LABOR MARKETS AND SOCIAL POLICY IN A RAPIDLY TRANSFORMING AND AGING THAILAND

# THE MACROECONOMIC AND FISCAL IMPACT OF AGING IN THAILAND





WORLD BANK GROUP

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **ADF** | Augmented Dickey-Fuller |
| **ARDL** | autoregressive distributed lag |
| **CS** | Civil Service |
| **DB** | Defined benefit |
| **FDI** | foreign direct investment |
| **FSA** | Fiscal Sustainability Analysis |
| **GDP** | gross domestic product |
| **GNI** | gross national income |
| **NPF** | National Pension Fund |
| **ILO** | International Labour Organization |
| **IMF** | International Monetary Fund |
| **LCH** | Life Cycle Hypothesis |
| **LTGM** | Long-Term Growth Model |
| **NRI** | Natural rate of interest |
| **NSF** | National Saving Fund |
| **OAA** | Old Age Allowance |
| **OECD** | Organisation for Economic Co-operation and Development |
| **PRC** | People's Republic of China |
| **PWT** | Penn World Table |
| **RMF** | Retirement Mutual Funds |
| **SSF** | Social Security Fund |
| **TFP** | Total factor productivity |
| **UMICS** | upper-middle-income countries |
| **WDI** | World Development Indicators |
| **ZLB** | Zero lower bound |

# FOREWORD

This report is one in a series on strengthening social protection and labor market policies in Thailand in the context of aging and economic transformation. Other report in the series provide an overview of the social protection system, analyze the labor market implications of population aging, assess Thailand's aged care system, and assess Thailand's pension schemes. The reports are:

- *Towards Social Protection 4.0: An Assessment of Thailand's Social Protection and Labor Market Systems;*
- *Aging and the Labor Market in Thailand;*
- *Caring for Thailand's Aging Population; and*
- *Pension Provision in Thailand.*

These reports are available online at:
www.worldbank.org/en/country/thailand/publication/labor-markets-and-social-policy-in-a-rapidly-transforming-and-aging-thailand

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# SUMMARY OF MAIN FINDINGS

- Thailand's population is aging rapidly. Its demographic shift is much more advanced than its level of income suggests.

- Projections show that long-term growth is likely to decline between 2020 and 2050, continuing the current downward growth trend.

- Demographic changes account for over half of the projected decline in long-term growth. This projected decline is due to a low fertility rate and aging leading to a decline in population growth and the size of the working-age population.

- Some countervailing effects such an increase in the female labor force participation rate or improvement in human capital can mitigate or even offset the negative impact of aging on long-term growth.

- The long-lasting effects of the COVID-19 pandemic could lead to a lower long-term growth path if it leads a decline in investment, a deterioration of human capital, or a contraction of global trade.

- The private saving pattern in Thailand is positively related to the speed of aging.

- The conditional forecast shows that private saving will likely rise over the next decade and a half and fall thereafter. It is projected be higher in 2050 compared to 2019.

- The combined fiscal costs of the Civil Service Pension Scheme, the Old Age Allowance, and health care are projected to rise from 4.9 percent of GDP in 2020 to 11.5 percent by 2060.

- The terms of mitigating the negative impact of aging on long-term growth policy measures should aim both to increase the size of the labor force and to increase its productivity.

- To ensure long-term fiscal sustainability, a combination of labor market and fiscal policy reforms will be needed, as well as reforms to the social protection system, pension system, and long-term care system.

A summary of policy reforms and their long-term growth and fiscal impacts are presented in **Table 1**.

**Table 1.** Summary of policy reforms and their long-term growth and fiscal impact

| Policy reforms | Long-term growth impact aon average over 2021–50 | Fiscal impact (compared to baseline in 2050) |
|---|---|---|
| Increase in the female labor force participation | 0.1–0.2 ppts | Primary balance: +1.0% of GDP<br>Public debt: -14% of GDP |
| Gradual increase in the official retirement age (from 60 to 65 over 2021–50) | 0.3 ppts | Primary balance: +1.5% of GDP<br>Public debt: -19% of GDP |
| Increase in human capital growth by improving learning outcomes and lowers stunting rate among children would boost | 0.2 ppts | Primary balance: +1.5% of GDP<br>Public debt: -18% of GDP |
| Increase in TFP growth | 0.4 ppts | Primary balance: +4.0% of GDP<br>Public debt: -51% of GDP |
| Increase in revenue | | Primary balance: +3.2% of GDP<br>Public debt: -36% of GDP |

*Source:* World Bank Staff.

# 1. INTRODUCTION

**Thailand's population is aging rapidly. Between 2000 and 2019, the old dependency ratio in Thailand increased from 6.5 percent to 12.4 percent.**[1] The country's demographic shift is much more advanced than its level of income suggests. For comparison, the old dependency ratio in Malaysia, a country with a higher income per capita, was estimated at 6.8 percent in 2019, compared to 3.9 percent in 2000. Population growth in Thailand is expected to turn negative within the next decade. Meanwhile the growth rate of the working-age to population ratio has been negative since 2011. These demographic changes raise some concerns about Thailand's macroeconomic environment and fiscal standing.

**In the past, Thailand's economy registered impressive growth rates that propelled the country to upper-income status.** High growth rates in the 1960s, 1970s, 1980s, and most of the 1990s led to a rapid rise in average income and a decline in poverty. The drivers of growth in Thailand included factors accumulation, aggregate productivity growth, and increased efficiency in the allocation of the factors of production, especially labor. The country's high degree of openness to trade also contributed to its economic success.

**In recent years, however, the past drivers of growth have stalled, leading to a slowdown in economic growth and threatening to undermine Thailand's prospects of becoming a high- income economy.** Since 2003, Thailand's growth rate has been below the average growth rate among all upper-middle-income countries. This is partly due to sluggish investment in physical capital and slower human capital growth. Although total factor productivity (TFP) growth has been favorable, greater innovation and technological advances will be required to transform the Thai economy into a high-income economy. That is because, as underscored by the literature on the middle-income trap, the drivers of growth that propel countries into middle income status, mainly factors accumulation paving the way for (low-cost) labor fueled manufacturing, are not enough to push them in the elite group of high-income economies. Instead, innovation and technological advances are paramount.

**Population aging will likely exacerbate the effects of these constraints that Thailand faces.** By shrinking the size of the labor force and putting pressure on the government's fiscal balance, aging could be detrimental to human capital and aggregate investment. This would in turn stifle innovation since qualify human capital is crucial for innovation and technological advancement.

**In this paper, we survey the literature and analyze the potential impact of aging on various macroeconomic indicators and fiscal sustainability in Thailand.** Moreover, we explore various policy reforms that can help Thailand better adapt the rapid demographic shift and mitigate the potential negative effects of aging.

**First, we use the World Bank's Long-Term Growth Model (LTGM) to make projections about Thailand's long-term growth prospects.** The LTGM is an extension of the Solow-Swan growth model where the key building blocks include saving, investment, and productivity. The model also takes into consideration human capital growth, demographics changes and labor market indicators. The drivers of long-term growth in the LTGM are TFP growth, labor participation growth, the working-age to total population ratio growth, human capital growth, population growth, and private and public investment to GDP ratio. The impact of aging on long-term growth is then captured through the impact of the changes in population growth and working age to population ratio growth. It is generally accepted that aging in itself is detrimental to long-term growth because it leads to a smaller working age population if there are no mitigating changes like immigration.

**Then we conduct a cointegration analysis to assess how aging would impact private saving pattern in Thailand.** The cointegration analysis is suitable to analyze the impact of aging on private saving because it is designed to assess long-term relationship between non-stationary variables. The old age dependency ratio, our measure of aging, and private saving to GDP ratio are both non-stationary. (Goh et al. 2020) employ the same methodology to analyze the macroeconomic implications of aging in Japan. Unlike the impact of aging on long-term growth, the impact of aging on private saving is not quite clear. That is because it depends on many other factors such as the type of pension schemes available in the country (Amaglobeli et al. 2019).

**Combining the projected growth rates from the LTGM with assumptions about the coverage and generosity of available public pensions, we make projections about their potential long- term fiscal costs.** For simplicity, we assume that the coverage rate and level of generosity remain constant over the projection period. Although the coverage is constant, the number the beneficiaries is expected to rise over time due to population aging. Our projections do not consider any pension reforms.

[1] Based on UN population data and World Development Indicators.

**By and large, existing studies find aging to be detrimental to long-term economic growth** (IMF 2019; Maestas et al. 2016; Park et al. 2011). Mainly, aging lowers potential growth by reducing the size of the labor force. There are some countervailing forces that can help mitigate or offset the negative impact of aging on long-term growth (Bloom et al. 2008; Maestas et al. 2016). The impact of aging on private saving has been widely studied, but conclusions remain mixed. For instance, Horioka et al. (2010) find that aging is negatively related to domestic saving rates in developing Asian countries. Meanwhile, Goh et al. (2020) document that the speed of aging is positively related to gross domestic saving.

**The literature agrees on the idea that aging could be detrimental to fiscal sustainability.** Aging mainly puts pressure on public finance by increasing age-related expenditures such as pensions and health care and by reducing fiscal revenues (IMF 2016). There is evidence that aging dampens the effectiveness of stimulus spending (Honda and Miyamoto 2020). IMF (2019) concludes that, in the absence of reforms, aging in Thailand would lead to a rapid rise in pension and health care spending, which would put pressure on public finance.

**This paper contributes to the existing literature in several ways.** First of all, to the best of our knowledge this is the first paper to exclusively model and analyze the impact of aging on long-term growth in Thailand. Although there several studies that have analyzed the relationship between aging and private saving in Thailand, this is the first to employ a cointegration analysis. This approach is more suitable given that we are interested in the long-term relationship between the two and the fact that demographic changes are slow. Moreover, this paper is the first most comprehensive study of the macroeconomic and fiscal impacts of aging in Thailand. Existing studies have focused on how aging impacts one particular variable (Pootrakool et al. 2005; IMF 2019).

**Projections from the LTGM show that long-term growth is expected to decline between 2020 and 2050.** The projected decline in growth is due to a decrease in population growth, working age population, human capital growth, and the effectiveness of private and public investment. However, the decline in population growth and the working age to population ratio growth account for more than half of the projected decline in GDP growth. The COVID-19 pandemic could lead to lower aggregate productivity, which would mean a lower long-term growth path than projected. Meanwhile, other countervailing effects such a rise in the female labor force participation rate and improvements in human capital could boost the long-term growth path.

**We find that private saving pattern in Thailand is positively related to the speed of aging.** In other words, it is not the size of the old dependency ratio that matters for private saving, but rather the rate of change in the ratio. As Thailand aged faster, private saving rose, albeit with a lag. And as aging slowed, private saving declined. This finding is a significant departure from most existing study on the effects of aging on private investment. Furthermore, our conditional forecast shows that private saving will likely rise over the next decade and half and fall thereafter. It is projected be higher in 2050, compared to 2019.

**On the fiscal side, the expected rise in public pension and health care costs due to aging are expected to complicate fiscal sustainability if no structural or fiscal reforms or reforms to the programs are undertaken.** Aging-related expenditure (Civil Service Pensions, the Old Age Allowance, and health care) is projected to increase from 5.9 percent of GDP in 2020 to 11.5 percent of GDP by 2060. In particular, the Social Security Fund (SSF) is projected to have a negative cash flow in the mid-2040s and run of cash reserves by 2054.

**In terms of mitigating the negative impact of aging on long-term growth policy measures should aim both to increase the size of the labor force and to increase its productivity.** Policy measures to increase the size of the labor force in Thailand could include extending the working period by raising the official retirement age and increasing the female labor force participation rate. Measures can also be put in place to increase the productivity of the labor force by improving the quality of education, increasing education attainment, and providing training to reskill and upskill the existing workforce.

**A combination of reforms of the labor market and revenue policy, as well as the social protection, pensions, and long-term care system, will be required to mitigate the fiscal impact of aging.** The labor market reforms mainly support long-term growth, but do not improve fiscal sustainability sufficiently. Fiscal reforms, especially on the revenue side, will also be essential for overall fiscal sustainability. Reforms to the Old Age Allowance (OAA), Civil Service Pension Scheme, SSF, and long-term care system are needed to make them adequate, fair, and fiscally sustainable. Reforms will likely be necessary to contain the costs of health care and long-term care in Thailand, but more analysis is needed for a more accurate assessment. Moreover, there is a clear need to start these reforms as soon as the post-COVID recovery has taken hold, as the cost of adjustment increases over time.

**The rest of this paper is organized as follows.** Section 2 presents an assessment of the impact of aging on macroeconomic variables. Section 3 analyzes how aging is likely to impact Thailand's fiscal standing. Section 4 discusses various reforms that can help mitigate the negative impact of aging on long-term growth and fiscal sustainability and Section 5 concludes.

# 2. THE MACROECONOMIC IMPACT OF AGING IN THAILAND

**While aging will likely lead to a lower long-term growth trajectory in Thailand, its impact on private saving will depend on fast the population ages.** One of the direct impacts of aging is the decline in population growth and in the share of the working age population. These demographic changes are projected to account for more than half of the decline in the projected GDP growth between 2020 and 2050. While the impact of aging on private saving depends on many other factors such the type of pension scheme available, we find that the speed of aging is positively related to private saving patterns.

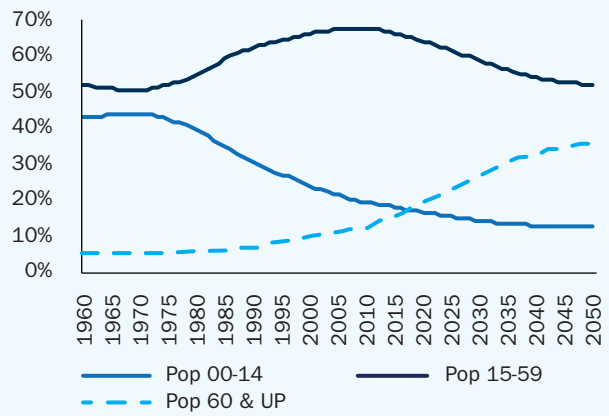
## 2.1. THE LONG-TERM GROWTH IMPACT OF AGING

**In several Asian countries, the demographic dividend contributed up to a third of economic growth between the 1960s and 1990s** (Bloom, Caning, and Finlay 2010; Bloom and Williamson 1998). Favorable demographics, fueled by a decline in the youth dependency ratio, contributed to fast growth rates experienced by several Asian countries. The demographic dividend is defined as the contribution to growth of the rise in the share of working age to total population. It is a period characterized by a decline in the youth dependency ratio due to falling fertility and mortality rates. This leads to the share of the working-age population being larger than the non-working-age share of the population. Like several other Asian countries, Thailand has already reaped the benefits of such a demographic dividend.

**Now Thailand and several Asian countries are having to deal with rapidly aging populations, as such the opposite effect of the demographic dividend.** Thailand faces the prospects of an aging population, which has aged faster than its level of income suggests. One of the direct impacts of aging is the decline in the share of the working age population and this has negative implications for the long-term growth. Figure 1 depicts the current and projected demographic profile of Thailand, showing that the fraction of the population aged 65 and over is steadily rising, while the share of the working population has been shrinking since 2012 (see Figure 2).

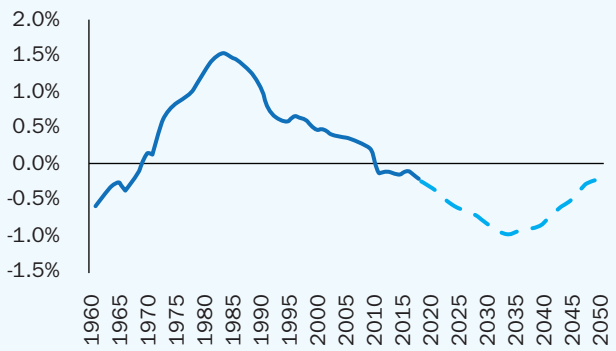
**Thailand's population has aged faster compared to structural peers.** Aging is an integral part of the development process: as countries become richer, fertility rate tends to fall and with access to better health care and nutrition people live longer. However, the process might be faster in some countries, compared to others. For example, Thailand's population aged almost as fast as the Republic of Korea's and faster than Malaysia, China, and other upper-middle-income countries (UMICs) (see Figure 3). But its average income rose slower (see Figure 4). Consequently, Thailand's population is much more aged compared to when Malaysia and Korea were at the same level of income (see Figure 5). Thailand's GNI per capita in 2019 was US$7,260, approximately the same as Malaysia's GNI per capita in 2008 and Korea's GNI per capita in 1991.2 However, Malaysia's proportion of the population aged 65 and over was only 4.8 percent in 2008 and Korea's proportion of the population aged 65 and over was 5.4 percent in 1991, compared to 12.4 percent in Thailand in 2019.

**Figure 1.** The fraction of the population aged 60 and over is steadily rising




*Source:* Author Calculations based on UN population data.

**Figure 2.** Meanwhile, the growth rate of the Working Age to Total Population (WATP) ratio has been negative since 2011

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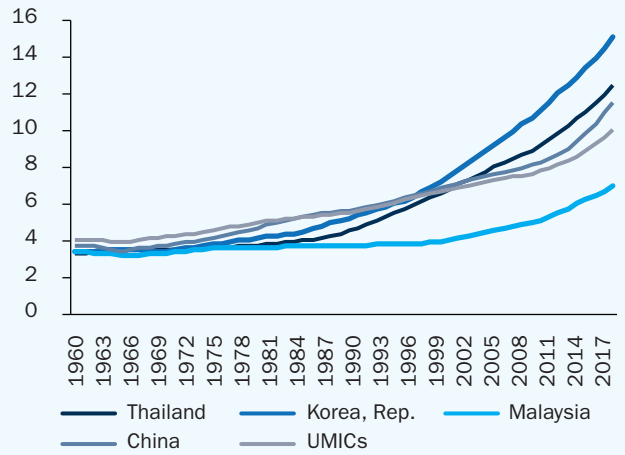
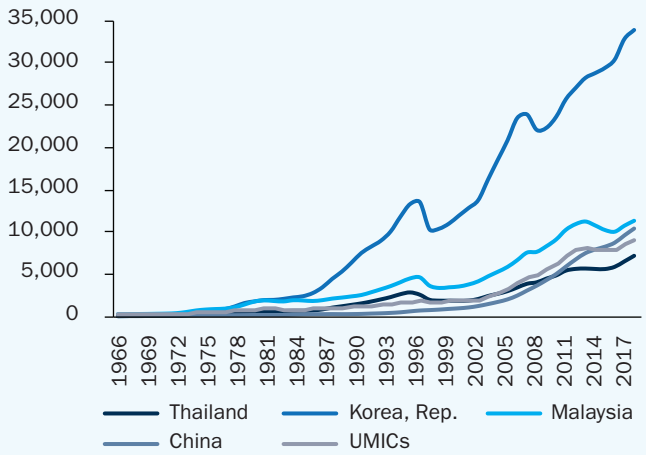
**Thailand has grown old before getting rich due to a combination of slow growth and improvement in health outcomes.** Thailand experienced high growth rates before the Asian Financial Crisis 1997. Since then, the average growth rate has remained below 4 percent. In addition to the slower economic growth, improvements in health outcomes led to an increase in life expectancy and fertility rates have fallen considerably. Consequently, while average growth in Thailand started to decline in the late 1990s, the share of the population aged 65 or older rose rapidly (see Figure 6). The combined effects of these forces have led to Thailand growing old before getting rich.

**Figure 3.** Thailand aged almost as fast as Korea and faster than China, Malaysia, and other UMICs



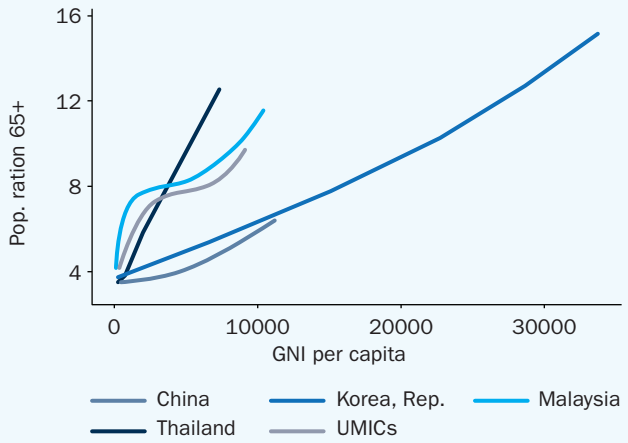

*Source:* WDI and authors' calculations.

**Figure 4.** But average income in Thailand rose slower and trails Korea, China, Malaysia, and other UMICs



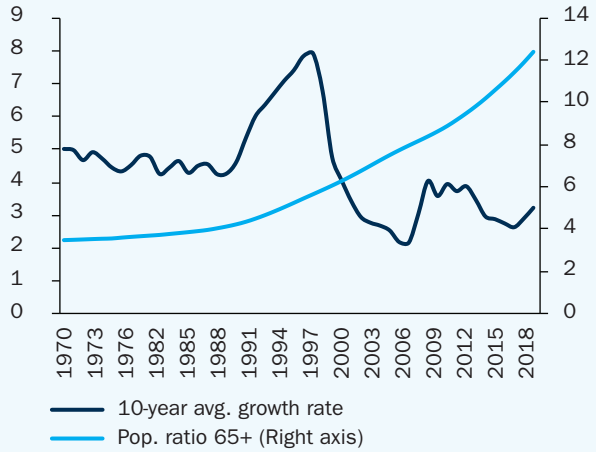

*Source:* WDI and authors' calculations.

**Figure 5.** Thailand has aged rapidly at low levels of income




*Source:* WDI and authors' calculations.
*Note:* Smoothed regression lines with 95% confidence bands.

**Figure 6.** A decline in average growth was accompanied by a rise in the share of the population aged 65 or older




*Source:* WDI and authors' calculations.

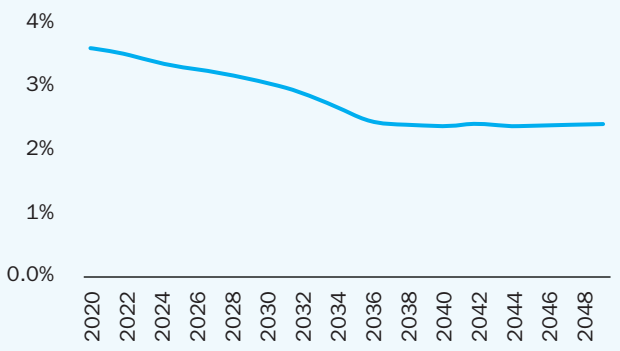
[1] The GNI estimates are based on the Atlas methodology, which is used in the World Bank's country classification by income level. The data is from the World Development Indicators.

**Using the World Bank Long-Term Growth Model (LTGM), we analyze how changes in the share of the working-age population impacts long-term economic growth in Thailand.** The LTGM used in our long-term projections is an extension of the Solow-Swan growth model where the key building blocks include saving, investment, and productivity. The model is developed and maintained by the Macroeconomics and Growth Team of the Development Research Group at the World Bank Group. More details about the model and calibration are presented in the Appendix.

**In the LTGM, aging impacts long-term growth through population growth and the working- age to population ratio growth.** Long-term growth in the LTGM is driven by TFP growth, labor participation growth, the working-age to total population ratio growth, human capital growth, population growth, and private and public investment to GDP ratio (see Appendix for more details).[3] With aging, population growth declines and the share of working population expands slower or shrinks. Both these changes have negative implications for long-term growth.

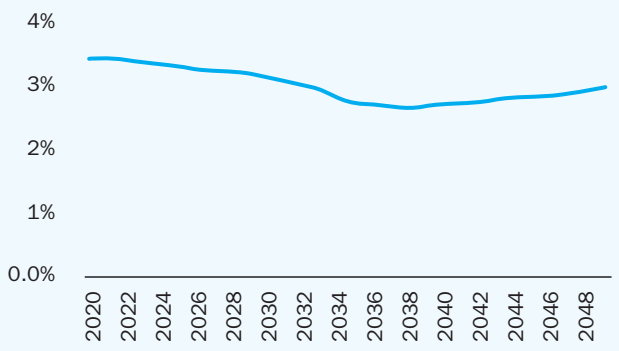
**In the business-as-usual baseline, aggregate potential economic growth in Thailand is expected to decline from 3.6 percent in 2020 to 2.4 percent by 2050** (see Figure 7). The growth rates derived from the LTGM are potential growth rates and thus different from short-term forecasts. Under an assumption of continuity of recent trends in the economy, growth is expected to slow down.[4] Per capita GDP growth is projected to fall from 3.4 percent to 2.9 percent between 2020 and 2050 (see Figure 8). The projected decline in growth can be attributed to a decrease in population growth, the size of the working age population, human capital growth, and the effectiveness of private and public investment.

**Figure 7.** Headline GDP Growth in the business-as-usual baseline




*Source:* WDI and World Bank Staff calculations.

**Figure 8.** GDP per capita growth in the business-as-usual baseline




*Source:* WDI and World Bank Staff calculations.

**The baseline projections presented above assume that current trends in the economy continue.** The baseline calibration assumes that the underlying structural trends of the economy remain constant and there are no reforms. More details about the calibration are presented in the Appendix. Economic growth in Thailand has lagged the average among upper-middle-income countries. The 10-year rolling average of GDP per capita growth in Thailand was estimated at 3.2 percent in 2019, compared to 4 percent among all upper-middle-income countries (Figure 9). In fact, since 2003, the average GDP growth in Thailand has trailed that of upper-middle-income countries. Average growth declined continuously between 2012 and 2017, but it rose between 2018 and 2019. In that sense, if no reform is undertaken and the underlying trends persist, then long-term growth will likely decline according to our calibration.

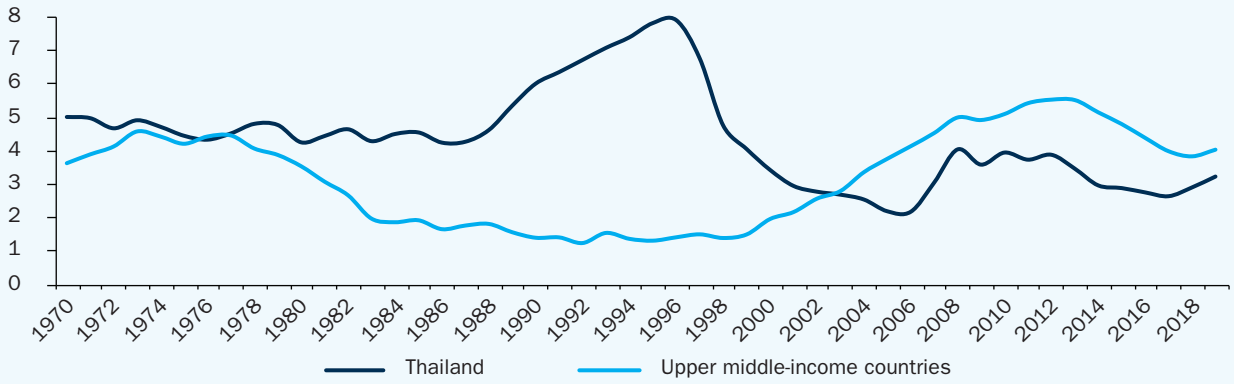
[3] GDP per capita growth can be expressed as:

$$g^{PC}_{y,t+1} \approx g_{A,t+1} + \beta\left(g_{Q,t+1} + g_{\omega,t+1} + g_{h,t+1}\right) - (1-\beta)\left(g_{N,t+1}\right) + \phi\left[\theta^N_t \frac{i^G_t/Y_t}{\theta_t K^{Gm}_t/Y_t} - \delta^G\right] + (1-\beta-\zeta\phi)\left(\frac{i^P_t/Y_t}{K^P_t/Y_t} - \delta^P\right)$$

. More details are presented in the Appendix.

[4] The calibrated trends reported potential long-term growth could be lower if COVID-19 has a lasted impact on the drivers of growth, especially TFP growth and human capital growth.

**Figure 9.** The 10-year GDP per capita growth average in Thailand has been below the average among all upper-middle-income countries




*Source:* WDI.

**Long-lasting negative impacts of COVID-19 would mean a lower long-term growth path than projected.** The COVID-19 pandemic could lead to a decline in productivity growth. The decline in long-term productivity growth can stem from lower investment, deterioration of human capital, and a contraction of global trade (World Bank Group 2020). Although the death toll of the outbreak was limited in Thailand, disruption in schooling could impact learning outcomes. If these negative effects are long-lasting, then Thailand's long-term growth path will likely be lower than our current projections suggest.

**Through counterfactual exercises we are able to isolate the contribution of demographic changes to the projected decline in long-term economic growth.** In the LTGM, demographic changes are captured by population growth and the growth of the working age to total population ratio. Population growth is projected to turn negative by 2030, while the Working Age to Total Population (WATP) ratio growth has been negative since 2012 and is likely to remain negative until 2050 (see Figure 2). A counterfactual exercise in which the growth rates of the ratios are kept constant can reveal an approximation of the long-term growth impact of aging.

**These approximations can be considered upper bound of the long-term growth impact of aging due to potential countervailing forces.** Many countervailing forces may mitigate the negative impact of aging on long-term growth. For instance, a lower fertility rate usually leads to an increase in female labor force participation (FLFP) and that can act as a countervailing effect to aging (Bloom et al. 2016; Canning et al. 2009; Lee and Chung 2008). However, in Thailand the FLFP rate has continuously declined since 2011. Other countervailing forces include improvement in productivity (see Box 1), increase in investment, and enhancements in human capital. In the presence of any of these countervailing effects, our approximation of the growth impact of aging can interpreted as the upper bound limit.

**Other things being equal, demographic changes are projected to account for more than half of the decline in the projected GDP growth between 2020 and 2050.** Our projected estimates show that the decline in population growth accounts for almost 36 percent of the projected growth slowdown, while the decline in the growth rate of WATP ratio accounts for 18 percent (Table 2). This means that if population growth and the growth rate of the WATP ratio were both to remain constant, at their 2020 level until 2050, then the long-run growth rate in 2050 would be 0.6 percentage points higher (3.0 percent instead of 2.4 percent in 2050). If only the WATP were to remain constant, then the growth rate would be 0.3 percentage points higher in 2050. These counterfactual exercises assume that all the other variables continue on the same path as assumed under the baseline.

**Table 2.** Understanding the Drivers of Thailand's Falling Economic Growth Rates

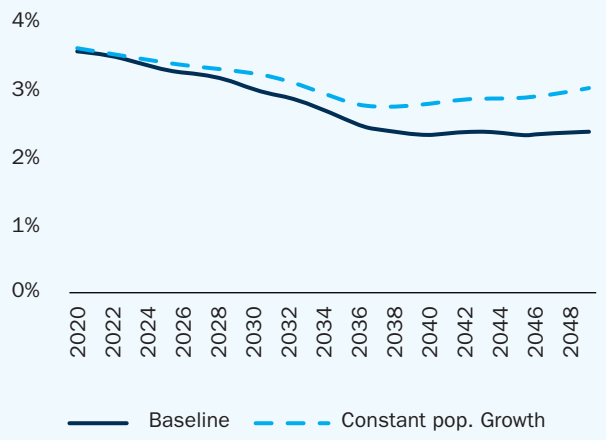
| | | HL GDP Growth |
|---|---|---|
| **Baseline ΔGDP Growth (2020–50)** | **-1.2%** | **100%** |
| Change due to change in: | | Share (Normalized) |
| Population Growth | –0.60% | 36% |
| WATP ratio growth | –0.30% | 18% |
| HC Growth | 0.01% | –1% |
| Public K/Y Ratio | –0.58% | 35% |
| Private K/Y Ratio | –0.18% | 11% |

*Source:* Authors' calculations.

**One limitation of the long-term growth model we used is that saving is held constant.** There is evidence that demographic changes impact saving patterns (IMF 2019; Horioka et al. 2010). So, by assuming a constant saving rate, the impact of demographic changes on saving are not considered.

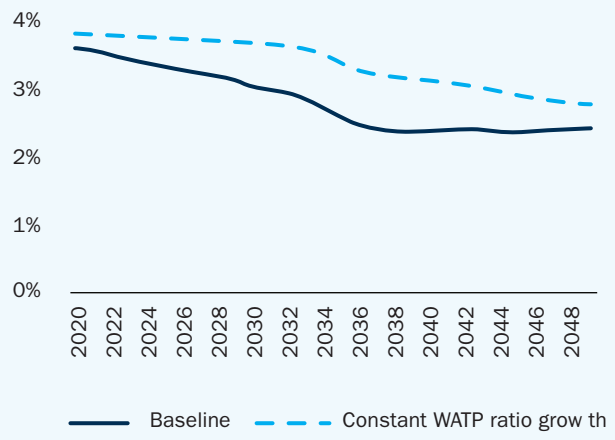
We remedy this shortcoming in the next section by using the projected GDP growth from the model and expected demographic changes to make long-term projections on saving.

**Figure 10.** If population growth were to remain constant at the 2019 rate, headline GDP growth in 2050 would be 0.6 percentage higher




*Source:* WDI and World Bank staff calculations.

**Figure 11.** If WATP ratio growth were to remain constant at the 2019 rate, headline GDP growth would be 0.3 percentage higher




*Source:* WDI and World Bank staff calculations.

**Box 1.** Population aging and productivity

The link between aging and labor productivity in particular has been difficult to establish for many reasons. Estimations of productivity tend to exclusively include only those elderly workers who have remained employed, which introduces a sampling bias. That is because a person's decision to retire is most certainly related to his or her level of productivity, so those included in sample estimations tend to be those are more productive. Furthermore, the link between aging and labor productivity depends squarely on the type of work: labor productivity declines faster in occupations that require more cognitive skills and agility, and productivity does not change or declines less in occupations that require more experience and verbal skills (Skirbekk 2008).

As such, current evidence of the impact of population aging on productivity, in general, remains mixed. A recent analysis of European countries found that aging was associated with a decline in labor productivity growth (Aiyar, Ebeke, and Shao 2016). Another study on a sample of 12 Asian countries including Thailand reported a decline in TFP growth due to aging (Park and Shin 2011).[a] Furthermore, lower firm productivity growth associated with aging has also been document among a sample of U.S. firms (Ozimek, DeAnthonio, and Zandi 2018). Entrepreneurship, an engine of innovation, also seems to decline with aging, another evidence of the negative association between aging and productivity. But some studies have also found no evidence to suggest that aging impinges on productivity. Using the U.S. Current Population Survey, Burtless (2013) finds little evidence that suggests that an aging workforce impedes productivity.

However, some interesting and surprising results have emerged from matched employer-employee surveys. According to Romeu Gordo and Skirbekk (2013) elderly workers who stay on the job are able to adapt well to technological advances that affect their jobs, and even be more productive in jobs requiring higher cognitive abilities. In addition, Van Ours (2009) finds that although physical productivity declines after the age of 40, mental productivity does not. And because of lower absenteeism among older workers (Martocchio 1989) and less switching between jobs compared to younger workers (AARP 2002), firms can save on various cost such as training. Furthermore, there is evidence to suggest that the skills of elderly and young workers might be complementary. It then follows that firms that employ workers with mixed ages are actually more profitable compared to those with exclusively elderly or young workers.

*Source:* Adapted from Box 3.2 (World Bank Group 2016).
a. The 12 countries in the sample are: People's Republic of China (PRC); Hong Kong, China; India; Indonesia; the Republic of Korea; Malaysia; Pakistan; the Philippines; Singapore; Taiwan, China; Thailand; and Vietnam.

## 2.2. THE IMPACT OF AGING ON PRIVATE SAVING IN THAILAND

**The long-term growth projections in the previous section assumed constant investment as a share of GDP, so in this section, we assess how aging might impact investment through saving.** The calibration of the long-term growth model presented in the previous section assumes that future investment as a share of GDP will be equal to its historical 10-year average. However, this might not be the case since aging has been documented to have an impact on saving (IMF 2019; Horioka et al. 2010). So, using the expected GDP from the long-term growth model, we assess the impact of aging on saving and make long-term projections. The impact of aging on private saving is important to understand because saving has a direct impact on investment. Based on the national saving and investment identity, saving and investment are positively correlated. Holding capital flows constant, higher national savings lead to higher investment. This section focuses on the impact of aging on private investment and Section 0 focuses on how it impacts public saving (fiscal balance).

**The effects of aging on private saving are not straightforward, but some evidence suggests a positive association in East Asia.** Aging can lead to a decline in aggregate private saving on one hand because a smaller fraction of the population is earning wages *(composition effect)*. On the other hand, because of longevity people might save more for the future, thus leading to a rise in saving *(behavioral effect)*. As such, the dynamics of saving depends on the comparative size of the composition and behavioral effects. The behavioral effect in the East Asia has been documented to be larger than the compositional effect. This implies that life expectancy and longevity is associated with higher savings (Kinugasa and Mason 2007; Li, Zhang, and Zhang 2007; Schult 2004; World Bank Group 2013).

**The pension system also matters for how aging impacts savings.** The pension scheme (defined contribution [DC] vs defined benefit [DB]), the funding mechanism (pay as you go vs fully funded), and the generosity may affect saving patterns. Firstly, a more generous pension scheme would likely disincentivize private saving, as pensioners wouldn't have to rely as much on their private saving in retirement. Theoretical and empirical evidence suggest that countries with pay-as-you-go pension system and more generous benefits tend to have lower private saving rates (see Chai and Kim 2018; Curtis, Lugauer, and Mark 2017; Rezk, Irace, and Ricca 2009; Bloom et al. 2007). Furthermore, there is some evidence to suggest that saving patterns are affected by the type of pension scheme (DB vs DC) (Amaglobeli et al. 2019).[5]

**Thailand's pension system has contributory (DB and DC) schemes and non-contributory schemes (OAA), so the impact of aging on private saving is not very clear.** Close to 82 percent of the elderly population in Thailand receives a flat benefit from the OAA scheme (Palacios and Jain 2021). Separate DB schemes (with different benefit levels at maturity) are available to private and public sector employees. However, a pension reform in 1997 introduced a DC benefits scheme and those enrolled will still qualify to receive payments from the DB scheme. In addition, private sector workers in the formal sector are mandated to contribute to the Social Security Fund (SSF), which covers pensions and various other social protection programs (unemployment, maternity, survivors, disability, and work injury).

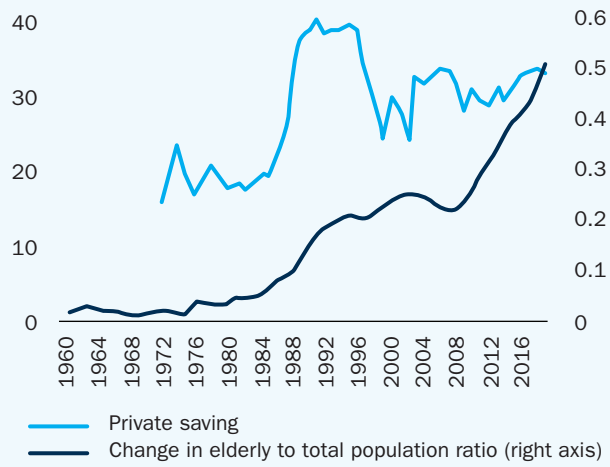
**As Thailand ages, private saving is expected to rise.**[6] We use the share of old age dependency ratio as a measure of aging to analyze how aging affects saving. We find that it is not the size of the dependency ratio, rather its rate of change that is directly related to private saving in the long run. Hence, as Thailand ages faster, private saving is expected to rise and vice versa. Figure 12 depicts private saving and the change in the old age dependency ratio. It shows that as the change in the ratio increased (faster aging), so did private saving, albeit with a lag. And as aging slowed, private saving declined. Before 1980, the change in the ratio of elderly to total population remained broadly constant and private investment as a share of GDP fluctuated around a constant trend. However, as the aging process accelerated in late 1980s and early 1990s, private saving rose rapidly. This observation is further confirmed through a cointegration analysis (see Table in the Appendix).

**Private saving, as a share of GDP, is projected to be slightly higher by 2050, compared to 2019** (see Figure 13). Using the estimated coefficients from the cointegration analysis, the conditional forecast shows that private saving is projected to rise over the next decade and half as the aging process accelerates in Thailand. However, aging is projected to start slowing down around 2035, leading private saving on a downward trajectory thereafter. By 2050, private saving is projected to be 34.8 percent of GDP, compared to 33.3 percent of GDP in 2019.

[5] The authors construct a simple open economy model with overlapping generations to make projections. Their theoretical conclusion is then further substantiated with empirical evidence from the estimation of a fixed-effect panel model.

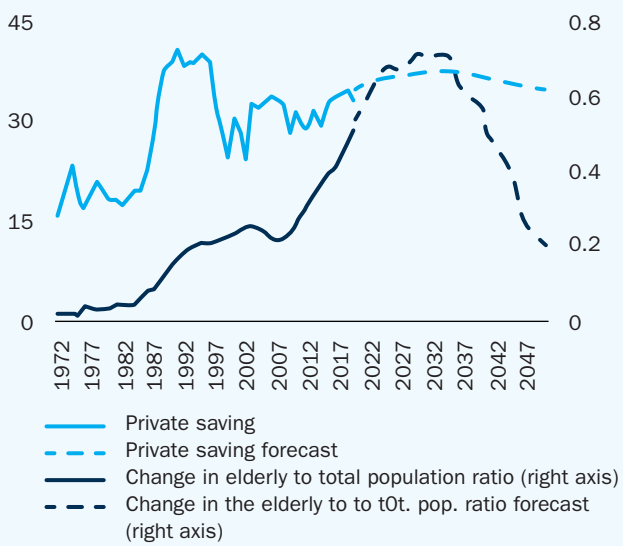
[6] We conduct a cointegration analysis to assess the long-term relationship between aging and private investment in Thailand. The cointegration analysis is suitable to analyze the impact of aging on private saving because it is designed to assess long-term relationship between non-stationary variables. Private saving and the demographic variables are all non-stationary. Plus, the demographic variables are slow moving, making them particularly suitable for a cointegration analysis given its long-term focus. However, the demographic variables are not stationary until they are differenced twice, while domestic savings is stationary after being differenced once. This implies that a long-term relationship can only exist between private saving and the first difference (or speed) of the old dependency ratio. In other words, we can only test for cointegration between private saving (order 1) and the first difference of the old age dependency ratio (order 1). This is finding is similar to (Goh et al., 2020) where the authors find that demographic variables in Japan to be stationary only after their second difference. This is major departure from most existing studies that have used a cointegration analysis to assess the long-term impact of aging on saving. More details about the cointegration analysis are presented in the Appendix.

**Figure 12.** Private saving is correlated with the speed of aging, with a lag




*Source:* World Bank staff calculations.

**Figure 13.** Private saving is projected to rise then fall between now and 2020




*Source:* World Bank staff calculations.

**Box 2.** Impact of aging on monetary policy

Evidence suggests that aging will likely lead to a decline in real interest rates in the long run (Eggertsson, Mehrotra, and Robbins 2019; Carvalho, Ferrero, and Nechio 2016). This is due to a projected lower natural rate of interest (NRI). Using a life-cycle model calibrated to the euro, Bielecki, Brzoza-Brzezina, and Kolasa (2018) show that aging will likely drive down the NRI from 4 percent to 0.4 percent by 2030. In their model, households accumulate assets faster due to the rise in life expectancy. Plus, capital becomes more abundant because of the declining share of the working age population. The combined effects of these two forces cause the NRI to fall. A lower long-term interest rate has implications for monetary policy: A lower NRI in any given country would mean less room for the central bank to lower the policy rate to boost employment and nudge inflation towards its target.

However, the impact of population aging on inflation remain inconclusive. While studies have found that aging puts downward pressure on inflation (Baksa and Munkacsi 2019; McKibbin and Panton 2018; Kim, Lee, and Yoon 2014; Lindh and Bo 1998), other studies have found that population aging puts an upward pressure on inflation (Juselius and Takats 2015, 2016).

Because population aging could lead to a decrease in the effectiveness of monetary policy, it will likely create challenges for monetary policy makers in the future. If aging leads to lower long-term interest rates and lower inflation, then countercyclical monetary policy would become less effective as population ages (Baksa and Munkacsi 2019; Deok Ryong and Dong-Eun 2017; Imam 2013, 2014). This in turn implies that central banks of (more) aged countries would have to react more strongly to nominal variables to reach the desired policy outcome.

*Note:* The natural rate of interest is defined as the interest rate at full employment, which drives the conduct of monetary policy: the policy rate is set below the NRI to incentivize spending and investment and raise employment/output and inflation and vis-versa. A lower NRI increases the probability of hitting the zero lower bound (ZLB), leading to a liquidity trap and rendering monetary traditional policy tools ineffective.

**Aging leading to an increase in savings is consistent with findings in recent studies on the effects of aging on the long-term interest rate and countercyclical monetary policy.** Recent publications have documented the impact of population aging on monetary policy and its transmission through the economy.

The evidence suggests that aging will most likely lead to a decline in real interest rates (see Box 2 above).

# 3. THE FISCAL IMPACT OF AGING IN THAILAND

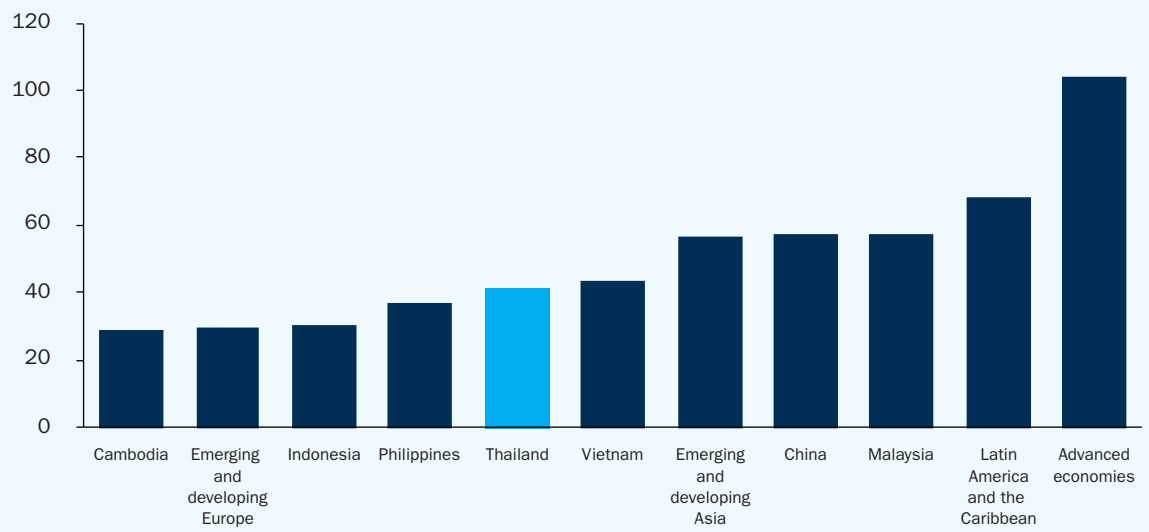
**The three important components of aging-related expenditure—pensions, health care, and long-term care—are projected to increase substantially in developed and developing countries.** Without reforms, age-related expenditures in developed economies are projected to increase by nearly 8.5 percent of GDP between 2015 and 2100 (Clements et al. 2015). The projected increase is mainly driven by health care spending (6.4 percent of GDP), and past pension reforms (1.9 percent of GDP). In developing economies however, age-related expenditure is projected to increase by 10.6 percent of GDP. The increase in pension spending is estimated at 5.1 percent of GDP and health spending at 5.5 percent of GDP. Projections for OECD countries show that long-term care spending will increase to 1.6–2.1 percent of GDP by 2060 and by 0.9–1.4 percent of GDP for a number of emerging economies.

**The long-term fiscal sustainability of aging-related expenditure ultimately depends on the ability to run primary fiscal surpluses and maintain a strong growth rate.** World Bank simulations show that countries with younger populations and low age-related spending have the best fiscal sustainability outlook, regardless of the initial debt level (World Bank Group 2016).[7]

The opposite was true for older countries with a high level of age-related spending. Maintaining a primary fiscal surplus and a strong growth rate (higher than the interest rate paid on public debt) are key determinants for the fiscal sustainability of age-related expenditures. Starting with a lower level of public debt is important, but ultimately, unfavorable growth and fiscal dynamics are more detrimental for fiscal sustainability.

**Thailand enjoyed a moderate and stable level of debt and favorable debt dynamics between 2010 and 2019 but has suffered from slow growth.** Thailand's average fiscal balance was 0.1 percent of GDP from 2015 to 2019 and public debt to GDP was stable at around 41 percent of GDP, comparing favorably to other countries (Figure 15) and below its debt ceiling, with a zero primary surplus over this period. While real GDP growth was relatively slow at 3.4 percent on average from 2015 to 2019, the real interest rate on debt was −0.9 percent. As a result, the real interest rate-growth differential was negative at −2.6 percent, leading to favorable debt dynamics. However, the dynamics have become less favorable in recent years.

**Figure 14.** Gross public debt, 2019 (percent of GDP)




*Source:* IMF WEO.

[7] The simulations were based on stylized representations of eight East Asian countries with combinations of a) older and fast-aging versus young and slowly aging countries, b) high versus low aging-related spending, and c) high versus low initial public debt.

**Post-COVID, aging will likely lead to a rapidly deteriorating fiscal and debt position.** Thailand's fiscal position deteriorated drastically due to the impact of COVID and the fiscal policy response, as in most other countries, with the fiscal deficit widening to 7.8 percent of GDP and the debt level rising to 58 percent of GDP in 2021.[8] Although it has traditionally run a low general government budget deficit, aging will lead to rapidly increasing fiscal costs, which will lead to a widening fiscal deficit and increasing debt level.

The key drivers of aging costs are expected to be pensions and health care. In 2017–19, Thailand spent about 2.0 percent of GDP per year on pensions (civil service pensions, OAA, and social security). In addition, there is spending on matching contributions for voluntary pensions schemes, old age care, and health care for the elderly through various levels of government (see Figure 15).

**Figure 15.** Key aging-related expenditure across levels of government

**Central government**

- Direct aging expenditure
  - Civil Service Pension Scheme DB (pre-1997 and post-1997)
  - Old Age Allowance
  - Health care for civil servants and retirees
- Intra-governmental transfers
  - Government Pension Fund DC (post-1997)
  - Contribution to Social Security Fund (2.75 percent)
  - Matching contribution voluntary pension schemes
  - Grants to NHSO and LGs

**Social Security Office (contributory)**

- Pensions for private sector contributors
- Health care for private sector contributors
- Voluntary pension scheme for informal workers

**National Health Security Office (non-contributory)**

- Health care for elderly (including long-term care)

**Local governments**

- Community-based long-term care for elderly

*Source:* World Bank staff.
*Note:* The long-term fiscal projections in this report include the underlying aging-related expenditure items.

## 3.1. THE FISCAL IMPACT OF PENSION SCHEMES

**Thailand's pension system is fragmented with six different government programs for formal sector, informal sector, and current elderly, with inadequate levels of protection.** Close to 82 percent of the elderly receive a modest, flat benefit from the Old Age Allowance (OAA) (Palacios and Jain 2021). Private and public sector workers are enrolled in separate defined benefit (DB) schemes, which are at different stages of maturity and have different benefit levels. Younger civil servants now contribute to a defined contribution (DC) scheme known as the Government Pension Fund and receive a smaller pension from the DB scheme than those that remain in the old scheme.

Meanwhile, workers in the formal private sector contribute to the Social Security Fund (SSF), which covers pensions as well as unemployment, maternity, death, disability, sickness, and child allowance. A significant fraction also participates in voluntary, private schemes known as provident funds and some contribute to Retirement Mutual Funds (RMF) and the National Saving Fund (NSF). Informal sector workers, which constitute about 54 percent of the working age population in 2019, have the lowest coverage rates. They are not mandated to join any pension scheme, but various schemes have incentives for them to contribute on a voluntary basis.

[8] Thailand Economic Monitor, January 2021 (https://www.worldbank.org/en/country/thailand/publication/key-findings-thailand-economic-monitor-january-2021-restoring-incomes-recovering-jobs).

### 3.1.1. CIVIL SERVICE PENSION (CS) SCHEME

**The CS scheme covers about 2.2 million civil servants, and currently has around half a million beneficiaries with an estimated cost of 1.4 percent of GDP.** Central government employees who joined the civil service prior to 1997 are entitled to a non-contributory DB scheme in retirement at age 60. Employees who joined after 1997 are entitled to a mix of a non- contributory DB and a DC benefit. The defined benefits for post-1997 retirees will be 10–20 percent lower on average than pre-1997 benefits, but they are still generous by international standards. The cost of the pre-1997 and post-1997 DB schemes is estimated at Bt 223.8 billion or 1.4 percent of GDP as of 2019[9] (see the accompanying note on public pensions (Palacios and Jain 2021)) with half a million current retirees (IMF 2019). The defined contribution component is considered a deferred wage and will not be counted as pension expenditure. The average benefit is Bt 447,000, which is 189.9 percent of GDP per capita and is considered generous.

**Assuming unchanged policies, the old-age CS pension is the real driver of expenditure growth.** Due to the lack of data, we assume that civil service demographics reflect the population's demographics; the number of retirees will represent a constant share of the over-60 population going forward; and the number of retirees will rise from half a million in 2018 to close to 1 million by 2060. Assuming that the benefit is indexed to GDP per capita, public expenditure will increase from 1.4 percent of GDP in 2019 to 2.9 percent of GDP in 2060 (see Table 3).

### 3.1.2. SOCIAL SECURITY FUND (SSF)

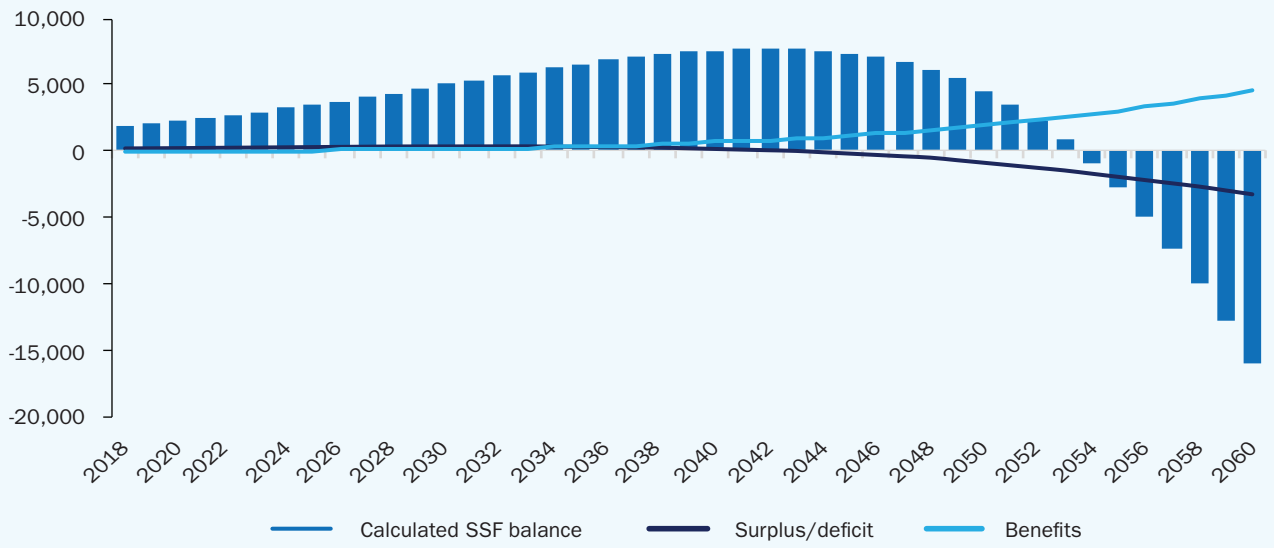
**The SSF is a DB scheme covering 13 million private sector workers out of an estimated total of 16 million and had around 444,000 beneficiaries in 2017.** The SSF was set up in 1990 with a 15-year vesting period.

The SSF rules under Article 33 mandate contributions from employees (5 percent), employers (5 percent), and the government (2.75 percent).The contributions are mandated for all private sector workers. However, the salary on which benefits can be calculated is capped at Bt 15,000 per month, which is about 82 percent of the average wage in Bangkok, and the cap is not indexed to price or wages.

**The two main challenges with the SSF are that (1) it provides inadequate benefits and (2) it is projected to run out of reserves by 2054.** Estimated old-age spending from the SSF in 2017 was Bt 41.4 billion, which amounted to Bt 93,000 per beneficiary, or 39.6 percent relative to GDP per capita (Chumjai 2017). Estimates show that if the wage ceiling used for calculating contributions and benefits is not revised in line with nominal wage growth, the replacement rate that pensioners will receive will be a smaller proportion of their wage each year, and the benefit will be negligible in a decade.

**The SSF will run out of reserves by 2054.** Based on an ILO (2013) report, expenditure on benefits will increase from Bt 11 billion in 2018 to Bt 4,600.7 billion in 2060, as the number of pensioners is projected to increase to 1 million in 2026 and to 10 million in 2056 with increasing life expectancy. The fund will have a cashflow deficit by the mid-2040s and will run out of reserves by 2054 (see Figure 16). However, while the main messages of the ILO (2013) analysis are still valid, the analysis was based on different demographic projections and more optimistic long-term real wage and GDP per capita assumptions compared to the macro projections in this report. The ILO is currently producing an updated long-term projection of the SSF, but the projections, reform scenarios, and underlying assumptions were not available to the team at the time of writing of the report, so the SSF is not included in this report's projections.

**Figure 16.** As the number of retirees and benefits increase, the SSF reserves are projected to be depleted by the mid-2050s (Bt billion)




*Source:* ILO (2013) and World Bank staff interpolations.

[9] Bureau of the Budget data on expenditure on pensions and gratuities.

### 3.1.3. OLD AGE ALLOWANCE (OAA)

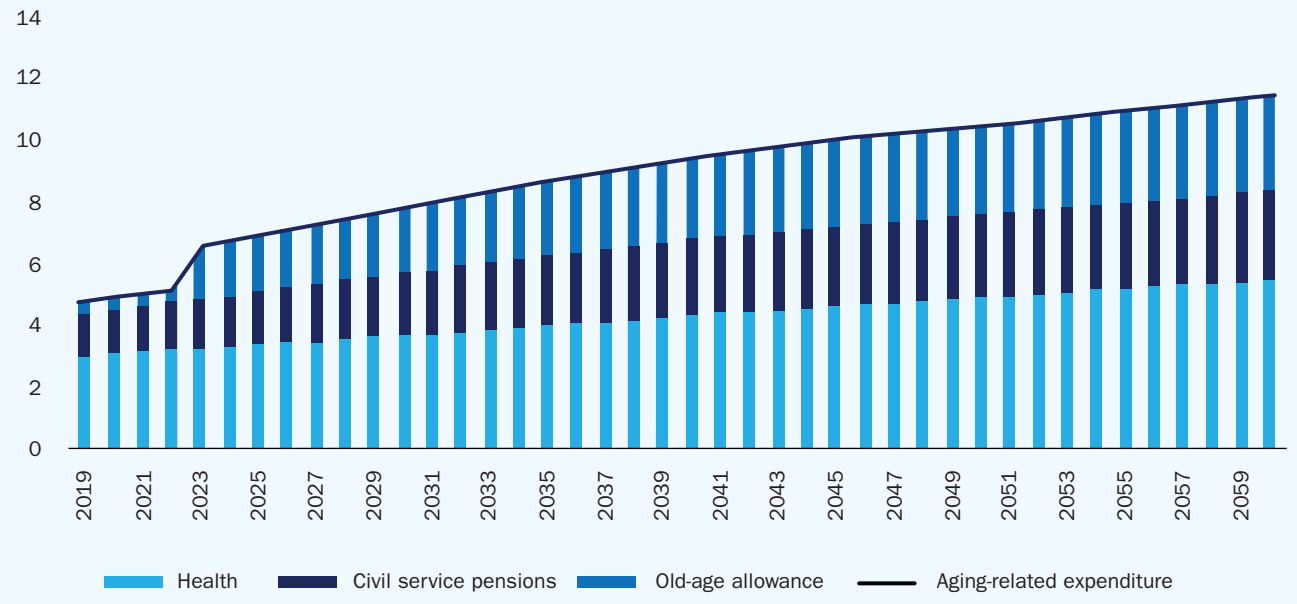
**In 2018, the OAA covered 8.4 million elderly or around 75 percent of the over-60 population, but the amount is not generous.** Since 2011, there has been a system of progressive rates related to age with Bt 600 per month for those aged 60–69, Bt 700 for 70–79, Bt 800 for 80–89 and Bt 1,000 for 90 and older. Its fiscal cost amounted to Bt 66.4 billion or 0.4 percent of GDP in 2018. The OAA is not very generous; at Bt 7.9 thousand, it amounts to 3.4 percent relative to GDP per capita or 29 percent relative to the national poverty line of around Bt 2,280 per month as of 2017 (Palacios and Jain 2021).

**OAA spending will increase to 0.9 percent of GDP by 2060, but that will still provide an insufficient benefit.** The number of elderly eligible for the OAA is projected to increase to 16 million by 2060. Assuming that the benefit is indexed to GDP per capita, the fiscal cost increases to Bt 735 billion or 0.9 percent of GDP by 2060. But the benefit will still be as inadequate in 2060 as it is in 2018, that is, only 3.4 percent relative to GDP per capita.

**The interaction of the OAA with other pension schemes will also affect the long-term dynamics.** If more private sector workers make regular contributions to the SSF and the scheme matures or if the voluntary schemes reaches scale, it is possible that fewer individuals will need to rely solely on the OAA. The benefit under OAA is minimal so pension income from other sources will be needed for individuals to attain the goal of income security in retirement. However, if private workers continue to make low contributions or voluntary schemes fail to expand their coverage of informal sector workers, the OAA will remain the only source of income. In such a situation, one could expect social pressure to increase benefit of OAA in order to provide income support to the growing share of elderly (Palacios and Jain 2021).

**Increasing the generosity of the OAA to the national poverty line will lead to a fiscal cost of the scheme of 3.1 percent of GDP by 2060.** Without any reforms to increase the coverage and adequacy in the other pension schemes, most of the population, except civil servants, will eventually be eligible for the OAA. This would make it necessary to increase its coverage as well as its generosity (Palacios and Jain 2021). Raising the benefit to the poverty line immediately and keeping it indexed to the poverty line would make it adequate, but the fiscal cost would rise to 3.1 percent of GDP by 2060.

**Figure 17.** Projected selected aging-related public expenditures, including increase in OAA generosity (percent of GDP)




*Source:* MoF, IMF, and World Bank staff projections.

**Table 3.** Summary table of Civil Service Pension Scheme (defined benefit), the Social Security Fund (SSF) and the Old Age Allowance (OAA)

| | Type | Number of beneficiaries in 2018 (% coverage of 60+) | Generosity per beneficiary in 2018 (% of GDP per capita of Bt 421,000) | Baseline cost (% of GDP) | Cost in 2060 (% of GDP) |
|---|---|---|---|---|---|
| **Civil Service Pension Scheme** | Government budget, defined benefit, from 60 years | 0.5 million (around 5 percent) | 189.9 percent (Bt 447,000) | 1.4 | 2.9 |
| **Social Security Fund** | Contributory, defined benefit, private sector contributors from 55 years | 0.5 million (around 5 percent) | 39.6 percent (Bt 93,000) | 0.1 | Not available |
| **Old Age Allowance** | Government budget, all over 60 years except civil servants | 8.4 million (around 75 percent) | 3.4 percent (Bt 7,900) | 0.4 | 0.9 (nobenefit change) 3.1 (if benefit raised to poverty line) |

*Source:* Palacios and Jain (2021); IMF (2019); World Bank staff calculations.

## 3.2. FISCAL IMPACT OF HEALTH CARE AND LONG-TERM CARE EXPENDITURES

**Public expenditure on health care will increase from 2.9 percent of GDP in 2017 to 5.5 percent of GDP in 2060.** Thailand achieved universal health care coverage in 2012, but it has a fragmented system with a mix of contributory and budget-financed schemes with varying levels of generosity. In particular, the distinction between a budget-financed health care scheme for civil servants and retiree, a contributory system for private sector workers, and a non-contributory scheme for elderly with a fixed per person budget is considered unfair.[10] Since health care is outside the scope of this report, it uses the same projections for health care costs as in IMF (2019), which is based on the "excess cost growth" methodology.[11] It projects that the public expenditure on health care will increase from 2.9 percent of GDP in 2018 to 5.5 percent of GDP in 2060. This assumes an excess cost growth of 1 percent and that the population will gradually become healthier at an older age according to the "healthy ageing hypothesis" (OECD 2013).

**Long-term care spending is the third most important aging-related expenditure item, but it is not yet possible to project the costs.** Projections indicate a rapid increase in the number of people needing long-term care in Thailand (Glinskaya, Walker, and Wanniarachchi 2021). In 2017, 400,000 people over 80 years required social assistance, and by 2037, this number is projected to reach 2.5 million. Similarly, in 2017, 180,000 people were bed ridden and by 2037, this number could reach to 500,000.

However, it is currently not feasible to generate cost projections for a number of reasons: there is no legal mandate to provide a minimum level of long-term care, which could be used to calibrate the projections. Long-term care is largely provided by volunteers or implicitly through the National Health Security scheme, and the government has not yet started considering possible options to provide long-term care in a fiscally sustainable and adequate way.

## 3.3. IMPACT ON FISCAL BALANCE AND PUBLIC DEBT

**Long-term fiscal sustainability is partly driven by demographic changes through GDP growth and aging-related expenditure and partly by endogenous debt dynamics.** The approach fits in the literature established for country-specific aging study such as Bulgaria and Vietnam (World Bank Group 2013, 2020). It combines the World Bank's medium-term fiscal projections with long- term fiscal projections-based World Bank's Fiscal Sustainability Analysis (FSA) tool.[12] The FSA uses the long-term growth rate projections from the first section of this report, which mainly serve as the denominator and which drive revenue and non-aging primary expenditure. We assume that revenue and non-aging-related primary expenditure are a constant share of GDP. The aging-related primary expenditure follows the projection described above.[13] Finally, interest payments are projected assuming a fixed interest rate in the long term applied over the entire debt stock.[14]

[10] According to discussion with experts on the cost of aging.

[11] This methodology is described in IMF (2010). Excess cost growth (ECG) is defined as the excess of growth in real per capita health expenditures over the growth in real per capita GDP after controlling for the effect of demographic change. The key insight is that only a small fraction of the increase health care spending as a share of GDP can be explained by aging and the rest is due to technology, health policies, and the upward cost pressure due to the relatively low productivity growth of health care compared to the rest of the economy. Excess cost growth can be estimated econometrically as a residual for a country. But since it is important that the health care system is relatively stable, this number can only be estimated realistically for advanced economies, and one can take the average ECG to project health care costs in emerging markets.

[12] The medium-term fiscal projections are as February 2021.

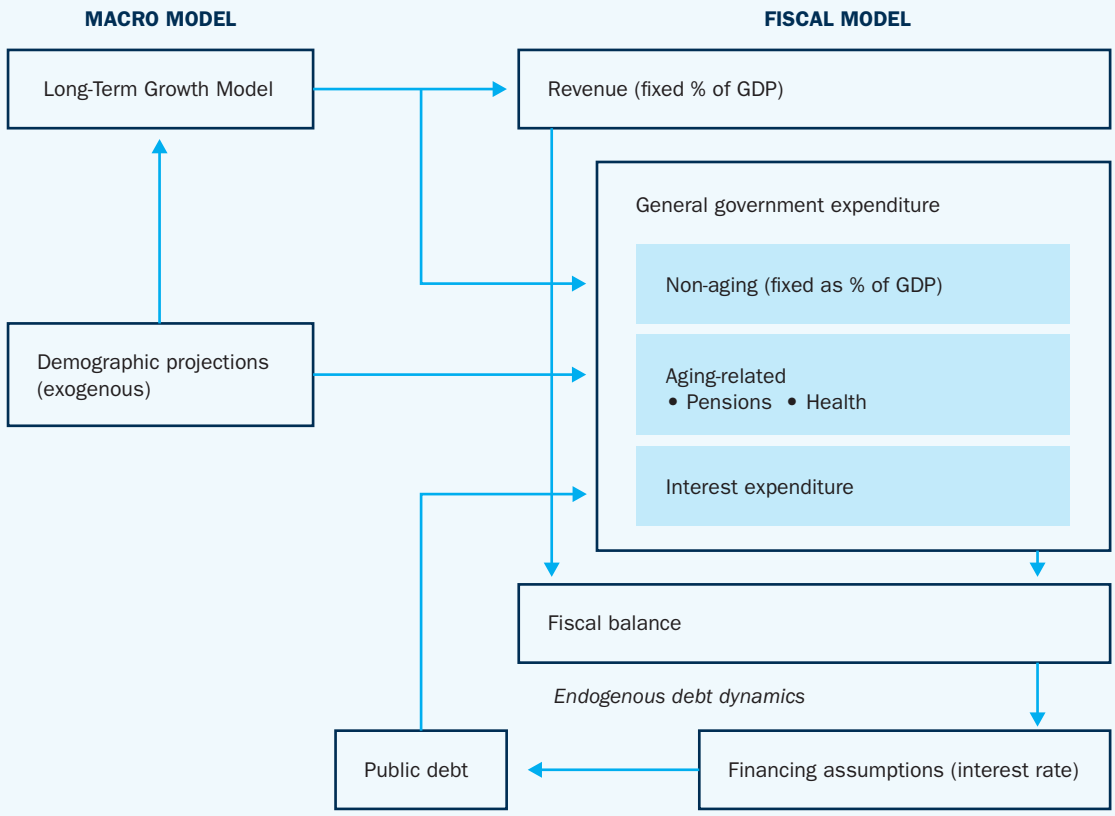
[13] Revenue is kept fixed at the projected 2022 level. This may not be entirely realistic, as it is very plausible that the revenue base, in the absence of reforms, would also erode with aging, in particular the tax base for personal income tax (PIT). However, there may be other exogenous factors, such as productivity growth, wage increases, and formalization, which would put upward pressure on PIT, and the government could use policy to expand the tax base or introduce new taxes, less affected by aging.

[14] The weighted average interest rate is kept at 2.4 percent, which is the projected interest rate as of 2022. With long-term inflation kept at 2 percent, the real interest rate remains below the long-term growth rate of 1.4 percent. If there is a gradual upward trend of the nominal interest rate in line with rising debt to a maximum of 200 basis points, this would lead to a positive interest rate-growth differential and the debt would rise to 91 percent of GDP by 2040 and 225 percent of GDP by 2060.

**In the absence of any labor market, fiscal reforms, or reforms to the programs, the debt level will rise to 66 percent of GDP by 2060 as a result of the long-term increase in pensions and health spending, but this would leave the majority of the elderly without an adequate OAA.** The primary balance will switch from a 1.4 percent of GDP surplus in 2022 to a 3.0 percent of GDP deficit by 2060, entirely the result of the increase in aging-related spending. However, since the interest rate-growth differential remains negative (–2.3 percentage points on average between 2023 and 2060), the debt dynamics remains favorable.

As a result, the overall fiscal balance will switch a 0.4 percent of GDP surplus in 2019 to a 4.2 percent of GDP deficit by 2060, and public debt will increase from 41 percent of GDP in 2019 to 66 percent of GDP by 2060. However, this maintains the inadequate spending for the OAA for the majority of the elderly. It should be noted that none of the projections include the SSF and long-term care, which would increase aging-related expenditure and increase the long-term fiscal and debt dynamics.

**Figure 18.** Structure of the macro-fiscal model




*Source:* World Bank team.

**These results are sensitive to the assumption on the interest rate.** Thailand has enjoyed low interest rates thanks to its macro-fiscal reputation and aging may put downward pressure on the real interest rate (see Section 0). However, a widening deficit and depletion of the SSF, which is largely invested in government bonds, may put upward pressure on the financial market and lead to a rising interest rate. Assuming the interest rate on debt increases gradually from 2.0 percent in 2025 to 4.0 percent by 2060, the debt level would increase to 83 percent of GDP by 2060. That is the result the deteriorating debt dynamics over time as the interest rate-growth differential approaches zero over time.

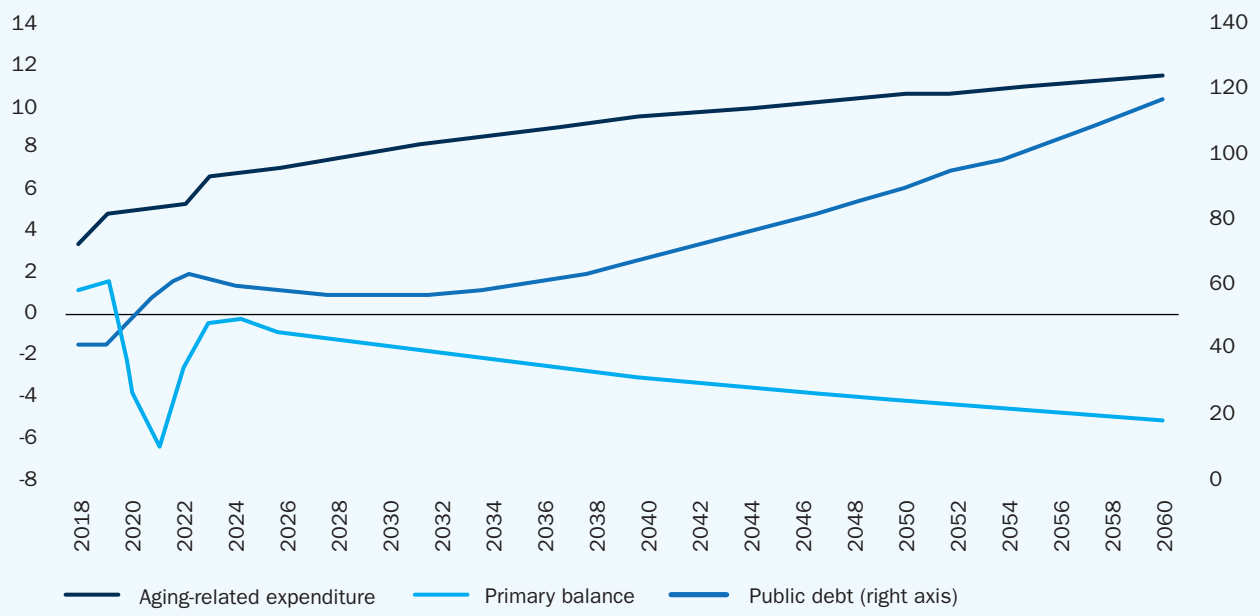
**The baseline scenario is therefore an increase in the OAA to an adequate level as described above, which would lead to a debt level of 116 percent of GDP in the absence of reforms.** In this scenario the OAA remains indexed to GDP per capita throughout the projection period. The primary deficit will widen to 5.2 percent of GDP by 2060. The overall fiscal deficit will widen faster to 7.4 percent of GDP by 2060. The debt level will increase to 116 percent of GDP by 2060.

**Table 4.** Medium- and long-term fiscal projections (OAA spending increased to adequate level) (percent of GDP)

| | 2019 | 2020 | 2022 | 2040 | 2060 |
|---|---|---|---|---|---|
| Revenue | 20.9 | 20.7 | 20.0 | 20.9 | 20.9 |
| Expenditure | 20.5 | 25.3 | 23.9 | 25.3 | 28.2 |
| Primary expenditure | 19.5 | 24.3 | 22.8 | 24.1 | 26.1 |
| Aging | 4.9 | 5.0 | 5.2 | 9.5 | 11.5 |
| Civil Service Pension | 1.4 | 1.4 | 1.6 | 2.5 | 2.9 |
| Old-Age Allowance | 0.4 | 0.4 | 0.5 | 2.7 | 3.1 |
| Health care | 3.0 | 3.1 | 3.2 | 4.3 | 5.5 |
| Non-aging | 14.6 | 19.3 | 17.6 | 14.6 | 14.6 |
| Interest | 1.0 | 1.0 | 1.1 | 1.3 | 2.2 |
| Fiscal balance | 0.4 | -4.5 | -3.9 | -4.4 | -7.4 |
| Primary balance | 1.4 | -3.6 | -2.8 | -3.2 | -5.2 |
| Public debt | 40.9 | 50.1 | 62.7 | 68.1 | 116.3 |

*Source:* Ministry of Finance, IMF, World Bank staff projections.

**Figure 19.** Projections for aging-related expenditure, primary balance, and debt (percent of GDP)




*Source:* Ministry of Finance, IMF, World Bank staff projections.

# 4. POLICY REFORMS IN RESPONSE TO AGING

## 4.1. THE LONG-TERM GROWTH IMPACTS OF REFORMS

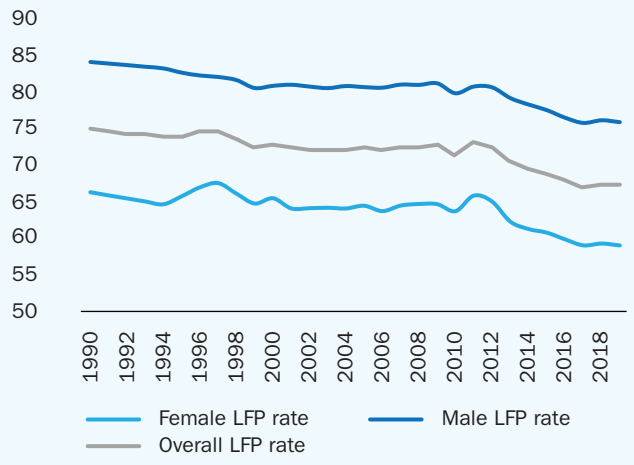
**Policies to mitigate the impact of aging on long-term growth ought to be aimed at increasing the size of the labor force and raising its productivity.** Policy measures to increase the size of the labor force in Thailand could include extending the working period by increasing the retirement age and reducing the gap between female and male labor force participation rates. An effective immigration policy could also boost the size of the workforce. Additionally, measures can be put in place to increase the productivity of the labor force such as improving the quality of education, enacting measures to increase education attainment, and providing training to reskill and upskill the existing workforce.[15] An increase in private investment can also help to raise labor productivity and mitigate the impact of aging.

### 4.1.1. INCREASE IN THE LABOR PARTICIPATION, ESPECIALLY FEMALE LABOR FORCE PARTICIPATION

**The female labor force participation (FLFP) rate in Thailand has been on a marked downward trend since 2011.** In 2019, the FLFP rate was estimated at around 59.2 percent, compared to 66 percent in 2011 (see Figure 20). Although overall labor force participation in the country has also been on a marked downward trend since 2011, the FLFP rate has declined faster. This is contrary to the experience of Korea and Malaysia, where FLFP has increased as their populations age and the fertility rate declines (Canning et al. 2009; Lee and Chung 2008; World Bank Group 2019, 2020).

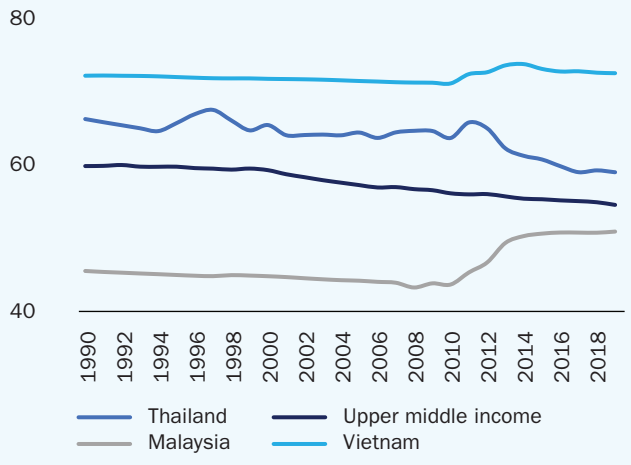
[15] These policies are discussed in detail in a companion report (Moroz and Naddeo 2021).

**Figure 20.** Overall labor force participation has been on a marked downward trend and FLFP has fallen faster (percentage)




*Source:* WDI (modelled ILO estimate) and World Bank staff calculations.

**Figure 21.** Although FLFP rate in Thailand is higher than the average among UMICS, it is far lower compared to Vietnam (percentage)

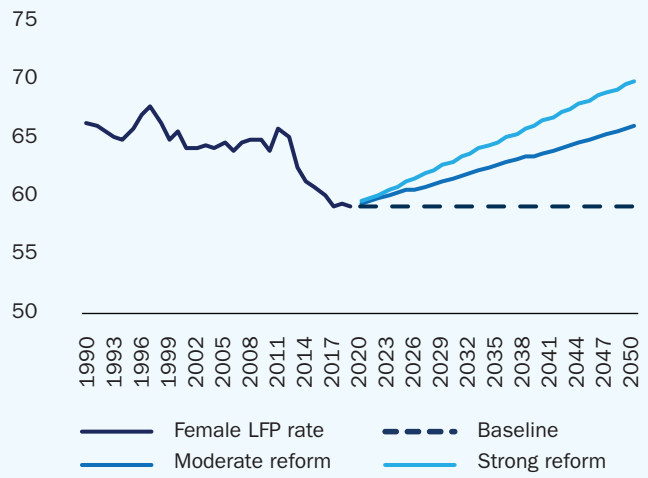



*Source:* WDI (modelled ILO estimate) and World Bank staff calculations.

**In the LTGM, a gradual increase in the FLFP over the next three decades rate has a modest impact on long-term growth, underscoring the importance of policy combination.** We simulate two reform scenarios; one (moderate reform) that raises the FLFP rate back its 2011 rate (after which it started to decline); and another (strong reform) that raises it to 70 percent over the period 2020–50.

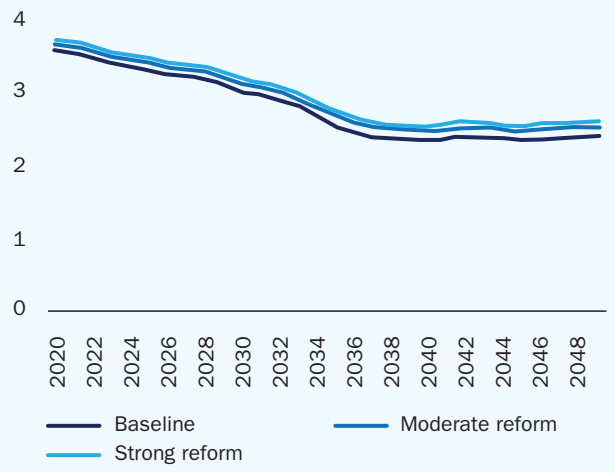
The moderate reform is projected to lead to a 0.1 percentage point increase in growth over 2020–50 and the strong reform is projected to increase growth by an average of 0.2 percentage points over 2020–50. Given the modest growth impact of these reforms, raising FLFP will have to be combined with other policy reforms.

**Figure 22.** Reforms to increase the female labor force participation rate (percentage) ...




*Source:* WDI (modelled ILO estimate) and World Bank staff calculations.

**Figure 23.** ... are projected to have limited impact on long-term headline growth (percentage)




*Source:* WDI (modelled ILO estimate) and World Bank staff calculations.

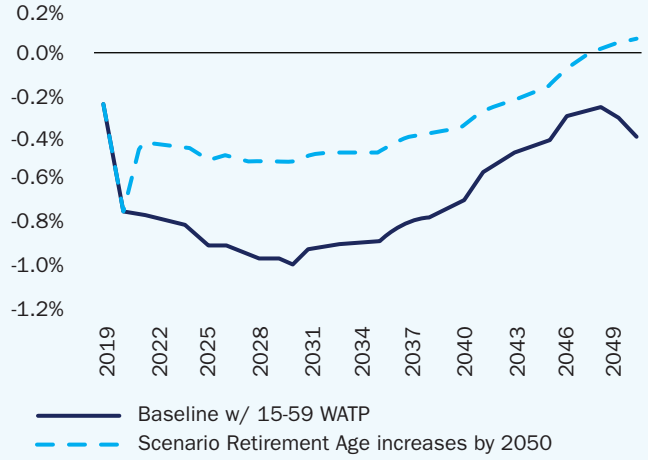
## 4.1.2. INCREASE IN THE OFFICIAL RETIREMENT AGE

**Gradually raising the mandatory retirement age from 60 to 65 by 2050 is projected to lead to a modest 0.3 percentage point increase in GDP growth, on average.** The current official retirement age in Thailand is 60 years. To reflect a potential increase in the official retirement age to 65 in Thailand, Figure 24 depicts a scenario where the definition of the working age population in the LTGM is changed from 15–59 to 15–64 with a gradual phase-in by 2050.[16] This leads to an increase in the WATP ratio and a considerable boost in its rate of growth, which remains nonetheless negative throughout most of the implementation period. The increase in the growth rate of the WATP ratio leads to a boost in long-term growth (see Figure 25).

[16] The population data is split in cohort of 5 years and goes from 59 to 64, so our retirement age policy simulation is therefore from 59 to 64, instead of 60 to 65. This would not make a difference since what matters for growth is the rate of the change of the WATP ratio.

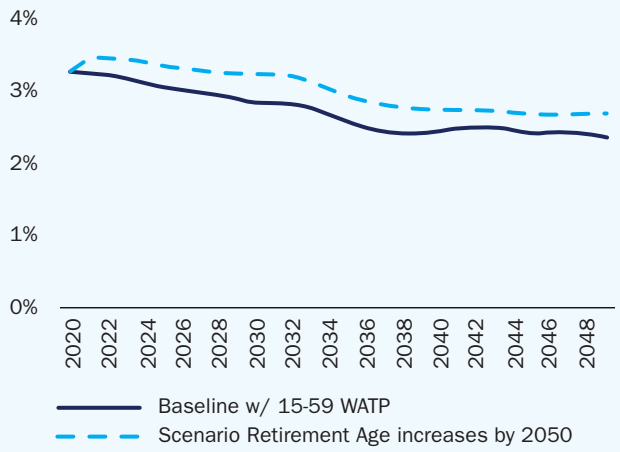
**Contrary to popular belief, evidence suggests that increasing the retirement age is not detrimental to youth employment and instead presents many advantages.** The first impact of raising the retirement age is on the size of the labor force, which in turn impacts long-term economic growth as depicted in the previous paragraph. In addition, raising the retirement age would ease pressure on pension funds and the additional saving from the compositional effect could also provide a boost to private investment by enlarging the potential pool of loanable funds. Some of the push back against this policy centers around concern about youth unemployment. Many argue that raising the retirement age denies employment to young people, who are more likely to be unemployed. The evidence seems to suggest that not only does raising the retirement age not have a negative impact on youth employment, it helps to boost it (Gruber and Wise 2010; Böheim and Nice 2019). An analysis of employment data from 12 countries revealed that as employment among those aged 55–64 rose, so did youth employment (Gruber and Wise 2010). This is due to higher economic activity, thus job creation, stemming from sustained income by those who remained in the workforce as a consequence of the policy change.

**Figure 24.** A rise in the retirement age leads to an overall increase in WATP ratio growth during the implementation period (WATP ratio growth)




*Source:* WDI (modelled ILO estimate) and World Bank staff calculations.

**Figure 25.** Economic growth increases in response to growth in size of the working age population and reaches a new growth path higher than the baseline (GDP growth)

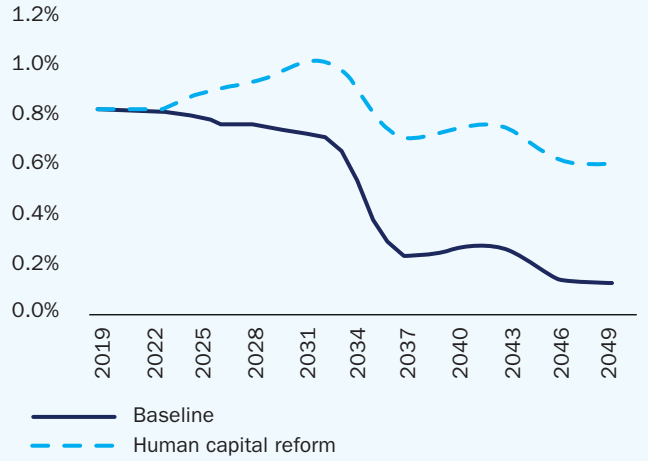



*Source:* WDI (modelled ILO estimate) and World Bank staff calculations.

## 4.1.3. INCREASE IN THE QUANTITY AND QUALITY OF HUMAN CAPITAL

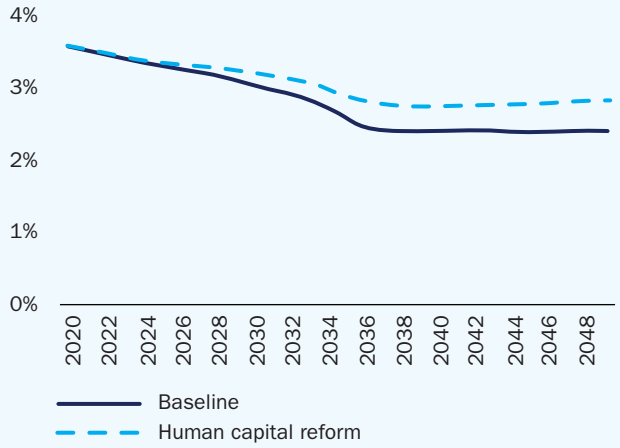
Raising the quality of the workforce through education, training, and improved health outcomes would also help to mitigate the negative impact of its shrinking size. Increasing the quality of the labor force would raise its productivity and help limit the long-term growth effects of aging. This can be achieved by reforms/incentives to increase education attainment, and by providing training, upskilling, and reskilling to the existing workforce. Human capital growth in Thailand is projected to fall to 0.1 percent by 2050, from 0.6 percent in 2020 (see 'Baseline' in Figure 26). We simulate a reform scenario in which policy is aimed at raising the expected years of schooling from 12.4 to 13.3 years (the 90th percentile of UMICs) and the quality of schooling as measured by the harmonized test scores from 70 to 80 percent (from 436 to 499 divided by 625), the 90th percentile of UMICs. Improving teachers' training and making changes to the curriculum to better prepare students for higher cognitive tasks would help to raise test scores and expected years of schooling. In addition, the reform scenario envisions a decline in the stunting rate among children below the age of 5, currently estimated at 11 percent, to 5 percent, the 90th percentile of UMICs. The combined effects of these reforms are projected to considerably enhance human capital growth (see 'Human capital reform' in Figure 26) and lead to a boost in long-term economic growth (see Figure 27). The reform described in the previous paragraph is projected to increase growth by 0.24 percentage points on average.

**Figure 26.** A reform agenda that improves learning outcomes and lowers stunting rate among children would boost human capital growth in Thailand (human capital growth, percentage)




*Source:* World Bank staff calculations.

**Figure 27.** A boost in human capital growth is projected to lead to higher long-term growth (GDP growth)



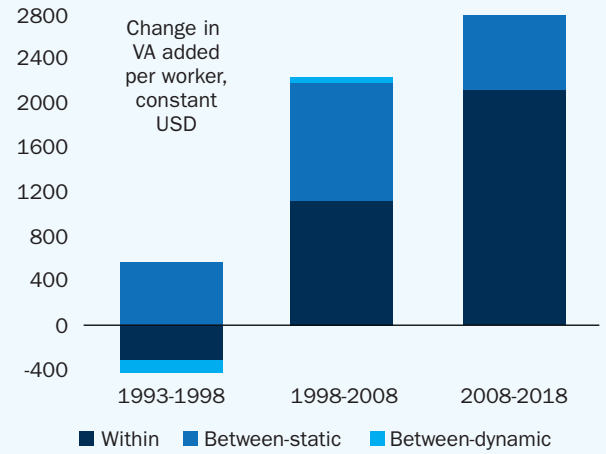

*Source:* World Bank staff calculations.

## 4.1.4. IMPROVEMENT IN AGGREGATE PRODUCTIVITY

**Improve aggregate productivity by facilitating structural change and boosting manufacturing sector productivity.** Aggregate productivity can increase due to (i) productivity gains within a sector and/or (ii) a reallocation of resources, notably labor, between sectors, from low- to high-productivity sectors. For instance, Thailand's productivity gains from 1980-96 were mainly driven by structural transformation. In this period, Thailand experienced a large-scale shift of labor away from agriculture to more productive sectors (manufacturing and services).

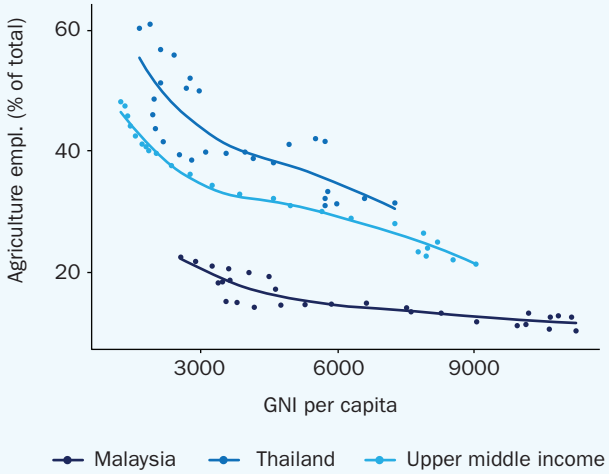
Although structural change has continued, it has at a much slower pace, and productivity growth has tended to come more from gains within sectors than from the movement of labor between sectors (see Figure 28). An indication of slow structural transformation is the continued high share of agricultural employment in Thailand compared to its structural peers (see Figure 29). The key factors slowing the move of labor away from lower productivity agriculture towards manufacturing include the growing skills mismatch between the skill set of agricultural workers and the skill set demanded in the modern sector and the rising agricultural subsidies and high global agricultural prices in the 2000s (Klyuev 2015).

**Figure 28.** Productivity gains are increasingly coming from within sectors rather than movement of labor between sectors




*Source:* World Bank staff calculations.

**Figure 29.** But the share of workers in agriculture in Thailand remains well above its peers

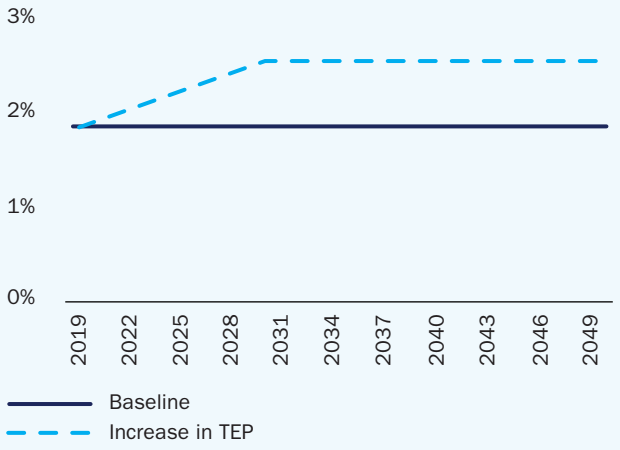



*Source:* World Bank staff calculations.

**Raising aggregate productivity growth from 1.8 percent to 2.5 percent over the next decadewould boost long-term growth by 0.7 percentage points.** In the baseline calibration, we assume that future TFP growth would be equal to its 10-year average of 1.8 percent.[17]

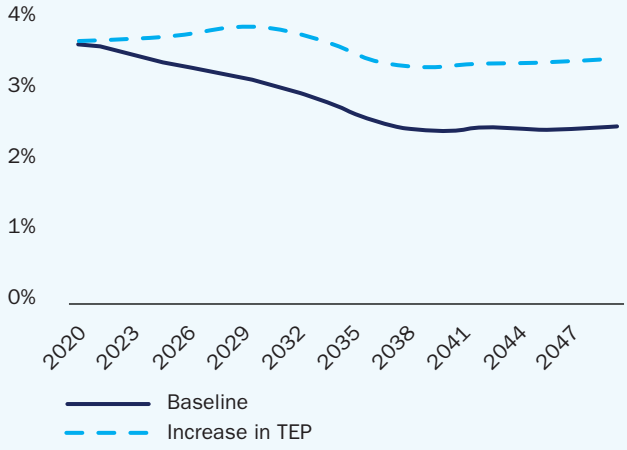
However, policy reformsthat increase the pace of structural change and boost manufacturing sector productivity could lead to higher future TFP growth. If TFP growth reaches 2.5 percent by the end of the decade, then long-term growth in 2050 would 0.7ppts higher.

**Figure 30.** A policy reform to increase the pace of structural change and boost manufacturing would improve TFP growth. Assuming TFP growth rises to 1.5% by 2030 ...




*Source:* World Bank staff calculations.

**Figure 31.** ... long term growth could rise 0.7 percentage points by 2050




*Source:* World Bank staff calculations.

## 4.2. THE FISCAL IMPACT OF REFORMS

**Reforms to improve long-term fiscal sustainability fall broadly into two buckets: reforms to increase the growth potential of the economy and reforms to improve the long-term fiscal position.** In each case, the reform is kept simple without second-order effects.

**Increasing the FLFP rate will significantly improve fiscal sustainability compared to the baseline, but it will not be enough by itself.** The increase in FLFP, especially in the private sector, could positive affect long-term fiscal sustainability through the long-term growth rate and an assumed corresponding increase on taxes, through the accumulation of savings in the SSF, and through increased income tax revenues. The previous section showed that even reforms raising the FLFP to 70 percent between 2020 and 2050 would increase long-term growth by an average of only 0.3 percentage points over 2020–50. Everything else equal, public debt is projected to reach 92 percent of GDP by 2060 instead of 116 percent of GDP under the baseline, thanks to slightly more favorable debt dynamics. Since the projections keep the tax-to-GDP ratio constant, an implicit assumption is that the increase in FLFP leads to an equal increase in taxes, mostly likely through personal income tax, so it is important that it creates formal sector jobs. There will be also be an impact on the SSF, where an increase in contributors may delay the moment when the fund runs out of reserves, but structural reforms to the SSF are needed to ensure that the fund will be adequate and sustainability (this is further described in Palacios and Jain (2021)).

**Similarly, increasing the retirement age by 5 years will improve fiscal sustainability compared to the baseline, but it will not be enough.** The increase in the retirement age, if limited to the private sector, would positively affect fiscal sustainability through the same channels as the increase in the FLFP. It boosts average long-term growth over 2020–50 by 0.3 percentage points. Everything else equal, public debt is projected to reach 82 percent of GDP by 2060 instead of 116 percent of GDP under the baseline, thanks to slightly more favorable debt dynamics.

**This means that reforms directly addressing the long-term primary deficit are necessary to preserve fiscal sustainability.** To offset the increase in aging-related expenditure one could target a gradual increase in revenue over the same period.

[17] Excluding the 2008-2009 Global Financial Crisis.

Targeting a gradual increase of the revenue-to-GDP ratio to 25.3 percent of GDP by 2060 would stabilize the debt level around 52 percent of GDP by 2060. The revenue reforms will have to account for changes in the tax base as the population ages and could include wealth or property taxes. It is again important to note that these projections do not include the SSF and the long-term care spending,[18] so the increase in revenue to purely offset the impact of aging (let alone other long-term trends such climate change or simply upgrading Thailand's provision of non-aging public service and investment) will require a structurally higher level of revenue-to-GDP.

**The results show that urgent, comprehensive, and sustained reforms are needed in Thailand to provide adequate pensions in the long term in a sustainable fiscal framework.** While the country has a network of social protection programs, they are in need of reform to increase adequacy and fairness, among other things. Thailand therefore needs three sets of broad reforms:

(1) Labor market reforms: these may help sustain long-term growth through a temporary boost in the number of employed, which will improve fiscal sustainability through a number of channels.

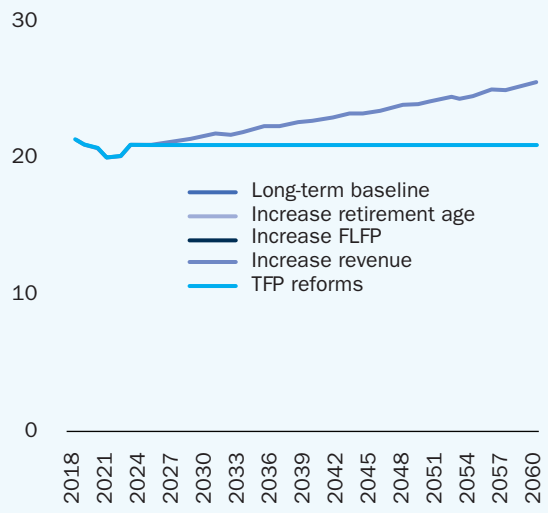
(2) Revenue and expenditure reforms: while there may be wasteful expenditure, this may be exhausted soon as a source of fiscal space. As Thailand's tax-to-GDP is well below that of other emerging markets, the scope to increase tax revenue is more promising to maintain fiscal sustainability.

(3) Finally, it is important to look at each of the social protection, pension, and long-term care programs and assess whether they provide adequate benefits, what the ideal funding source should be, and how make them sustainable in the long term.

For all three areas of reform, there is also a clear case for starting these reforms as soon as the post- COVID recovery has taken hold, as the costs of adjustment will increase over time. The accompanying reports provide detailed recommendations on reforms in the labor market, social protection system, pensions, and long-term care.

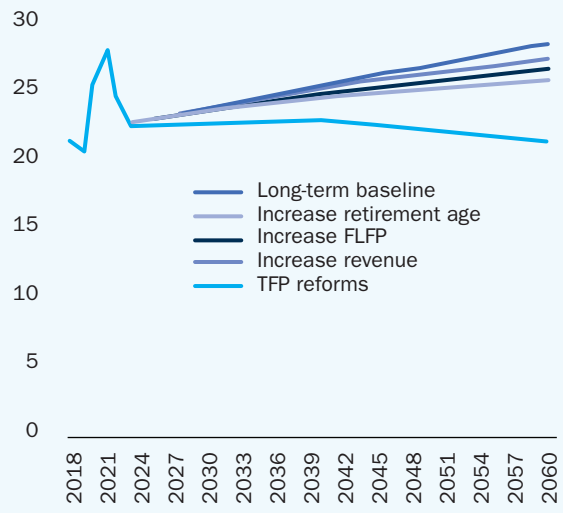
[18] The projections also do not include long-term expenditure on education. It is not clear if aging will lead to lower public expenditure on education. While one would expect that the demand for primary and secondary education may start to decrease over time, the demand for tertiary and especially continuous education is likely to increase productivity, especially amongst the elderly. Moreover, to the extent that education is labor- intensive and non-tradable, it will be subject to higher cost inflation due to the Balassa-Samuelson or Tobin effect, compared to the price level in tradable sectors.

**Figure 32.** Projected revenue (percent of GDP)



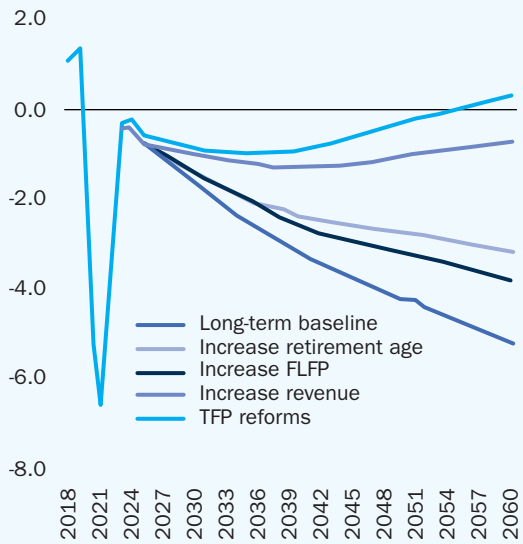

*Source:* MoF, IMF, World Bank staff projections.
*Note:* The lines are surperimposed

**Figure 33.** Projected expenditure (percent of GDP)



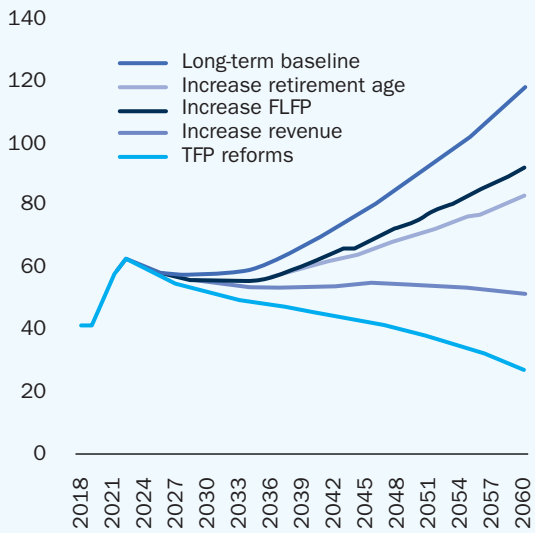

*Source:* MoF, IMF, World Bank staff projections.

**Figure 34.** Projected primary balance (percent of GDP)




*Source:* MoF, IMF, World Bank staff projections

**Figure 35.** Projected public debt (percent of GDP)




*Source:* MoF, IMF, World Bank staff projections

# 5. CONCLUSION

**Thailand's population is aging rapidly and will likely lead to an unfavorable macroeconomic environment.** The decline in the share working age population that ensues from the aging process will likely be detrimental to long-term growth. Long-term economic growth in Thailand is projected to decline over the next three decades. Demographic changes are expected to account for more than half of the projected decline in long-term growth.

**Evidence suggests that private saving will likely rise and fall with the speed of aging.** private saving pattern in Thailand is positively correlated with the speed of aging, which is projected to rise over the next decade and half and decline thereafter. As such, private saving is expected to rise and fall with the speed of aging, but it is projected to be higher in 2050, compared to 2019.

**Population aging will likely make fiscal sustainability more difficult to achieve.** Aging is projected to cause a rise in public spending on pensions, especially with the expenditure on the Civil Service Pension Scheme and the Old Age Allowance doubling as a share of GDP and the SSF expected to run out of reserves by 2054. This would have a direct negative impact on the fiscal balance, leading to higher levels of public debt. Moreover, the expected rise in healthcare and long- term care spending will likely make fiscal sustainability more complicated.

**To mitigate the impact of aging on long-term growth, polices should aim to increase the size of the labor force and to enhance its productivity.** Policy reforms to increase the size of the labor force could include increasing the retirement age and increasing the female labor force participation rates. An effective immigration policy could also boost the size of the workforce. Reforms ought to also be enacted to enhance the productivity of the labor force. These include improving the quality of education, enacting measures to increase education attainment, and providing training to reskill and upskill the existing workforce. Although not modelled here, an increase in private investment can also help to raise labor productivity.

**A combination of reforms of the labor market and revenue policy, as well as the social protection, pensions, and long-term care system, will be required to mitigate the fiscal impact of aging.** The labor market reforms mainly support long-term growth, but do not improve fiscal sustainability sufficiently. Fiscal reforms, especially on the revenue side, will also be essential for overall fiscal sustainability. Reforms to the OAA, CS Pension Scheme, SSF, and long-term care system are needed to make them adequate, fair, and fiscally sustainable. Reforms will likely be necessary to contain the costs of health care and long-term care in Thailand, but more analysis is needed for a more accurate assessment. Moreover, there is a clear need to start these reforms as soon as the post-COVID recovery has taken hold, as the cost of adjustment increases over time.

**Table 5.** Summary of policy reforms and their long-term growth and fiscal impact

| Policy reforms | Long-term growth impact on average over 2021–50 | Fiscal impact (compared to baseline in 2050) |
|---|---|---|
| Increase in the female labor force participation | 0.1–0.2 percentage points | Primary balance: +1.0% of GDP<br>Public debt: –14% of GDP |
| Gradual increase in the official retirement age (from 60 to 65 over 2021–50) | 0.3 percentage points | Primary balance: +1.5% of GDP<br>Public debt: –19% of GDP |
| Increase in human capital growth by improving learning outcomes and lowers stunting rate among children would boost | 0.2 percentage points | Primary balance: +1.5% of GDP<br>Public debt: –18% of GDP |
| Increase in TFP growth | 0.4 percentage points | Primary balance: +4.0% of GDP<br>Public debt: –51% of GDP |
| Increase in revenue | | Primary balance: +3.2% of GDP<br>Public debt: –36% of GDP |

*Source:* World Bank staff.

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# APPENDIX: THE LONG-TERM GROWTH MODEL (LTMG)

We used the Long-Term Growth Model (LTGM) to analyze demographics changes, specifically, how the working age to total population ratio growth, impacts economic growth in Malaysia through the framework of the LTGM. The LTGM used in our long-term projections is an extension of the Solow- Swan growth model where the key building blocks include saving, investment, and productivity. The model is developed and maintained by the Macroeconomics and Growth Team of the Development Research Group at the World Bank Group. In addition to saving, investment, and productivity, the model also takes into consideration TFP, human capital, demographics, labor participation and the country's external environment (FDI and external debt).[19] Solving the model requires data on three key parameters: the labor share in production, the depreciation rate of capital, and the initial capital to output ratio, which are all provided by the Penn World Table. TFP growth is either pulled from the Penn World Table (PWT) or can provided by the user from other sources. Data on human capital is also provided by the PWT. Demographic changes and projections (population growth and working age population ratio) are sourced from the World Bank Human Development Network.[20]

## 1. DESCRIPTION OF THE LONG-TERM GROWTH MODEL

Underlying the simulations in this paper is the following base model, reproduced here in an abridged manner from (Devadas and Pennings 2019). All the simulations are run using the Excel- based toolkit constructed based on this model.

### 1.1. THE PRODUCTION FUNCTION

We assume a Cobb-Douglas specification, where the public and private capital stocks have unitary elasticity of substitution. The following production function at time, $t$:

$$Y_t = A_t\, S_t (K_t^P)^{1-\beta} (h_t L_t)^{\beta} \tag{1}$$

Each firm takes technology (TFP), $A_t$ and public services $S_t$ as given, that is, these are externalities to the firm. $K_t^P$ is the private capital stock, $h_t L_t$ is effective labor, which can be further decomposed into $h_t$, human capital per worker and $L_t$, the number of workers. 1 – $\beta$ and $\beta$ are private capital and labor income shares. Next, we consider the following specification for public services $S_t$:

$$S_t = \left[\frac{G_t}{K_t^{P\zeta}}\right]^{\phi} \tag{2A}$$

$G_t$ is the efficient physical public capital stock – the public capital that is actually used in production. $\zeta$ captures whether public capital is subject to congestion (or not). $\phi$ is the usefulness of public capital (more technically the elasticity of output to efficient public capital).

$$G_t = \theta_t K_t^{Gm} \tag{2B}$$

Due to corruption, mismanagement or pork-barreling, only a fraction $\theta_t \leq 1$ of measured public capital is useful for production. The measured capital stock $K_t^{Gm}$ is what is recorded in international statistical databases, constructed using the perpetual inventory method. $\theta_t$ is the average *efficiency/quality* of the public capital stock. Equations (1), (2A) and (2B) can be written in a more conventional production function as:

$$Y_t = A_t (\theta_t K_t^{Gm})^{\phi} (K_t^P)^{1-\beta-\zeta\phi} (h_t L_t)^{\beta} \tag{3}$$

**Population and labor force growth**

Equation (3) can be translated into per worker terms by dividing both sides by $L_t$:

$$y_t \equiv \frac{Y_t}{L_t} = A\left[\theta_t (L_t)^{1-\zeta} k_t^{Gm}\right]^{\phi} (k_t^P)^{1-\beta-\zeta\phi} h_t^{\beta} \tag{4}$$

where $y_t$ is output per worker and $k_t^P$ is private capital per worker and $k_t^{Gm}$ is measured public capital per worker (note the lower case). $L_t = \varrho_t \omega_t N_t$, where $N_t$ is total population, $\omega_t$ is the working age-population ratio and $\varrho_t$ is the labor participation rate (labor force-to-working age population ratio). The above equation can then be used to calculate growth rates of output per worker from $t$ to $t+1$:

$$\frac{y_{t+1}}{y_t} = \left[\frac{\omega_{t+1}}{\omega_t}\frac{\varrho_{t+1}}{\varrho_t}\frac{N_{t+1}}{N_t}\right]^{(1-\zeta)\phi} \left[\frac{A_{t+1}}{A_t}\right] \left[\frac{\theta_{t+1}}{\theta_t}\right]^{\phi} \left[\frac{k_{t+1}^{Gm}}{k_t^{Gm}}\right]^{\phi} \left[\frac{k_{t+1}^P}{k_t^P}\right]^{1-\beta-\zeta\phi} \left[\frac{h_{t+1}}{h_t}\right]^{\beta} \tag{5}$$

Equation (5) can be rewritten in terms of growth rates from $t$ to $t+1$:

$$1 + g_{y,t+1} = [(1+\Gamma_{t+1})^{(1-\zeta)\phi}](1+g_{A,t+1})(1+g_{\theta,t+1})^{\phi} (1+g_{k^{Gm},t+1})^{\phi} (1+g_{k^P,t+1})^{1-\beta-\zeta\phi} (1+g_{h,t+1})^{\beta} \tag{6}$$

[19] The LTGM with various extensions can be found here: https://www.worldbank.org/en/research/brief/LTGM.
[20] Population estimates can be found at: https://databank.worldbank.org/source/population-estimates-and- projections.

where the growth rate of a variable $x$ from $t$ to $t+1$ is denoted by $g_{x,t+1}$, and $\Gamma$ is the growth rate of the number of workers:

$$1+\Gamma_{t+1} = (1+g_{\varrho,t+1})(1+g_{\omega,t+1})(1+g_{N,t+1}) \quad (7)$$

$1+\Gamma_{t+1}$ drops out from equation (6) in the congestion default ($\zeta = 1$).

To obtain output per capita, $y_t^{PC}$ from equation (4), $y_t^{PC} \equiv \frac{Y_t}{N_t} = \frac{Y_t}{L_t}\varrho_t\omega_t$. Rewriting this equation in

$$1+g_{y,t+1}^{PC} = (1+g_{y,t+1})(1+g_{\varrho,t+1})(1+g_{\omega,t+1}) \quad (8)$$

To obtain output growth, we multiply (8) with population growth:

$$1+g_{Y,t+1} = (1+g_{y,t+1}^{PC})(1+g_{N,t+1}) \quad (9)$$

## 1.2. PUBLIC AND PRIVATE CAPITAL ACCUMULATION, AND CHANGES IN THE EFFICIENCY/QUALITY OF PUBLIC CAPITAL

The measured quantity of public capital (as in international statistical databases) accumulates according to a standard capital accumulation identity, with the next period's stock coming from the previous period's undepreciated stock, $(1-\delta^G)K_t^{Gm}$ (where $\delta^G$ is the public capital depreciation rate) and new public investment, $I_t^G$.

$$K_{t+1}^{Gm} = (1-\delta^G)K_t^{Gm} + I_t^G \quad (10)$$

The gross growth rate of measured public capital (not per worker) is:

$$K_{t+1}^{Gm}/K_t^{Gm} = (1-\delta^G) + \frac{I_t^G/Y_t}{K_t^{Gm}/Y_t} \quad (11)$$

The growth rate of measured public capital per worker, which enters equation (6), is:

$$1+g_{k^{Gm},t+1} \equiv \frac{K_{t+1}^{Gm}}{K_t^{Gm}} / \frac{L_{t+1}}{L_t} = \frac{(1-\delta^G)+\frac{I_t^G/Y_t}{K_t^{Gm}/Y_t}}{(1+g_{\varrho,t+1})(1+g_{\omega,t+1})(1+g_{N,t+1})} \quad (12)$$

The stock of efficiency-adjusted public capital (which is actually used in production) evolves based on the previous period's efficiency-adjusted undepreciated stock and efficiency-adjusted new investment $\theta_t^N I_t^G$.

$$G_{t+1} = (1-\delta^G)G_t + \theta_t^N I_t^G \quad (13A)$$

$\theta_t$ is the average efficiency of existing public capital (rather than the efficiency of new investment). Substituting $G_t = \theta_t K_t^{Gm}$ into Equation 13A and rearranging as 13B, one can see the $\theta_{t+1}$ evolves as a weighted average of the quality of existing public capital $\theta_t$, and the quality of new investment $\theta_t^N$.

$$\theta_{t+1} = \theta_t \frac{(1-\delta^G)K_t^{Gm}}{(1-\delta^G)K_t^{Gm}+I_t^G} + \theta_t^N \frac{I_t^G}{(1-\delta^G)K_t^{Gm}+I_t^G} \quad (13B)$$

As such, the quality/efficiency of the stock of public capital only changes when the quality of new investment projects is different from that of the existing public capital stock: $\theta_t^N \neq \theta_t$. Using equation (13B), the growth in quality which enters equation (6) can be written as follows:

$$1+g_{\theta,t+1} \equiv \frac{\theta_{t+1}}{\theta_t} = \left[(1-\delta^G) + \frac{\theta_t^N}{\theta_t}\frac{I_t^G/Y_t}{K_t^{Gm}/Y_t}\right] / (K_{t+1}^{Gm}/K_t^{Gm}) \quad (14)$$

The quantity of private capital follows the same accumulation process as public capital. But with $\delta^P$ as the private capital depreciation rate, and $I_t^P$ as private investment. The growth rate of private capital per worker is as follows:

$$1+g_{k^P,t+1} = \frac{(1-\delta^P)+\frac{I_t^P/Y_t}{K_t^P/Y_t}}{(1+g_{\varrho,t+1})(1+g_{\omega,t+1})(1+g_{N,t+1})} \quad (15)$$

## 1.3. ANALYSIS OF THE DRIVERS OF GROWTH

To better understand and simplify the analysis of the drivers of growth, we take a log-linear approximation of equation (6). Specifically, equations (12), (14) and (15) are substituted into equation (6). Then, taking logs and using the approximation ln $(1+g) \approx g$ (for small g) we arrive at the following:

$$g_{y,t+1}^{PC} \approx g_{A,t+1} + \beta(g_{\varrho,t+1} + g_{\omega,t+1} + g_{h,t+1}) - (1-\beta)(g_{N,t+1}) + \phi\left[\theta_t^N \frac{I_t^G/Y_t}{\theta_t K_t^{Gm}/Y_t} - \delta^G\right] + (1-\beta-\zeta\phi)\left(\frac{I_t^P/Y_t}{K_t^P/Y_t} - \delta^P\right) \quad (16)$$

## 1.4. IMPLEMENTATION

The future growth rates of the labor participation rate $(g_{\varrho,t+1})$, the working age-population ratio $(g_{\omega,t+1})$, population $(g_{N,t+1})$ and pure TFP $(g_{A,t+1})$, are exogenously determined. The growth rate of measured public capital per worker $(g_{k^{Gm},t+1})$ is given by equation (12), using the growth rate of the public capital stock (equation (11)) as an intermediate step. Private capital per worker growth $(g_{k^{P},t+1})$ is as given by equation (15). The growth rate of the efficiency of public capital $(g_{\theta,t+1})$ as given by equation (14) using the growth rate of the public capital stock (equation (11)) as an intermediate step.

Finally, the model is closed by updating public capital-to-output using equation (17) and the private capital-to-output ratio using equation (18) (with the growth rates in per-worker terms):

$$\frac{K_{t+1}^{Gm}}{Y_{t+1}} = \frac{K_t^G}{Y_t}\frac{(1+g_{k^{Gm},t+1})}{1+g_{y,t+1}}$$

$$\frac{K_{t+1}^{P}}{Y_{t+1}} = \frac{K_t^P}{Y_t} \qquad (17)$$

## 1.5. CALIBRATION

**Table A1.** Calibration and Summary of Assumptions the Baseline

| | | |
|---|---|---|
| Labor Share | 64% | PWT 9.1 from 2017, based on average income |
| Depreciation rate | 6.6% | PWT 9.1 from 2017 |
| Capital-output ratio | 2.3 | Steady state value |
| Human capital growth | 0.8%-0.1% | Calculated using LTGM Human Capital Extension |
| TFP growth | 1% | PWT 9.1, 10-year average (2008-17) |
| Investment-GDP ratio | 23% | WDI 2018 estimate |
| Public investment-GDP ratio | 6% | WDI 2018 estimate |
| Private investment-GDP ratio | 17% | WDI 2018 estimate |
| Population growth | 0.15%- -0.55% | UN Population projections |
| Atlas GNI per capita | $6610 | WDI, estimate from 2018 |

## 2. COINTEGRATION ANALYSIS

**The theoretical framework:** The Life Cycle Hypothesis (LCH) states the working population saves in order to support their consumption expenditures after retirement, and those in retirement or below the working dis-save. Viewed from the LCH, saving is negatively related to both young and old population ratio. But as mentioned, other factors such pension schemes also affect the relationship between saving and old population ratio. For the purpose of the cointegration analysis, we consider the following equation:

$$Private\ Saving = F(Young, Old, RGDP, R)$$

Where Young is the young population (0-14) ratio, old is the ratio of elderly population (65+), RGDP is the real GDP and R is the real interest rate.

**Unit root test:** Before we conducted the cointegration test, the first step is to establish that all the variables are not stationary. The Augmented Dickey-Fuller (ADF) test is used to establish the order of integration. The results are presented in Table A2.[21] Private saving, real GDP and real interest have integrated of order one, while all the demographic variables (Old, Young, and Working) are integrated of order two. This means that the demographic variables have to be differenced twice in order to render them stationary. However, the implication of this finding is that the cointegration (or long-run relationship) can only exist between the rate of change of the elderly population (the speed of aging) and private saving.

[21] The results are unchanged when the Phillips-Perron test is used instead.

**Table A2.** Augmented Dickey-Fuller Unit Root Test

| | Level | 1st Difference | 2nd Difference |
|---|---|---|---|
| Gross domestic private saving (% of GDP) | -1.99 *(t, 0)* | -7.80*** *(c, 0)* | - - - |
| Real GDP | -0.80 *(t, 1)* | -4.2*** *(c, 0)* | - - - |
| Real interest rate | -2.3 *(c, 2)* | -7.7*** *(c, 0)* | - - - |
| Young population, 0-14 (% of total) | -4.06** *(t, 1)* | -1.87 *(c, 1)* | -4.79*** *(c, 0)* |
| Working population, 15-64 (% of total) | -3.00 *(t, 1)* | -0.97 *(c, 1)* | -4.48*** *(c, 0)* |
| Elderly population, 65+ (% of total) | 1.69 *(t, 2)* | 2.00 *(c, 1)* | 2.63* *(c, 0)* |

*Note:* *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively. Null hypothesis is that the variable has a unit root. The parentheses indicate the exogenous process included, trend or constant, and the selected number of lags.

**Cointegration test:** To test for cointegration we use the ARDL bound test introduced by (Pesaran, Shin, and Smith 2001). The framework has two tests: A F-test on all the coefficients of the lagged level variables and a t-test on the coefficient of the lagged level of the dependent variable.

The results of the bound test are presented in **Table A3** and show that the null hypothesis of no cointegration is rejected, there is exist a long-run relationship between private saving and the explanatory variables. This result then allows us to forecast private saving using the estimated coefficients of the long-run equation.

**Table A3.** Cointegration test (dependent variable is domestic private investment)

| **Error Correction Equation** | |
|---|---|
| | **Coefficients** |
| Privsaving_t-1 | -0.5*** (0.1) |
| Δ(old pop.) | 19.1** (8.0) |
| Δ(young pop.)_t-1 | -7.5 (2.3) |
| Δ(young pop.)_t-2 | 17.1*** |
| Δ(log(Real GDP))_t-1 | (6.1) -84.0*** (26.8) |
| **The long run or levels equation:** *EC = Privsaving - (35.3*DOLD -13.9*DYOUNG + 0.3*LRGDP+ 1.2*Rint + 12.56)* | |
| | **Coefficients** |
| Δ(old pop.) | 35.3** *(14.9)* |
| Δ(young pop.) | -13.9*** *(3.9)* |
| Log(Real GDP) | 0.3 *(6.5)* |
| Real interest | 0.6 *(0.6)* |
| **F-Bounds Test (Null Hypothesis: No levels relationship)** | |
| | **Coefficients** |
| F-statistic | 6.3*** |
| T-test | -4.9*** |

*Note:* *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively. Numbers in parenthesis are standard errors. The F-statistic falls outside the 1% significance bounds, so the null hypothesis of no levels relationship is rejected.

**Conditional forecast:** Using the estimated coefficients of the long-run equation from the cointegration analysis, we forecast private investment conditional on old dependency ration, young dependency, real GDP, and real interest rate.

The old and young dependency ratios are taken from the UN population projections. Baseline projections from the LTGM are used to obtain future real GDP, while real interest rate is kept constant at its previous 10-year average.

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