$11,000 and then to S$13,000 in line with inflation, and to include smaller private residences (CPF Board 2018).

In 2016, the frequency of WIS payouts also changed from quarterly to monthly payments. This meant that each month of work would be eligible for the WIS in a relaxation of the 6-monthly and annual work criteria. Further details of policy changes can be found in Appendix 10.1.

Figure 10.1 shows the changes in payouts for the group of employed WIS recipients aged 35 to 44, from 2007 to 2019. It is clear that while the range of incomes qualifying peak payout has expanded, the increase in payouts is uneven at different income levels. This appears to be a consequence of income ceiling changes, shifting the peak payout while maintaining the relative phase-in and phase-out slopes. Such a design was originally meant to prevent steep drop-off cliffs for polices but inadvertently caused disparities in the increases of WIS payouts for slightly different income groups. The gaps between the different payout curves in Figure 10.1 illustrates this. As discussed earlier, the initial peak payout was set at around the 20th percentile

Figure 10.1: Illustration of WIS Payouts for Employed Individuals Aged 35–44 since 2007



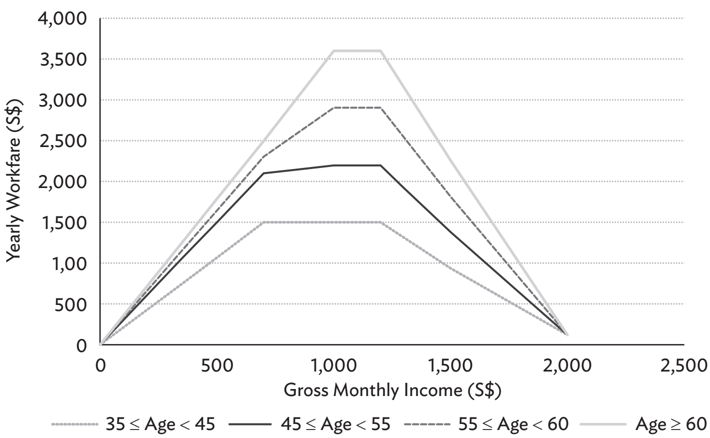
WIS = Workfare Income Supplement.

Source: Authors, compiled from Ministry of Manpower website.

of gross monthly income earned, while the phase-out was extended to the 30th percentile to prevent drop-off cliff effects. In addition, we see that earlier workfare curves with single point peaks (see orange line for 2010–12 in Figure 10.1 for example) were replaced with flat plateaus in later reviews.

At any given time, WIS payouts are also differentiated by age groups: 35 to 44, 45 to 54, 55 to 60, and 65 and above. The arbitrary drop from 10-year to 5-year age groups likely follows the age thresholds of CPF contribution rates. Figure 10.2 illustrates the differentiation by age groups for the period 2017–2019. Again, we can observe some peaking of payouts around the S$1,000 level, which has moved from middle-of-the-range to the lower end of the "plateau". This may be because of increasing payout levels across age cohorts.

Figure 10.2: Illustration of WIS Payouts for Employed Individuals across Age Groups, 2017–2019



WIS = Workplace Income Supplement.

Source: Authors, compiled from Ministry of Manpower website.

The sloped WIS is designed such that every additional dollar of income earned always increases the total amount in wages and supplements received. The maximum WIS payout peaks at around the 10th percentile of wage earners aged 35 and above but the increment in

WIS payout for every dollar differs across the age bands. Workers under 35 are assumed to have the opportunity to upskill themselves to raise their incomes and move out of receiving the workfare.

The next section, thus, looks at the WIS in a broader social policy landscape and at recent evidence regarding its efficacy.

10.3 Current Policy Stance and Debate

The WIS is often said to encourage recipients to work as it is targeting at the individual level, contrary to similar polices in the United States, like the Earned Income Tax Credit (EITC). The EITC pays out at the family level, and it has been found that families reduce the amount of work when they are close to reaching the income threshold in order not to lose their benefits. Besley and Coate (1989) cite two key advantages of in-work poverty alleviation programs: it screens out those in need from those who do not need the additional support and provides incentives for individuals to invest in training. In addition, Lee and Saez (2012) find that a workfare type program complements minimum wage floors, acting in a “push-and-pull” manner to raise wages at the bottom.

The positive effects on the extensive margin in individual and spousal labor market outcomes were shown in studies by government economists (Lee, Leong, and Kuhan 2014; Leong et al. 2014), who looked at the introduction of the WIS in 2008, using data from 2004 to 2010 with regression discontinuity and difference-in-differences methods. Such effects were confirmed by Freire who utilized public data on Singapore and conducted a comparison with Hong Kong, China (Freire 2018). These findings largely agree with other empirical studies in the United States, the United Kingdom, etc. (Adireksombat 2009). Later enhancements that increased annual WIS payouts likely suffered from diminishing marginal returns and ever-increasing labor market tightness (the local unemployment has consistently hovered around 3% in the past decade and it is arguable whether the economically inactive left would be as willing to enter the labor market).

Interestingly, there is thus far insufficient evidence to judge the efficacy of WIS as a retirement savings scheme given the lack of public data and government studies to account for how the monies paid out have improved retirement incomes. Instead, economic studies have focused on its impact on the labor market, an important but secondary result at best. For that reason, the current reviews of WIS may be distracted from their original design intent of improving retirement savings. However, the trapezium-shaped payout schedule (see Figure 10.1), meant to discourage work disincentives, causes workers with the lowest income (below S$1,000) who need more help to receive less, which is why they are less likely to save enough for retirement, reducing the efficacy of a redistributive scheme. This is made worse by the low phase-in payouts at the lowest income levels.

To secure retirement, the WIS currently works on a tiered approach to meet the expenditure needs of workers, using other social transfers when familial and personal savings are insufficient.

It is also evident that if the WIS income ceiling keeps increasing to match wage growth at the lower end of the income distribution, it will become unsustainable in another two or three review cycles, if this growth was not based on productivity increases but instead induced by spillover effects from foreign labor tightening and pseudo-minimum wage schemes like the Progressive Wage Model, a job/skills-based wage seniority system. Also, the cross-comparing eligibility criteria to younger demographic segments may put pressure on expanding the WIS to them.

The immediate problem facing Singapore's policy makers is thus how to find the appropriate balance between helping low-wage workers achieve retirement adequacy in the long run and meeting their current spending needs.

We examine this issue by projecting the amounts that employed individuals will accumulate in their CPF Special Accounts at age 55. We then suggest how the WIS can be recalibrated to better support retirement savings using the projection models we develop in Section 10.4.

10.4 Model and Details of Simulation

We use a simple projection model that compares the difference in savings in the CPF Special Account at age 55, a common benchmark used to estimate retirement adequacy in Singapore.

The simulation projects the impact of the proposal to improve retirement adequacy outcomes by projecting savings in the CPF Special Account as the dedicated retirement saving vehicle, assuming that the CPF member right-sizes their public housing flat and that money in the Ordinary Account (OA) is sufficient to cover any mortgage due. Any excess from the OA further contributes to retirement adequacy. Abeysinghe and Gu (2011) and Chia and Tsui (2012) describe the details on the right-sizing of homes.

The simulation finds that the current CPF policy parameters adequately prepare approximately the top 80% of the current cohorts of workers for retirement (based on retirement projections from age 25). This largely agrees with Chia and Tsui (2012), who include monies from the OA and tend to have higher projections under current rules. In our model, we assume zero savings at age 35, do not include OA monies, and note that housing choice is a critical component to retirement adequacy. In interpreting the figures across different WIS settings below, we emphasize the differences that our recommendations will make over absolute figures projected.

We assume no wage growth and increment in BRS sums to more cleanly measure the difference between current and our proposed schemes. We also project the potential further increase in savings if the age of eligibility for WIS is lowered to encompass workers age 25 to 34. For full analysis of retirement adequacy outcomes across income deciles, refer to Appendix 10.2.

10.4.1 Three Recommendations to Recalibrate the WIS

In the earlier section, we discussed how current WIS payouts do not fully prepare the bottom 20% of low-wage workers for retirement. To address this, we first make two recommendations. The first proposes combining WIS payout curves across different age groups into one, getting rid of the arbitrary drop in the size of older age groups at age 55 from 10 to 5 years. This would also align WIS with broader CPF policy age parameters, particularly with the current CPF withdrawal eligibility at 65 years old.

This recommendation calls into question the assumption that older workers need more help and are given additional WIS because the older they are, the lesser opportunities they have to retrain. Instead, we believe that younger workers can accumulate (more) interest with a longer runway. This is how our first and second recommendations work in tandem to address this anomaly.

Thus, secondly, we propose to vary the WIS cash-to-CPF ratio across age groups instead of varying total payouts (Figure 10.2). This tiered system is illustrated in Table 10.4.

Table 10.4: Illustration of Adjusted WIS Payouts of Cash-to-CPF Ratio Tiered According to Age Bands

Age	Cash to CPF Ratio
25–34	0:100
35–44	20:80
45–54	40:60
55–64	80:20
65 and above	100:0

CPF = Central Provident Fund, WIS = Workfare Income Supplement.
Source: Authors.

The ratios have been adjusted so that the CPF portions are higher at lower ages to allow workers to have a longer runway to accumulate interest earned. Giving the WIS fully in cash at age 65 (which is also the CPF pension withdrawal age) provides an additional incentive to attract older workers back into the workforce.

Lastly, as our third recommendation, we also propose introducing a younger age band, from 25 to 34, to be paid fully into the CPF Special Account (Table 10.4). This change is expected to further improve retirement adequacy outcomes of low-wage workers. For illustration, a S$1,000 yearly WIS payout starting from age 25–34 will more than double to approximately S$2,300 by the time they turn 55. The full proposed WIS payout structure can be found in Table A10.6 of Appendix 10.3.

10.4.2 Impact of Recommendations on Retirement Adequacy and Government Expenditure and Labor Market Outcomes

Taken together, the first two recommendations approximately halves shortfalls for the current cohorts aged 35 and above (see Tables A10.1 and A10.2, Appendix 10.2) for two reasons—workers allocate more into their CPF accounts when they are younger, which benefit from compounding interest rates in the CPF, and are compounded over time. Recent studies (Abeysinghe 2014; Lim 2014; Ng et al. 2019) suggest that up to the bottom 30% struggle to meet their current expenditure even with the WIS. By skewing cash payouts to later ages as suggested in Table 10.4, we cater for increasing demands from disposable income like medical expenses and older children in tertiary education. We note that this does not mean younger age groups do not need cash, but that these needs (e.g., parents of young children) should already receive support through other means via the Ministry of Social and Family Development.

This is a departure from the differential amounts given across age groups currently that runs counterintuitive to both the longer runway for compounded interest as well as accounting for out-of-pocket expenditure of older workers across the life cycle.

The current WIS payout schedule suggests that workers differ in their deservedness in payouts because of the differences (increases) in ability with age. However, instead, such differences should be automatically accounted for though market mechanisms rewarding for skill levels in the labor market. Potential work and upskilling disincentives, and the buying of outsized homes are minimized as payouts at 25 are given solely to the CPF Special Account, which cannot be used for home purchases unlike the Ordinary Account.

In addition, by paying out additional cash under our proposed recommendations, the close to half (47%) (Teo 2018) who have yet to meet the required retirement sum can benefit now from direct increases in cash payout ratios when they continue to work past the age of 65. This addresses shortfalls in retirement income for current cohorts in transiting to greater retirement adequacy levels for future cohorts as shown in Chia and Tsui (2012). This also alleviates fiscal concerns in aging populations, as government spending is focused on subsidizing paid work instead of being spent on pure welfare programs like the Silver Support Scheme.

Simulations with the proposed WIS payout found that almost all workers will be able to achieve the BRS with just Special Account monies if all the three recommendations are adopted—an increase of 20 percentage points from current measures. A separate simulation finds that, if only the first two recommendations are implemented, the difference in retirement savings at age 55 between the current and proposed WIS structures, starting from age 35, will help the bottom two deciles save an additional S$23,000 and S$16,000, respectively. Comparisons of the impact of the proposed changes in WIS policy can be seen by comparing Tables A10.1 and A10.2, as well as A10.3 and A10.4 in Appendix 10.2.

Fiscally, our proposed changes would cost the government more on three fronts:

(1) a standardized workfare payout across age bands would imply that more younger workers are receiving higher WIS payments.
(2) higher payouts imply that more CPF interest will be paid over the years.
(3) the new age band of 25–34, introduced to allow younger low-wage workers benefit from WIS.

Therefore, the revised policy is expected to cost approximately S$400 million more per year, bringing up the total expenditure on WIS to approximately S$1.4 billion in the first year if the first two recommendations are adopted. Split, this would mean that S$800 million would be paid in cash and S$600 million would be funneled into the CPF. If only the first recommendation is adopted, the cost would be the same, only S$560 million would be given out in cash, while S$840 million would be channeled into the CPF.

If all three recommendations were implemented together, the payout in cash would amount to S$790 million, while S$810 million would be committed to the CPF system for a combined total of S$1.6 billion dollars, benefiting approximately 650,000 Singaporeans.

While this represents a significant cost increase, the impact would potentially limit the need for supplementing retirement incomes to only the most vulnerable, those who are unable to find work throughout their lifetime, reducing expenditure in other social programs. We do not make an explicit judgment regarding the feasibility of these cost increases since the necessary data on expenditure are not available to us at this moment, but believe that they can be balanced with lower overall WIS payouts and lower social support expenditure. The implementation of our recommendations would also reinforce the work ethos, particularly in older age groups, by ensuring that everyone who works consistently can secure their retirement without additional help form the government, and be "rewarded" for work past age 65. Lastly, since the WIS is enshrined as a part of the CPF act, implementing our recommendations would enable a harmonization of WIS's numerical parameters with other CPF policies.

10.5 Nonnumerical WIS Policy Parameters

In the earlier part of the chapter, we discussed the changes in the numerical parameters such as age groups and cash-to-CPF payout ratios. We deliberately refrained from changing WIS income qualifying levels and maximum payout levels as they are exogenously determined, e.g., by relative 2nd to 3rd decile income levels and government budget allocations. The discussion of these "rules" is emphasized in this section as the introduction of a workfare scheme is nested in wage and pension systems, which are highly country-specific and (we argue) greatly affect parameter design.

In this second part of the chapter, we use the Singaporean context to discuss how administrative and operational parameters also impact the WIS efficacy and efficiency, and also discuss future directions.

10.5.1 Operational Efficacy and Administrative Efficiency

While past WIS reviews have focused on the numerical aspects of the policy, that is, the maximum income threshold and the amount paid, less attention has been paid to the operational and administrative efficiency of WIS. These can range from how workers' income is measured to the requirements regarding the months of work.

Initially, WIS had both income and month of work requirements, which, for example, can be seen from this paragraph in the 2012 frequently asked questions:

> Today, employees are eligible for half of the annual WIS if they worked 3 months in a 6-month period while those who worked at least 6 months in the year will be eligible for the full annual WIS. With the increase in payment frequency, an employee will now qualify for a quarter of the annual WIS if he works at least two out of three months, and if the average gross monthly income is not more than (SGD)$1,700 for the period worked.

The criteria, meant to disqualify workers with varying month-to-month incomes such as salespersons on commissions, and the months-in-period work requirements nonetheless made operationalizing the scheme more complicated. The government also has to conduct audits to make sure that companies report the correct income levels. For example, the CPF Board does not necessarily take overpayment as an offense, but overreporting income (which benefit companies in other government schemes such as fulfilling local hiring quotas for the hiring of foreign workers) could impact the individual receiving WIS payments.

Secondly, for higher-wage workers who lose their jobs, the maximum income level is a moving 12-month average income requirement that must go down to qualify for WIS. This means that worker A, who was earning more than worker B before unemployment, needs to either take up a lower-paying next job or risk losing out on several months of benefit. This income difference that affects the WIS qualifications can be rather marginal.

With regards to the measurement of monthly income, the WIS scheme only takes into account the total income earned in the respective month as collected by the CPF Board, disregarding hours of work and number of jobs held. This can potentially have an impact on the work effort of lower income workers, who may work multiple jobs to make ends meet. At the intensive margin, they may vary their supply of labor by varying the number of hours they work. Leong et al. (2014) fail to address this by regressing the intensive margin on months of work, where they did not find significant changes. A simple but difficult to operationalize move would be to move toward the reporting of hourly wages and hours of work. That would not only help the administration of WIS be fairer by paying workers based on hourly rates, but would also contribute to improving the future administration of other economic and social policies, such as the Progressive Wage Model, which are most effective when based on hourly wage rates.

Although the WIS income ceiling is adjusted every two or three years through parliamentary acts, we believe that may be less efficient than a pegged income level, as low-wage workers whose wages grow out of the range are automatically disqualified until the ceiling is raised again. Thus, those at the margin just below the income cap may drop in and out of qualifying for WIS that year before WIS income ceilings are revised given their wage growth. We therefore propose that the government consider pegging WIS income ceilings to a measure such as Singapore's core inflation rate produced by the Monetary Authority of Singapore or the annual wage growth. That would better reflect average yearly rising incomes. While we believe that the government can also consider this yearly "inflation factor" for WIS payouts, the mechanics of adjusting the curves (in Table 10.2 for example) are less straightforward.

Other disqualifying criteria, such as the property ownership and income of spouses, also matter when going through, e.g., long, drawn-out court proceedings on divorce, as well as incomplete records that may not have been updated or connected across different government agencies. For example, Muslim marriages in Singapore are done in the Syariah Court, which operates separately from the official state Registry of Marriages.

The above discussion shows that studying rule changes can help genuinely deserving recipients. Furthermore, older and less-educated workers who constitute a majority of WIS recipients, may not have the knowledge necessary to navigate the system of automatic opt-out administrative rules such as those regarding the marital status and may thus not realize they do not qualify even though they meet the income criterion. We, however, note that some of these rules are inherently embedded in the greater CPF system, a historical artefact from 1955, when the British colonial government set it up for colonial employees, and that the inertia to change is high (See Section 10.2 on the CPF).

More realistically, we recognize that some WIS recipients may thus end up needing a mix of measures to meet their basic expenditure, particularly in retirement, such as the Silver Support GST Vouchers; U-Save rebates, government subsidies; Medisave, MediShield, and MediFund (3Ms); the Community Health Assist Scheme (CHAS); the Pioneer and Merdeka cohort generation packages; familial transfers; old-age work; and charitable food banks (Zaqy 2019). This tiered approach to meeting basic needs raises the question of whether applying the Tinbergen Norm and the work in behavioral economics on "bandwidth taxes" (Mullainathan and Shafir 2013) may suggest that reducing the number of schemes can help improve the efficiency of the overall system by discouraging those in need from "shopping" across different schemes and, instead, channeling those who are able to work toward paid work, particularly with improved WIS payouts.

Not surprisingly, it is in this context that the National Trades Union Congress (NTUC) has made calls to increase the percentage of WIS cash payouts, as WIS recipients still face trouble financing daily expenditure. The NTUC is the main body under which all labor unions in Singapore reside. The NTUC has also lobbied for higher WIS payments for younger low-wage workers with young dependents (Seow 2019). These issues were raised as recently as in the annual Committee of Supply debates in 2019 (Zaqy 2019). The challenge facing policy makers is thus finding the appropriate balance between helping low-wage workers achieve retirement adequacy in the long run and meeting their current expenditure needs.

Thus, our earlier three recommendations and suggestions to simplify WIS administrative rules strengthens WIS now and lessens the pressure on other social support mechanisms in helping Singapore's elderly in the future.

10.5.2 Trends in Education Profiles—Future WIS Recipients

In looking toward the future, the post-COVID-19 era, we used a proxy of current education profiles for those below 35, which is the eligibility threshold for WIS, to measure the size of future cohorts of WIS recipients (Appendix 10.5).

Our proxy of labor force education trends suggests that the low-waged workforce is here to stay for the medium term. In 2008, there were 546,800 workers (or about 44% of the labor force) with secondary or below education. In 2018, this number increased slightly to 547,500, but proportionally dropped to 37% of the labor force (Ministry of Manpower 2008, 2018). If we take the 25–29 cohort in 2018 as a rough guide, about 18% of that cohort remains with secondary or below education. The targeting of the WIS may have thus have to be adjusted in line with the labor force profiles both in the short and medium-long terms.

Two trends are immediately apparent: first, those with only post-secondary education and age 35 and over continue to form the largest share of workers in the labor force. This translates to roughly slightly less than one-third of the 400,000 current recipients of the WIS. The second trend is that those with post-secondary and below education aged 25 to 34, in contrast, form the smallest group, but it is not clear if they will trend toward zero. Even if they do, relative income differences do not mean that the WIS is no longer needed. Narrowing income gaps between these and other groups, particularly with the workers who hold a vocational diploma and professional (non-degree) qualifications, may prove to be a problem in the sense that improving education may not necessarily lead to an income growth beyond Workfare income benchmarks.

It is difficult to answer these questions beyond a simple trend analysis, considering the lack of accessible micro-data for determining who the prospective bottom 20% are. Using education profiles is a rough proxy for illustrating broad trends.

Lastly, another potential problem with narrowing incomes is that even those with some education (and presumably higher income trajectories) may end up receiving the WIS if the WIS income ceilings increase faster than income growth. This is most tricky for those with post-secondary vocational education, who become eligible to receive WIS when they turn 35.

10.5.3 WIS in the Context of COVID-19

The COVID-19 pandemic has further highlighted the gap in social support for lower-income workers. In Singapore, individuals who experienced job or significant income loss were eligible to apply for a COVID-19 support grant of up to S$800 a month for 3 months. Those who only experienced an income drop of up to 30% were eligible only for a S$500 grant. This was extended in October 2020 for another 3 months, but with additional requirements regarding job search and training. Meanwhile, self-employed persons (SEP) received three cash payments under the SEP Income Relief Scheme (SIRS) of S$3,000 each (S$9,000 in total) in May, July, and October 2020, respectively.

As for universal payments, S$600 was given to all Singaporean citizens in April 2020 as a "solidarity payment", to which additional S$300 and/or $600 were added in case their annual incomes assessed in 2019 were below S$100,000. The individuals who were also WIS recipients in 2019 would receive an additional S$3,000, paid out equally in two payments in July and October 2020. In August 2020 it was also announced that individuals who became WIS recipients in that year would also receive the S$3,000 handout. Some permanent (non-citizen) residents were also eligible for a portion of the solidarity payment (S$300). This excludes other payments in-kind available to households living in smaller-sized flats in the form of grocery vouchers, goods and services and tax (GST) (U-Save (utilities and conservancy) credits, grants to self-help groups, and service and conservancy charges rebates.[2]

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[2] See the Singapore Budget website for details: https://www.singaporebudget.gov.sg/budget_2020/budget-measures/care-and-support-package.

This tiering of the benefits, including the in-kind credits and rebates, signals a heavy skew towards lower-income households, providing them with regular cash payments from April through to the end of the year and helping them with the costs of living.

These measures suggest that low-wage workers, exemplified by WIS recipients, typically older and with lower income, required more help, particularly during crises. The Singapore government also provides cash payments under the Care and Support Package, particularly for different groups of workers who may have experienced job or significant income loss. Other monies were also set aside for subsidizing groceries, social services, and mandatory utility payments. These payments are expected to run until the end of 2020.[3] More importantly, these measures indicate that low-wage workers, such as WIS recipients, tend to be older and have lower income, and need more help, even outside of crises. Examples of such assistance include unemployment and wage-loss income support, structured training and more effort in continuing to coordinate different social services (Ministry of Social and Family Development 2018).

Lastly, while a key pillar of retirement savings, transfers are not an end-all for solving the monetary problems lower-waged workers face. Efforts should be made not only to coordinate between different social services, but also to consolidate their provision in order to better monitor the policy outcomes and recipient conditions in moving towards better evidenced-based policies.

10.6 Lessons from the Workplace Income Supplement Scheme for Asian Countries

It is clear that the WIS has some distinct advantages over programs such as the EITC, which pays out at the household level but encounters intra-household work maximization problems. This issue stems from the design of the program, which leads workers to maximize their work hours while staying under the threshold so as not to exceed the eligibility criterium of the EITC. This again highlights the importance of non-numerical scheme parameters, such as eligibility conditions that impact scheme take-up. This is of particular importance in Asian countries with a large nonformal sector. While it is likely that formal sectors are composed of higher-income individuals, lower-income individuals could be attracted to first join the formal sector or start reporting their incomes in order to receive the income supplement.

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3 For more details, see the Singapore Ministry of Finance website) https://www.singaporebudget.gov.sg/budget_2020/budget-measures/care-and-support-package.

A second benefit of paying an income benefit based on taxes levied on higher-income individuals is that it encourages the reporting of income by employees, which goes toward validating the employer–employee relationship and can be used as a basis for enforcing other labor laws relating to workplace safety, conditions and rights. Lee and Saez (2012) find that an income supplement, with an existing minimum wage in place, is nonetheless efficient if the redistribution is valued and the program is financed by taxes at higher income levels. This means that countries can consider an income tax specifically targeted at redistributing toward lower-income groups without distorting the existing labor markets.

Despite the lack of studies accounting for the benefits of WIS for current cohorts of workers, it is clear from our simulations that as long as workers work and receive workfare payouts into their retirement savings, their retirement adequacy improves at no cost to their current consumption. This suggests the better potential of WIS-type income and/or retirement supplements in comparison to traditional welfare payments in pay-as-you-go systems.

While it has to be tailored to the specific labor market conditions within a country or city, an income supplement not only enforces the existing social security systems in a way that costs less, but also helps lower-income individuals save towards retirement through individual effort, particularly in developed countries that face rapid population aging, with limited economic growth going forward. Nevertheless, a version of WIS can be considered for low income workers in cities in developing countries as well.

10.7 Conclusion and Outstanding Questions

In this chapter, we have suggested why we think that the prevalence of low-wage work in Singapore will persist and proposed three amendments to the current WIS policy in the context consisting of a rapidly aging population and the need to improve retirement incomes for the current cohorts of low-waged workers. We have also quantified the impact of our suggested changes on the retirement adequacy for future cohorts of Singaporean low-wage workers.

In the earlier half of the chapter, we started by arguing that the current workfare and CPF policies prepare, roughly, the top 80% of workers for retirement adequacy. Consequently, workers with earnings in the bottom 20% appear to struggle to hit the BRS by the time they turn 55. The first two recommendations for the WIS, that it be combined into a single curve instead of the confusing age-differential curves and that the cash-to-CPF ratios be adjusted across the life-cycle, would help older workers save more though work and the CPF system.

By enhancing WIS to start at a younger age of 25, more low-waged workers would be covered, and the benefits they can derive from WIS would be larger down the road. For example, if low-waged workers accumulated more CPF savings from age 25, they would need less CPF housing grants when they eventually need to buy a public housing flat using their CPF monies. The chapter's findings suggest that when our recommendations are put together, they narrow the income–expenditure shortfall in disposable incomes, particularly for workers in industries with low wage growths. Workfare payouts based on relative levels of consumption across different age profiles imply that a higher cash component helps when the worker is older and has less opportunities to upskill. If WIS payments could start at a younger age, low-wage workers would be able to better build their retirement savings and have significantly improved retirement adequacy outcomes.

Some outstanding questions we suggest for future work include:

- Is the lack of education (and, hence, the prevalence of low-wage work) a cohort problem rather than something more permanent?
- Should WIS continue to only serve the bottom 30% of workers if inequality increases? If so, how should WIS be expanded to compensate for such widening income gaps?
- What is the impact of other schemes supporting spending on basic needs and their implications for the WIS coverage.
- Should WIS also take on the responsibility of bridging unemployment gaps, given the huge difference (up to a third of savings) that is generated by just one month of unemployment every year.

Overall, the above analysis shows that the WIS-related policies and procedure simplification we have proposed significantly improve the retirement adequacy outcomes of the current cohorts of Singapore's low-wage workers as they save for retirement in the conditions of rapid population aging. Saving now is likely to alleviate future pressures. Lastly, the impact on other schemes is likewise significant if the CPF system, with our WIS recommendations, improves CPF retirement adequacy and reduces the need for other social policies (e.g., Public Assistance, Silver Support, etc.) unnecessary in terms of supplementing workers' retirement incomes.

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Appendix 10.1: Details of Workfare Income Supplement Changes over the Years

When the Workfare Income Supplement (WIS) was introduced in 2008, it followed after a year of its predecessor—the Workfare Bonus Scheme (WBS), which paid out. The WBS was introduced in 2007 as part of the 2006 budget package for people who were signed up to the Progress Package.[4] Singapore citizens who were employed for at least 6 months in 2006, aged 40 and above, lived in a property with the annual value of S$10,000 or less and had an average income of S$1,500 or less qualified for the WBS. Employment records were automatically verified using CPF records and maximum payouts of S$600 for the year. The WBS payouts were split between cash and CPF components.

When introduced, the WIS was given to workers above age 35 (lowered from 40 in the WBS) who were earning S$1,500 a month or less, residing in a property, the annual value of which could not exceed S$10,000 (an amount that covered all public housing), and worked for at least 3 months in any 6-month period, or at least 6 months in the calendar year. Payouts started at S$900 per annum for those aged 35 to 44, and were given twice a year based on the assessment of the income earned in previous two quarters.

In 2010, the maximum WIS workers could receive was raised by between S$150 and S$400, with more going to older workers. The income ceiling was also extended to S$1,700 from S$1,500 a month. A Workfare Special Bonus was then issued in 2011, which amounted to the equivalent of 50% of the WIS for the work done in 2010 and 25% per year for the work done in 2011 and 2012. This was implemented in view of the fact that Singapore's economy performed exceptionally well that year. Subsequently, in 2012, the WIS was made to be disbursed four times a year instead of twice a year. This change was made after calls from various members of parliament, who had asked whether the WIS could be paid more frequently so that the payments could be used to meet the daily expenses of low-wage workers.

The next major review in 2013 saw the monthly income ceiling being raised to S$1,900 a month from S$1,700. It was highlighted that the WIS would benefit approximately 480,000 Singaporeans, which amounted to 30% of the citizen workforce. The maximum payment for the WIS was increased between 25% and 50%, and the proportion of the cash component in the payout was raised to 40%, an increase from the original cash-to-CPF ratio of 1:2.5. A larger portion of the increment in

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4 Workfare Bonus Scheme, http://www.mof.gov.sg/progress/wbs_ovw.htm

WIS payouts would be channeled into workers' Medisave and Special Account equally. Lastly, the government also introduced new rules to tighten the WIS focus on low-income households by excluding those who own a second property and those whose spouses earned more than S$70,000 a year.

Similar enhancements to the policy were made in the next review in 2016. The qualifying income ceiling was raised by another S$100 a month to S$2,000 a month. WIS payouts were also increased, but the ratio of cash to CPF was kept the same. The government also simplified the qualifying criteria for WIS by disbursing WIS for every month worked instead of the past criteria of having to work two out of three consecutive months. These payouts were also made more frequent, from quarterly to monthly, which helped meet some of the recipients' immediate expenses.

In the most recent enhancement of WIS in 2019, the qualifying monthly income ceiling was raised by S$300 a month to S$2,300 a month with the maximum annual payouts increasing by up to S$400, similar to the adjustments made during the previous reviews in 2016, 2013, and 2010.

Appendix 10.2: Simulation Results

The simulation is based on the current rule, where workers become eligible to receive the WIS when they turn 35. We examine if they will be able to meet the projected Basic Retirement Sum by the time they turn 55. The key assumption in this second simulation is that there is no accumulation of savings in their Special Account before age 35. The purpose of this simulation is to show the impact of the proposed WIS, as compared to the existing WIS, in the event that only the first two recommendations we proposed are considered.

For the simulation, we first assume no changes in wage growth, increment in the Basic Retirement Sum or Workfare Income Supplement payouts so as to make a direct comparison between the current and proposed Workfare Income Supplement schemes. We arrive at similar findings when we factor in growth across these three parameters.

Next, we also conduct a similar analysis for young entrant workers aged 25, with similar starting salaries at different deciles, as seen in Tables A10.3 and A10.

Table A10.1: Shortfall/Excess to BRS across Income Deciles Based on Current WIS (received from age 35)

Individual Monthly Income Percentile (age 35 and over)	Individual Monthly Income (excluding employer CPF) (S$)	Accumulated Savings in Savings Account by 2049 (S$)	Shortfall/Excess to BRS by 2049 (S$)
10th	1,160	41,740	(46,260)
20th	1,630	52,720	(35,280)
30th	2,190	66,370	(21,630)
40th	2,860	86,680	(1,320)
50th	3,700	112,140	24,140
60th	4,010	121,530	33,530
70th	5,980	181,230	93,230
80th	8,140	246,700	158,700
90th	11,810	357,920	269,920

BRS = Basic Retirement Sum, CPF = Central Provident Fund, WIS = Workfare Income Supplement.
Source: Authors.

Table A10.2: Shortfall/Excess to BRS across Income Deciles Based on Revised WIS (received from age 35)

Individual Monthly Income Percentile (age 35 and over)	Individual Monthly Income (excluding employer CPF) (S$)	Accumulated Savings in Savings Account by 2049 (S$)	Shortfall/Excess to BRS by 2049 (S$)
10th	1,160	64,890	(23,110)
20th	1,630	69,220	(18,780)
30th	2,190	76,280	(11,720)
40th	2,860	86,680	(1,320)
50th	3,700	112,140	24,140
60th	4,010	121,530	33,530
70th	5,980	181,230	93,230
80th	8,140	246,700	158,700
90th	11,810	357,920	269,920

BRS = Basic Retirement Sum, CPF = Central Provident Fund, WIS = Workfare Income Supplement.
Source: Authors.

Table A10.3: Shortfall/Excess to BRS across Income Deciles Based on Current WIS (received from age 25)

Individual Monthly Income Percentile (age 25 and over)	Individual Monthly Income (excluding employer CPF) (S$)	Accumulated Savings in Savings Account by 2049 (S$)	Shortfall/Excess to BRS by 2049 (S$)
10th	1,240	68,950	(19,050)
20th	1,810	92,720	4,720
30th	2,380	119,790	31,790
40th	3,040	153,000	65,000
50th	3,730	187,730	99,730
60th	4,570	230,010	142,010
70th	5,650	284,370	196,370
80th	7,470	375,970	287,970
90th	8,530	429,320	341,320

BRS = Basic Retirement Sum, CPF = Central Provident Fund, WIS = Workfare Income Supplement.
Source: Authors.

Table A10.4: Shortfall/Excess to BRS across Income Deciles Based on Revised WIS

Individual Monthly Income Percentile (age 25 and Over)	Individual Monthly Income (excluding employer CPF) (S$)	Accumulated Savings in Savings Account by 2049 (S$)	Excess to BRS by 2049 (S$)
10th	1,240	107,960	19,960
20th	1,810	117,130	29,130
30th	2,380	129,550	41,550
40th	3,040	153,000	65,000
50th	3,730	187,730	99,730
60th	4,570	230,010	142,010
70th	5,650	284,370	196,370
80th	7,470	375,970	287,970
90th	8,530	429,320	341,320

BRS = Basic Retirement Sum, CPF = Central Provident Fund, WIS = Workfare Income Supplement.
Source: Authors.

Sensitivity Analysis

We make two key assumptions in our analysis—the year-on-year wage growth and continuous employment. In the last and second-to-last decile, a 1% change in wage growth would result in an increase of approximately 4.9% and 13.0%, respectively in the accumulated savings over the span of 30 years. A month of unemployment every year in the bottom two deciles would also result in a decrease of approximately 38% and 34% in the accumulated savings over the same time period.

Appendix 10.3: Additional Tables and Results

Summary of Proposed WIS Changes

Table A10.5: Illustration of Current and Proposed WIS Payouts across Different Age Groups

Age Group (years)	Current Max WIS Payout for Employees (S$)	Current WIS Payout per Dollar increase in Gross Monthly Wage (S$)	Current Cash to CPF Component Ratio	Gross Monthly Income Ceiling (S$)
35 to 44	1,500	2.20	40:60	$2,300
45 to 54	2,200	3.00		
55 to 59	2,900	3.30		
60 and above	3,600	3.60		
Age Group (years)	**Proposed Max WIS Payout for Employees (S$)**	**Proposed WIS Payout per Dollar increase in Gross Monthly Wage (S$)**	**Proposed Cash to CPF Component Ratio**	**Gross Monthly Income Ceiling (S$)**
25 to 34	3,600	6	0:100	2,600
35 to 44			20:80	
45 to 54			40:60	
55 to 59			80:20	

CPF = Central Provident Fund, WIS = Workfare Income Supplement.

Source: Authors.

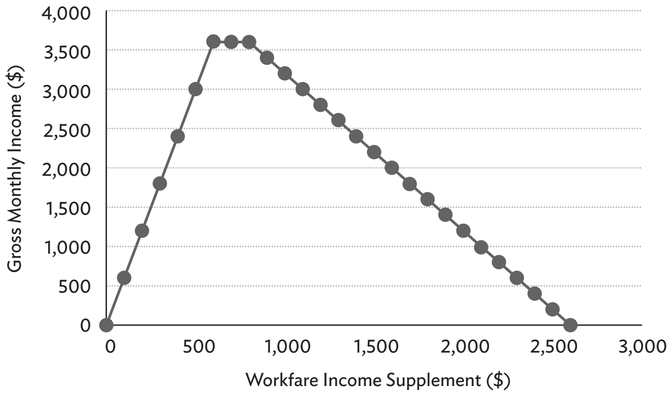
Table A10.6: Illustration of the Proposed WIS Payout Structure

Income (S$)	Workfare (S$)
0	0
100	600
200	1,200
300	1,800
400	2,400
500	3,000
600	3,600
700	3,600
800	3,600
900	3,400
1,000	3,200
1,100	3,000
1,200	2,800
1,300	2,600
1,400	2,400
1,500	2,200
1,600	2,000
1,700	1,800
1,800	1,600
1,900	1,400
2,000	1,200
2,100	1,000
2,200	800
2,300	600
2,400	400
2,500	200
2,600	0

WIS = Workfare Income Supplement.

Source: Authors.

Figure A10.1: Illustration of the Proposed WIS Payout Structure



WIS = Workfare Income Supplement.

Source: Authors.

Appendix 10.4: Data, Methodology, and Assumptions

In order to conduct the simulation, we interpolated income data from the Ministry of Manpower's website to find out the individual monthly income of each decile for those aged 25 to 34 and those aged 35 and above. We also used the following CPF allocation and interest rates to project the individual's savings in their Ordinary Account and Special Account.

Table A10.7: CPF Allocation Rates by Age

Employee Age (Years)	Allocation Rates (for monthly wages ≥S$750)		
	Ordinary Account (% of Wage)	Special Account (% of Wage)	Medisave Account (% of Wage)
Below 35	23	6	8
35 to 44	21	7	9
45 to 49	19	8	10
Above 50 to 54	15	11.5	10.5
Above 55 to 59	12	3.5	10.5
60 to 64	3.5	2.5	10.5
65 and above	1	1	10.5

CPF = Central Provident Fund.

Source: CPF Board 2020a.

Table A10.8: WIS–CPF Allocation Rates by Age

Age (Years)	Ratio of WIS CPF		
	Ordinary Account	MediSave Account	Special Account
Below 35	0.6217	0.2162	0.1621
35 to 44	0.2856	0.3711	0.3433
45 to 49	0.2785	0.3816	0.3399
50 to 54	0.2498	0.3751	0.3751
55 to 59	0.4315	0.4545	0.1140
60 to 64	0.2080	0.6384	0.1536
65 and above	0.0784	0.8408	0.0808

CPF = Central Provident Fund, WIS = Workfare Income Supplement.

Note: The highest age group should be pegged to and adjusted with increasing CPF payout eligibility ages, if any.

Source: CPF Board 2020b.

Table A10.9: CPF Interest Rates

Type of Account	Ordinary Account	Special Account
Interest Rate	2.50%	4.00%

CPF = Central Provident Fund.
Source: CPF Board 2020c.

We make the following assumptions in our analysis aimed at illustrating the change in cash-to-CPF ratios for workfare payouts:

- The worker is an employee and is not self-employed
- We exclude all bonuses that the worker receives
- Workfare payouts do not increase over the years and remain at the current quantum for all age groups
- Continuous employment throughout the simulation period

In calculating the workfare payouts, we round off the income to the nearest S$10 and follow the workfare calculator that can be found here: https://www.workfare.gov.sg/Pages/Calculator.aspx

Interpolating Income Data

Reusing the same formula from an earlier paper, we interpolated income data to get relevant percentile for the age 25 and above group using the formula:

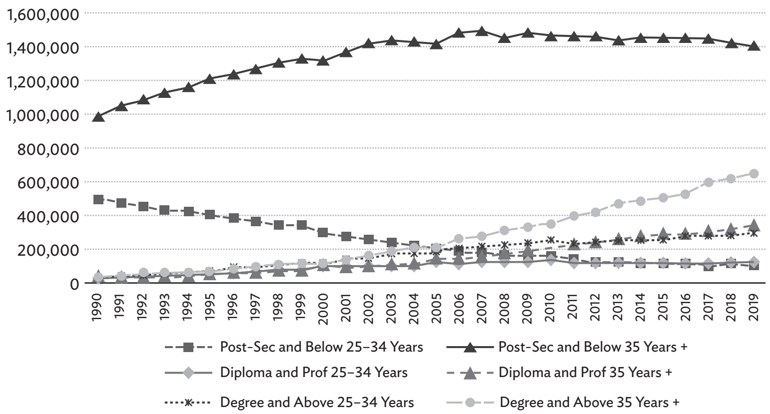
$$P = B + (Popratio*R)$$

where *P* is the income percentile
B is the bottom of the income range
Popratio divides the nth person of the decile in the range by the total number of persons in the range, e.g., the 20th percentile person is calculated by the formula [(43,460 - 16,600) / 31,600]
R is the income range the nth person of the decile is in.

Note: Figures retrieved from Table 31, "Gross Monthly Income from Work 2018", Ministry of Manpower website, retrieved from https://stats.mom.gov.sg/Pages/Gross-Monthly-Income-Tables2018.aspx

Appendix 10.5

Figure A10.2: Education Profiles in Singapore, 1990 to 2019



Source: Authors.

11

Rural–Urban Migration and Demographic Transition in Viet Nam

Huong Vo

11.1 Introduction

11.1.1 Rural–Urban Migration in Viet Nam

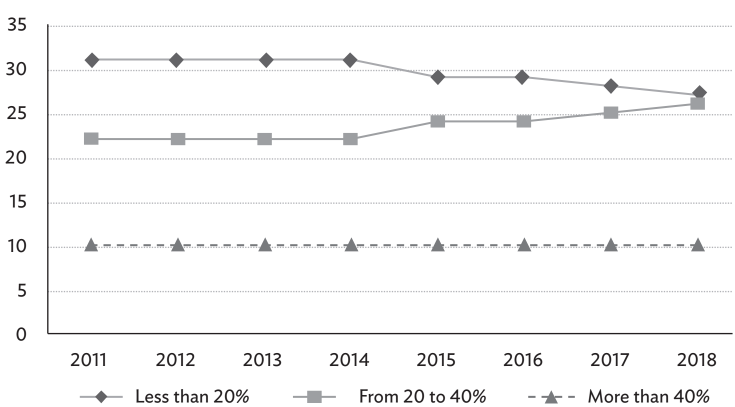
Đổi Mới, the economic and political reforms launched in Viet Nam in 1986, guided the country to becoming a "socialist-oriented market economy" by abandoning a centrally planned economy and adopting market-oriented measures, including opening the domestic market, encouragement of the private sector, and foreign direct investment (FDI), at the same time reducing subsidies to state-owned enterprises (SOEs). Since the Đổi Mới policy, Viet Nam has witnessed rapid industrialization. Complementing the industrial development process, the policy reform has allowed citizens to relocate to urban areas for the first time. These favorable conditions have facilitated the rural-urban migration flow in Viet Nam, which has shown an unbroken upward trend. The 2015 National Internal Migration Survey found that almost half of the migrants (49.8%) move from rural to urban areas. In contrast, the opposite direction (urban–rural) accounts for only 2.9% of the total internal migration flow (GSO and UNFPA 2016). "Pull factors" of destinations play a predominant role in rural–urban migration decisions in Viet Nam, while "push factors" of sending places are less influential. This phenomenon was also captured by another study based on a different dataset: the Viet Nam Rural–Urban Migration Survey conducted in 2013. Nguyen, Dang, and Liu (2019) found that, despite being pushed away from their rural homes as a defensive attempt to reduce expenditure, workers' ultimate purpose for migration was to improve their life quality. Cities like Ho Chi Minh City, Ha Noi, Da Nang, and some emerging regions such as the southeast provinces (Binh Duong, Dong Nai) have been attracting people from rural areas (Cu 2005; Nguyen-Hoang and McPeak 2010; Coxhead, Nguyen, and Vu 2015).

11.1.2 Rural–Urban Migration, Urbanization, and its Consequences

Internal migration in Viet Nam is characterized by migrants' uneven flow to different destinations of their choices. There are 63 provinces in three geographical areas: the northern, central, and southern. Even though urbanization is developing rapidly as a whole, with the urban population of 40.9% of the country's population in 2019 (UNFPA 2019), the number of provinces with more than 40% of urban citizens remained constant at 10 over a period of 8 years, from 2011–2018 (Figure 11.1). In contrast, the figure for rural regions with less than 20% of the population living in metropolitan areas started to decline from 2014, from 31 to 27.

To understand the provincial characteristics in the context of urbanization, a panel data with information on population, employment-related factors, basic infrastructure, and public services of 63 provinces

Figure 11.1: Number of Provinces by Percentage of Urban Population



Source: General Statistics Office (GSO) of Viet Nam.

from 2011–2018 is constructed. The primary data sources are local data collected by the General Statistics Office (GSO) of Viet Nam; the amount of foreign direct investment inflow from the Foreign Investment Agency—Ministry of Planning and Investment; the Provincial Governance and Public Administration Performance Index (PAPI), provided by the Centre for Community Support Development Studies (CECODES), and the United Nations Development Programme (UNDP).

In this dataset, the provincial net migration rate acts as a proxy of provinces' attractiveness and varies by the destination's urban population rate. In Table 11.1, low urbanized provinces have an urban population rate of less than 20%; areas with the proportion of urban citizens from 20% to 39% are classified as medium urbanized. In comparison, super-urbanized provinces are regions where more than 60% of the population lives in metropolitan areas. This classification allows us to compare locational characteristics at different levels of urbanization.

Table 11.1 highlights the opposite status of the net migration rate in rural and urban regions. With population density of fewer than 400 people per square km, rural provinces are sending areas with a negative migration rate. In contrast, super-urbanized cities, with an average of 75% urban population and a density of 1,316 people per square km, witnessed the highest average net migration rate, at almost 10%. This trend is alarming because the limited infrastructure in Vietnamese cities can harm the quality of life of its citizens. For instance, the 8-year average PAPI score for basic infrastructure in super-urbanized regions is 2.07, lower than the score of provinces within the highly urbanized category (2.14). This basic infrastructure index represents the quality of public goods and services provided by local governments, including access to electricity, the quality of nearby roads, waste management in residential areas, and the quality of drinking water.

There are also concerns that overurbanization in big cities such as Ha Noi and Ho Chi Minh decreases health care and lowers the quality of the education system. Although urban areas have a lower mortality rate among infants and under-five children than rural areas, the healthcare system in cities is under pressure. The number of doctors, nurses, and hospital beds per capita in cities is slightly higher than in rural regions. However, well-known hospitals are concentrated in cities and provide services for both local patients and those from other provinces. Therefore, the quantities per capita are significantly overestimated. In 2018, Ho Chi Minh City's Health Department stated that non-locals accounted for approximately 60% of the city's total patients, and that the city's hospitals received 41.9 million people for check-ups and treatment in 2017, accounting for 25.8% of the total number of patients nationwide that year (VNA 2018). Concerning the education system,

Table 11.1: Provincial Characteristics by Level of Urbanization

	Low urbanized (urban pop. <20%) (N=237)	Medium urbanized (urban pop. <40%) (N=187)	High urbanized (urban pop. <60%) (N=41)	Super urbanized (urban pop. >60%) (N=39)
Population				
Net migration rate	−2.14	−2.38	0.15	9.98
	(4.75)	(5.50)	(3.09)	(16.58)
Density	384.74	351.30	864.29	1,316.22
	(345.34)	(334.26)	(743.94)	(1,337.59)
Urban population (%)	0.16	0.28	0.48	0.75
	(0.03)	(0.05)	(0.05)	(0.11)
Natural increase rate	9.56	9.84	8.54	10.22
	(3.96)	(3.18)	(1.83)	(3.18)
Employment & Industry				
Labor force	762.22	722.56	1,340.84	1,502.80
	(427.45)	(321.16)	(1,231.27)	(1,428.01)
Average income	1,985.06	2,364.51	3,305.71	3,943.65
	(757.24)	(839.41)	(1,158.11)	(1,159.54)
FDI inflows	208.53	289.45	1,283.88	1,376.77
	(416.25)	(643.88)	(1,611.62)	(1,792.90)
Percent employed	61.07	58.04	53.79	55.21
	(3.07)	(3.04)	(1.81)	(4.77)
Facilities & Services				
Number of supermarkets	8.15	6.02	33.20	55.13
	(7.97)	(5.80)	(41.15)	(67.73)
Living cost (Ha Noi = 100)	90.49	90.85	94.52	94.74
	(4.84)	(4.01)	(3.86)	(3.63)
Volume of passenger traffic	897.71	1,298.25	3,371.06	5,423.27
	(872.44)	(1,210.84)	(3,791.34)	(5,620.04)
Volume of freight traffic	1,051.42	933.51	4,856.53	5,866.82
	(1,491.33)	(876.55)	(6,038.13)	(8,364.40)
Personal procedures (PAPI score)	1.89	1.89	1.86	1.87
	(0.08)	(0.08)	(0.07)	(0.09)
Basic infrastructure (PAPI score)	1.70	1.80	2.14	2.07
	(0.24)	(0.23)	(0.24)	(0.29)

continued on next page

Table 11.1 *continued*

	Low urbanized (urban pop. <20%) (N=237)	Medium urbanized (urban pop. <40%) (N=187)	High urbanized (urban pop. <60%) (N=41)	Super urbanized (urban pop. >60%) (N=39)
Healthcare & education				
Vaccination (%)	95.90	95.69	96.61	95.98
	(4.21)	(4.13)	(3.03)	(4.25)
Under-5 mortality rate	26.843	26.437	19.579	14.954
	(12.644)	(12.091)	(6.241)	(3.826)
Infant mortality rate	17.681	17.420	13.010	9.938
	(7.939)	(7.710)	(4.075)	(2.575)
Doctors per capita	0.66	0.64	0.56	0.67
	(0.20)	(0.17)	(0.14)	(0.29)
Nurses per capita	0.95	1.01	0.89	1.03
	(0.28)	(0.32)	(0.33)	(0.47)
Hospital beds per capita	2.06	2.14	1.91	2.58
	(0.46)	(0.49)	(0.58)	(1.00)
Public primary education (PAPI score)	1.65	1.66	1.66	1.64
	(0.16)	(0.14)	(0.18)	(0.20)
Primary school teachers per student	0.06	0.06	0.05	0.04
	(0.01)	(0.01)	(0.01)	(0.01)
Libraries per capita	0.02	0.02	0.01	0.01
	(0.02)	(0.02)	(0.02)	(0.01)
Literacy rate	91.883	92.520	96.176	96.833
	(8.766)	(4.756)	(2.269)	(1.383)
Trained employees (%)	14.73	14.94	26.21	27.96
	(4.06)	(5.00)	(8.21)	(9.48)

FDI = foreign direct investment, PAPI = Public Administration Performance Index.
Source: Author's calculation of the data from GSO, Foreign Investment Agency, and PAPI.

the average primary teacher-student ratio is the lowest in some of the most urbanized regions. The average PAPI score for public primary education also supports the observation that primary education is lagging in big cities.

However, highly urbanized destinations have not yet lost their attractiveness, especially for people who migrate to work. With the highest average income of as high as VND4 million (approximately $170) in big cities, double the figure in rural regions and a reasonable living cost, which is not much higher than in less urbanized provinces, working in cities can be considered a good decision. The proportion of workers who are trained is also higher in more urbanized regions. Additionally, urban amenities such as supermarkets and good connectivity (indicated by a much higher volume of passenger and freight traffic) are also advantageous in big cities.

According to the United Nations Population Fund (UNFPA) (2019), the annual population growth rate in urban areas from 2009 to 2019 was the fastest, at 2.64% on average. This growth rate doubles the national average population growth rate and is almost six times higher than the figure in rural areas over the same period. Dyson (2011), in his study on the role of the demographic transition and urbanization, argues that this pattern of migration typically raises the urban rate of population growth and reduces the rural growth rate. Eventually, it would lead to urbanization. This phenomenon is well observed in the urbanization process in Viet Nam, which has caused issues such as overurbanization and demographic imbalance between rural and urban areas.

Managing human mobility is one of the most significant challenges for receiving regions, especially in emerging economies such as Viet Nam. The causes of migration and migratory flows for different types of migrants are difficult to understand and forecast, posing difficulties for national and local governments, particularly in already crowded cities, such as Ha Noi and Ho Chi Minh City. A high volume of migrants arriving in the cities, raising pressure for the provision of essential urban infrastructure and services to meet the growing population needs. According to the People's Committee of Ho Chi Minh City, in recent years, the city has received at least 200,000 to 400,000 people migrated from other provinces yearly (VOV–TPHCM 2018). It is also projected that urbanization will intensify, requiring the government to come up with a timely response to some of the challenges of integration. For example, a study by the Viet Nam General Statistics Office in 2011 reported that there was a high proportion of households sharing a cramped dwelling in the most-developed urban areas (GSO 2011).

On the other hand, there is a gender imbalance between rural and urban areas in Viet Nam. In 2015, female migrants made up 52.4% of total migrants. This phenomenon is referred to as the "feminization of migration" and was first noticed in the 2004 Viet Nam Migration Survey (GSO and UNFPA 2016). This phenomenon was also observed by the 2019 Housing and Population Census, given that the gender ratio in urban and rural areas was 96.5 males per 100 females and 100.4 males per 100 females, respectively (UNFPA 2019). Industrialization in Viet Nam is fueled by the export of labor-intensive manufactured goods of key sectors such as apparel, footwear, electronics, and seafood processing, which tend to employ more females than males. For example, approximately 80% of the garment and electronics manufacturing workers are women (ILO 2018, IPEN and CGFED 2017). Besides, as most people migrate for employment, older adults are left behind. UNFPA (2019) shows that 72.5% of the elderly population live in rural and mountainous areas. The demographic imbalance between rural–urban areas leads to social inequality and intensifies regional disparity in Viet Nam. However, research has shown that economic gains and remittances from urban migration play an essential role in improving living standards and reducing the poverty of the family members left behind (Duong 2010, Nguyen 2013, Pfau and Giang 2010).

11.1.3 Motivation of the Study

Rural–urban migration plays an important role in both two major demographic trends in Viet Nam, namely urbanization and aging. Urban regions attract the young people from rural areas, which increases the urbanization rate at receiving regions, yet leaving a rapidly aging population in the sending regions. Besides, the influx of migrants also significantly complicates the age structure of cities. This chapter seeks to produce some insights into the problem of over urbanization and aging by studying the rural–urban migration determinants and its impacts on the demographic transition of Viet Nam.

11.2 Bigger City, Better Life?

Many provinces, such as the ones in the Mekong Delta and Northern Mountainous region, are suffering from an ongoing population decline. In contrast, other cities, including Ha Noi and Ho Chi Minh City, have experienced an increase in the numbers of inhabitants in recent years. What makes a city attractive? To answer this question, we will first analyze the determinants of the internal migration imbalance in Viet Nam between 2011 and 2018.

11.2.1 The Random Effects Model

The first objective of this chapter is to identify the factors in receiving regions that attract migrants. For this purpose, a balance panel model with random effects (RE) for the period 2011 to 2018 is estimated for

63 provinces. Although the fixed effects (FE) method is often preferred, it is considered a within-group estimation method that can potentially ignore the between-group variance (Çağatay et al. 2014). Furthermore, the RE model is chosen because there is a time-invariant variable in the model, namely the level of urbanization. As shown in Figure 11.1, the number of provinces with more than 40% of urban citizens was constant at 10 over the course of 8 years. In the context of Viet Nam, rapid urbanization is witnessed only in a few regions, while the urbanization level of most of the other areas does not change over time. In this case, the FE model is not feasible to estimate the net migration of regions whose urbanization level is not significantly varied over time and will lead to collinearity. For this reason, RE has also been widely used in the study of migration, especially internal migration. For example, Pavković, Pejović, and Palić (2018) applied RE to investigate the international migration pattern in the European Union, where borderless migration between member countries makes it closely resemble internal migration. The same approach is employed by Doğan and Kabadayı (2015) to study Turkey's internal migration phenomenon. Nevertheless, a Hausman specification test is performed to assess the suitability of the model statistically. Testing the random effects procedure against fixed effects, a Hausman test statistic is calculated as χ^2 equals 5.77 with an insignificant p-value at 10%; thus, a random effect model is preferred.

Besides, to determine whether RE is better than the pooled ordinary least squares (P-OLS) model, a Breusch and Pagan Lagrangian multiplier (LM) test is also performed. The test statistic is computed as χ^2 of 40.91 with a probability smaller than 0.001. Thus, the null hypothesis that there is no panel effect is rejected. According to Wooldridge (2010), P-OLS can be better employed to analyze pooled data than panel data. As we are using the same sample of 63 provinces and cities during the same period (2011 to 2018), the RE model is more suitable than P-OLS in capturing the panel effect of the dataset. However, the results for both estimations are recorded as a robustness check.

11.2.2 Empirical Results

The results of both models are shown to be consistent, given that RE and P-OLS estimates do not differ significantly. As the LM test favors the RE model, the results drawn from the RE estimation will be discussed in Table 11.2.

The net migration rate of a province is expected to increase when there are rises in employment-related factors, such as the percentage of employed people, foreign direct investment (FDI) inflows, and average income. These findings are considerably consistent with

Table 11.2: Empirical Results for the RE and P-OLS Models of Migration Determinants

Lagged independent variables	Dependent variable: net migration rate					
	RE (1)	P-OLS (1)	RE (2)	P-OLS (2)	RE (3)	P-OLS (3)
Employment rate	0.620***	0.728***	0.679***	0.725***	0.833***	0.987***
	(0.140)	(0.103)	(0.135)	(0.102)	(0.143)	(0.111)
Percent of trained employees	0.0299	-0.040	0.0664	0.00685	0.172**	0.180**
	(0.080)	(0.0620)	(0.079)	(0.061)	(0.086)	(0.073)
FDI inflows ($ million)	0.001	0.001***	0.001**	0.002***	0.001*	0.002***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(0.0005)
Average income (D 1,000)	0.0028***	0.0035***	0.0029***	0.0034***	0.0034***	0.0037***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Equity in employment indexz	−0.407	−2.834	−1.023	−3.374*	−0.202	−1.645
	(1.561)	(1.774)	(1.613)	(1.798)	(1.647)	(1.797)
Living costs (Ha Noi = 100)	−0.147	0.023	−0.117	0.022	−0.159	−0.077
	(0.099)	(0.092)	(0.099)	(0.090)	(0.109)	(0.105)
Basic infrastructure index			3.579**	3.593**	4.579***	4.372***
			(1.581)	(1.392)	(1.636)	(1.417)
Connectivity indicators	No	No	Yes	Yes	Yes	Yes
Quality of public services	No	No	Yes	Yes	Yes	Yes
Healthcare system indicator	No	No	No	No	Yes	Yes
Education system indicator	No	No	No	No	Yes	Yes
Urbanization level (low urbanized as the base)						
Medium urbanized	1.052	1.133	1.045	0.700	1.548	1.690**
	(1.030)	(0.706)	(0.965)	(0.685)	(0.974)	(0.708)
Highly urbanized	1.758	0.936	0.749	0.116	-0.194	-0.345
	(2.322)	(1.482)	(2.163)	(1.457)	(2.145)	(1.431)
Super-urbanized	8.554***	7.281***	7.922***	7.146***	8.501***	8.071***
	(2.396)	(1.523)	(2.230)	(1.492)	(2.291)	(1.524)
Observations	248	248	248	248	248	248
R^2 within	0.0104	NA	0.0157	NA	0.0442	NA
R^2 between	0.5625	NA	0.6235	NA	0.7167	NA
R^2 overall	0.4688	0.503	0.5183	0.554	0.5976	0.623

FDI = foreign direct investment, NA = not available, P-OLS = pooled ordinary least squares, RE = random effects.

Notes: Standard deviation in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Source: Prepared by the author.

previous studies on internal migration in Viet Nam. The amount of FDI inflow indicates foreign employment opportunities, which were found to attract more migrating individuals (Fukase 2013). The model estimates that if a province manages to raise its FDI inflow by $1 billion a year, it could increase the net migration rate by only 1%, which is a moderate figure for such a high amount of investment. A region that attracts more FDI inflow will create more job opportunities, and, hence, increase the province's employment rate. Indeed, the RE model found that an increase of 1% in a province's employment rate can boost its net migration rate by as high as 0.83%. As long as employment is concerned, migrants tend to move when there is a positive earning gap at the destination. Giang, Nguyen, and Nguyen (2020) also observe that the migration flow is often from low-income provinces to high-income ones. The RE model estimates that an increase of D100,000 ($4.30) in monthly earnings will lead to a 0.34% rise in the net migration rate.

Basic infrastructure appears to have an influence on the migration flow in Viet Nam. The infrastructure index for the 63 provinces in the model ranges from 1.2 to 2.46. The result indicates that an increase of 0.1 in this score raises a province's net migration rate by 0.5%. Therefore, a decline in infrastructure quality may also discourage possible immigrants or push people to emigrate. Other proxies for living quality, such as the education and health care systems, are found to be insignificant. The benefits of economic opportunity in the urban region seem to overshadow these factors. Furthermore, despite the overwhelming quantitative pressure on them, education and healthcare in cities are considered to be of better quality than in rural areas. It is common for Vietnamese people to move to cities to study at a higher level or have special medical treatments that are not available in their home provinces. However, for migrants, access to these public services is considerably more limited as most of them do not have the permanent residential status (*ho khau*) (Duong 2010, Taylor 2011, Demombynes and Vu 2016, Vo 2020). Such exclusiveness of the residence (household) registration system might be the factor that makes education and healthcare appear as they have no significant impact on the migration decisions. Living costs are found to have a negative effect on the net migration rate; however, this effect is also insignificant. From a regional perspective, economic gain is viewed as outweighing the increase in living costs.

It is not surprising that super-urbanized provinces are 8.5 times more likely to be chosen as a destination in comparison with the most rural ones. It is interesting to note that for those provinces that are moderately urbanized but still have less than 60% of the urban population, the results are not significant. This implies that migrants considerably favor big cities over other moderately urbanized regions.

If this trend persists, the problem of overurbanization in some Vietnamese cities might intensify.

11.3 Rural–Urban Migration and Demographic Transition

11.3.1 The Driven Force of Urbanization: Rural–Urban Migration or Natural Increases?

One crucial question to ask in urbanization and migration studies is whether rural–urban migration complications will alter urban demographics. The results from the RE model shows that migrants are still drawn into some of the biggest cities in Viet Nam instead of settling down in other regions. Is rural–urban migration still the main driving force in those already crowded cities? Or is it the natural increase rate that contributes the most to cities' growth? Keyfitz (1980) argues that rural–urban migration is the chief cause of urban growth in the pre-transition period. But with an overall urban population of 50%, the urban natural increase would become the main contributor to urban population growth. De Vries (2006) shows that a large body of literature relates to European cases, where the urban sector was believed to be a significant "sink" in the pre-transitional period and would count on rural–urban migration for population growth. An explanation for this observation can be taken from Dyson (2011). He explained that the crude death rate (CDR) in urban areas is very high in the pre-transitional period due to infectious diseases. However, as deaths from infectious diseases decline, the urban death rate falls more rapidly than the rural one. Therefore, there is a "transition" period: after reaching a certain proportion of urban citizens, the urban population growth will stop relying on rural–urban migration, and instead start relying more on the natural increase due to the number of births surpasses deaths among those already dwelling in cities.

To examine whether most urbanized areas in Viet Nam have passed the "transition," a Pearson correlation test is run to see if there are any potential links between the proportion of the urban population CDR over the observed period (from 2011 to 2018).

From Table 11.3 it is noticeable that the negative correlation between the proportion of the urban population and the CDR increases with the urbanization level, but only for regions that have less than 60% of urban population. For super-urbanized provinces and cities, the correlation is weaker, at –0.24. This confirms the presence of the above-mentioned "transition." That is, after reaching a certain proportion of

Table 11.3: Pearson Correlation Between Crude Death Rate and Level of Urbanization

	Urban population (%)			
	Low urbanized (urban pop. <20%)	Medium urbanized (urban pop. <40%)	High urbanized (urban pop. <60%)	Super urbanized (urban pop. >60%)
	(N=237)	(N=187)	(N=41)	(N=39)
Crude death rate (CDR)	−0.0423	−0.2319	−0.4277	−0.2392

Source: Author's calculation from GSO data.

urban citizens, the urban population growth will stop relying on rural–urban migration, and instead start relying on the natural increase due to the number of births surpasses deaths among those already dwelling in cities. As shown in Table 11.1, the average natural growth rate in super-urbanized regions is higher than in less-urbanized areas, indicating that natural population increase contributes significantly to the population growth of mega-cities. Therefore, decreasing the migration flow to big cities will only be a short-term solution that solves half of the problem regarding overurbanization. For long-term policy planning, we need to consider the structural demographic changes in both urban and rural areas to capture the dynamic of receiving and sending regions.

11.3.2 Rural–Urban Migration and Age Structural Change

Figure 11.2 compares the population pyramids of regions by their urbanization level in 2019. As the percentage of urban population increases, the shapes of the pyramids gradually convert to the shape of super-urbanized regions, with the proportion of older people smoothing out as it gets smaller. The total fertility rate (TFR) in some of the biggest cities are the lowest, with a much smaller base in comparison with rural areas. The correlation shown in Table 11.4 confirmed that the more urbanized the region is, the lower the TFR. Evidently, the 2019 Housing and Population Census indicated that the TFR in rural areas of Viet Nam was 2.26 children per woman, while this figure in urban regions was lower, at 1.83, with Ho Chi Minh City having the lowest TFR in the country (1.39 children per woman) (UNFPA 2019).

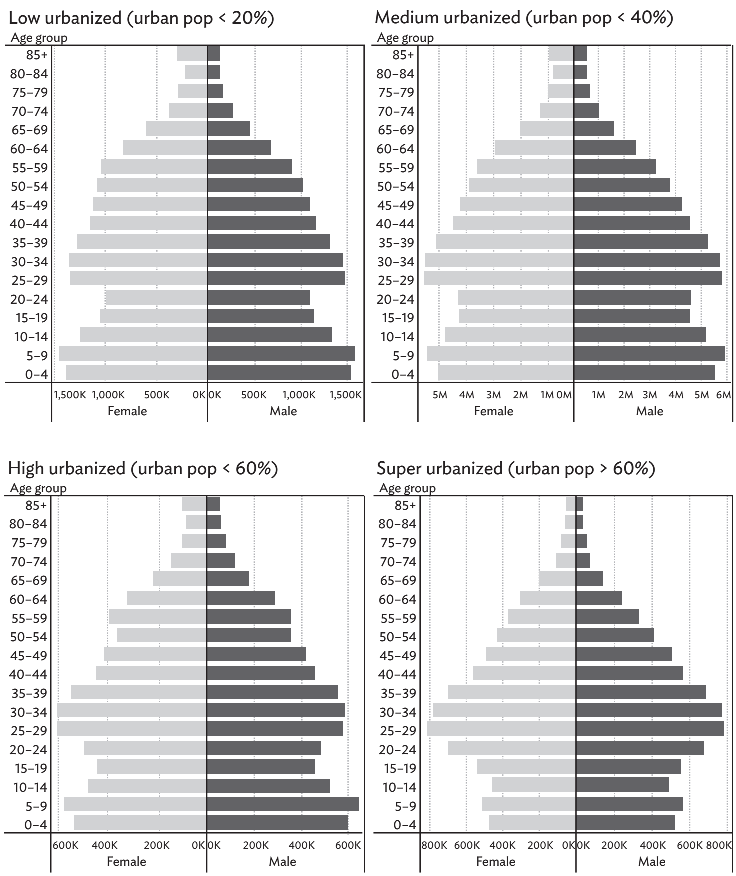
However, the average natural increase in super-urbanized regions is still the highest (Table 11.1) thanks to "population momentum." There are still many women in the reproductive age bracket; therefore, the number of births will be high even when the fertility rate is low. The number of children in cities will not decline as rapidly as the fertility

Table 11.4: Pearson Correlation Between Total Fertility Rate and Urbanization Level

	Urban Population (%)			
	Low urbanized (urban pop. <20%)	Medium urbanized (urban pop. <40%)	High urbanized (urban pop. <60%)	Super urbanized (urban pop. >60%)
	(N=237)	(N=187)	(N=41)	(N=39)
Total fertility rate	0.0615	0.0985	−0.2671	−0.3036

Source: Author's calculation from GSO data.

Figure 11.2: Population Pyramids by Urbanization Level, 2019



Source: Author's calculation from the Viet Nam Housing Population Census 2019.

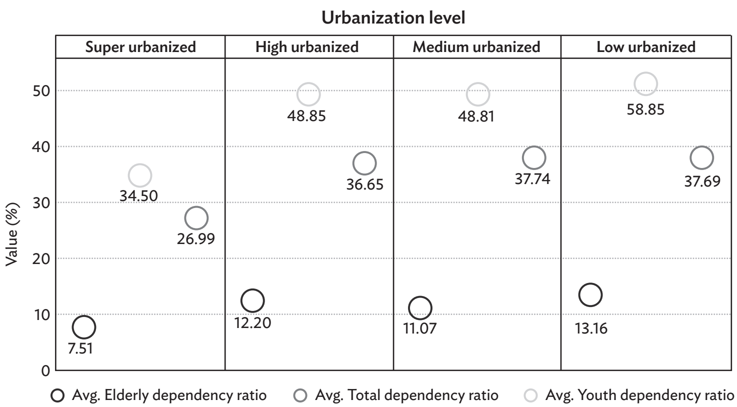
rate as long as the number of women of reproductive age in the cities is still significant.

In some of Viet Nam's biggest cities, the male and female population aged 20–40 years old is much higher than other age groups as illustrated by a large bulge in the body, indicating an influx of immigrants from other regions, especially in the rural areas where the population pyramids have an indentation in the profile due to emigration of young people. The UNFPA (2019) reported 68% of the total migrants are young people from 20–39 years old. The arrivals of female migrants during the past 30 years have contributed to the natural increases rate of big cities such as Ho Chi Minh City.

Figure 11.3 shows the dependency ratios of all regions. The youth and elderly dependency ratios in super-urbanized regions are lowest among regions, due to low fertility rates and high immigration rates of young people. However, this ratio does not take remittances into account as migrants in big cities have dependents in other provinces. More than 30% of migrants sent remittances to their remaining family members at the places of origin (GSO and UNFPA 2016). Other regions surprisingly have a similar total dependency ratio at 49%, with the ratio for most rural areas slightly higher, at approximately 51% due to a higher number of elderly people.

The analysis implies that in the upcoming year, the aging problem in rural areas will continue to be intensified in comparison with urban areas. The more rural the region is, the more vulnerable it is to the

Figure 11.3: Dependency Ratio by Urbanization Level



Source: Author's calculation from the Viet Nam Housing Population Census (2019).

issues, as the low urbanized regions' population pyramid shows they are suffering from the biggest emigration of young people, and the largest proportion of people older than 45.

Without migrants from other regions, the number of young people in super-urbanized regions will decrease in the next 20 years due to the low fertility rate. The urban population will age quickly, and will eventually catch up with rural aging, which will speed up the whole country's aging problem. The result of the RE model implies that super-urbanized regions are still magnetic and continue to attract more migrants. Consequently, Viet Nam's urbanization rate will increase as the "population momentum" will continue to contribute to the increase of urban populations, despite the lower fertility rate.

11.3.3 Challenges Ahead

The complexity and dynamics introduced by rural–urban migration pose some great challenges for Viet Nam's government in population planning, from elderly care for the rural population and managing strained urban infrastructure, to a rapidly decreasing fertility rate in urban regions.

11.3.4 Elderly Care in Rural Regions

Viet Nam is known as being in the "golden population structure" with the country's dependency ratio lower than 50. However, the dependency ratio in some of the most rural regions is above 50 (Figure 11.3) due to out-migration of young people. There are two pressing issues related to elderly care in rural regions of Viet Nam: health care and pensions.

Regarding health care, Viet Nam has been trying to improve the health system. In 2009, Viet Nam passed a law on health insurance regulating a unified system that covered 89% of the population by mid-2020, with the remaining 5% of the poor senior citizens expected to be covered by 2021 (Anh 2021). The insured are reimbursed with up to 80% of treatment costs at a local hospital where the insurance holders registered their citizenship (*đúng tuyến*). Given that rural facilities have limited-service capacity where only a few diseases can be treated (Duong et al. 2019, Nguyen et al. 2019), patients often have to go to a higher-level hospital (provincial or central level) to carry out treatments and check-ups, which is not the designated hospital (*trái tuyến*) on their insurance card. Taking that into account, from January 2021 onward, health insurance will cover 100% of inpatient treatment costs at provincial hospitals, even for *trái tuyến* insurance holders, according to Clause 1, Article 22 of the Law on Health Insurance. Within 3 months after the regulation had been in effect, hospitals in Ho Chi Minh City saw a sharp increase in the number of enroled patients from other districts (a 26% increase) and from other provinces (a 20% increase). Despite the government efforts to improve the health care system for rural senior citizens, there are still inevitable consequences. First, elderly people living in rural areas have to travel to adequate hospitals for most of their treatment, which is a financially and physically taxing endeavor. Second, the influx of non-local patients will put more pressure on the already strained hospitals in big cities.

Regarding the pension fund, according to the 2018 Longitudinal Study of Ageing and Health in Viet Nam, while 38.5% of older persons' income source is from their children and 37.3% is from work, only 23.8% of them live on pensions nationwide (Tran, Dang, and Vu 2020). Given that rural people who work in informal sectors do not have employers' contributions to the social pension, Viet Nam started a voluntary pension scheme in 2008, which is available to the self-employed, farmers, and other rural citizens. However, while 15.67 million workers in formal sectors are covered by social insurance, only 890,000 informal workers enrolled in the voluntary pension scheme due to the unaffordability of the scheme (Lan 2021). Nguyen and Chen (2017) also observe that despite the effort to expand social coverage, modern welfare in Viet Nam is still exclusive to the rural population.

11.3.5 The Immediate Problem of Overurbanization

Managing rural welfare is difficult, yet dealing with the urbanization problem is even more strenuous. As mentioned, urban infrastructure in big cities such as Ho Chi Minh City and Ha Noi cannot expand fast enough to keep up with the growing population. UNFPA (2020) stresses that there is immense immigration pressure on jobs, housing, and social security in these cities. They report that for every 1,000 people living in Ha Noi and Ho Chi Minh city, there are nearly 200 immigrants, which is 2.7 times higher than the national average. With lagging infrastructure, residents are forced to improvise with whatever is available to fulfil their basic needs.

11.4 Conclusion

The results indicate that Viet Nam's rural–urban migration is driven mainly by economic opportunities differentials. Regional variations in amenities, including health care and education systems, play a less critical role in this regard. However, it is found that migrants also take into consideration the basic infrastructure of the destination. As important as it is, employment is not the only driver of rural–urban migration. The more urbanized the city is, the more attractive it is to migrants. This chapter also suggests that for big cities such as Ho Chi Minh City, natural increase will become the chief cause of urban population growth; thus, decreasing the influx of migration alone cannot address the issues of overurbanization. While big cities still need to draw in young migrants from rural regions to maintain economic development and slow down the urban aging process, it also poses some great challenges for Viet Nam.

11.5 Policy Implications

To mitigate the impact of overurbanization in big cities, Viet Nam's government needs to exert more effort in managing migration flow while ensuring that there is a necessary labor force for the ongoing industrialization. At the same time, the government needs to improve life quality for older people in rural areas and to prepare for healthy urban aging as urban fertility rate decreases.

Economic Opportunity

This chapter found that employment and economic opportunity are the main factors that draw migrants to big cities. More alarmingly, small and medium-sized cities, including those in the Mekong Delta region, are found to be unattractive to migrants. Viet Nam is in urgent need of strategies to uplift the medium-sized cities in terms of industrialization, as well as public and private goods and services. Once there are more employment opportunities with significant economic gains, there will be more incoming workers, who are also consumers, which will, in turn, contribute to the development and urbanization of the medium-sized cities. However, the limited infrastructure and poor regional connectivity prevent such progress from happening. For instance, seaports in the Mekong Delta can only handle 20%–25% of the total cargo in the region, and the remainder must be transported through ports in the southeastern region, including the major ports in Ho Chi Minh City and Ba Ria-Vung Tau, which have already experienced congestion (VNS 2018). To boost industrialization in the Mekong Delta, the management of the existing ports in the region must be improved. Once successful, this will solve many development issues in the Mekong Delta and surrounding areas, including the migration dilemmas.

Health Care System

Together with the development of regional connectivity and economic development, the health care system in some of the mid-size provincial cities in the sending regions needs to be upgraded to divert the flow of rural patients to hospitals in the big cities. Doing so will significantly reduce the travel time and financial burden of rural residents who are currently seeking specialized treatments in Ho Chi Minh City, Ha Noi, or Da Nang, as well as lessen the burden to central hospitals in big cities. Besides, when mid-sized cities become industrialized and urbanized, the need for a good health care system from an increasing number of migrants and citizens will be met.

Facilitate Returning Migrants

Nguyen, Grote, and Sharma (2017) suggest that most rural–urban migrants intend to return home in the future, while their families expect them to stay in nearby provincial cities, where there are better facilities and more job opportunities, yet are not too far away from their rural homes. This chapter also shows that a decline in basic infrastructure quality may discourage possible immigrants or push people to emigrate. Addtionally, as the urban population also starts to age and will age fast due to the lower fertility rate, it is expected that the number of returning old-age migrants following retirement will increase. Having better infrastructure in small- and mid-sized cities will also facilitate returning migrants, and, at the same time, lift the population pressure from big cities.

Restructure Urban Industries

The government can also restructure urban industries to encourage capital-intensive industries in big cities, while gradually shifting the labor-intensive sectors to other (surrounding) areas. Even in labor-intensive industries such as garment and footwear production, some work segments involving research and development, planning, and customer liaisons can be done in metropolitan areas such as Ho Chi Minh City and Ha Noi, while the actual production can be carried out in other regions. Doing so will require the cooperation of different ministries, as well as numerous private and public organizations.

Reform Minimum Wage System

This study has found that living cost differentials, in general, do not have a substantial effect on migration determinants, especially when the average income is taken into consideration. It would be beneficial for the government to restructure the current minimum wage system to gradually introduce a unified minimum wage in order to avoid the concentration of laborers in urban areas.

Improve Interprovincial Connectivity

To uplift other economic regions and restructure urban industries, we need better connections from and to the central regions such as Ho Chi Minh City and Ha Noi. While high-speed rail is desirable, it would not be realistic due to the high cost and long developing time. With a limited budget and many more pressing issues, such as providing urban infrastructure development and social services, uplifting small and mid-sized cities, improving health care, and social inclusion for rural populations, high-speed rail might need to wait. Some experts also observe that expressways connecting a locality to others should be the top priority in improving regional connection (Huynh 2019), which is a prerequisite for all of the above recommendations.

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12

Economic Impacts of Demographic Transition: The Case of Germany

Dieter Eissel

12.1 Introduction

Declining birthrates and increasing life expectancy have for decades been causing a downscaling relationship between young people, working-age people, and the elderly. This demographic transition, accompanied by an increase of retired citizens, especially those aged 80 and over, has impacts on the demand side, which in Germany is currently almost neglected. It is clear that consumption patterns will change in an aging society. However, the main focus is instead directed at current forecasts of the shrinking of the labor force, which is projected to decrease to only one-third of the current number of workers by 2060 if Germany does not allow immigration (Federal Statistical Office 2016, BMFSFJ 2016).

This chapter will focus on the economic impacts of this demographic transition. The public discussion in this field focuses on the shrinking workforce, especially on experts and specialists needed to meet the challenge of Industry 4.0, since many German companies are already complaining about not having enough highly qualified workers.

There are three main strategies to meet the perceived problem of a shrinking workforce: to prolong the working life period beyond the retirement age, to include more women in the labor market, and to increase the number of highly qualified immigrants from abroad. Nonetheless, there are numerous obstacles to these. With regard to prolonging working life, we have to consider the fact that this will not be possible in all fields where hard, physical labor, and fitness are a precondition, for example, in steel production, mining, roofing work, etc. Engaging more women in the labor market in principle is a good idea because the educational level of both genders is equal.

Nevertheless, there are traditional attitudes concerning the role of men and women that block a higher female occupation ratio, even if the conservative attitude has changed to more equality in the last decades but still is virulent. Second, it is dependent on places in kindergartens for mothers, who have to care for their small children. Most kindergartens are provided by local authorities, which are urged to supply adequate utilities, but many towns are in a financial crisis and do not know how to fulfill the expectations. The strategy of increasing the number of highly qualified immigrants is endangered by rising xenophobia and extreme-right parties, which mobilize against foreigners. Also, there are doubts about whether it would be possible to stop the mass immigration of poorer educated young Africans fleeing their countries because of poverty, climate change, harmful impacts of European highly subsidized agrarian exports on local production, and civil wars. Furthermore, there is a moral problem, when Germany would try to favor a “brain drain” for recruiting experts and specialists from poorer regions in Africa and Asia, where they are needed to develop their own country (Vaupel and Edel 2017).

It is possible that all the complaints about the lack of workforce could be counteracted by the ongoing digitalization of services and robotization of production, which could lead to mass unemployment instead of labor shortages. The debate about the impact of further modernization is controversial. On the one hand, there is the warning that across industries, millions of jobs in production, administration, banking and insurance, and retail, will disappear. Other authors, in contrast, insist on the positive vision that industrial robots secure production sites and will be an important driver for millions of jobs. Both assumptions can be true; nonetheless, are dependent on the time perspective. In the past decade, automation had indeed had a positive net effect on demand for work, because it reduced production costs and prices, and thus increases the demand for products. The additional workers and experts, who were engaged in the starting phase of installing robots and digitalization of services are possibly no longer needed in the long run. The impact on future employment could be negative. Whether rising demand for care in an aging society could compensate this shrinking is not clear.

12.2 Aging Society

Germany, like many other developed countries, is experiencing population aging. In the future, the age structure in all federal states will deteriorate (Vogler-Ludwig, Düll, and Krieche 2013). “Germany is one of the countries in the EU where demographic change has advanced the

Table 12.1: Development of Age Groups in Germany (share in %)

Age Groups	1960	1970	1980	1990	2000	2010	2017
Under 1	1.7	1.3	1.1	1.1	0.9	0.8	0.9
Under 15	21.6	23.1	18.2	17.2	15.5	13.4	13.5
18–59	61.1	56.8	62.4	63.3	60.9	60.3	58.7
60–64	5.8	6.1	3.8	5.5	7.0	5.7	6.5
65 and older	11.6	13.8	15.5	14.9	16.6	20.6	21.4

Source: Federal Statistical Office (2019a).

most. Today, more than a quarter of people in Germany are aged 60 and over" (Federal Statistical Office 2016, BMFSFJ 2016, 6). Life expectancy in Germany has doubled over the past 100 years; there has been an increase of 11 years in the past 50 years (Table 12.1).

More advanced medical care, better welfare, and pensions for elderly persons, as well as other related factors "allow older persons to approach their own maximum lifespan in healthier and more widely conditions" (Baltes and Smith 2003, 126; Felser 2018). Thus, the change in mortality is the result of an improved level of life and medical progress, not only in old age. The main reasons for increasing life expectancy are "initially due to improvements in hygiene, especially in infancy; success in tackling epidemics and preventing diseases; medical improvements in the handling of diseases; progress in health education; the construction of water, energy and other forms of infrastructure essential to good health, especially in densely populated areas; the provision of social welfare benefits; and the improvement of individual development chances through new education opportunities" (Vaupel and Edel 2017, 52).

Nevertheless, this is not true for all elderly people: better nutrition, healthier living, improved social security, and better medical care are dependent on income and education. There is clear evidence that education plays an essential role. In all European Union (EU) countries, there is a strong correlation between education and income on the one hand and the state of health on the other. Poor and less-educated people have a shorter life expectancy, whereas people with a high level of education have a better chance of achieving better living conditions and reaching an older age with better health (Kuntz and Lampert 2018). In addition to the material aspects, income is important for social integration and sociocultural participation as well as for psychosocial well-being and health-related quality of life (Berlin Institute for Population and Development 2017). Even though health problems increase in old age, the majority of senior citizens in Germany aged 65 and over feel fit. Less than 25% say their health is impaired to such an extent that they are unable to pursue their everyday routines. “Among the respondents in the 65 to 74-year-old category, the 20% of people in the highest income quintile are twice as likely to assess their health as being either ‘good’ or ‘very good’ as the 20% of persons in the lowest income quintile” (Federal Statistical Office 2016; BMFSFJ 2016, 7).

The increase of the lifespan was accompanied by declining birthrates, which has already led to a downsizing relationship between young people, working-age people, and the elderly in the past several decades. In Germany, for about 40 years, only two-thirds of the parent generation have been replaced by births. The baby boom generation in the mid-1960s will reach retirement age after 2020 and potential parents are meanwhile pensioners. Regarding the low fertility rate, we have no hope for compensation of the aging society, because Germany has one of the lowest fertility rates in Europe even with the fertility rates increasing since unification from 1.38 in 2000 to 1.57 live births per woman in 2018. “A total fertility rate of around 2.1 live births per woman is considered to be the replacement level in developed countries: in other words, the average number of live births per woman required to keep the population size constant in the absence of migration” (Eurostat 2020). As the micro census of 2018 shows, this moderate rise is in part due to higher fertility rates among immigrants and lower educated women, whereas about one-quarter (26%) of women with academic degrees remained without children (Federal Statistical Office 2019b). So far, the low fertility rate has been in part compensated through a positive migration balance. “Thus, it seems that the only way to substantially increase fertility rates is through immigration, which would boost the number of potential parents” (Vaupel and Edel 2017, 52). However, despite this, there are doubts about whether the number of immigrants to Germany will increase substantially in the next decades. All predictions, therefore, assume that the high life expectancy accompanied by low fertility rates will continue in the coming decades. “That is why the German Federal Statistical Office predicts in the population projection a decrease in population from about 82 million people in 2018 to about 77 million people in 2060” (Martinez-Fernandez et al. 2012, 92).

According to current forecasts, the main problem would be the shrinking of one-third of the workforce by 2060 if Germany does not allow further immigration. This threat of a shrinking workforce is accompanied by an enormous increase of retired citizens. The forecast from 2018 to 2050 assumes that the number of children below age 15 will fall by 1.7 million within the next 30 years, while the number of inhabitants aged 67 to 80 will increase by about 1 million (from 19.5% to 27.1%). The number of very old people (80 and more) will increase by 3.6 million. In relation to 2018, this age group will supposedly have the highest growth rate until 2050 of plus 79.1% (Table 12.2).

Table 12.2: Forecast* of Development of Age Groups (2018 = 100)

	2020	2030	2040	2050
Absolute (in million)	83,365	83,088	80,722	77,578
Below 15	102.1	107.4	100.2	98.7
15–19	96.6	100.8	107.4	99.1
20–29	97.3	87.8	94.0	94.3
30–39	102.6	97.5	88.0	93.6
40–49	96.9	108.4	102.8	93.3
50–59	98.9	74.8	83.6	79.6
60–66	105.4	117.8	89.7	103.7
67–80	98.2	122.6	130.4	109.1
80 and more	109.9	114.0	141.9	179.1

*Moderate development of birthrate, life expectancy, and balance of migration.
Source: Federal Statistical Office (2019a).

This demographic change has impacts on consumption patterns, because the needs of old people are different from those of the younger generation.

12.3 Change of Consumption Patterns in an Aging Society

In view of the progressive aging of German society, seniors will shape demand even more in the future. Health-related products and health and care services will become more important. “The 65 plus generation in Germany is much less inclined to purchase consumer electronics than people of younger age groups. They do however spend more on mobility aids. 7% of senior citizen households in Germany own an e-bike, compared to just 3% of younger households. 42% of senior citizen households own a new car compared to 32% of younger households" (Federal Statistical Office 2016, 8).

Currently, elderly people have, on average, significantly more wealth than younger people. In 2017 the age group of 65–74 years had a net wealth of €166,800 (median), while the corresponding figure for 25–34 year olds was only €13,600 (German Bundesbank 2019). This is the consequence of the higher salary in older age groups.

Table 12.3: Annual Salary Income in 2019 for Different Ages (€)

20 years old	30.131	45 years old	57.456
25 years old	37.428	50 years old	58.213
30 years old	45.213	55 years old	58.121
35 years old	51.819	60 years old	58.658
40 years old	55.627	Average	50.296

Source: Salary Biography (2019).

Seniors in Germany have become an increasingly important group of buyers and an important economic factor. Between 1993 and 2013, consumer spending among the over-60s increased from €192.2 billion to €375.3 billion, almost doubling. During this period, total private consumption rose by 47% to €1,263.1 billion. This is the result of a study by the demographers Tobias Vogt and Fanny Kluge (Max Planck Institute for Demographic Research), which was supported by the initiative "Seven Years Longer" (Vogt and Kluge 2015).

As a result, they also gained weight as consumers. Their share of the total private consumption grew from 22.4% to 29.7% between 1993 and 2013, even though they "only" account for 26% of the population (Table 12.4).

This shows that elderly people in Germany also had above average purchasing power (Paul and Stegbauer 2005). Although the statutory pension level dropped, company and private pensions apparently compensated for this. As the German Institute for Retirement Provision reports, almost every third euro now comes from elderly people. That is why, at the same time, elderly persons in Germany are not only becoming an increasingly important target group for companies, but also an important economic factor (Vaupel and Edel 2017). Nevertheless, there are assumptions and political discussions

Table 12.4: Private Consumption in Germany in by Age Group, 1993 and 2013 (%)

	Percentage of Population		Share of Private Consumption	
	1993	2013	1993	2013
Age group below 30	37.0	29.7	28.0	21.9
30–59	43.8	44.2	49.5	48.4
60 and over	19.1	26.1	22.4	29.7

Sources: National Transfer Accounts (2017), Association of the German Insurance Industry (2017).

that in the future it will be necessary to cut pensions or change the whole pension system, which has until now been dependent on the social contributions of the working generation. It is clear that the current system cannot be continued in the future. At the moment it is unclear in which direction the pension reform will proceed, but the fear of poverty in old age, mainly for those who have earned less than the average during their work life, is real.

The question is whether immigration can compensate for these negative impacts of the aging German society. Can and should Germany acquire the necessary workforce for further technological development from abroad, or would it be sufficient to mobilize more women and the elderly, and engage in better training of migrants, who have already arrived in Germany in recent years?

12.4 Immigration to Meet the Demand for the Qualified Labor Force?

Newer data show that the number of foreigners in Germany increased from 6.7 million in 2007 to 10.9 million in 2018, now accounting for one-quarter of the population (Federal Statistical Office 2019a). About 4.8 million foreigners are EU citizens, mainly coming from Poland, Italy, and Romania. If all people with a migration background are included, then Germany now has 19.3 million people with a migration background, of which 6.1 million were born in Germany and 13.2 million are immigrants.

"Immigration has undergone a massive shift in the recent past, and Germany, which before the outbreak of the civil wars in the Arab world had relatively low levels of immigration, has had a jump in population growth. Therefore, it is not hard to predict that in the coming years, more pressure will be experienced by immigrants coming from other crisis regions of the world" (Vaupel and Edel 2017, 52). For now, Germany will remain a destiny for migrants. Nevertheless, concerning the strategy to meet the issue of shrinking domestic workforce through the immigration of qualified workforce from abroad, Germany faces several problems. The main problem is that an increasing number of German citizens perceive immigration from outside the EU as a threat, and xenophobia is increasing. This has to do with the fact that already about one-quarter of the German population has a migrant background and is also a consequence of the increasing number of refugees and asylum seekers entering Germany since 2015. The debate on immigration and refugees became a main topic in election campaigns and led to a rise in the popular support for the extreme right-wing party "Alternative für Deutschland", which entered the federal parliament for the first time in 2017. One of their main slogans is the simple strategy ″foreigners out″ (Eißel 2020: 8). A survey taken in 2017 showed that 35% of the interviewees had the perception that "Immigration is more of a problem" (European Commission 2018). "These developments could make a permanent settlement in Germany less attractive option for many potential immigrants, including those who are highly qualified immigrants" (Vaupel and Edel 2017: 1). In addition to asylum seekers from Syria (746,.000) and Afghanistan (257,000), many refugees from Africa entered the country, fleeing civil wars, hunger, and bad future prospects. In the public discussion, these African refugees are perceived as fleeing poverty and wanting to enjoy social security in Germany. They are seen as unwanted competitors in the welfare system. However, it is doubtful whether their flight to Europe can be reduced or even stopped as long as the causes for their—often deadly—flight are existent. What is nearly totally neglected in the debate about African refugees is the negative influence of subsidized European agrarian exports to Africa, which ruin non-competitive local farmers, and reduce the independence of the food supply. In addition, food security is endangered by climate change (FAO 2017). Furthermore, we have to face the issue of arms exports from EU countries heating up civil wars in Africa, also leading to emigration. Lastly, following the United Nations prospects on population growth 2050, migration pressure is also aggravated by the fact that in African countries unemployment affects up to 80% of young people. "Poorly developed economies, mainly based on the mining industry, are not able to provide the right number of jobs, while agriculture, affected by climate change, cannot absorb surplus labor. In addition, unstable political situation, land and water wars can worsen living conditions, deepen poverty, desperation, and the hunt for rescue. On average, the GDP per capita in Africa was 1.895 Euro per year in 2016, which was 15 times less than the EU's average of 29.000 Euro" (UN 2017).

If the wealthier countries in northern Europe like Germany do not support positive developments in Africa and other poor regions in the world but continue to exploit the resources, the consequences could and will be hunger, wars, flights, and expulsions in those regions. Without a positive outlook for the young generation to find a job, they will continue to try to reach Europe. This is, among others, the intensive warning of the current German Federal Minister of Development Gerd Müller in his book *Umdenken. Überlebensfragen der Menschheit*, 2020 (in English: Rethink. Survival Issues of Humanity). His warning, until now, has remained without a positive response. So far, in light of the ongoing disastrous impacts of climate change, the negative consequences of European agrarian policy, and fast-growing population, it is doubtful whether emigration from Africa to Europe will end in the future. Furthermore, African refugees, mainly young males, who succeed to reach European countries have, on average, very low skills and do not meet the demand by German entrepreneurs, which is why they need longer language and vocational training. There are serious doubts about whether Germany or the EU can steer immigration preferences, which tend to favor only skilled workers, to meet the challenges of the aging society. Regarding the ongoing migration to Europe, the hope of the European governments, Germany included, to recruit only skilled workers through immigration is, thus, an illusion (Eißel 2020). In addition, there is a rising rejection of Africans the more the media report on crimes committed by them.

In general, refugees have become scapegoats for the unsatisfactory situation of many Germans, who are the losers in the process of globalization. They suffer already from low income, unemployment, and eroding welfare, so many of them have become supporters of extreme-right parties. As mentioned above, Germany should not participate in the "brain drain" for recruiting experts and specialists from poorer regions in Africa and Asia, where they are needed to develop their own countries. Instead of waiting for the immigration of a highly qualified workforce from abroad, Germany should continue with more efforts to offer immigrants, who have been in Germany for years, especially the young ones, the education and vocational training they need to succeed in the technologically changing labor market.

Currently, not only insufficient knowledge of the German language but also missing professional skills hinder the immediate entrance of new immigrants to the German labor market. Even regarding the population with a migrant background, which has lived for a long time in Germany, there is a comparable task of better training, even though the second and third generation of people with a migrant background have improved in terms of obtaining general school and vocational

Table 12.5a: Level of Education in 2018—Citizens 15 Years and Older (%)

School Certificates	Age Group 25–34		Age Group 45–54	
	People without migrant background	People with migrant background	People without migrant background	People with migrant background
Without any graduation certificate	2	9	1	14
Lower secondary school certificate	15	20	23	30
High school diploma	31	20	42	24
University entrance qualification	52	49	34	31

Source: Federal Statistical Office (2019a).

Table 12.5b: Vocational Certificates of the Population with a Migrant Background (%)

Age Groups	Without vocational training	Vocational training	Technical college degree	Bachelor's degree	Master's degree	Doctoral degree
15–24	14.2	10.3	1.1	2.0	0.3	–
25–34	62.8	31.4	4.7	9.7	7.2	0.8
35–44	64.3	36.5	5.5	3.9	3.7	1.3
45–54	59.7	37.6	5.7	1.7	1.5	1.1
55–64	60.5	38.5	6.4	1.1	0.7	0.9
65 and over	54.1	33.2	5.9	0.6	0.5	1.3
All	53.0	31.1	4.8	3.6	2.7	0.9

Source: Federal Statistical Office (2019a).

certificates (Tables 12.5a and 12.5b). This primarily concerns migrants from Turkey, who are Germany's largest group of immigrants. Because their educational level is lower than the average, they are harder hit by unemployment (Göttsche 2018). Most of them have a low level of education in comparison to immigrants from Eastern Europe and from former Yugoslavia (Bünning 2018).

These people immigrated to Germany as invited “guest workers”, which means that they were expected to go back home after working in Germany for some years. This concept failed, however, since their family members joined them and they now live together in Germany as third generation immigrants—most of them with German passports.

Table 12.6: Employees in Different Age Groups by Gender (%)

Age Groups	2005		2018	
	Men	Women	Men	Women
All	58.4	45	64.2	54.3
55–59	71.3	55.3	84.9	76.7
60–64	35.8	20.7	65.5	55.6
65 and older	5	2.1	10.2	5.2

Source: Federal Statistical Office (2019a).

Improving their school success and vocational training is, according to the German constitution, the task of German states. While it is possible that, similar to them, asylum seekers, mainly from Syria and Afghanistan, would stay in Germany even if peace is secured in the future in their war-torn countries, that remains an open question.

12.5 Working in Old Age as a Resource?

In Germany, more and more people are working beyond retirement age. The number of employees who are subject to social security contributions aged 60 and over has more than doubled since 2005. In 2005, 1.9 million employees were aged 60 and over; by 2018, the number had risen to 4.6 million. However, gainful employment at retirement age is not a mass phenomenon in Germany. Beyond the age of 65, a total of 6% were gainfully employed. Since 2005, the quota has increased slightly (BMFSFJ 2016).

Even people 70 years and older have prolonged their working life. The Datenreport (German Data Report) of 2018 showed an increase from 3.9% to 8.3% in 10 years (2006–2016) (Crößmann and Günther 2018).

As a result, the number of older employees grew faster than that of employees as a whole. The share of employees older than 65 was 3.3% in 2005 and 7.4% in 2018. This mainly concerns male employees (Table 12.6). Men and academics in particular continue to work. The number has risen steadily in recent years. Retired employees work an average of just under 32 hours a week. Over half of them work part-time and over one-fifth work for at least 48 hours per week (Presse und Informationsamt der Bundesregierung 2018). That this rate is so high, is also due to the fact that there are many self-employed people helping family members, who still work in older age. Nonetheless, the rate of employees excluding the self-employed who still work in old age has also increased significantly in the past decades.

"The reasons for the growing employment rate among elderly people are twofold: on the one hand, revised legal regulations have made it more difficult to take early retirement, while on the other hand, the educational standard of older than 55 years has risen steadily, and higher levels of education are often associated with a longer period spent in working life. Accordingly, highly-skilled people in this age group were employed much more frequently than low-skilled people" (Federal Statistical Office 2016, BMFSFJ 2016, 22).

A comparison of the employment rate for the age group of 65 to 69 years old in Europe shows that in the past decade, more people in Europe as a whole have been working after retirement. However, there are clear differences between individual countries. The leader in this EU statistic is Estonia, where almost every third pensioner (29.3%) was still employed, but this might be due to the fact that the retirement age is currently 63 years. Also, in Sweden (21.6%) and the United Kingdom (21.2%), every fifth pensioner still worked. Germany is currently above the EU average of 11.7%, but in comparison, for instance, with Sweden (where the retirement age in the guaranteed pension scheme is 65), there is still potential for increasing the number of employed pensioners (Romanski 2016). In Germany, the standard age limit for retirement provided for a gradual increase from the 65th to the 67th year of life since 2012 (Federal Ministry for Work and Social Affairs 2019). With regard to the strategy to postpone the end of work-life, we nevertheless have to consider the fact that the quota of workers goes down significantly when people exceed the age limit of 55. There are several different reasons for that: about one-third cited health problems as the main reason for early retirement (See Figure 12.1 with differences between eastern and western Germany).

"In 2014, persons aged between 55 and 64 who ended their work life, frequently cited health problems as the main cause (31%). A further 15 % stated age or similar factors as the main reason why their last employment ended. The need to look after children or people in need of care, or other personal or family obligations, was mentioned by 14% of

Figure 12.1: Inactive Persons Aged 55-64 Years Old—Main Reason for Ending Most Recent Employment, 2014 (%)

Sources: Federal Statistical Office (2016), BMFSFJ (2016).

respondents. Reasons such as 'dismissal', 'retirement for health reasons' and 'expiry of a fixed-term employment contract' were mentioned much more often in Eastern than in Western Germany. Conversely, looking after children, persons in need of care, or disabled people, as well as other personal or family obligations were common reasons less in the eastern than in the western part of Germany. Statutory pension insurance is the central income component of the old-age provision in Germany" (Federal Statistical Office 2016, BMFSFJ 2016, 25). In 2016, the average retirement age was 64.2 for women and 63.9 for men. However, in 2016, around 36% of all people who received an old-age pension for the first time had previously been subject to social security contributions (Himmelreicher 2018).

Nevertheless, more elderly people feel fit to continue work as pensioners. German companies and public institutions could make better use of this potential by offering special courses of retraining and upskilling for the new digital environment.

12.6 Women as an Untapped Labor Market Reserve?

12.6.1 Untapped Potential and Blockades

In addition to immigrants and elderly people who still feel fit and active enough to continue working after retirement age, the third strategy to compensate for the shrinking workforce is addressed to women. There is a great potential of well-educated women who are excluded from or not fully integrated into the German labor market. Despite the fact that the possibilities for reconciling family and gainful employment have changed in recent decades—mainly thanks to more places in kindergartens—and despite the fact that the employment rate of women has increased continuously, there is still considerable potential in the untapped female workforce in Germany. The hope of employers and the corresponding public strategy is to mobilize this untapped work potential among women. A current statistic points to the existence of the so-called "silent reserve" (Table 12.7).

To mobilize this potential, it is important to support families and especially young mothers by improving public child care. While they may have fewer children to take care of than in the past, women still have problems combining family and work. Furthermore, in most cases, it is women who provide care for aging family members (Vaupel and Edel 2017). In addition, young mothers have difficulties returning to their previous occupation after some years of caring for small children.

The ability to increase women's labor market participation is dependent on two main factors: first, on places in kindergartens for mothers, who have to care for their small children. Most kindergartens are provided by local authorities, which are urged to supply adequate utilities, but many towns are in a financial crisis and do not know how to fulfill these expectations. Therefore, it is necessary that the state governments and federal government support the local level financially. Furthermore, places in kindergartens are normally not free of charge. Even though the charges are in most cases linked to the income scale, poorer families and single mothers cannot afford to pay for the contributions.

Table 12.7: Untapped Workforce Among Women Aged 15–74 (results of the labor force survey)

	2011	2012	2013	2014	2015	2016	2017	2018
Not working (million)	11.9	11.8	11.5	11.3	11.3	11.0	10.8	10.8
Silent reserve* (in 1,000)	599	570	561	525	525	518	504	459
Unused labor force** rate in %	17,9	16,5	15,8	14,8	13,9	12,8	11,8	10,5

*Searching for employment but not available in the short run, available but not searching

** Share of the total of unemployed, underemployed, and silent reserve in the total of the labor force and silent reserve.

Source: Federal Statistical Office (2020a).

Second, there are still conservative attitudes concerning the role of women and men in family and work. The attitudes have mostly changed toward more gender equality in the last decades, but the issue is still virulent. The traditional understanding of roles assumes that the woman should stay primarily at home, rearing children and keeping the household, while the man is responsible for income via employment. An "egalitarian" understanding of gender roles, on the other hand, makes no distinction between the sexes; rather, an approximation of roles between men and women is advocated (Table 12.8). Nevertheless, it is often financial need that—despite a conservative attitude—forces women to earn additional money for the household. For many poor families, one income is not enough to bear the costs of living.

Table 12.8: Egalitarian Attitude Concerning the Roles of Men and Women (%)

	1982		2016	
	Male	Female	Male	Female
General attitude	32	32	88	95
Consequence for work	25	32	91	95

Sources: Data by ALLBUS-survey: German citizens as interviewees; Blohm and Walter (2018).

These role stereotypes are still widespread; even in the labor market there are still typical women's jobs and men's jobs. This differentiation of roles in the labor market is also one of the reasons behind the gender pay gap because typical women's jobs are usually paid less. According to a press release by the Federal Statistical Office (2020b), women earned 20% less than men in Germany. The fact that men contribute more to the family income than women and the widespread attitude that children need first of all their mothers had the consequence that more mothers took parental leave than fathers. Judging by the data of the Federal Statistical Office, the number of fathers taking parental leave has increased, but in 2018, still three times more mothers went on parental leave (433,000 fathers and 1.4 million mothers). In Germany, employed mothers and fathers are entitled to apply for parental leave until the child reaches the age of 3. After parental leave, parents are entitled to the same working conditions as before, as specified in their employment contracts (BMFSFJ 2019). The way parental leave is handled in Germany clearly shows that there is still an imbalance in the perception between mothers' and fathers' roles, but solving such an imbalance would have no further positive impact on the labor market because, if mothers take less parental leave, fathers will take more, generating a zero-sum game. It is more important to provide enough care places available for 3- to 6-year olds in kindergartens in order to give the mothers the chance to participate in the labor market during this phase.

Comparing the labor market participation from 2000 and 2018 (Table 12.9) we find that, in general, the number of female workers in Germany has already grown remarkably, by nearly 3 million.

Despite this growth, we see that women unlike men are far more often employed in part-time and marginal jobs, which could be perceived as unused potential. Thus, the strategy to win these women over for full-time work could be an adequate concept, especially since German women have reached the same high education level as men.

Table 12.9: Occupation Structures of Dependent Employees (millions)

	2000		2010		2018	
	Men	Women	Men	Women	Men	Women
All	**16.4**	**13.5**	**16.2**	**14.9**	**17.5**	**16.2**
Full-time work	14.8	9.1	13.8	9.3	15.1	11.1
Part-time work	0.4	3.5	0.7	4.3	0.7	3.9
Marginal work	0.3	1.5	0.6	1.9	0.5	1.5

Source: Federal Statistical Office (2019a.

12.6.2 Special Demand for Specialists and Experts, Women in MINT Jobs

"Skilled professionals are the key to innovation and competitiveness, to growth and employment, and to prosperity and good quality of life. As the demographic development progresses, securing a sufficient supply of skilled labor will be one of the most important challenges that lawmakers and the business and science communities will be facing in the decades to come. (...) The aging of society is exacerbating the skills shortage. According to current forecasts, the working-age population, i.e. people aged between 20 and 64, will drop by 3.9 million to 45.9 million by 2030. In 2060, there will be 10.2 million fewer people of working age" (Federal Ministry for Economic Affairs and Energy 2019).

In comparison to the demand for a low- or nonqualified workforce, which is increasingly abundant in an economy with growing digitalization and high tech, the overall demand for the highly qualified, and especially those who have qualifications for mathematics, engineering, natural sciences, and technical (MINT) jobs has increased. In 2018, 7.92 million MINT jobs were registered with the Federal Employment Agency, which was an increase of more than 600,000 employees over the space of 5 years. Nevertheless, 179,000 jobs for specialists with a vocational qualification and 62,000 jobs for experts and specialists remained vacant. The number of MINT job occupations is increasing. In the case of specialists with vocational training, the shortage of skilled workers could further worsen in the future (Federal Employment Agency 2019a). The demand will further increase, because, over the next few years, many people who are now in MINT professions will be retiring. In 2018, almost every third employee was 55 years or older. The rapidly increasing digitalization additionally increases the status of many MINT professions. Fulfilling the need for skilled workers is therefore of great importance. Many positions are vacant and the untapped potential of the industry is great. In particular, there is a lack of female specialists (Frielingsdorf 2019).

In 2013, only 14.4% of German women were engaged in MINT jobs. In 2018, this quota increased moderately to 15.4% of all employees. Even though the percentage has increased significantly, they are still outnumbered by men. No matter whether you are an electrician, mechanical engineer, or software developer—women are still a rarity in the so-called MINT professions. A current analysis of the job market by "StepStone" shows that scientific and technical professions are still male domains today. Accordingly, many professions are determined by gender in the application process. The analysis is based on an international study for which StepStone interviewed more than 100,000 applicants about the further course of the application process. The evaluation showed that 99% of the applications for electrician jobs come from men, compared to more than 90% for engineering positions. The IT area is also still male: Around eight out of 10 applications for jobs as IT administrators or software developers come from men (STEPStone 2019). The employment of women—especially younger women—in MINT professions has increased more significantly than that of men. Nevertheless, the proportion of women in MINT jobs is still significantly below average at 15.4% (Federal Employment Agency 2019a, Table 12.10).

Table 12.10: Overview of Application Rates for Selected MINT Professions, 2019

	Women	Men
Electrician	1	99
Mechatronic engineer	5	95
Mechanical engineer	5	95
Engineer in-vehicle technology	6	94
Electrical engineer	7	93
Automation technology engineer	9	91
Sales engineer	10	90
Software developer	18	82
Help desk employee	18	82
Web developer	20	80
Industrial engineer	21	79
SAP/ERP consulting and development	28	72
Research & development employee	56	44

MINT = mathematics, engineering, natural sciences, and technical.
Source: StepStone (2019).

According to the MINT statistics of the Federal Employment Agency, only 150 women work in a MINT company with 1,000 employees.

The demographic change and the shortage of skilled workers require more permeability. The high demand for MINT jobs in the medium term only will be satisfied if the promotion and working conditions correspond with the interests and life planning of women (StepStone 2019).

Despite the small number of MINT jobs for women, there is some progress. Thanks to numerous initiatives, the female students of the MINT subjects already make up around 30% of the total (see Table 12.11). The value is twice as high as the percentage of women currently employed in MINT jobs. There is hope, that in a few years this number will be reflected in the employment rate. The number of women in MINT professions would then have doubled, and yet there would still be a lot of room for improvement in view of the general shortage of skilled workers in the MINT fields (Federal Employment Agency 2019a). The number of new dual training contracts in a MINT profession has also increased significantly compared to the previous year. A total of around 183,000 people started dual MINT vocational training in Germany in 2018. The proportion of women here was only 11.4% (Federal Employment Agency 2019b). Facing these data, there are now numerous initiatives that are addressed to attract more women for MINT jobs (Frielingsdorf 2019).

Table 12.11: Percentage of Female Students in Their First Semester (2018–2019)

	Female students
All	48.9
Humanities	67.1
Sports	39.2
Law, economics, and social sciences	57.0
Mathematics, natural sciences	**48.1**
Human medicine, health sciences	66.7
Agricultural, forestry and nutritional science, veterinary medicine	59.0
Engineering sciences	**23.6**
Arts	62.7
Others	51.1

Source: Federal Statistical Office (2019a).

The promotion of women in MINT professions through projects such as "Come, do MINT" or "Girls' Day" is making progress. The MINT initiative for women is a unique project that opens up diverse perspectives for women and encourages them to use their potential. It is positive in an egalitarian view, but also helpful for the economy. The positive change where more women are in the so-called male jobs is mainly the result of early career orientation and internships during school time, such as the "girls' and boys' day" intended for questioning the role of stereotypes in choosing a career (Bertelsmann et al. 2015).

Despite the numerous strategies to gain an additional qualified workforce by increasing the number of older people and women in the labor market, the question remains, whether the forecast of a shrinking workforce in an aging society is a true perspective or not. The ongoing modernization of the economy through the introduction of robots and digitalization could lead to masses of redundant labor. In that case, the threat of a shrinking workforce would be only a short-run phenomenon.

12.7 Debate About Impacts of Digitalization and Robotization on the Labor Market and Productivity

The next major industrialization—digital industrialization—has just started. It will have a more severe impact on our lives than the industrialization of almost 250 years ago (Federal Ministry for Work and Social Affairs 2017). A gigantic wave of digitalization, the replacement of human work with machines, and computer programs are coming. Industry 4.0 will fundamentally change the world. Whether there will be job losses as a result of digitalization, or in contrast to this negative scenario, a new wave of job creation is a topic of debate.

In 2012, the Emerald Group made the following forecast: “A growth in robot use over the next five years will result in the creation of one million high-quality jobs around the world” (Emerald Group 2012). In a way, this perspective was right. The new “World Robotics Report” of January 2020, shows that more than 2.4 million industrial robots are operating in factories around the world. Global sales value hit a new record of $16.5 billion. In a global comparison, Germany ranks fourth in terms of the number of machines per 10,000 employees after the Republic of Korea, Singapore, and Japan, as the International Federation of Robotics announced in Frankfurt (IFR 2020). No other EU country uses as many industrial robots as Germany. “Germany is (...) number one in Europe, followed by Italy and France. In 2018, the number of robots sold increased by 26% to almost 27,000 units – a new all time record” (IFR 2020).

Across industries, millions of jobs in production, administration, banking, and insurance, and retail will disappear; on the other hand, numerous new jobs will be created. However, these are usually not occupied by those who have lost their jobs. People without technology affinity will have difficulties finding a job in the labor market of the future. People without qualifications or even with inadequate or insufficient language skills will mostly have no chance of a job (Weik and Friedrich 2017).

On the one hand, studies present horror scenarios of disappearing jobs. As part of its social initiative “Germany 2064 – the World of our Children”, the management consultancy A.T. Kearney found a wider audience in Germany by warning that 45% of current jobs are threatened by robots (A.T. Kearney 2015). “In twenty years, almost half of today’s jobs in Germany will be replaced by robots that can do the jobs more efficiently”, said Martin Sonnenschein, European Chief at Kearney in a press release (Sonnenschein 2015). The calculations of A.T. Kearney are based on the research by Frey and Osborne (both Oxford professors) on the German labor market (Frey and Osborne 2013). According to their research, over 300, and thus a quarter of all job profiles, would be at a high automation risk in the next 20 years. This affects 17.2 million people, employed in these areas and that is 45% of all German employees. The endangered jobs concern: secretarial tasks, sales, catering, and commercial and technical business management. Also, by 2064 robots will carry and deliver mail, cook food for people, do banking and bookkeeping, process metal, and keep warehouses in order. They cannot replace people everywhere and so the consultants also provide a list of jobs that are not threatened by automation. This concerns above all social professions like child-rearing, nursing, and elderly care (A.T. Kearney 2015).

A contrasting position is published by the research company Metra Martech (London) in cooperation with the International Federation of Robotics under the title: “Positive Effects of Industrial Robots on Employment” (Metra Martech and IFR 2013). According to their statistics, industrial robots secure production sites and millions of jobs. The growth in the use of robots in the next 5 years would result in the creation of 1 million high-quality jobs around the world. The study found that 1 million industrial robots that are currently in operation were directly responsible for the creation of almost 3 million jobs. Robots will help create jobs in some of the most critical industries of this century: consumer electronics, food, solar and wind power, and advanced battery manufacturing, to name a few (Metra Martech and IFR 2013). In addition to the million jobs that will be created directly through the increased use of robotics, the report also pointed out that securing jobs in the manufacturing sector would also lead to jobs in society as a whole. This means that restaurants, shops, and services would also benefit from this development (IFR 2020). The positive outlook on the impacts of digitalization on the labor market is shared by, among others, the Centre of European Economic Research (2016). For these research institutions, the issue is clear: automation has a positive net effect on demand for work in Europe. Automation reduces production costs, reduces product prices, and thus increases the demand for products.

The German government supports the use of new digital technologies within industry and administration as part of its high-tech strategy. One important technology program is “Platforms for Additive Manufacturing/Imaging/Communication/Engineering” (PAiCE) under the responsibility of the Federal Ministry for Economic Affairs and Energy (BMWi), for which a total of 16 associations from science and industry have qualified for funding. This program aims to further strengthen Germany’s leading position as a high-quality production location and as a provider of the latest production technologies. As part of the digital agenda, the BMWi technology program makes another important contribution to the implementation of the future government project Industry 4.0. The PAiCE technology program develops and tests new solutions that span several links in the value chain by combining different technology fields. In this way, innovative technologies and methods are developed that open up new possibilities for integrated product engineering and its correlation with production processes (Federal Ministry for Economic Affairs and Energy 2020). The goal is that digitalization would lower transaction costs and increase efficiency.

For the coming years, many business associations and consulting companies expect high productivity effects in the field of information and communication technology and the manufacturing sector. According to technological optimists, the digital revolution will lead to significant productivity increases soon. The current weak development is in particular due to the reluctance of companies to invest in the phase of transition from the analog to the digital world (Federal Ministry of Work and Social Affairs 2017). However, the extent to which productivity progress can be shown and measured in the digital economy is still controversial. In any case, the prerequisite for its implementation is substantial corporate and public investments in infrastructure, technology, work processes, and skills (Rüßmann et al. 2015, Bauer et al. 2014).

Of course, digitalization will intensify the dynamism in the job market. The forecast expects a significant decline in production occupations and increases in IT and the natural sciences (Federal Ministry for Work and Social Affairs 2017). Digitalization could be an opportunity for everyone, but according to a World Economic Forum study on the "future of jobs" in 2018, only 46% of employees in Germany are prepared for it (WEF 2018).

To sum up, against the former scenario of millions of jobs which would be lost by continuing digitalization, a more realistic picture of the impacts has prevailed. The asserted mass unemployment triggered by technological change does not take place. Since the horror figures of 2013 dominated by the Frey and Osborne study, the scientific debate now has a much more differentiated picture of the effects of digitalization. For example, one study for the Federal Ministry of Labor and Social Affairs created in 2016—based on the base year 2014—predicts the creation of additional 250,000 jobs in Germany by 2030. Current employment figures in Germany and the United States are confirming this trend. Nevertheless, digitalization will change our working world within one generation. Thus, it is all the more important today to undertake appropriate steps, mainly in the field of education and vocational training to meet the challenges of the future labor market in an aging society.

12.8 Conclusion and Policy Recommendations

Concerning strategies on how to meet the threats of the shrinking workforce, public institutions and private companies in Germany should implement appropriate strategies and respect the specific situation of the labor force they want to add. There is a significant number of elderly people, who still feel fit and active enough to continue working. Nevertheless, we should be aware that many older workers in Germany have already retired for health reasons. Furthermore, in general, elderly people do not want to work full time, and most of them are unable to work in hard physical jobs. Thus, the state and the companies have to provide flexible solutions for the specific situation of workers in old age when postponing the entrance to pension time, which is currently on the agenda. Instead of working full time, the parliament should pass a law allowing part-time work for elderly people without reducing their pension.

To attract more women to the labor market is dependent on public support for families and especially for young mothers through improved public child care. To better realize opportunities, the federal and state governments should financially support the local authorities so that they can provide the needed measures. Furthermore, initiatives such as the girls' day to surmount the gender gap of specific male and female jobs should be intensified. In addition, it is necessary to reduce the gender pay gap, which is an additional barrier to increase female labor participation. It is not enough to celebrate the yearly "equal pay day" but to force private and public employers to reduce the discrimination in the pay of female workers by an adequate law and by an effective control including the work councils of the trade unions. Finally, labor offices or local initiatives should support mothers to return to their previous occupation after years of caring for small children through specific training, especially concerning refresher courses in rapidly evolving computer technology.

To meet the labor shortage by using immigration should not be included as a measure to solve the problems of the shrinking workforce. One concern regarding that is the rising xenophobia. Also, there are doubts regarding whether Germany (and the EU) would be able to regulate immigration in such a way that only the highly qualified workers, who face the disastrous situation, mainly in Africa, can be employed. Above all, recruiting highly qualified young people from abroad, who are needed in the development of their own countries, is morally problematic. It would be better to fully integrate the already present foreigners into the German labor market by providing specific educational and vocational offers to them.

Lastly, there is some uncertainty about the impacts of the ongoing modernization of the economy through robots and digitalization on the labor market. Of course, there will be losers (low qualified workers) and winners (experts and specialists), but we cannot exactly predict the extent of change. Above all, education and training for an economy, in which digitalization and robots play a massive role, should be on the top of the agenda in order to provide better labor market opportunities for all.

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Demographic Transition and Its Impacts in Asia and Europe

Demography is a principal driving force for economic growth and social development in all countries. In Asia and Europe, more developed economies are facing aged or aging societies, while younger economies are experiencing rapid shifts in the age structures of their populations. Although demographic transition has occurred at different times in Asia and Europe, both regions have undergone comparable processes and patterns of change, with the impacts spanning across sectors and groups of people in society.

Demographic Transition and Its Impacts in Asia and Europe highlights the crucial factors and aspects of demographic transition subject to the different characteristics of economies in Asia and Europe. In response to the phenomenon of rapid population aging, the book provides practical academic analysis and useful policy implications and insights to help build on comprehensive policy frameworks for a resilient economy and sustainable development.

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