# The Effect of Population Structure on Economic Development: Thailand's Provincial Panel Data

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# ผลกระทบของโครงสร้างประชากรต่อการพัฒนาเศรษฐกิจ: ข้อมูลพาแนลระดับจังหวัดของประเทศไทย

นายศตายุ ภัทรกิจกุศล



วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรมหาบัณฑิต
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ศตายุ ภัทรกิจกุศล : ผลกระทบของโครงสร้างประชากรต่อการพัฒนาเศรษฐกิจ: ข้อมูลพาแนลระดับจังหวัดของประเทศไทย. ( The Effect of Population Structure on Economic Development: Thailand's Provincial Panel Data) อ.ที่ปรึกษาหลัก : ผศ. ดร.ยศ อมรกิจวิกัย

งานวิจัยฉบับนี้มีวัตถุประสงค์เพื่อศึกษาผลกระทบของ การเปลี่ยนแปลงทางประชากร การเปลี่ยนแปลงทางอุปทานแรงงาน และทุนมนุษย์ ที่ส่งผลถึงการพัฒนาเศรษฐกิจของประเทศไทย งานวิจัยนี้จะแสดงให้เห็นถึงความสัมพันธ์ระหว่างประชากร (ทั้งในเชิงปริมาณและเชิงคุณภาพ) กับการพัฒนาเศรษฐกิจ กรอบแนวคิดการวิจัยประกอบไปด้วยสามแนวคิดได้แก่ แนวคิดเรื่องการปันผลประชากร ทฤษฎีการเจริญเติบโตทางเศรษฐกิจ สำนักนีโอคลาสสิก และแนวคิดเรื่องทุนมนุษย์ ข้อมูลทุติยภูมิพาแนลระดับจังหวัดระหว่างปี พ.ศ. 2550-2562 มาจากหน่วยภาครัฐจะถูกนำมาใช้เพื่อการวิเคราะห์ทางสถิติ ตัวแบบ Fixed effect และตัวแบบ Random effect model จะถูกนำมาใช้กับตัวแบบประมาณ (estimated model) ผลการศึกษาแสดงให้เห็นว่าผลิตภาพแรงงาน ระดับการจ้างงาน สัดส่วนแรงงานที่มีงานทำในตลาดแรงงาน และอัตราการเป็นภาระในวัยเด็กมีนัยยะสำคัญทางสถิติ และมีอิทธิพลที่ชัดเจนต่อการพัฒนาเศรษฐกิจไทย ส่วนตัวแปรอื่น ๆ มีอิทธิเพียงเล็กน้อยเท่านั้น นอกจากนั้น งานวิจัยฉบับนี้ยังมีผลการศึกษาที่สวนทางกับแนวคิดทฤษฎีที่นำมาใช้เป็นกรอบแนวคิด ได้แก่ อัตราการเป็นภาระในวัยสูงอายุที่มีอิทธิพลทางบวกกับการพัฒนาเศรษฐกิจไทย และสัดส่วนประชากรวัยทำงานที่มีอิทธิพลทางลบกับการพัฒนาเศรษฐกิจไทย จากการศึกษาแสดงให้เห็นว่าประเทศไทยควรได้รับประโยชน์จากผลิตภาพแรงงาน ในระยะยาวรัฐบาลควรดำเนินการพัฒนาผลิตภาพแรงงานผ่านวิธีการต่าง ๆ เช่น การเรียนรู้ตลอดชีวิต การพัฒนาการศึกษา และการฝึกอบรมฝีมือแรงงาน ส่วนอัตราการเป็นภาระในวัยเด็กที่มีอิทธิพลเชิงลบต่อการพัฒนาเศรษฐกิจไทยนั้น ผลการศึกษาบ่งชี้ว่าการลดอัตราการเป็นภาระในวัยเด็กจะส่งผลดีต่อการพัฒนาเศรษฐกิจไทย อย่างไรก็ดี การลดอัตราการเป็นภาระในวัยเด็กย่อมหมายความถึงจำนวนแรงงานที่จะเข้าสู่ตลาดแรงงานในอนาคตมีจำนวนลดลงด้วย ดังนั้น รัฐบาลจึงควรให้ความสำคัญต่อนโยบายการเกิด เพื่อเป็นการเพิ่มอัตราการเกิดอันจะส่งผลถึงอุปทานแรงงานของประเทศในอนาคต นโยบายนี้จะต้องสร้างความสมดุลทั้งในระยะสั้นและระยะยาว ถ้าหากมีอัตราการเกิดมากจนเกินไปก็จะนำไปสู่การเพิ่มขึ้นของอัตราการเป็นภาระในวัยเด็ก ในทางตรงกันข้ามถ้าหากอัตราการเกิดไม่เพียงพอก็จะนำไปสู่สภาวะการขาดแคลนแรงงาน



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| สาขาวิชา | นโยบายประชากรกับการพัฒนามนุษย์ | ลายมือชื่อนิสิต ..... |
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# # 6384503651 : MAJOR POPULATION POLICY AND HUMAN DEVELOPMENT
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Satayu Pattarakijkusol : The Effect of Population Structure on Economic Development: Thailand's Provincial Panel Data. Advisor: Asst. Prof. YOT AMORNKITVIKAI, Ph.D.

This research investigates the effects of demographic change, the change of labor supply, and human capital on Thailand's economic development. This will help shed light on the relationship between population (quantitatively and qualitatively) and economic development. The demographic dividends, the neoclassical growth Solow-Swan model, and human capital are adopted as the conceptual framework for this research. The secondary panel data at the provincial level from government officials will be used for statistical analysis. Fixed effect or random effect with lagged dependent variable is introduced into the estimated model. The finding suggests that the labor productivity, employment level, share of the active labor force have significant and strongly positive to Thailand's economic development. While youth dependency ratio has a significant and strong negative effect on Thailand's economic development. The rest of the variables have weakly effect on Thailand's economic development. In addition, there are some findings that reversed the original proposal which is the old-age dependency ratio that has a significant and weakly positive effect on Thailand's economic development and the share of the working-age population that has a significant and weakly negative effect on Thailand's economic development. The finding suggests that Thailand should benefit from labor productivity and enjoy benefits from this. In the long run, the government to develop labor productivity, this may be achieved through training, lifelong learning, and education among other means. Concerning the negative of the youth dependency ratio Thailand's economic development, the research findings suggested that the reduction of the youth dependency ratio would lead to better economic development. However, the decrease in the youth dependency ratio also implies a lower number of labor force who will enter the labor market in the future. This will also negatively impact Thailand's economic development. Therefore the problem will become loops. the government must pay more attention to the fertility policy because a good fertility policy will increase the birth rate, which will impact the country's future labor supply. This policy must strike a balance between the short- and the long-run. If there are too many births, this will increase dependency. On the contrary, without enough births,

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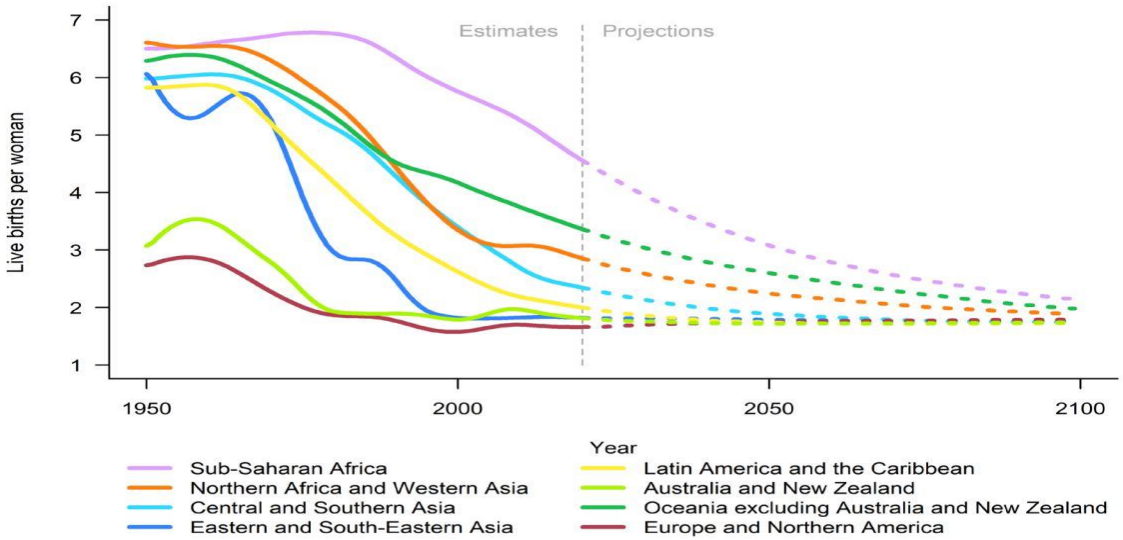
# CHAPTER 1
# INTRODUCTION

## **1.1** Global and Thailand Fertility Trends

The total fertility rate (TFR) has declined in several countries except for southern Africa (United Nations, 2017). The TFR in every region across the globe has experienced downward trends, which are projected to continue to the year 2100. There are no exceptions to such trends, even in Sub-Saharan Africa, where the TFR has been the highest compared with other regions. Their TFR fell from 6.3 births per woman in 1990 to 4.6 births per woman in 2019. Fertility globally decreased from 3.2 births per woman in 1990 to 2.5 births per woman in 2019 (United Nations, 2020). United Nations (2020) noted that the replacement level is at 2.1 birth per woman. The TFR trends in each region are illustrated in Figure 1.1.

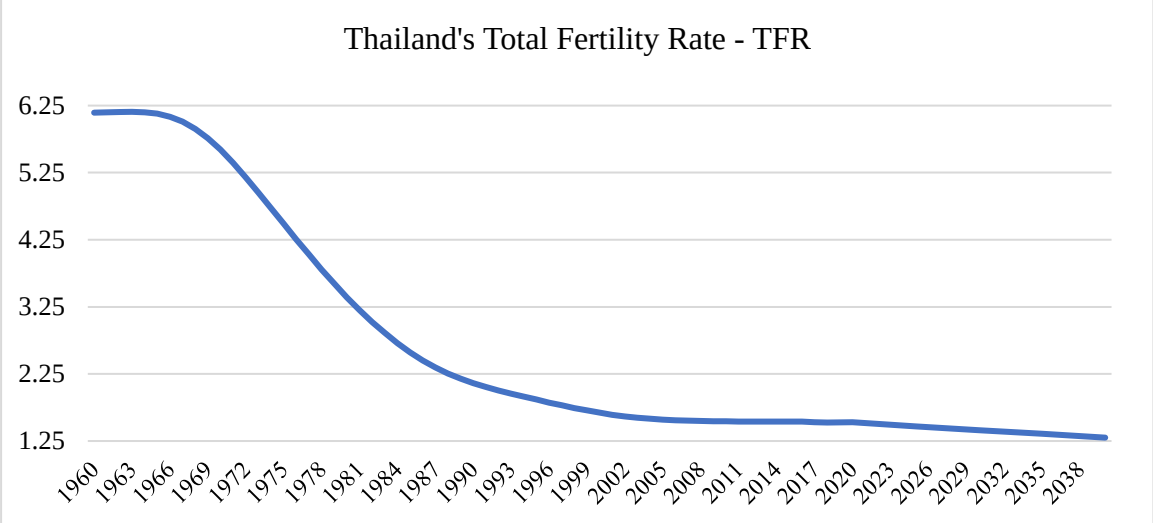
Figure 1.1 Total Fertility Rates by Regions, Estimates, and Projections, 1950–2100




Source: United Nations (2020)

Thailand's TFR declined dramatically from 6.14 children per woman in 1960 to 1.67 children per woman in 2000 and continued to decline to 1.52 children per woman in 2018 (World Bank, 2021b). According to the Social and Quality of Life Database System (2021), Thailand's TFR is expected to decline to 1.30 children per woman in 2040. Figure 1.2 illustrates Thailand's TFR trends from 1960 – 2040. With a TFR level of 1.30 children per woman, Thailand will become one of the world's countries with ultra-low fertility.

Figure 1.2 Thailand's TFR trends, 1960 – 2040 (unit: children per woman)




Source: World Bank (2021b) and Social and Quality of Life Database System (2021).
Note: Medium variant estimates were used for the anticipation period between 2020 – 2040.



Figure 1.2 reveals that Thailand's TFR has been declining since the 1970s. The TFR declined sharply by almost a half between 1970 and 1980 due to the national family planning program initiative introduced in the Second National Economic and Social Development Plan (NESDP) (1967-1971). During that period, the government was concerned that an increase in TFR would prevent the development of the nation's economy. Hence, the second NESDP proposed a birth control, or the family planning program, which encouraged couples to plan a small-sized family as part of the policy (Office of the National Economic and Social Development Board, 1966).

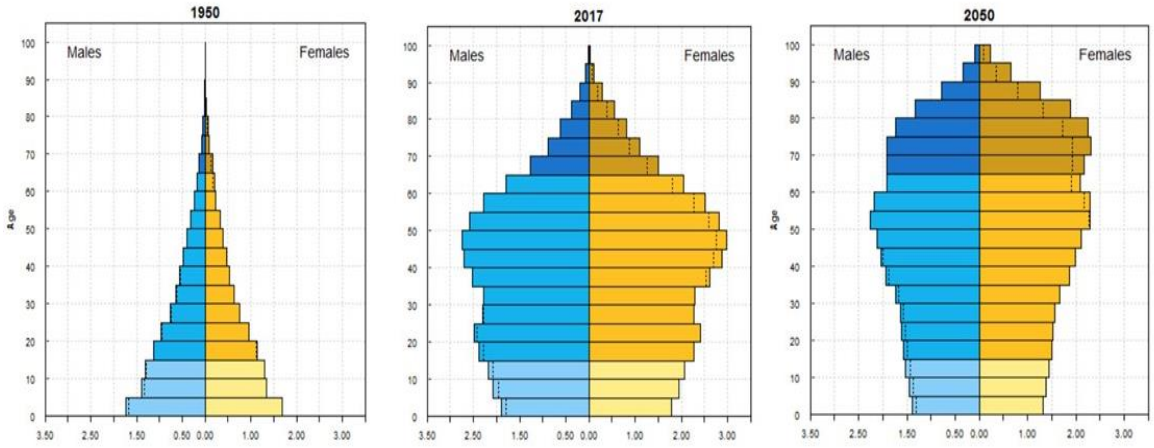
Thailand’s TFR continued to decline after the 1980s. Finally, Thailand’s TFR reached the replacement level for the first time in 1990. However, the TFR has continuously declined lower than the replacement level since 1991, reaching approximately 1.6 – 1.5 children per woman from 2000 to 2019. This figure persists until 2040.

The significant decline in TFR has posed a risk for national economic development, as stated in the 11th NESDP (2012 – 2016), which concluded that the fertility decline would lead to a decline in the nation’s productivity as a result of underemployment and a lower number of skilled labor (Office of the National Economic and Social Development Board, 2011). Nevertheless, when low fertility becomes apparent in Thailand, increasing its TFR to the replacement level is challenging. P. Wongboonsin, Keeratipongpaiboon, and Wongboonsin (2018) used the data from United Nations to project Thailand’s TFR in 2100. Their finding revealed that it would not be possible for Thailand’s TFR to reach the replacement level at 2.0 children per woman.

## **1.2** The Effects of Low Fertility on Population Structure

The decline in TFR has changed Thailand’s population structure, as shown in the population pyramid in Figure 1.3. The United Nations (2017) reported the changes of Thailand's population demographic pyramids, as illustrated in Figure 1.3. Thailand's demographic structure was in an expansive pyramid shape in 1950, signifying a larger young population while the older population contracted. This expansive pyramid shape implies that Thailand had high fertility and mortality rates in 1995. More specifically, Thailand’s expansive population pyramid in 1995 indicated large numbers or percentages of the young-age population due to a high fertility rate which is lower than the average life expectancy.

Figure 1.3 Thailand's Population Structures: Past, Present, and Future




Source: United Nations (2017)

Following the striking 1950 pyramid population structure, was observed in 2017. From Figure 1.3, Thailand's young population reduced significantly due to lower levels of fertility rate compared to the 1950 population pyramid. This constrictive demographic structure shows the expanding middle and old-age groups. In addition, the oldest population group started to shrink. Finally, after many decades of a continuously low fertility rate, the United Nations forecasted that Thailand's population would decrease and eventually stabilize in 2050.

According to the demographic transition theory, economic development is reflected in the decline of both fertility and mortality rates. The demographic transition theory has been widely used to explain the changes in human behavior. For instance, how lower level of infant mortality influences couples to plan their smaller family sizes. (Weeks, 2021). An issue with the use of the demographic transition theory is that the theory does not specify if mortality declines today, when would fertility decline. Furthermore, the theory does not explain other factors that influence a couple’s fertility decision. For instance, the demographic transition does not explain how many children a couple would have and what conditions the couple decides to have more children (K. O. Mason, 1997). Besides, the evidence on the relationship between infant mortality and fertility reveals that infant mortality's effects on fertility are minimal when predicting the decline in fertility (Palloni & Rafalimanana, 1999).

In Thailand, the past public health services were inadequate; thus, the death rate was high. With such a high death rate, people preferred to have more children to replace the members of the family who died (Chuanwan & Katewongsa, 2014). However, the country's public health services have enhanced due to technological and knowledge enhancement in medical services. This has resulted in a rection in the country's death rates. With lower death rates, people no longer exhibited high fertility levels as the need to replace those who died has been reduced. Eventually, such trends would result in the shrinkage of the population (Lundquist, Anderton, & Yaukey, 2015).

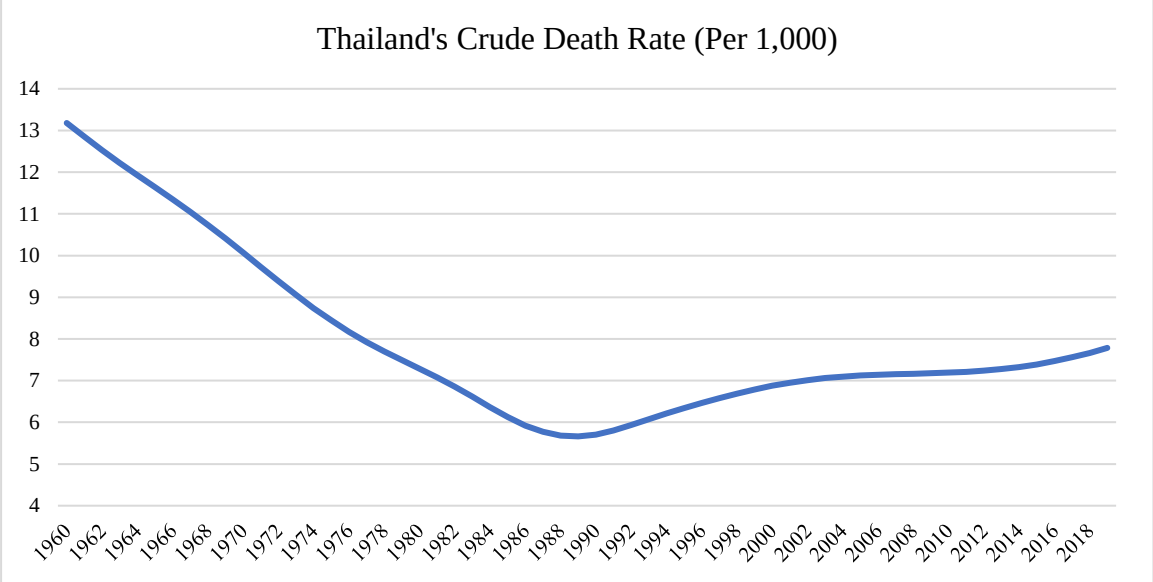
As a result, Thailand's present demographic structure is in line with the demographic transition assumption which discussed how there is a tendency that fertility would decline if mortality declines. However, due to the decline in fertility rates, it expects that the size of Thailand's labor force entering the labor market is likely to decline. Stevenson (2012) studied the labor supply and tax revenue level in the United States and suggested a positive association between the labor force level and the level of federal tax revenue. Hence, the labor force's shrinkage may challenge Thailand's future tax revenue in the coming years.

The effects of demographic changes also lead to economic growth or decline. K. Wongboonsin, Guest, and Prachuabmoh (2005) suggested that high fertility leads to increasing numbers of the labor force in the labor market; thus, this will drive the country's economic development. The positive effect of the labor force on the growth of Asian economies, including Thailand, was confirmed by Kajimura (2020). She adopted growth accounting to study this effect. She employed labor input, capital stock, and human capital to verify the relationships between labor force-related factors and economic growth. Her study revealed that the level of the labor supply rate had a positive effect on economic development in Thailand and other Asian countries. Hence, the decline in Thailand's fertility results in a lower level of labor supply in the labor market, which eventually affects the country's economic development.

## 1.3 The Effects of Low Mortality on Population Structure

It is not only the total fertility rate that influences population growth or decline, but the mortality rate also determines population growth. According to the World Bank (2021a), Thailand's crude death rate (per 1,000) declined from 13.18 per 1,000 population in 1960 to 7.29 per 1,000 population in 1980. The crude death rate (per 1,000) continued to decline to the lowest crude death rate (per 1,000) in 1989, when the crude death rate (per 1,000) was 5.66 per 1,000 population. However, the crude death rate has slightly bounced back to around 7.00 per 1,000 population since 1989.

Figure 1.4 Thailand's Crude Death Rate (Per 1,000) between 1960 - 2019






Source: World Bank (2021a)

When the mortality rate declines, it implies an increase in the elderly population's longevity. When the elderly's longevity increases, the elderly population would be accumulated, leading to a rise in the ratio of the elderly population relative to the total population (Weeks, 2021). An increase in the elderly population's longevity leads to the rise of the share of the elderly population to the total population, as indicated in Figures 1.5 and 1.6. Thus, Thailand's population structure has moved towards the constrictive population pyramid, which indicates that the country's population is generally older due to a rise in life expectancy, a low death rate, and a low birth rate.

This evidence may suggest the future's high dependency ratio resulted from a decline in the working age population in Thailand.

The figures discussed above demonstrate that the low or crude death rate during the last decades significantly increased the proportion of the elderly population. The ratio of the elderly population is anticipated to double from 10.00 percent in 2003 to 20.00 percent in 2023. The ratio of the elderly population is expected to increase to 30.14 percent by 2040 (National Statistic Office, 2012, 2021; Office of the National Economic and Social Development Board, 2021).

Even though Thailand's publich health system has developed to the point that the the crude birth rate has reduced since 1960, the reason why this has happened is because the Thai health officials have been able to treat communicable diseases well. Currently, the reason for the Thai population's death which involves diseases is mainly due to non-communicable diseases. There are upward trends of deaths due to non-communicable diseases such as malignant neoplasms, all forms which increased from 104. 8 per 100,000 to 1 2 0 . 5 per 100,000 people between 2013 - 2017. The diseases of the circulatory system which increased from 84.1 per 100,000 to 103.7 per 100,000 people between 2013 – 2017 and the diseases of the respiratory system which increased from 52.4 per 100,000 to 64.0 per 100,000 people between 2013 – 2017. All these cause of death cause the slightly upward trand in mortality as shown in figure 1.4 (Ministry of Public Health, 2018).



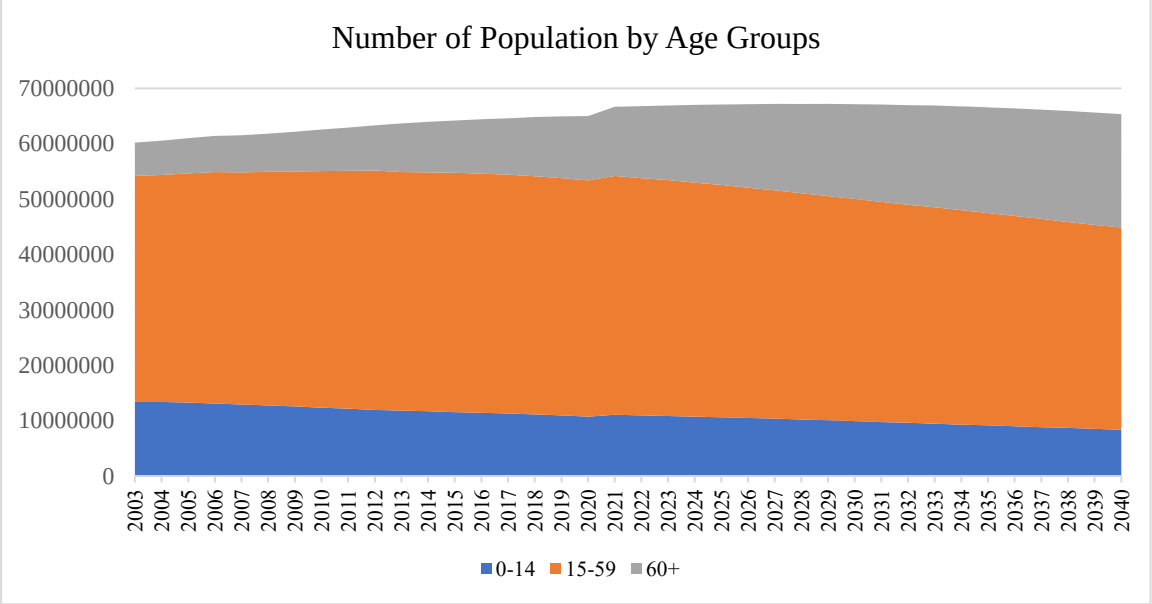
In summary, the decline in mortality primarily affects the ratio of the elderly population to the total population. The decline in crude death rate implies elderly longevity; therefore, the accumulation of the elderly population influences the country's population structure.

## **1.4** Thailand Population Structure and Labor Force Trends

Focusing on Thailand's population structure, Figure 1.4 illustrates Thailand's population growth trends between 2003 - 2040. Thailand's population grew from 60.2

million in 2003 to 62.5 million in 2010, and it continued to grow to 65.0 million in 2020. The Office of the National Economic and Social Development Council (2019) anticipates that Thailand's population will slightly grow until 2028. Subsequently, Thailand's population will start to shrink. As a result, the total population is expected to shrink by 2 million between 2028 to 2040.

Figure 1.5 Number of Thailand's population by age groups 2003 – 2040




Source: National Statistic Office (2012), National Statistic Office (2021), and Office of the National Economic and Social Development Council (2019)

Note: Medium variant estimates were used for the anticipation period between 2020 – 2040.



According to the Thai population classified by age groups, Figure 1.5 illustrates the ratio of the Thai population, which can be divided into three groups; 1) elderly population who are older than 60 years old, 2) working-age population aging between 15 – 59 years old, and 3) youth population aging between 0 -14 years old. In addition, the top, middle, and bottom parts of Figure 1.5 represent the elderly population, the working-age population, and the youth population, respectively.

The ratio of the elderly population increased from 10.00 percent to 17.90 percent between 2003 and 2020. The share of the elderly population is estimated to increase to

25.50 and 31.40 percent in 2030 and 2040, respectively. On the other hand, the ratio of the youth population decreased from 22.30 percent in 2003 to 16.50 percent in 2020. As a result, the share of the youth population is estimated to decrease to 14.80 and 12.80 percent in 2030 and 2040. For the working-age population ratio, the working-age population ratio decreased from 67.70 percent in 2003 to 65.60 percent in 2020. As a result, the ratio of the working-age population is estimated to decrease to 59.30 and 55.80 percent in 2030 and 2040, respectively.

According to Figure 1.5, the population ratio has both microeconomic and macroeconomic implications. In terms of the microeconomic factor, the variation of the population ratio among the elderly population and the youth population may have a negative effect on the working age population. The higher ratio of the elderly population and the youth population is reflected in the higher dependency on the working age population. Hence, the working age population will not be very productive as a result of the high dependency from both the elderly population and the youth population (Zhao & Gao, 2014).

Furthermore, the higher ratio of the elderly population tends to have a positive effect on public expenditures. For example, a study in China revealed that the country's healthcare expenditure positively correlates with the aging population (L. Li, Du, & Hu, 2020). This means that the higher ratio of the elderly population would increase healthcare expenditures in China. On the contrary, a study in the United States suggested that tax revenue is dependent on the level of labor supply in the labor market. Thus, a decline of the labor force in the labor market due to a change in the population structure will adversely affect the tax revenue in the US (Stevenson, 2012).



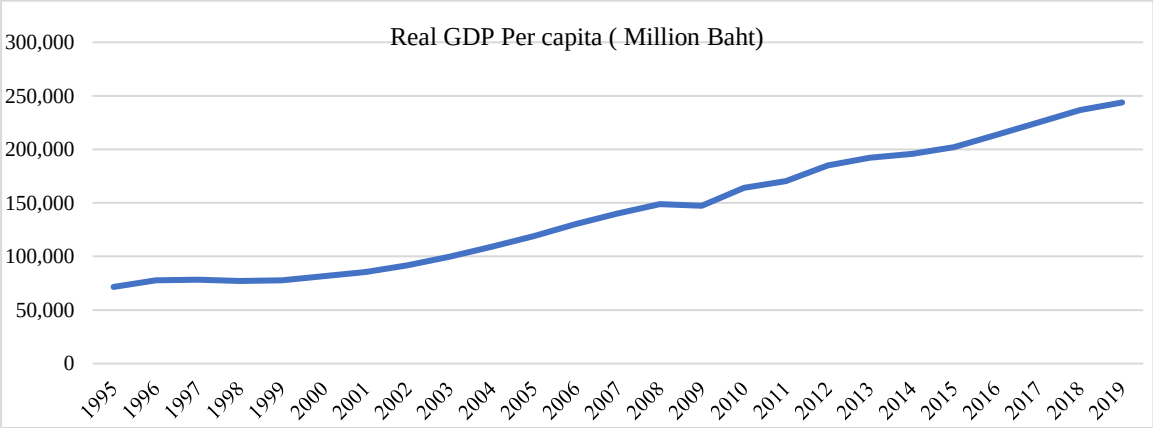
## **1.5** Thailand's Economic Development

The terms "economic growth" and "economic development" have been used interchangeably in the literature. Both growth accounting and development accounting frameworks examine the relationship between demographic structure and economic variables. Economic variables can be measured by economic growth and economic

development. Focusing on the growth accounting framework, the term “economic growth” refers to the changes in the country's amount of goods and services. Therefore, economic growth can be measured by the growth of the country’s output per capita. With respect to the development accounting framework, the term “economic development” is measured by the level of output per capita. In addition, several empirical studies have incorporated the demographic structure to investigate its impact on the level of output per capita as the measurement of economic development (Feyrer, 2007; Zhang, Zhang, & Zhang, 2015).

Hence, this research focuses on the development accounting framework to measure the economic development in Thailand, which is measured by the GDP per capita. Thailand’s real GDP per capita has been continuously increasing for decades. According to the Office of the National Economic and Social Development Council (2021), Thailand’s GDP per capita increased by three times between 1995 – 2019: from 71,543 million baht in 1995 to 243,787 million baht in 2019. Figure 1.7 illustrates Thailand’s real GDP per capita trends between 1995 -2019.

Figure 1.6 Real GDP per capita trends 1995 - 2019




Source: Office of the National Economic and Social Development Council (2021)

Although the real GDP per capita trends 1995 – 2019 in Figure 1.6 demonstrated an upward trend, Thailand’s GDP per capita growth rate 1995 – 2019 pointed to the contrary (see Figure 1.7).

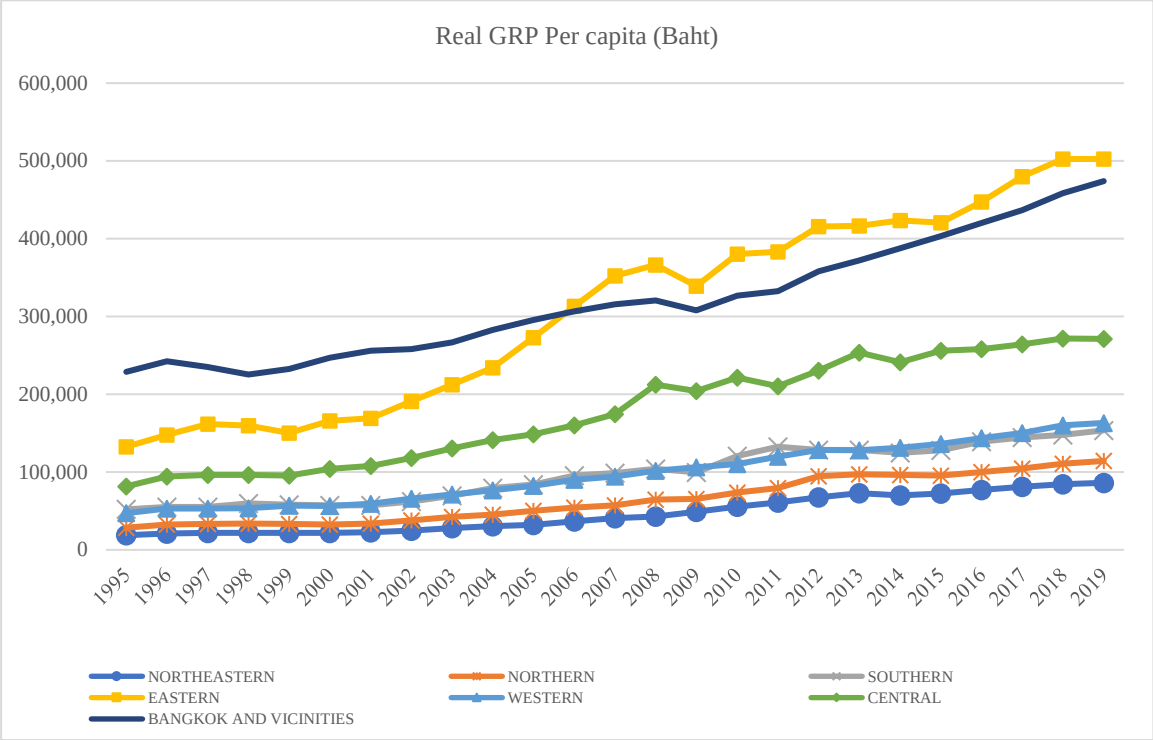
Figure 1.7 Thailand's real GDP per capita growth rate 1961 – 2019


Source: Office of the National Economic and Social Development Council (2021)

According to the Office of the National Economic and Social Development Council (2021), Thailand's GDP per capita growth rate was negative in 1998 due to the Tom Yum Kung crisis. With the collapse of the Thai baht, the government no longer could afford to keep the currency pegged to the US dollar. This subsequently led to the floating of the currency with capital flight and significant amounts of US denominated liabilities. With the Tom Yum Kung crisis, Thailand's economy declined by 18 percent and never returned to the same level. Ketsawa (2019) opined that a large proportion of Thailand's capital stocks were damaged; thus, there was a slow growth in the country's economic development.

After the Tom Yum Kung crisis, Thailand's GDP per capita growth rate increased until 2006. In 2009, the Hamburger crisis negatively affected Thailand's GDP per capita growth rate again; therefore, Thailand's GDP per capita growth rate became negative. Even though Thailand's GDP per capita growth rate bounced back in 2010, the growth magnitude slowly declined until recent years.

Figure 1.8 illustrates Thailand's gross regional product (GRP) per capita 1995 -2009.

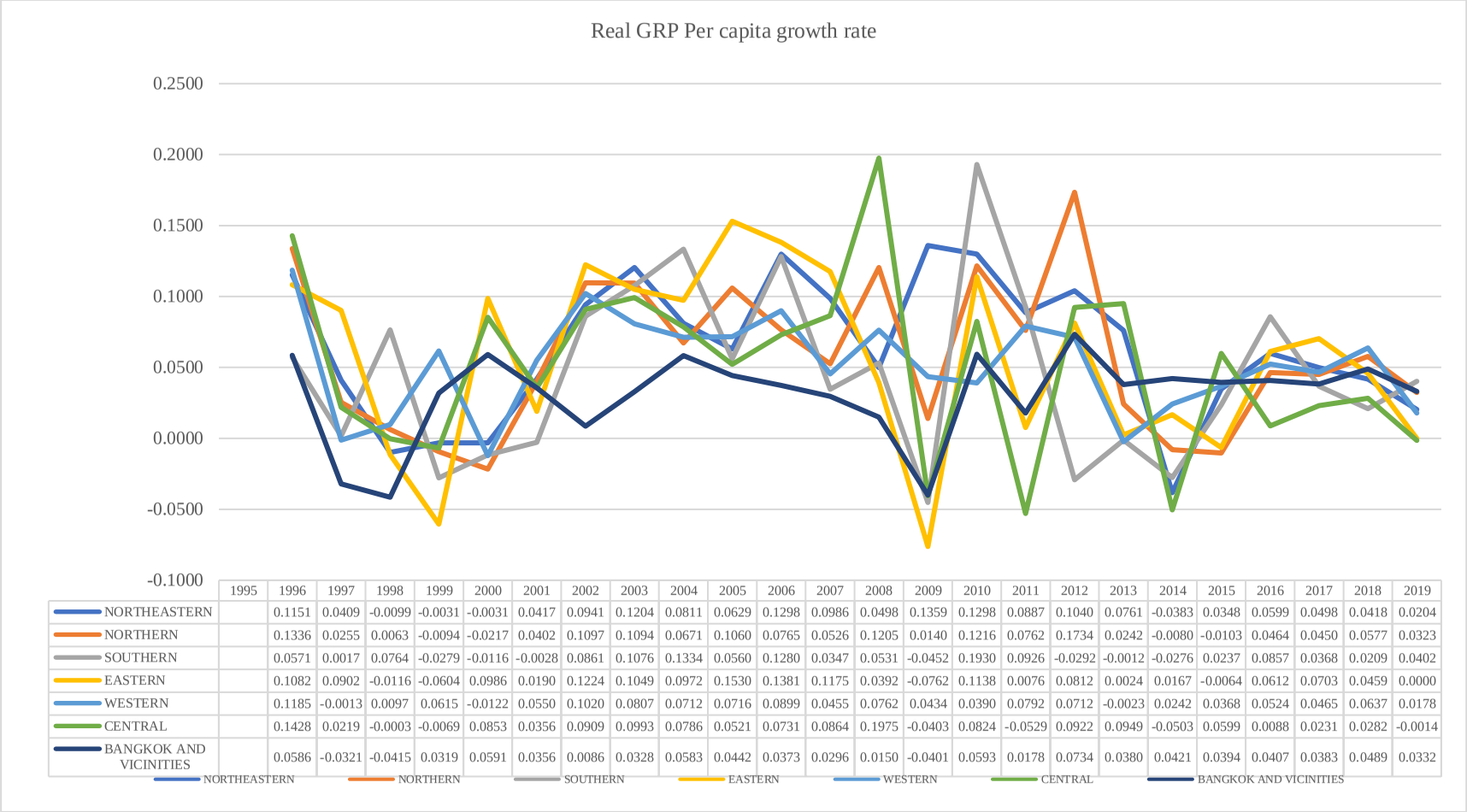



Source: Office of the National Economic and Social Development Council (2021)

According to the Office of the National Economic and Social Development Council (2021), eastern region, Bangkok and vicinities, and central region have the highest GRP per capita among all regions in Thailand. The cause of higher real GRP per capita among eastern region, Bangkok and vicinities, and central region may be the result of the concentration of factories and industrial estates within the respective regions such as Phra Nakhon Si Ayutthaya province, Chonburi province, Rayong province, and Bangkok.

Figure 1.9 illustrates Thailand's gross regional product (GRP) per capita growth rate 1995 -2009.

Figure 1.9 Thailand GRP per capita growth rate 1961 – 2019




| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NORTHEASTERN | | 0.1151 | 0.0409 | -0.0099 | -0.0031 | -0.0031 | 0.0417 | 0.0941 | 0.1204 | 0.0811 | 0.0629 | 0.1298 | 0.0986 | 0.0498 | 0.1359 | 0.1298 | 0.0887 | 0.1040 | 0.0761 | -0.0383 | 0.0348 | 0.0599 | 0.0498 | 0.0418 | 0.0204 |
| NORTHERN | | 0.1336 | 0.0255 | 0.0063 | -0.0094 | -0.0217 | 0.0402 | 0.1097 | 0.1094 | 0.0671 | 0.1060 | 0.0765 | 0.0526 | 0.1205 | 0.0140 | 0.1216 | 0.0762 | 0.1734 | 0.0242 | -0.0080 | -0.0103 | 0.0464 | 0.0450 | 0.0577 | 0.0323 |
| SOUTHERN | | 0.0571 | 0.0017 | 0.0764 | -0.0279 | -0.0116 | -0.0028 | 0.0861 | 0.1076 | 0.1334 | 0.0560 | 0.1280 | 0.0347 | 0.0531 | -0.0452 | 0.1930 | 0.0926 | -0.0292 | -0.0012 | -0.0276 | 0.0237 | 0.0857 | 0.0368 | 0.0209 | 0.0402 |
| EASTERN | | 0.1082 | 0.0902 | -0.0116 | -0.0604 | 0.0986 | 0.0190 | 0.1224 | 0.1049 | 0.0972 | 0.1530 | 0.1381 | 0.1175 | 0.0392 | -0.0762 | 0.1138 | 0.0076 | 0.0812 | 0.0024 | 0.0167 | -0.0064 | 0.0612 | 0.0703 | 0.0459 | 0.0000 |
| WESTERN | | 0.1185 | -0.0013 | 0.0097 | 0.0615 | -0.0122 | 0.0550 | 0.1020 | 0.0807 | 0.0712 | 0.0716 | 0.0899 | 0.0455 | 0.0762 | 0.0434 | 0.0390 | 0.0792 | 0.0712 | -0.0023 | 0.0242 | 0.0368 | 0.0524 | 0.0465 | 0.0637 | 0.0178 |
| CENTRAL | | 0.1428 | 0.0219 | -0.0003 | -0.0069 | 0.0853 | 0.0356 | 0.0909 | 0.0993 | 0.0786 | 0.0521 | 0.0731 | 0.0864 | 0.1975 | -0.0403 | 0.0824 | -0.0529 | 0.0922 | 0.0949 | -0.0503 | 0.0599 | 0.0088 | 0.0231 | 0.0282 | -0.0014 |
| BANGKOK AND VICINITIES | | 0.0586 | -0.0321 | -0.0415 | 0.0319 | 0.0591 | 0.0356 | 0.0086 | 0.0328 | 0.0583 | 0.0442 | 0.0373 | 0.0296 | 0.0150 | -0.0401 | 0.0593 | 0.0178 | 0.0734 | 0.0380 | 0.0421 | 0.0394 | 0.0407 | 0.0383 | 0.0489 | 0.0332 |

Source: Office of the National Economic and Social Development Council (2021)

Overall, Thailand's GRP per capita growth rate 1961-2019 does not significantly differ from the country's GDP. In other words, there is an upward trend following the Tom Yung Gung crisis in 1997. However, following the Hamburger crisis, there is a continual downward trend. Regardless, the GRP per capita growth rate for Bangkok and vicinities appear to be stable and was least impacted by the Tom Yung Gung crisis and the Hamburger crisis. Subsequent to the Hamburger crisis, the growth remained steady every year thereafter. This differs for the GRP per capita growth rate trends for the central and eastern regions which experienced more fluctuations and declines toward the end of the given period.

In conclusion, even though the overall economic development of Thailand appears to be positive with an upward trend, the level of increase is less significant each successive year. At the same time, the country's GDP growth rate has experienced a downward trend. Thus, it is imperative to find out the reasons for the declining growth rate. It would be beneficial to identify and examine the aspects of the population structure which can be used to explain the impetus and contributing factors of this downward trend.

## **1.6** Significance of the Study

Thailand is one of the countries that can be categorized as having ultra-low fertility and aging population. Moreover, the threat to Thailand's public health has been caused by the longevity of the Thai population. The effects of the country's ultra-low fertility and low mortality contribute to rapid changes in its population structure, leading to an increase in the elderly population and a decline in the working-age population. This implies that Thailand's births are not sufficient to meet its demands for labor.

An increase in the share of the elderly population may lead to skyrocketing the country's high dependency ratio which will impact its economic development. This is because the ratio of the working age population is lower. A portion of the revenue earned by the working age population will have to be shared with the elderly population which depends on them

However, economic development does not rely solely on the quantity of the labor force. It is also dependent on the quality of the labor force. Thus, a better quality labor force may facilitate the nation's economic development. Hence, the study on the effects of the population structure on economic development is of great importance.

According to the literarutres, they point out the fact that the population structure influences economic development. For instance, demographic dividend which shows that the changes in the dependency ratio have an impact on economic development (David E. Bloom & Williamson, 1998) or the neo-classical growth states that labor supply has an impact on economic development (Solow, 1956). In addition, human capital also has an impact on economic development (Mankiw, Romer, & Weil, 1992). Even though in Thailand there have been studies on these issues, they are studies at the country level using aggregate data. This study is carried out at the provincial level, so the data is different. No researcher has ever carried out this type of research before. Thus, it is necessary to carry out this research to compare the results.

## **1.7** The Objectives of the Study

1. General objective: To investigate the factors related to population structure that affect Thailand's economic development.



2. Specific objectives:

2.1 To investigate the effects of the variations of Thailand's dependency ratio on its economic development.

2.2 To investigate the effects of the changes of Thailand's labor supply on its economic development.

2.3 To investigate the effects of Thailand's human capital on its economic development.

## **1.8** Research Questions

1. What are the effects of the changes in dependency ratio (youth/old-age) toward economic development in Thailand between 2008-2019?
2. What are the effects of the decline of labor supply toward economic development in Thailand between 2008-2019?
3. What are the effects of the human capital on economic development in Thailand between 2008-2019?

## **1.9** Expected Outcomes

1.1 To identify the impacts and implications of the changes in Thailand's population structure.

1.2 To apply knowledge from this study to determine population policies at the national level, which can stimulate economic development.

# CHAPTER 2
# Literature Review

## **2.1** Previous Studies on Population and Economy

In this chapter, the researcher has compiled the literature that shows a relationship between population and economic development. Then, the related theories will be discussed, including demographic transition, demographic dividend, the Solow-Swan Model of economic development, and human capital. This chapter will present a detailed explanation and exploration of each theory. Furthermore, this chapter develops the hypotheses used in this study.

### 2.1.1 Demographic change

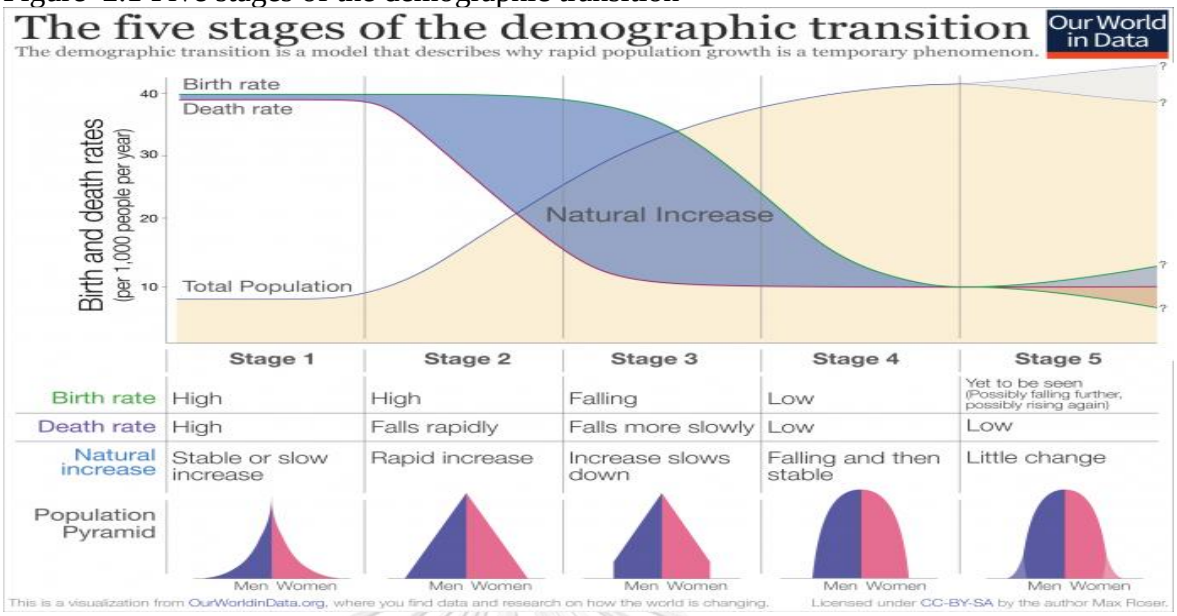
2.1.1.1 Demographic transition theory and concept

Demographic transition theory is used to explain the fertility decline in each fertility transition. Demographic transition is the theory that sheds light on how the demographic trends change over time due to the interactions of the changes in birth and death rates (Weeks, 2021).



According to the demographic transition theory, the demographic transition begins from stage 1, where the birth and death rates are high, which results in a stable or slow increase in total population (Roser, Ritchie, & Ortiz-Ospina, 2019). Stage 2 illustrates the decline in mortality rate while the birth rate is still high. In this stage, the mortality decline is mainly a result of the improvements in public health quality that help people have healthier lives; thus, more people live longer (David & Grant, 2005). Mortality decline does not only occur among the adult population, but mortality decline also occurs among infants.

Figure 2.1 Five stages of the demographic transition




Source: Roser et al. (2019)

Stage 3 illustrates the falling birth rate, while the death rate falls more slowly. In this stage, the effects of infant mortality decline lead to parents' perceptions to have a smaller number of children since concerns parents have about losing their children have been reduced (Montgomery & Cohen, 1998). Stage 4 illustrates both a low birth rate and a low death rate, resulting in a fall in the total population (Roser et al., 2019).



The demographic transition theory has been widely used to explain the changes in human behavior, such as how lower infant mortality influences couples to plan for smaller family sizes. However, fertility decline does not necessarily begin after mortality declines (Weeks, 2021). Therefore, another issue with the use of the demographic transition theory is that the theory does not answer this situation: if mortality declines today, when would fertility decline? Furthermore, the theory also does not explain other motivational factors that influence a couple's fertility decision, such as how many children they would have and on what conditions the couple would decide to have or not to have additional children (K. O. Mason, 1997). Besides, the new evidence on the relationship between infant mortality and fertility reveals that the effects of infant mortality on fertility is minimal when used to predict fertility decline (Palloni & Rafalimanana, 1999).

The demographic transition theory has not only been adopted to forecast growth or decline in the total population but also to predict the variations in economic development. Although the increase or decline of infertility and/or mortality does not directly affect economic development, it is associated with the population structure and the nation's fiscal burden, which eventually relates to the country's economic development.

The rate of population growth accelerates with an increase in fertility while the rate of mortality declines. Consequently, the population size would be enlarged. In this situation, firms benefit from the concentration of output of the population or households in a particular area. Hence, the economy would develop due to the agglomeration of economies (Sato & Yamamoto, 2005).

On the contrary, the circumstances when fertility rises while mortality declines put pressure on the working-age population. This is because the rise in fertility increases the youth dependency ratio, the mortality decline increases the old-age dependency ratio (Hussain, 2002), and the high dependency ratio tends to negatively affect economic development (Choudhry & Elhorst, 2010).



When the mortality declines, it implies a rise in the elderly population's longevity within a particular society. The empirical evidence on the effects of the elderly population's longevity has been found in Japan, a country with one of the highest if not the highest life expectancies in the world. Studies in Japan revealed that low mortality leads to a higher total number of the elderly population. Therefore, there is an emergence of budget imbalance (Kitao, 2015) or fiscal burden (Fehr, Jokisch, & Kotlikoff, 2008) issues. More specifically, problems with the public pension, healthcare, and long-term care tend to emerge in a society where the elderly population is large.

A decline in fertility implies that the labor force would shrink. However, the effects of the decreased labor force are inconclusive. Studies in China, India, and Pakistan

suggested that the growth of the labor force (working-age population) is positively associated with the growth of GDP per capita (Choudhry & Elhorst, 2010). However, studies in western Europe and some of the less developed countries reveal opposite results. The average wage rate tends to decrease when there is a high level of labor supply. In this circumstance, the GDP per capita should decrease accordingly (Sato & Yamamoto, 2005).

To find conclusive findings on the association between economic development and labor forces, Bjorvatn and Farzanegan (2013) conducted a study utilizing panel data covering the period from 1982 to 2006 for more than 120 countries to identify an association between economic development and the level of labor forces. The findings suggested that the higher ratio of the working-age population may increase economic development. However, economic development is limited by the availability of the nation's resources. Furthermore, the crowding-out effect tends to occur when resources are overly consumed. Finally, the labor forces would be left unemployed, and economic development would decline.

In summary, studies on the effects of the demographic transition on economic development are still inconclusive. A similar transition could yield different direct and indirect effects on economic development. For example, an increase in fertility while the rate of mortality declines may facilitate economic development due to the agglomeration of the economy. This may mitigate economic development because of the rise in the dependency ratio to the working-age population. Similarly, fertility decline facilitates economic development as the dependency ratio decreases. However, fertility decline would reduce the number of the labor force and the production factors entering the labor market. This would eventually result in a slowdown in the economy.

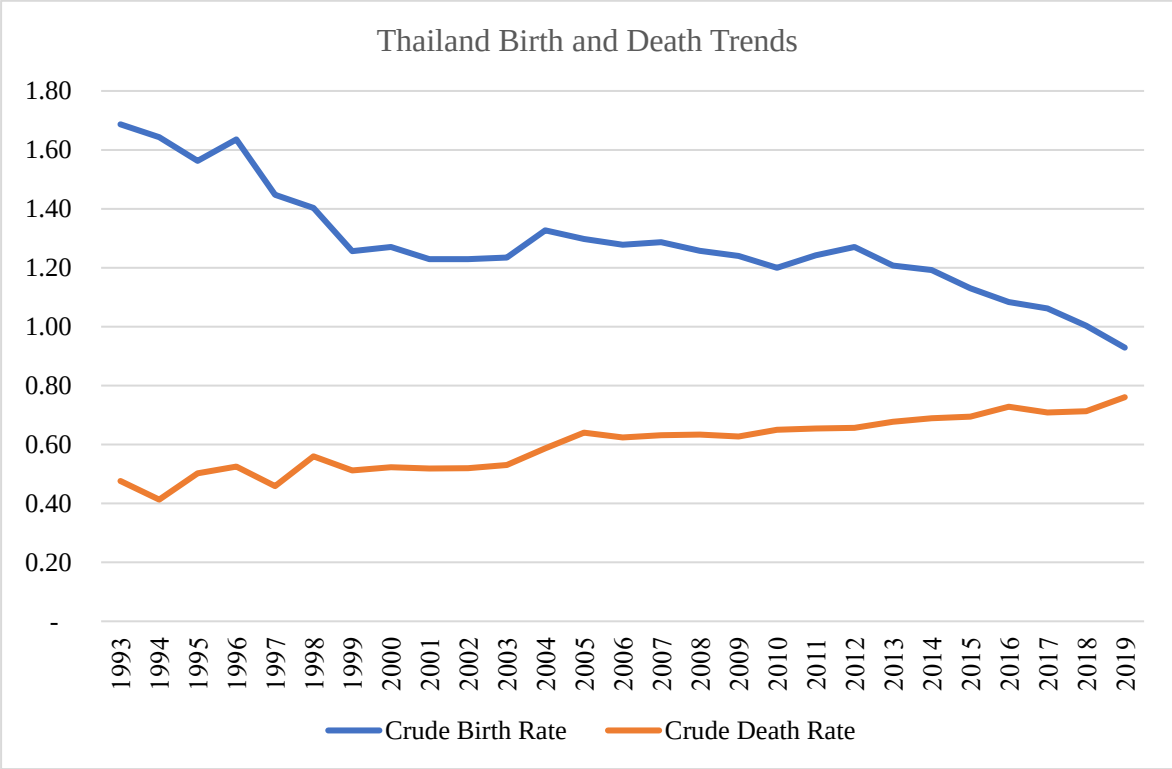


#### 2.1.1.2 Thailand's transition

According to the figures 2.2, Thailand's mortality trends have been relatively stable during these past three decades. The crude death rate had been slightly increasing from 0.48 in 1993 to 0.76 in 2019. On the contrary, Thailand's crude birth rate in the same period had been declining dramatically.

Fertility decline and stable mortality have had stable effects on Thailand's population structures (see Figures 1.4 and 1.5 for more information).

Figure 2.2 Thailand's Birth and Death Trends




**Source:** Office of the National Economic and Social Development Board (2021)



As can be seen in extreme cases such as Japan's situation, low mortality allows the old-age population to live longer. Therefore, the proportion of the elderly population has been expanding, and the working-age population has been shrinking annually (Kitao, 2015). Nonetheless, the downward trends of Thailand's crude birth rate (see also Thailand TFR in Figure 1.2) result in a smaller youth population proportion.

There are still mixed results from previous studies, which are still inconclusive. Thus, Thai policymakers must study the country's demographic transition to determine appropriate policies for the country.

2.1.1.3 Demographic dividend theory and concept

In 1998, David E. Bloom and Williamson (1998) studied the population changes based on the outcomes of rapidly expanding economies in East Asian countries. They proposed the idea of a demographic dividend which was initially called a "Demographic gift" and later was transformed into the "Demographic dividend."

According to the United Nations, a demographic dividend refers to when fertility declines and the dependency ratio is lowered. In such a case, the working-age population is likely to be more productive because of lower dependents. Hence, the overall level of economic development would rise (United Nations Population Fund, 2016).

The dependents that prevent working-age populations from being productive could be both young as well as older-age dependents. However, there is a chance to transform the elderly population into economic contributors, a phenomenon known as the second demographic dividend. For instance, the government should expand human capital investment, help elderly workers work longer, and improve personal consumption (Cai, 2020). However, for young dependency, the youth are not ready to contribute to economic development. Therefore, creating human capital in the youth is challenging or perhaps even impossible.



For this reason, the problems which make it challenging to achieve a demographic dividend stem from a high dependency ratio. This is likely due to a youth dependency ratio. In other words, economic development rapidly decreases because there are more young mouths to feed (Lee & Mason, 2006).

David E. Bloom and Williamson (1998) were the very first scholars to propose the idea regarding economic development due to the changes in the population structure. Although David E. Bloom and Williamson (1998)'s proposal was wildly accepted, there were questions concerning some variables. In addition to David E. Bloom and Williamson (1998), A. Mason and Lee (2007) offered a simple demographic dividend model that links economic development into the share of the working-age population

and labor productivity. According to A. Mason and Lee (2007), a simple demographic dividend model is explained in the following equation:

$$\frac{Y}{N} = \frac{Y}{L}\frac{L}{\text{Working Age Population}}\frac{\text{Working Age Population}}{N}$$

Where:

Y is the real Gross Domestic Product (GDP).

N is the total population.

Working Age Population is the total population aged 15 – 59.

L is the total number of active workers.

Y/N can be expressed as a product of income per effective producer.

Y/L can be expressed as labor productivity.

L/Working age population can be expressed as the employment level.

Working-age population/N can be expressed as the changes in the share of the working-age population to the total population.

The demographic dividend model demonstrates that the GDP per capita income is a function of the growth of labor productivity, employment level, and the share of the working-age population.



2.1.1.4 Demographic dividend and population structure

Numerous studies suggest a significant driver of economic development with population factors (Cai, 2020; Dissanayake, 2017; Franco-Henao, Rodriguez-Sumaza, Borondo-Arribas, & Muzigirwa-Muke, 2018). A higher labor force ratio to the total population and a higher percentage of labor participation lead to economic development (Jafrin, Mahi, Masud, & Ghosh, 2021). However, the variation of the number of the labor force may not adequately stimulate the demographic dividend. Labor participation in the labor market is a stronger predictor of the demographic dividend (Krishnamurty & Kumar, 2015).

Fertility decline is one of the issues mitigating countries from enjoying benefits from a demographic dividend. In China, for instance, the One-child policy caused a sharp drop in fertility. Hence, the labor input in the labor market also declined. The government has been trying to address the problem by stimulating fertility by initiating two-child policies to increase labor input, eventually leading to a demographic dividend (Wu, Wu, & Wu, 2018). The main idea is that a fertility decline reduces the dependency ratio and enlarges the working population ratio, which opens an opportunity for the country to enjoy the benefits from a demographic dividend. Low fertility may change the population structure and lead to demographic dividends for some reason. For instance, females with low fertility tend to attach themselves to the labor market, and lower fertility allows the government to invest more in health and education (D. E. Bloom, Kuhn, & Prettner, 2017).

In China, a study was conducted using panel data between 1990 – 2015. The research findings demonstrated that when comparing the effects of age structure variations, economic development relies the most on the variations of the working-age population (Ye, Chen, & Peng, 2021).

In Sri Lanka, there is a possibility of a demographic dividend resulting from a transition of the demographic structure, as forecast by Dissanayake (2017). The paper's objective was to assess the changes in Sri Lanka's population structure, which would regulate the period when Sri Lanka would benefit from its demographic dividend. The paper employed secondary data in order to analyze Sri Lanka's population structure. The data was comprised of 1980 and 2012 national's censuses which were collected by Sri Lanka's Department of Census and Statistics. According to the data, Sri Lanka's percentage of child dependency ratio declined from 35 percent in 1981 to 24 percent in 2006 and is expected to decline to 18 percent in 2025. At the same time, the old-age dependency ratio increased from 6 percent in 1981 to 10 percent in 2006. In addition, it is predicted to climb to 18 percent in 2025. Concerning the age structure, the proportion of youth, working-age, and elderly population in 1981 was 35 percent, 58.2 percent, 6.6 percent, respectively. In 2012, the proportion for the youth, working-age,

and elderly populations changed to 25.8 percent, 62 percent, and 12.4 percent, respectively.

Navaneetham and Dharmalingam (2012)stated that Sri Lanka would benefit from a demographic dividend when the proportion of youth, working-age, and elderly populations are 30 percent, 55 percent, and 15 percent, respectively. However, the preferable population proportion for youth, working-age, and elderly age gourp reached 30 percent, 62 percent, and 8 percent in 1992, respectively. As a result, Dissanayake (2017) suggested that Sri Lanka has been gaining benefits from a demographic dividend since that time.

Although the share of the working-age population is a crucial driver of economic development, economic development cannot be achieved if the working-age population is not active in the labor market. A study in the European Union (EU) using data in 2020 suggested that a higher dependency ratio would depress economic development. Nevertheless, a higher employment rate helps stimulate economic development. The magnitude of the employment rate that affects economic development is greater than the magnitude of the dependency ratio that affects economic development (Van Der Gaag & de Beer, 2015).



In summary, the population factor is one of the essential drivers of economic development, leading to a demographic dividend. The benefit from a demographic dividend emerges when the share of the working-age population is large and the dependency ratio is low. On the other hand, youth dependency seems to be the issue preventing the emergence of a demographic dividend since it is almost impossible to transfer the youth population into economic contributors.

Fertility decline is one of the main factors which affect the changes in the population structure. First, fertility decline reduces the youth dependency ratio, which allows the working population to be more productive. Second, the fertility decline allows the female labor force to attach themselves to the labor market, which would lead to a

higher labor supply. Third, fertility decline also allows the government to reallocate its public expenditure to other areas for better public investments.

Even though fertility decline may lead to a demographic dividend, it also means that the total labor force would also decline in the future because there is less labor force input in the labor market. For instance, the one-child policy caused a sharp drop in fertility in China. Hence, the labor input in the labor market also declined. The government has been trying to address the problem by stimulating fertility by initiating the Two-child policies, which aim to increase the labor input, eventually leading to a demographic dividend (Wu et al., 2018).

2.1.1.5 Demographic dividend and labor productivity

The reduction in the dependency ratio to the working-age population stimulates economic development. This favorable evidence is known as the demographic dividend, accepted for decades. Nonetheless, recent research reveals that a large share of the working-age population does not lead to a demographic dividend by default. Appropriate policies to increase labor force productivity are required (Ahmed, Cruz, Go, Maliszewska, & Osorio - Rodarte, 2016; D. E. Bloom et al., 2017; Oosthuizen, 2015; Sánchez-Romero, Abio, Patxot, & Souto, 2018; Ssewamala, 2015). A study using panel data from Mexico and Spain conducted by Rentería, Souto, Mejía-Guevara, and Patxot (2016) suggested that a demographic transition that allows the working-age population to grow in the first stage positively affects economic development. Nevertheless, the government's investments in education yield economic development at a higher rate compared to the effects of a demographic transition. Hence, it is essential to realize that higher educational attainment of a population implies faster economic development. Similar results of this study were also identified in Spain (see Sánchez-Romero et al. (2018)) and India (see Narayana (2015)).

Recent researches pointed out two similar investigations for the data used in their studies. First, researchers investigated the effects of the population structure and labor productivity on economic development using their data in the past. Second, some

researchers used projected data to predict the effects of population structures and labor productivity on economic development.

For the studies about the effects of population structures and labor productivity on economic development using data from the past, the findings suggested that an increase in the proportion of the working-age population as a result of fertility decline is only a window to gain benefits from the demographic dividend. In order to maximize benefits from a demographic transition, the government must develop labor productivity through efficient human capital policies such as those that relate to education and health (Islam, 2016; Q. Li, Tsui, Liu, & Ahmed, 2018).

Lutz et al. (2019) conducted a study that adopted a lagged model using data from 1980 – 2015 from 165 countries across the globe. The findings suggested that a larger proportion of the labor force would facilitate a demographic dividend. However, the more years of education the labor force attains, the more improvements on the labor force's productivity. Thus, there would be a greater magnitude of economic development.

Developing labor productivity requires time and investment. It is believed that a demographic dividend is a result of long-term effects. Therefore, the results can not be achieved in a short period (Joe, Kumar, & Rajpal, 2018). In addition, the changes in the population structure are the results of fertility decline; therefore, recent studies on predicting the effects of population structure and labor productivity on economic development using projected data have been carried out in Sub-Saharan and African countries where the fertility rate is still high with a downward trend. This is to ensure that these countries would be well prepared for a possible demographic dividend.

According to the predictions on the effects of population structure and labor productivity on economic development using projected data in Sub-Saharan and African countries, researchers have suggested similar results: an increase in the proportion of the working-age population does not necessarily yield a demographic dividend if the working-age population is incapable of performing economic activities.

Educational policies that enhance knowledge and health policies that facilitate better health conditions are required to build a nation's economic productivity (May & Turbat, 2017; Ssewamala, 2015).

To recapitulate, a demographic dividend results from a reduction of the dependency that allows the working population to be more active in the labor market. Therefore, the overall national economy can be broadened. However, the demographic dividend will not occur by default; it requires policies to manipulate the dividend. Based on the papers discussed, both at the country and the global levels, the development of the education policies seems to be the key to maximizing benefits from a demographic dividend. This is because improved education will allow the country to benefit from enhanced productivity.

According to the review of the literature, it can be hypothesized that:

Hypothesis 1: The youth dependency negatively affects Thailand's economic development.

Hypothesis 2: The old-age dependency negatively affects Thailand's economic development.

Hypothesis 3: Labor productivity positively affects Thailand's economic development.

Hypothesis 4: Employment level positively affects Thailand's economic development.

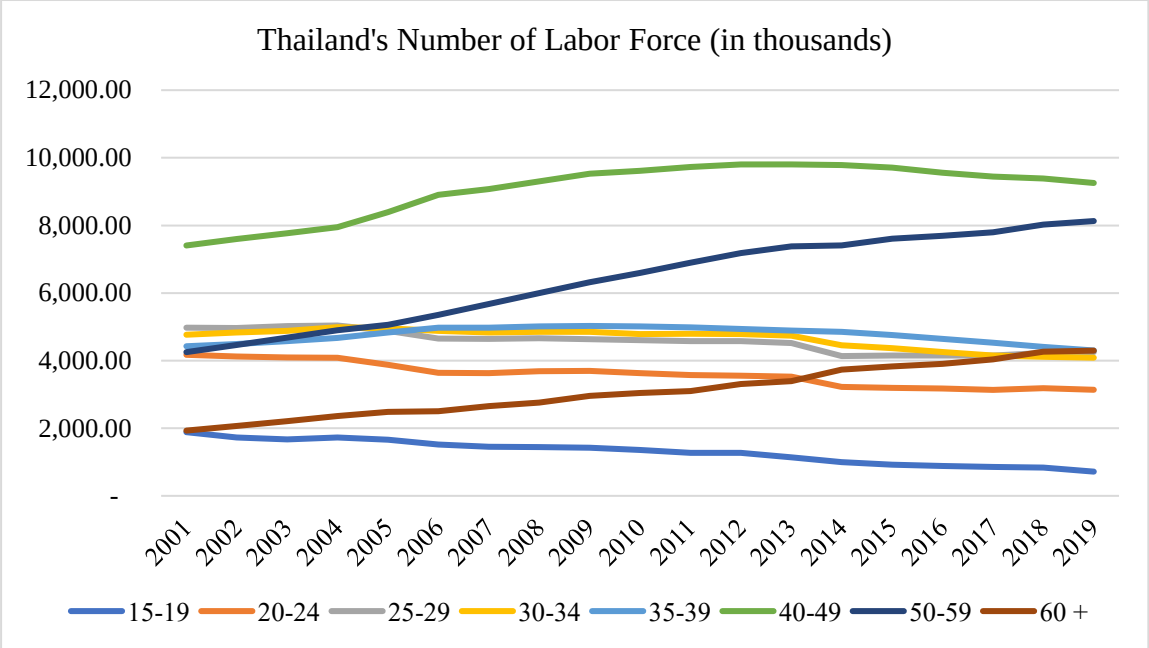


2.1.1.6 Thailand's labor force characteristics

The overall picture of the labor force in Thailand shows that it is already aged. Around 60 percent of the total labor force (approximately 20 million people) are aged between 40 years of age and older(Office of the National Economic and Social Development Board, 2021). At the same the time, the labor force that is below the age of 40 represents only 40 percent of the total labor force. In addition, according to the graph, there is an upward trend of the labor force that is 50 years and older, which signifies that the country's labor force will age more and more. On the other hand, the figures show a

downward trend for the labor force between 15 and 20. In particular, the labor force between 15 and 19 has declined by half within one decade. The reduction of the youngest labor force at such rapid rates may be attributed to Thailand's decline in total fertility.

Figure 2.3 Thailand's number of labor force characteristics




Source: Office of the National Economic and Social Development Board (2021)



The reduction of the labor force has implications on the demographic dividend. The number of the labor force that has declined will impact the country's economic development shortly.

### 2.1.2 The Solow-Swan Model

The neoclassical growth model was developed by Solow (1956). The central idea of the growth model is the concept of aggregate production function, which is the function of aggregate capital stock and aggregate employment. This function can be written as shown in the following equation:

$$Y(t) = F(K(t), L(t), t)$$

Where Y is aggregate output, K is the aggregate capital stock, L is aggregate employment, and t is the time index which appears separately in the production function to indicate that the technology itself may not be constant over time.

According to Solow (1956), economic development depends on two factors: the accumulation of capital stock and the level of labor supply within a particular country. This implies that a higher level of capital stock and labor supply would stimulate economic development at a specific period.

Focusing on the level of labor supply, which is one of the factors stimulating economic development, the labor force is a key to any production activities. Hence, labor supply plays a vital role in economic development. Some studies point out that the level of the labor force has a positive effect on economic development, but H. J. Chen and Miyazaki (2020) proposed that this is not always accurate in some circumstances. They pointed out that the relationship between the level of the labor force and economic development may not be linear when the labor supply consists of old agents. This is because the old agent labor force raises wage income while productivity is low. Nonetheless, education investment in old agent labor force tends to be higher than in the young agent labor force. Hence, the age of the labor force may have a role in stimulating economic growth.



Economic development depends on many factors, one of which is labor supply. A country's labor supply is not dependent solely on how many people there are in a country. Instead, what has to be considered is the population structure—for instance, A. Chen and Groenewold (2021) suggested that China is the most populous country in the world; however, it still faces challenges with an insufficient labor force. This problem comes from the fact that it has a high ratio of the elderly and a low birth rate. Thus, the problem of labor supply is not the number of people in a country but rather the structure of a country's population. Finally, A. Chen and Groenewold (2021) revealed that the level of the labor supply and labor productivity have a role in stimulating economic development in China.

The ideas proposed by A. Chen and Groenewold (2021) were confirmed by Ahmad and Khan's (2019) study, which was based on data from 67 developing countries. Significant findings of their study revealed that the population growth rate has a minimal effect on economic development in some models. However, the working-age population ratio, the labor force participation ratio, and the growth rate of the total labor force have a greater effect on economic development. As a result, it may be concluded that the total population may not be significant to economic development compared with the total working age population of a country.

The Sun (2020)'s study also pointed to a similar result. The aging society in China causes changes in the population structure. The ratio of the elderly in China is greater than the ratio of the working-age population. These older adults are those exiting the Chinese labor market; hence, this implies that labor supply in the labor market will eventually decline. Sun's research also showed the impacts of the increase in the ratio of the elderly population, which leads to a decline in the labor supply and economic development.

Nonetheless, Stevenson (2012) studied the level of labor supply and tax revenue in the United States and suggested a relationship between the labor force level and the level of federal tax revenue. Hence, the labor force's shrinkage may challenge Thailand's future tax revenue in the coming years.



The educational level plays an essential role in an individual's fertility, which would result in the number of labor input into the labor market and female labor participation. Those women who attain a higher level of education tend to be more modernized. In contrast, those who cannot attain a high level of education tend to behave more traditionally. As a result, those women who attain a higher level of education would gain better access to a career path, which would allow them to yield better benefits from society (Scanzoni, 1975; Soriano, 1991). The higher educational level would lead to a larger proportion of female labor force participation. However, female labor force participation is also somewhat determined by cultural attitudes (Jaumotte, 2003). For example, Japan's labor force is characterized by male domination and female

subordination; thus, the female population stays at home to take care of their children. As a result, females are likely to withdraw from Japan's labor market (İmrohoroğlu, Kitao, & Yamada, 2019). An aging population in Japan coupled with gender-based attitudes have led the Japanese government to experience a fiscal burden. Many women face barriers to entry to the labor market starting from the recruitment process. This is because in Japan many women tend to resign when they become pregnant and have children, so companies have to incur additional costs to recruit new employees to replace these women. As a result, İmrohoroğlu et al. (2019) proposed a way to reduce the government's fiscal burden and stimulate the nation's economy by encouraging females to participate in the labor force, which would lead to the growth of Japan's economy in the future.

To verify the effects of female labor participation on economic development, Folasade and Olarewaju (2019) conducted a study in Nigeria and Ghana, where female labor participation in the labor market is increasing. The result of the study found that the level of female labor participation in the labor market had a positive effect on both countries' economic development.

A similar result of female labor participation on economic development can also be found in South Korea. For example, the study by Suh (2017) found that labor participation in the labor market in South Korea had a positive relationship to economic development. Moreover, the social condition, such as female education and equality of income distribution, stimulated female labor participation.

In summary, the neoclassical growth model which was developed by Solow (1956) posits that aggregate output is a function of capital stock and labor supply. The implication is that an increase in capital and labor supply would increase aggregate output, namely, economic development. However, H. J. Chen and Miyazaki (2020) pointed out that a large proportion of an advanced age labor force may mitigate the economic development since this particular group of the labor force has low productivity while earning high wages. A. Chen and Groenewold (2021) also confirmed this proposal, providing an example to show that China faces challenges with

insufficient labor even though they are the most populous country in the world. This is due to a large proportion of the elderly population. Furthermore, attitudes towards female labor participation affect the level of the female labor force in the labor market. İmrohoroğlu et al. (2019) suggested that increasing female labor participation may stimulate economic development. This was confirmed by studies in Nigeria and Ghana (Folasade & Olarewaju, 2019) and Koran Suh (2017).

According to the review of the literature, it can be hypothesized that:

Hypothesis 5: The share of the working-age population positively affects Thailand's economic development.

Hypothesis 6: The share of the active labor force positively affects Thailand's economic development.

### 2.1.3 Human Capital

2.1.3.1 Human capital theory and concept

A nation's output depends not only on the quantity of the labor supply, but also on the quality of the population who engage in the production activities. Therefore, human capital has a vital role in developing the quality of the labor force rather than just being a quantitative figure. As an extension to the neoclassical growth model developed by Solow (1956), Mankiw et al. (1992) found that some residuals could not be explained by Solow's economic development model equation. They explained that the growth of an economy does not rely only on the accumulation of capital stock but also on the stock of human capital. There are some depreciations in the capital stock; however, human capital tends to appreciate over time.



According to the World Bank (2017), human capital is comprised of knowledge, skills, and health. All three aspects will remain throughout the individual lifespan, enabling him/her to be productive and contribute to society. For the past half-century, scholars have paid particular attention to human capital issues because the outcomes of physical capital could not fully explain economic development. Schultz (1961) proposed the idea for the human capital theory of economic development that covered three elements: 1)

Countries without much human capital cannot effectively manage their physical capital; 2) Economic development can only proceed if physical capital and human capital rise in tandem; and 3) Human capital is the factor most likely to limit growth. Becker (1967) extended Schultz (1961)'s human capital idea that human capital can be strengthened by improving people's education, providing specific on-the-job training, and ensuring that their mental and physical health are in good condition. As a result, the concept of human development has become widely adopted in stimulating economic development, both at the macro and the micro-levels.

2.1.3.2 Human capital and economic development

The macro view of the relationship between human capital and economic development suggests that human capital influences economic development across the globe. There is empirical evidence from various studies which reveal the positive relationships, both direct and indirect effects, between these two factors.

In the late 1900s, Benhabib and Spiegel (1994) employed panel data between 1965 – 1985 from 121 countries worldwide to study the role of human capital in economic development. The study found that human capital (average years of schooling in a particular country) does not directly affect economic development (GDP per capita). However, when introducing the model that tests the influences of human capital on the total factor of productivity, human capital became a significant factor. This implied that the average years of schooling do not influence GDP per capita income directly. However, the labor force's average years of schooling improve their knowledge, increasing their productivity. Finally, labor forces with higher productivity would generate a better income. A similar finding was found in the European Union, NUTS-2 region. Makkonen and Inkinen (2013) demonstrate that human capital (education attainment) has both direct and indirect effects on economic development (GDP per capita). In terms of direct effect, higher education attainment facilitates economic development in the NUTS-2 region. As for the indirect effect, education attainment also influences innovative capacities, which allows the labor force to implement technologies in their production activities, resulting in higher GDP per capita within the region. Gruzina, Firsova, and Strielkowski (2021) confirm the indirect effects of human

capital on economic development, finding that the magnitude of economic development varies among developing and developed countries. Their study suggested that new technology formation opens opportunities for people's personal development. This can be achieved by fostering human capital through such means as reducing education inequality in society.

In Thailand, Ketsawa (2019) revealed that the Tom Yum Kung financial crisis in 1997 led to much damage to the nation's capital stock. However, investments in the nation's education improved the labor force's skills. Thus, he found a relationship between economic development and the ratio of the educated labor force to total labor in the labor market. This implies that the higher ratio of the educated labor force in the labor market would stimulate economic development. For this reason, human capital is a crucial factor that affects Thailand's economy. Teerawichitchainan, Prachuabmoh, and Knodel (2019) assert that the elderly population who hold higher education attainment levels tend to engage in the labor market longer than those who hold lower levels of educational attainment. In addition, elderly individuals who are part of the labor market can assist their families. Thus, human capital is likely to increase an individual's lifetime security.



Roseline Tapuwa, Ronney, and Andrew (2020) conducted a study in Sub-Saharan Africa regarding the relationships between economic development, human capital, and government investments in education. The study suggested that human capital and government investments in education lead to economic development in Sub-Saharan Africa countries. The findings implied that the government should invest more in education because education improves a nation's human capital which would subsequently lead to economic development.

Affandi, Anugrah, and Bary (2019) adopted the economic model proposed by Mankiw et al. (1992), which comprises capital stock, labor force, and human capital to study how these determinants affect Indonesia's economic development. The study suggested that capital stock and labor force had positive effects on economic development in every region. However, human capital had a positive effect on economic development only

in Sumatra and Java. However, human capital did not affect economic development in Kalimantan and Eastern Indonesia. Affandi et al. (2019) explained that labor in Kalimantan and Eastern Indonesia is mainly concentrated in the agricultural sector, such as fisheries and mining. Thus, skilled labor may not be required in those areas, resulting in human capital's insignificant effect on economic development.

Theoretically, human capital leads to economic development. Thus, it can be implied that the more educated the labor force, the more the economy would also develop accordingly.

2.1.3.3 Human capital measurement

As previously mentioned, human capital refers to knowledge, skills, and health (World Bank, 2017); therefore, the measurements used in previous studies on human capital are diverse.

In the early stage of studies on human capital, average years of schooling and the school enrollments were widely used as measurements for human capital (Benhabib & Spiegel, 1994; Castelló-Climent & Hidalgo-Cabrillana, 2012; Glaeser, La Porta, Lopez-de-Silanes, & Shleifer, 2004; Gylfason, 2001; Hanushek, 2013; Makkonen & Inkinen, 2013; Teerawichitchainan, Prachuabmoh, et al., 2019). However, these measurements focused on the number of students who are included in the educational system. Hence, the higher number of students who are in the school implies better human capital.



Recent studies have placed emphasis on the labor force's level of education. Therefore, the share of a certain age of the population which holds a certain level of education has been used as a human capital measurement. The most widely used measurement is the share of the labor force with a university degree in the labor market (Barra & Zotti, 2017; Liu, Qian, & Haynes, 2021; Meyer & Sinani, 2009; Pink-Harper, 2015). The studies employing the share of the labor force with a university degree in the labor market focus on the spillover effect of the university in a particular area to its economic development because there is evidence that the concentration of universities tends to point to higher economic development. This is because there is knowledge spillover from the university. University graduates would tend to live in a region where they

graduated from for at least ten years after their graduation. As a result, the region where a university is located would have higher human capital stock compared to other regions without a university.

Other human capital measurements include the concentration of knowledge producers such as higher education institutions and the number of universities and research universities (Barra & Zotti, 2017; Pink-Harper, 2015) and the number of patent applications and R&D expenditures (Barra & Zotti, 2017; Liu et al., 2021; Makkonen & Inkinen, 2013; Meyer & Sinani, 2009; Pink-Harper, 2015). For these measurements, the studies focus on how much knowledge has been generated in a specific area. The idea of the study is that the area where knowledge is generated tends to have better economic development.

Finally, there are a few studies that employ health factors to measure human capital. For example, Roy (2014) found that the HIV prevalence rate negatively affects economic development. Colantonio, Marianacci, and Mattoscio (2010) demonstrated that countries with higher health expenditures, longer life expectancy, and a high proportion of primary school completion rates tend to have higher GDP per capita. This implies that countries with a population with a high level of education tend to take better care of their health. Nevertheless, a healthy population is more productive and generates a better per capita income.



In summary, recent studies utilized varying measurements for human capital depending on the objectives of each study. However, what is similar is that human capital measurements still emphasize quantity rather than quality. For instance, studies have often looked at the years of schooling, the number of students enrolled, etc. Measurements that are solely based on quantitative factors may not yet be sufficient to reflect human capital. Measurements in quality are also an important topic that should be investigated. For example, there are discrepancies in the economic outcomes between 9-years of schooling in developed and developing countries. Therefore, human capital has shifted toward educational quality rather than total years of schooling (Hanushek, 2013).

Thus, measurements in human capital should shift away from pure quantity to quality.

2.1.3.4 Issues on the study of human capital and economic development

Previous sections suggest that there is a positive effect of human capital on economic development. It seems that better human capital, such as higher average years of schooling or a higher number of school enrollments, would lead to better economic development. However, it is not necessarily true. The results found in Qadri and Waheedy (2017) show that this is not the case. They studied the number of enrollments in primary-, secondary- and tertiary-level education to measure human capital. They verified the relationships between human capital and economic development.

Nevertheless, their study revealed that some students enrolled in secondary-level education affect economic development. Hence, a higher level of education does not necessarily guarantee that there will be higher economic development. What is important is the optimal level of education and not the total number of years of education.

Muhammad, Arshad, Kashif, Muhammad Asim, and Yasir Bin (2020) studied human capital which affects economic development in OECD countries. The results of their study pointed to a different conclusion compared to previous studies: human capital has no impact on economic development, but it is the utilization of human capital that impacts economic development. The utilization of human capital is the number of hours of work of the labor force in the labor market. The study implied that without the utilization of human capital, there would be no economic development.



It has been some time that researchers have found that human capital relies on other factors to stimulate economic development (Benos & Zotou, 2014). Glaeser et al. (2004) revealed variations in terms of human capital in different countries. The study shows different factors influencing human capital depending on factors, such as institution, colonization, juridical independence, constitutional review, and the presence of democracy, autocracy, or other forms of governance. Hence, countries with different institutions may have different capabilities when it comes to developing their economies. Liu et al. (2021) found an association between human capital and the share

of the population aged 25 and above who hold at least a bachelor's degree in economic development in all industries. However, economic development in high-tech industries is influenced by the share of the population aged 25 and above who hold at least a bachelor's degree and the number of patents granted.

Moreover, Kelly, Ruther, Ehresman, and Nickerson (2017) pointed out that it is difficult to find a causal relationship between economic development and human capital. Places where the economy is highly developed tend to attract highly skilled workers who migrate themselves for work. On the contrary, the economy can hardly be developed without human capital stock. Studies on quality of place reveal that skilled workers prefer to live in a place where their quality of life would improve, such as countries with low crime rates, availability of entertainment, and accessibility to quality housing. This issue was found to be the case in mid-sized metropolitan areas, but it was found that the same was not statistically significant in small-sized metropolitan areas.

According to the review of the literature based on human capital, it can be hypothesized that:

Hypothesis 7: The average years of school positively affects Thailand's economic development.

Hypothesis 8: The growth rate of the population with non-communicable diseases to the total population negatively affect Thailand's economic development.

# CHAPTER 3
# Conceptual Framework and Methodology

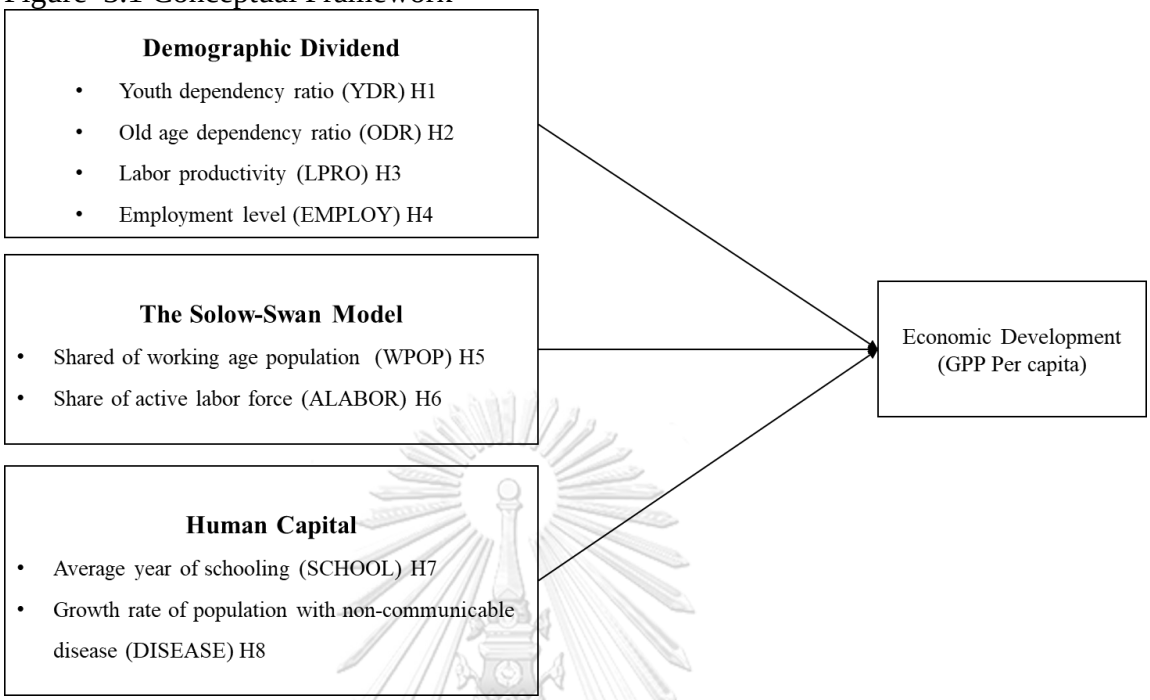
This chapter provides the explanation for the estimated models in this study which comprised of demographic dividend model, the Solow-Swan model, human capital model, and overall empirical model. Furthermore, data source of each variable and the variable description will also be discussed.

## **3.1** Conceptual Framework and Variables

3.1.1.1 Conceptual Framework

Figure 3.1 illustrates the conceptual framework based on the review of the literature in Chapter 2. The conceptual framework provides the factors affecting the country's economic development. These factors, which are included in Figure 3.1, are based on the literature focusing on the demographic dividend concept, the Solow-Swan model, and the human capital theory.

Figure 3.1 Conceptual Framework




Source: Author

First, the demographic dividend concept posits that fertility and mortality changes lead to the changes of dependency (youth dependency and old-age dependency), which affect the working-age population. The higher the level of the dependency ratio, the higher the economic difficulties experienced by the working-age population, which, in turn, affects the overall economic development (K. Wongboonsin et al., 2005).

Second, the Solow-Swan model proposes that economic development is a function of capital stock and labor supply in a particular labor market. There will be greater economic activities if the labor supply and the growth rate of the working-age population are high. Therefore, economic development would arise accordingly (Solow, 1956). The growth rate of the elderly population is likely to affect the proportion of the working-age population negatively. Hence, the higher ratio of the elderly population implies that there would be a decline in the labor supply, which adversely affects economic development. The female labor force tends to withdraw themselves to raise their children, which results in the reduction of the labor supply.

The ability to increase the growth rate of female labor participation means that there would be an increase in the labor supply in the labor market, which would eventually stimulate economic development.

Finally, the human capital theory proposed that labor force quantity is not sufficient to stimulate economic development. The quality of the labor force is also the key to success (Mankiw et al., 1992). The improvement of education and health would ensure that the labor force is productive. Thus, the education and health factors are included in the model.

## **3.2** Excluded variables

According to the literature review, some variables should be included in the conceptual framework. However, the unavailability of data at the provincial level serves as a barrier for data collection. Therefore, these variables must be exempted from the conceptual research framework. These variables comprise of 1) total fertility rate, 2) life expectancy, 3) Female labor participation, 4) school enrollments, 5) share of the labor force with a university degree, 5) the number of patent applications and R&D expenditures, 5) healthcare expenditure, 6) education expenditure, and 7) GINI coefficient.



## **3.3** Methodology

### **3.3.1 Fixed effects model vs. random-effects model**

Two possible statistical estimations can be conducted in this study; i) fixed-effects regression model and ii) random-effects regression model. These two estimations can be written as the unobserved effects model as follows (Wooldridge, 2020):

$$Y_{it} = \beta_0 + \beta_1 X_{it1} + \ldots + + \beta_1 X_{itk} + a_i + \varepsilon_{it} \quad (1)$$

Where, we explicitly include an intercept so that we can make the assumption that the unobserved effect, ai, has zero mean (without loss of generality). We would usually allow for time dummies among the explanatory variables as well (Wooldridge, 2020). Equation (1) will refer to a **random-effects model** when the unobserved effect $a_i$ is uncorrelated with each independent variable:

$$\mathrm{Cov}(x_{it,}\ a_i) = 0 \qquad (3)$$

Nevertheless, a fixed-effects model is applicable when the unobserved effect $a_i$ is correlated with each independent variable:

$$\mathrm{Cov}(x_{it,}\ a_i) \neq 0 \qquad (4)$$

Moreover, if $a_i$ is correlated with each independent variable in all periods. Then, using a transformation to eliminate $a_i$ leads to efficient estimators. In other words, in using fixed effects, the goal is to eliminate the unobserved variable, $a_i$ , since the fixed effect model is assumed to be correlated with independent variables, whereas if $a_i$ is uncorrelated with each independent variable in all periods. Hence, adopting a transformation to eliminate $a_i$results in efficient estimators



### 3.3.2 Hausman test

To determine between fixed or random effects, a Hausman test where the null hypothesis indicates that the preferred model is the random effects. The alternative hypothesis indicates that the fixed effects model is preferred (see Green, 2008, chapter 9). This test examined whether the idiosyncratic errors ($u_i$) are correlated with the independent variables.

### 3.3.3 Endogeneity and multicollinearity issues

More importantly, the problem of endogeneity caused by reverse causality is taken into consideration in this paper. Applying estimated model with lagged independent variables, as shown in equations 5 to 12, we can solve endogeneity problem for this study (Leszczensky & Wolbring, 2019).

After having checked endogeneity, the researcher also verified the multicollinearity issue in order to ensure that there are no relationships among the independent variables which would impact the accuracy of the statistical analysis. The following table shows the results of the multicollinearity analysis. The results of the statistical analysis reveal that there are no independent variables thare are highly correlated with each other.

Table 3.1 multicollinearity analysis

| | YDR | ODR | LPRO | EMPLOY | WPOP | ALABOR | SCHOOL | DISEASE |
|---|---|---|---|---|---|---|---|---|
| YDR | 1 | | | | | | | |
| ODR | -0.6062 | 1 | | | | | | |
| LPRO | 0.0043 | -0.0858 | 1 | | | | | |
| EMPLOY | -0.0643 | 0.0145 | 0.2494 | 1 | | | | |
| WPOP | -0.5328 | -0.3492 | 0.0818 | 0.0569 | 1 | | | |
| ALABOR | -0.1703 | 0.2205 | 0.1651 | 0.2508 | -0.0367 | 1 | | |
| SCHOOL | -0.3405 | 0.2713 | 0.1521 | 0.0094 | 0.1246 | 0.0085 | 1 | |
| DISEASE | 0.0164 | -0.0378 | -0.0914 | -0.0416 | 0.022 | -0.0641 | 0.026 | 1 |

## **3.4** Empirical model

This study will employ STATA as the primary statistical instrument. The following estimated equation is the equation for this study.



Demographic dividend or DD model

This study employ independent variable derived from demographic dividend to examine the influence of the demgraphi9c change on economic development as proposed by David E. Bloom and Williamson (1998). According to David E. Bloom and Williamson (1998), the higher ratio of young as well as older-age dependents prevent working-age p population from being productive in the labor market. As a result the level of economic development would be low. Furthermore, the variable; namely labor productivity and employment level, from simple demographic dividend pioneered by A. Mason and Lee (2007) are included into the model. These independent variables are assumes to affect the Thailand's economic development: for instance, Thailand's GPP per capita.

DD model

$$Y_{it} = \beta_0 + \beta_1 YDR_{t-1} + \beta_2 ODR_{t-1} + \beta_3 LPRO_{t-1} + \beta_4 EMPLOY_{t-1} + a_i + \varepsilon_{it} \quad (5)$$

DD model with time trend

$$Y_{it} = \beta_0 + \beta_1 YDR_{t-1} + \beta_2 ODR_{t-1} + \beta_3 LPRO_{t-1} + \beta_4 EMPLOY_{t-1} + \beta_5 TIME + a_i + \varepsilon_{it} \quad (6)$$

The Solow-Swan model or SS model

The neoclassical growth model developed by Solow (1956) is the central idea for this model. Solow (1956) posited that economic development depends on two factors: the accumulation of capital stock and the level of labor supply within a particular country. This implies that a higher level of capital stock and level of labor supply would stimulate economic development at a specific period. Therefore, the higher share of working-age population to the total population tend to influence the economic development. However, the share of the active labor force become an interest since H. J. Chen and Miyazaki (2020) found that the higher share of working-age population is not as important factors stimulating economic development as share of active labor. Therefore, the share of the working-age population and the share of the active labor force will be tested for their effect on Thailand's economic dev elopement.



SS model

$$Y_{it} = \beta_0 + \beta_1 WPOP_{t-1} + \beta_2 ALABOR_{t-1} + a_i + \varepsilon_{it} \quad (7)$$

SS model with time trend

$$Y_{it} = \beta_0 + \beta_1 WPOP_{t-1} + \beta_2 ALABOR_{t-1} + \beta_3 TIME + a_i + \varepsilon_{it} \quad (8)$$

Human capital model or HC model

Concerning the quality of the labor force that effect the economic development, human capital model will also be tested for its effect on Thailand's economic development. World Bank (2017) referred human capital to knowledge, skills, and health. There are various studies pointed out that labor force's average year of schooling

play an imp[ortqant role on stimulating economic development (Benhabib & Spiegel, 1994; Castelló-Climent & Hidalgo-Cabrillana, 2012; Glaeser et al., 2004; Gylfason, 2001; Hanushek, 2013; Makkonen & Inkinen, 2013; Teerawichitchainan, Prachuabmoh, et al., 2019). Therefore, the average year of schooling among Thais will be test for its effect on Thailand's economic development. Furthermore, those who are healthy tend to be able to work more than those who are not. The growth rate of people with communicable diseases may have an impact on economic development. As a result, this variable is included in the model.

HC model

$$Y_{it} = \beta_0 + \beta_1 SCHOOL_{t-1} + \beta_2 DISEASE_{t-1} + a_i + \varepsilon_{it} \quad (9)$$

HC model with time trend

$$Y_{it} = \beta_0 + \beta_1 SCHOOL_{t-1} + \beta_2 DISEASE_{t-1} + \beta_3 TIME + a_i + \varepsilon_{it} \quad (10)$$

Overall model

The following equations (11 and 12), the lagged independent variable model, which examines the impacts of demographic dividend, the Solow-Swan Model, and the Human Capital model which examine the impacts of demographic change, labor supply, and quality of labor force on economic development.



Overall model

$$Y_{it} = \beta_0 + \beta_1 YDR_{t-1} + \beta_2 ODR_{t-1} + \beta_3 LPRO_{t-1} + \beta_4 EMPLOY_{t-1} + \beta_5 WPOP_{t-1} + \beta_6 ALABOR_{t-1} + \beta_7 SCHOOL_{t-1} + \beta_8 DISEASE_{t-1} + a_i + \varepsilon_{it} \quad (11)$$

Overall model with time tend

$$Y_{it} = \beta_0 + \beta_1 YDR_{t-1} + \beta_2 ODR_{t-1} + \beta_3 LPRO_{t-1} + \beta_4 EMPLOY_{t-1} + \beta_5 WPOP_{t-1} + \beta_6 ALABOR_{t-1} + \beta_7 SCHOOL_{t-1} + \beta_8 DISEASE_{t-1} + \beta_9 TIME + a_i + \varepsilon_{it} \quad (12)$$

Where,

$Y_{it}$ is the current year of the logarithm of the real gross provincial product per capita (GPP per capita);

$YDR_{t-1}$ is the previous year of the youth dependency ratio;
$ODR_{t-1}$ is the previous year of the old-age dependency ratio;
$LPRO_{t-1}$ is the previous year of labor productivity;
$WPOP_{t-1}$ is the previous year of the working-age population;
$EMPLOY_{t-1}$ is the previous year of employment level;
$ALABOR_{t-1}$ is the previous year of the share of the active labor force;
$SCHOOL_{t-1}$ is the previous year of the average years of schooling;
$DISEASE_{t-1}$ is the previous year of the growth rate of population with non-communicable disease.
TIME is the time trend.

Fixed effect or random effect with lagged dependent variable is introduced into the estimated model to provide robust estimates of the independent variables' effects to yield more accurate parameter estimates. Also, if the dependent variable is time series, it is most likely true that its present value depends on its past values (i.e., autocorrelated). Thus, it is logical to include lagged values of this dependent variable as explanatory variables, and this is the main idea of time series models.

Table 3.2 Estimated Testable Models

| **Dependent variable: Economic development** | **DD Model** | **SS Model** | **HC Model** | **Overall Model** |
|---|---|---|---|---|
| **Independent Variables:** | | | | |
| H1: Youth dependency ratio (YDR) | ✓ | | | ✓ |
| H2: Old-age dependency ratio (ODR) | ✓ | | | ✓ |
| H3: Labor productivity (LPRO) | ✓ | | | ✓ |
| H4:Employment level (EMPLOY) | ✓ | | | |
| H5: Share of the working-age population (WPOP) | | ✓ | | ✓ |

| **Dependent variable: Economic development** | **DD Model** | **SS Model** | **HC Model** | **Overall Model** |
|---|---|---|---|---|
| **Independent Variables:** | | | | |
| H6: Share of the active labor force (ALABOR) | | ✓ | | ✓ |
| H7: Average years of schooling (SCHOOL) | | | ✓ | ✓ |
| H8: The growth rate of population with non-communicable disease (DISEASE) | | | ✓ | ✓ |

**Source: Author**

Variable Description and Descriptive Statistics

Table 3.3 Variable Description

| **Variable** | **Description** |
|---|---|
| H1: Youth dependency ratio (YDR) | The youth dependency ratio is the ratio of the youth population (0-14 years old) compared to the number of working-age (15-59 years old). A high youth dependency ratio indicates that a greater investment needs to be made in schooling and other services for children (Weeks, 2021). |
| H2: Old-age dependency ratio (ODR) | The old-age dependency ratio is the ratio of the old-age population (60 years old and above) compared to the number of working-age (15-59 years old). The old-age dependency ratio is the ratio of the number of older people who are generally economically inactive compared to working-age people (Weeks, 2021). |
| H3: Labor productivity (LPRO) | The Gross Provincial Product (GPP) / total number of active workers (Mason & Lee, 2007). |

| Variable | Description |
|---|---|
| H4: Employment level (EMPLOY) | The total number of active workers / total population aged 15 – 59 (Mason & Lee, 2007). |
| H5: Share of the working-age population (WPOP) | The percentage of population aged between 15 -59 years old compared to the total population (Weeks, 2021). |
| H6:Share of the active labor force (ALABOR) | The labor force employed / total number of the labor force (Mason & Lee, 2007). |
| H7: Average year of schooling (SCHOOL) | The average number of years the population participated in formal education. |
| H8: The growth rate of population with non-communicable disease (DISEASE) | The growth rate of five non-communicable diseases occurring among the population of a given geographical area during a given year, per 1,000 mid-year total population of the given geographical area during the same year. |

Table 3.4 illustrates the expected direction of the relationships between independent variables and economic development as a dependent variable.

Table 3.4 Summary of Variables of Conceptual Framework of Testable Model

| Variable | Expected Sign |
|---|---|
| H1: Youth dependency ratio (YDR) | - |
| H2: Old-age dependency ratio (ODR) | - |
| H3: Labor productivity (LPRO) | + |
| H4: Employment level (EMPLOY) | + |
| H5: Share of the working-age population (WPOP) | + |
| H6: Share of the active labor force (ALABOR) | + |
| H7: The average year of schooling (SCHOOL) | + |
| H8: The growth rate of population with non-communicable disease (DISEASE) | - |

**Source: Author**

## **3.5** Data Collection and Research Statistical Methodology

### 3.5.1 Data and Data Collection

This study would be conducted employing panel data between 2007 – 2019 at the provincial level comprising 77 provinces across Thailand. The data comes from various governmental official sources. Table 3.4 illustrates the sources of data in this research. After the raw data from official governmental sources are obtained, the researcher would conduct a data cleaning procedure to ensure the data's accuracy before conducting statistical analysis.

Due to the unavailability of some of the data at the provincial level, the researcher would calculate some of the variables to obtain the provincial-level data. The data which research would calculate based on the data obtained from official governmental sources include 1) youth dependency ratio, 2) old-age dependency ratio, 3) labor productivity, 4) employment level 5) share of the working-age population, 6) share of the active labor force, and 7) growth rate of population with non-communicable disease. The rest of the variables would be employed as is.

Table 3.5 illustrates the data source for each variable in the research.



Table 3.5 Data sources

| **Variable** | **Data Sources** |
|---|---|
| H1: Youth dependency ratio (YDR) | The number of youth population and working-age population between 2007 – 2010 are from National Statistical Office (2015), The number of youth population and working-age population between 2011 – 2019 are from National Statistic Office (2021b) |
| H2: Old age dependency ratio (ODR) | The number of old-age population and working-age population between 2007 – 2010 are from National Statistical Office (2015), |

| Variable | Data Sources |
|---|---|
| | The number of old-age population and working-age population between 2001 – 2019 are from National Statistic Office (2021b) |
| H3: Labor productivity (LPRO) | Gross Provincial Product (GPP) between 2007-2019 are from Office of the National Economic and Social Development Council (2021) |
| | The total number of active workers between 2007-2016 are from National Statistic Office (2016) |
| | The total number of active workers between 2017-2019 are from (Labor Market Information Administration Division, 2020) |
| H4:Employment level (EMPLOY) | The total number of active workers between 2007-2016 are from National Statistic Office (2016) |
| | The total number of active workers between 2017-2019 are from (Labor Market Information Administration Division, 2020) |
| H5: Share of the working-age population (WPOP) | The number of the working-age population between 2007 – 2010 are from National Statistical Office (2015), |
| | The number of the working-age population between 2011 – 2019 are from National Statistic Office (2021b) |
| | The number of population in each cohort between 2007 – 2010 are from National Statistical Office (2015), |
| | The number of population in each cohort between 2001 – 2019 are from National Statistic Office (2021b) |

| Variable | Data Sources |
|---|---|
| H6: Share of the active labor force (ALABOR) | Office of the National Economic and Social Development Board (2021) |
| H7: Average years of schooling (SCHOOL) | Office of the National Economic and Social Development Board (2021) |
| H8: The growth rate of the population with non-communicable disease (DISEASE) | Division of Non Communicable Diseases (2016) and Division of Non Communicable Diseases (2019) |
| Gross provincial product (GPP) Per capita | Office of the National Economic and Social Development Council (2021) |

**Source: Author**

Table 3.6 Descriptive Statistic

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Gross provincial product (GPP) Per capita | 997 | 11.5726 | 0.6946 | 10.2747 | 13.8585 |
| Youth dependency ratio (YDR) | 920 | 28.5302 | 5.0406 | 18.5698 | 49.2833 |
| Old age dependency ratio (ODR) | 920 | 20.1690 | 4.4121 | 10.8495 | 35.7634 |
| Labor productivity (LPRO) | 874 | 258422.4000 | 284944.5000 | 32109.4500 | 2308822.0000 |
| Employment level (EMPLOY) | 874 | 0.8752 | 0.1669 | 0.5034 | 1.9493 |
| Share of the working-age | 920 | 0.6730 | 0.0187 | 0.6001 | 0.7177 |

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| population (WPOP) | | | | | |
| Share of the active labor force (ALABOR) | 874 | 0.9859 | 0.0098 | 0.9234 | 0.9995 |
| Average years of schooling (SCHOOL) | 919 | 10.4185 | 0.7809 | 7.1800 | 12.7311 |
| The growth rate of the population with non-communicable disease (DISEASE) | 920 | 0.0612 | 0.1025 | -0.8590 | 0.6273 |

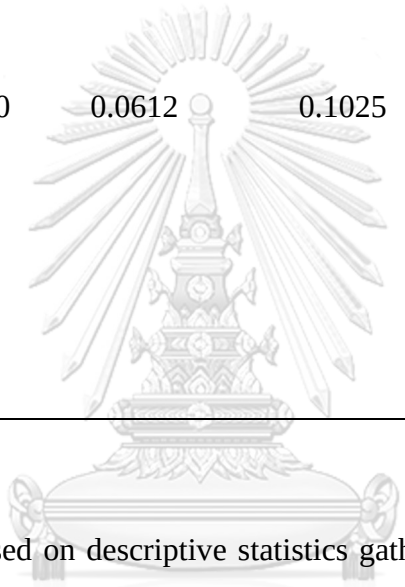


Table 3.6 is based on descriptive statistics gathered during the course of this research. Firstly, the maximum , minimum, and mean of real GPP per capita are 13.8585, 10.2747, and 11.5726 respectively. These numbers appear in logarithmic form which can be translated into the following maximum, minimum and mean of 1,043,911, 28,990.43 and 141,361.70 respectively. These numbers reflect the serious inequalities that exist in Thailand's economic development because the mean differs a great deal from the maximum rather than being in the middle between the two figures, it is close to the minimum average.



The youth dependency ratio has a mean of 28.5302, a minimum of 18.5698 and a maximum of 49.2833. The old age dependency ratio has a mean of 20.1690, a minimum of 10.8495 and a maximum of 35.7634.

Labor productivity has a mean of 258422.4000, a minimum of 32109.4500 and a maximum of 2308822.0000. For the value of productivity, the researcher decided to use the actual figure instead of using the logarithmic form because the researcher conducted tests on STATA and found that when using the logarithmic values, the results were not valid. Thus, the researcher opted for the as is figures. From these figures, it can be seen that the productivity of Thailand's labor force in some areas may still require further development. This is due to the fact that the maximum of productivity of one worker reaches a maximum of 2308822.0000. However, there is a ten-fold difference when comparing with the minimum figure for productivity.

The employment level has a mean of 0.8752 , a minimum of 0.5034 and a maximum of 1.9493. An employment level in excess of 1.9 was found in Samut Sakhon province between 2014 and 2019. There is a real need to use a high number of laborers given the importance of its fishery industry. Ths is the reason why this province's employment level is higher than normal. Regarding Thailand's employment level, its mean is equivalent to almost one, but this does not imply that there is no unemployment in the country. On the contrary, there may be some problems in certain large cities. The maximum figure shows that labor may be concentrated in specific areas of the country.

The Share of the working-age population has a mean of 0.6730, a minimum of 0.6001 and a maximum of 0.7177. The share of active labor force has a mean of 0.9859, a minimum of 0.9234 and a maximum of 0.9995.



Average years of schooling has a mean of 10.4185 , a minimum of 7.1800and a maximum of 12.7311. Finally, the growth rate of the population with non-communicable disease has a mean of 0.0612, a minimum of -0.8590, and a maximum of 0.6273. This rate is very low, with a negative figure, which point to the fact that the quality life of Thai people has improved with better access to healthcare and medical treatments.

In conclusion, there are eight estimate models which will be tested to determine if they have an effect on economic development. The first four models are the demographic

dividend model, the Solow-Swan Model, Human Capital model, and the empirical model or overall model. The remining four models are these models but controlled with time trend. The study applies fixed effects estimations since it is assumed that the unobserved effect of fixed effect which is fixed over time is correlated with explanatory variables in the estimated model. The application of lagged independent variables can help address the endogeneity issue which appeared in this study. In addition, all models can be used to help in the forecast of economic development so that it is more accurate.

# CHAPTER 4
# Research Findings

In this chapter, this research will describe the results of fixed effects estimates based on the provincial panel data between 2007 – 2019. The provincial data were collected from various official organizations, such as the National Statistical Office, the Labor Market Information Administration Division, and the Office of the National Economic and Social Development Council (see Table 3.4). The researcher tests the research's hypotheses by employing STATA version 14.2. The conceptual framework that summarizes the hypotheses in this research is provided in Figure 3.1 in Chapter 3. Hence, this chapter investigates the factors affecting Thailand's economic development derived from 1) the demographic dividend theory, 2) the Solow-Swan model, and 3) the human capital theory.

## 4.1 Empirical findings

Based on the conceptual framework in Figure 3.1, the empirical results obtained from the fixed effects model are given in Table 3.1. The empirical results are subject to eight models. For Table 4.1, the empirical results derived from the demographic dividend theory model are provided in columns 1 and 2. In addition, the empirical results derived from the Solow-Swan model are provided in columns 3 and 4. Furthermore, the empirical results based on the human capital theory are provided in columns 5 and 6. Finally, the overall model includes all factors given in columns 7 and 8.

Firstly, the empirical result in the first column are derived from the demographic dividend theory, which is without control for time trends, but the second column includes time trends. The third column is the empirical result for the Solow-Swan model without time trends, but the fourth column is for the Solow-Swan Model with control for time trends. In addition, the fifth column is the empirical result for the human capital

model without control for time trends, but the sixth column provides the control for time trends.

Finally, columns 7 and 8 are the empirical result of the overall model without and with control for time trends, respectively.

The statistical analyses were carried out to determine whether to use fixed effects model or random effects model. The researcher used these data in his analysis. The results of the Hausman test from STATA used to make a decision. The results of these statistical analyses are in the Table 4.1. Thus, models 1, 2, 3, 5, 7 and 8, the Hausamn test results were below 0.05; therefore, the research has decided to use the fixed effects model. At the same time, the Hausaman test results for models 4 and 6 are greater than 0.05; hence, the random effects model was selected to carry out a statistical analysis.

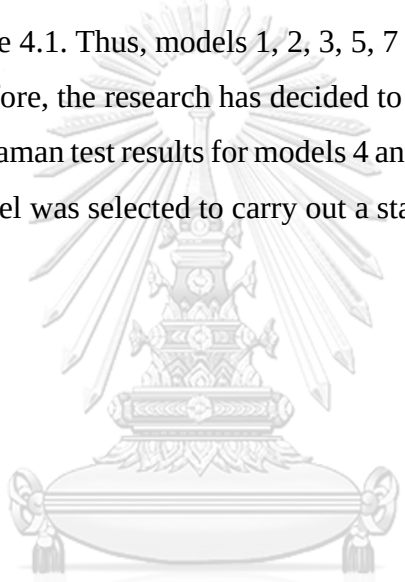


Table 4.1 Fixed Effects Estimates Based on variables derived from 1) demographic dividend theory, 2) The Solow-Swan Model, and 3) human capital theory on Thailand's economic development.

| | **DD (1)** | **DD with time trend (2)** | **SS (3)** | **SS with time trend (4)** | **HC (5)** | **HC with time trend (6)** | **Overall (7)** | **Overall with time trend (8)** |
|---|---|---|---|---|---|---|---|---|
| Constant | 12.541*** | 12.063*** | 12.667*** | 11.355*** | 10.558*** | 11.948*** | 10.959 | 15.778* |
| | (0.149) | (0.179) | (0.887) | (0.681) | (0.177) | (0.124) | (8.777) | (8.283) |
| Youth dependency ratio ($YDR_{t-1}$) | -0.055*** | -0.050*** | | | | | -0.054 | -0.073** |
| | (0.004) | (0.008) | | | | | (0.044) | (0.042) |
| Old age dependency ratio ($ODR_{t-1}$) | 0.018*** | 0.035*** | | | | | 0.016 | 0.008 |
| | (0.002) | (0.004) | | | | | (0.044) | (0.042) |
| Labor productivity ($LPRO_{t-1}$) | 5.73E-07*** | 4.58E-07*** | | | | | 5.47E-07*** | 4.62E-07*** |
| | (7.29E-08) | (7.29E-08) | | | | | (7.30E-08) | (7.27E-08) |
| Employment level ($EMPLOY_{t-1}$) | 0.122*** | 0.064* | | | | | 0.109*** | 0.070** |
| | (0.033) | (0.033) | | | | | (0.033) | (0.033) |
| Share of the active labor force ($ALABOR_{t-1}$) | | | -12.005*** | -2.301*** | | | -0.748 | -5.827 |
| | | | (0.617) | (0.649) | | | (9.856) | (9.283) |
| Share of active labor force ($ALABOR_{t-1}$) | | | 7.116*** | 1.993*** | | | 2.076*** | 1.532*** |
| | | | (0.767) | (0.547) | | | (0.525) | (0.518) |

| | DD (1) | DD with time trend (2) | SS (3) | SS with time trend (4) | HC (5) | HC with time trend (6) | Overall (7) | Overall with time trend (8) |
|---|---|---|---|---|---|---|---|---|
| Average years of schooling ($SCHOOL_{t-1}$) | | | | | 0.101*** | -0.013 | 0.010 | -0.009 |
| | | | | | (0.017) | (0.010) | (0.010) | (0.010) |
| The growth rate of the population with non-communicable disease ($DISEASE_{t-1}$) | | | | | -0.117** | -0.024 | -0.036 | -0.028 |
| | | | | | (0.061) | (0.041) | (0.033) | (0.037) |
| Year dummies (t) | | Y | | Y | | Y | | Y |
| R-squared | 0.7321 | 0.7715 | 0.3824 | 0.7444 | 0.0422 | 0.7242 | 0.7380 | 0.7488 |
| F-statistic | 541.84 | 175.97 | 246.10 | N.A. | 18.52 | N.A | 277.84 | 140.84 |
| Prob (F-statistic) | 0.0000 | 0.0000 | 0.0000 | N.A | 0.0000 | N.A | 0.0000 | 0.0000 |
| Hausman test (chi2) | 913.33 | 20043.39 | 61.64 | 4.19 | 15.65 | 2.91 | 190.75 | 498.64 |
| Prob>chi2 | 0.0000 | 0.0000 | 0.0000 | 0.9890 | 0.0004 | 0.9983 | 0.0000 | 0.0000 |
| No. of observations | 874 | 874 | 874 | 874 | 919 | 919 | 874 | 874 |
| No. of groups | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 |

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

**Source: Author**

### 4.1.1 Empirical result for demographic dividend model

The demographic dividend model includes four lagged independent variables which aim to resolve the endogeneity caused by reverse causality: the lagged youth dependency ratio ($YDR_{t-1}$), the lagged old-age dependency ratio ($ODR_{t-1}$), the lagged labor productivity ($LPRO_{t-1}$), and the lagged employment level ($EMPLOY_{t-1}$). In addition, economic development is the dependent variable, as measured by real GPP per capita.

According to the fixed effects estimates illustrated in column 1, Thailand's economic growth, as measured by the real GPP per capita, is influenced by 1) the lagged youth dependency ratio ($YDR_{t-1}$), the lagged old-age dependency ratio ($ODR_{t-1}$), the lagged labor productivity ($LPRO_{t-1}$), and the lagged employment level ($EMPLOY_{t-1}$).

For the first fixed effects model, the significant F-statistics for Models 1 and 2 indicate that at least one of the independent variables in the first and second models are statistically significant at the 1 percent level of significance. In other words, the overall model is statistically significant at the1 percent of significance. In addition, the R-squared ($R^2$) for Models 1 and 2 are 0.7321 and 0.7715, respectively, indicating that approximately 73.21 and 77.15 percent of the variability of Thailand's economic development are explained by the independent variables in these models.



The fixed effects estimates in Column 1 revealed four statistically significant factors at the 1 percent level of significance; the lagged youth dependency ratio ($YDR_{t-1}$), the lagged old-age dependency ratio ($ODR_{t-1}$), the lagged labor productivity ($LPRO_{t-1}$), and the lagged employment level ($EMPLOY_{t-1}$).

From Table 4.1, it is found that that youth dependency is likely to be negatively correlated with economic development, as measured by the real GPP per capita since they still rely on the work-aging population and they are not likely to participate in the labor market. As a result, they cannot contribute to the country's economic development. This result is consistent with the finding of Cai (2020), which suggested

that the reason for a larger share of the youth population is that it prevents the nation (where study conducted) from receiving a demographic dividend. This is because it is impossible to transform the youth population into economic contributors. Similarly, this result is consistent with David E. Bloom and Williamson (1998), which posits that the smaller share of dependency to the working-age population would allow the working-age population to be more productive, eventually resulting in a demographic dividend.

On the contrary, this study found that the old-age dependency ratio is significantly and positively associated with economic development. This result contradicts David E. Bloom and Williamson (1998)'s evidence which found that a larger share of dependents (youth and old-age) would prevent the nation (where study conducted) from experiencing a demographic dividend. However, the results of this study are consistent with the recent study of Teerawichitchainan, Prachuabmoh, et al. (2019), which asserts that the old-age population who hold higher levels of educational attainment tend to engage in the labor market for longer. In addition, elderly individuals who are part of the labor market can assist their families.

Therefore, this old-age population would not be dependent even though they are old. More importantly, this study contributes to the existing literature since the old-age population positively contributes to Thailand's economic development. In other words, the old-age population positively contributes to the third demographic dividend for Thailand.



In this study, the fixed effect estimates on the effects of labor productivity and employment level positively endorse the demographic dividend, as highlighted by A. Mason and Lee (2007), which propose that GDP capita is a function of income per effective producer, labor productivity and employment level.

Finally, this study confirms hypotheses 1, 3, and 4, but fails to confirm hypothesis 2, as summarized in Table 4.2.

Table 4.2 The demographic dividend model hypotheses testing results for Models 1 and 2 (columns 1 and 2)

| Variables | Fail to Reject $H_0$ $H_0: \beta_x = 0$ | Reject $H_0$ $H_1: \beta_x \neq 0$ |
|---|---|---|
| Hypothesis 1: Youth dependency affects Thailand's economic development. | | ✓ |
| Hypothesis 2: The old-age dependency affects Thailand's economic development. | | ✓ |
| Hypothesis 3: Labor productivity affects Thailand's economic development. | | ✓ |
| Hypothesis 4: Employment level affects economic development. | | ✓ |

**Source: Author**

### 4.1.2 Empirical result for the Solow-Swan Model

In this study, two independent variables are derived from the Solow-Swan model, such as 1) the lagged of the share of the working age population ($WPOP_{t-1}$) and 2) the lagged of the share of the active labor force ($ALABOR_{t-1}$). The share of the working age population is defined as the proportion of the population aged between 15 – 59 years old to the total population. In contrast, the share of the active labor force is defined as the proportion of those employed in a particular labor market to the total number of the labor force in that labor market. The working-age population examines those eligible for being in the labor force, but they may not be active in the labor market. When looking at the share of the active labor force, they are the active workers in the labor market.

According to the fixed effects estimates of Models 3 and random effects estimates of Model 4, it could predict the variation of GPP per capita based on 1) the lagged share

of the working-age population ($WPOP_{t-1}$) and 2) the lagged share of the active labor force ($ALABOR_{t-1}$). Overall, Models 3 and 4 are statistically significant at the 1 percent of significance due to the significant F-statistics, implying that at least one of the independent variables is statistically significant at the 1 percent level of significance.

Furthermore, Model 3 with time trends shows approximately 74.44 percent of the variability of Thailand's economic development is explained by the independent variables in this model. The fixed effects estimates for Models 3 and 4 revealed two statistically significant factors, which are 1) the lagged share of the working-age population ($WPOP_{t-1}$) and 2) the share of the active labor force ($ALABOR_{t-1}$). Thus, this study revealed that the working-age population and the active labor force play a significant role in promoting Thailand's economic development. This research finding concerning the impact of the share of the working-age population on economic development is in line with Solow (1956), who posited that the aggregate output is the function of the aggregate capital stock and labor. Moreover, this research findings on the impact of the share of the active labor force on economic development confirm the previous studies conducted by Ahmad and Khan's (2019) and A. Chen and Groenewold (2021). According to Ahmad and Khan's (2019) and A. Chen and Groenewold (2021), the share of the working-age population has less impact on economic development compared to the share of the active labor force. The result of the aforementioned impacts can be seen from the size of fixed effect estimates' coefficient among these two variables.



The result of the testing of the hypotheses are illustrated in the following table.

Table 4.3 The Solow-Swan Model hypotheses testing results for Models 3 and 4 (column 3 and 4)

| **Variables** | **Fail to Reject $H_0$ $H_0: \beta_x = 0$** | **Reject $H_0$ $H_1: \beta_x \neq 0$** |
|---|---|---|
| Hypothesis 5 The working-age population affects Thailand's economic development. | | ✓ |

| | |
|---|---|
| Hypothesis 6: The share of the active labor force affects Thaliana's economic development. | ✓ |

**Source: Author**

### 4.1.3 Empirical result for the human capital model

Based on the human capital model, this study introduces independent variables: average years of schooling and a population growth rate with non-communicable disease. More specifically, people equipped with higher education imply better knowledge and skills required for their job.

The lower growth rate of the population with non-communicable disease implies an improvement in its health condition; therefore, if the Thai population has a better health condition, they will likely participate in the labor market. As a result, the Thai economy would be developed by those with better knowledge and health conditions.

The fixed effects estimates illustrated in columns 5 and the random effects estimates illustrates in column 6 suggested a significant impact of the lagged average years of schooling and a growth rate of the population with non-communicable disease on economic development. Overall, Models 5 and 6 are statistically significant at the 1 percent level of significance due to the significance of F-statistics, as shown in Table 4.1. In addition, the fixed effects estimates found that average years of schooling significantly and positively affect Thailand's economic development. This study found that the Thai population with non-communicable disease is positively associated with economic development.



The result of this study confirms the results of various studies which suggested that more years of schooling lead to better economic development (Benhabib & Spiegel, 1994; Castelló-Climent & Hidalgo-Cabrillana, 2012; Glaeser et al., 2004; Gylfason, 2001; Hanushek, 2013; Makkonen & Inkinen, 2013; Teerawichitchainan, Prachuabmoh, et al., 2019). This is because people with higher years of schooling tend to have better knowledge to apply to their jobs.

A few studies examined the impact of a better health condition on economic development. The proxy extensively used in the previous studies is life expectancy. However, the data on life expectancy at the provincial level is unavailable in Thailand; therefore, this study decided to adopt non-communicable diseases. However, the result of this study is consistent with previous studies that applied life expectancy proxy, since a country with better health conditions is likely to have better economic development than a country with poorer health conditions.

Finally, this study confirms hypotheses 7 and 8, which are illustrated in the following table.

Table 4.4 The human capital model hypotheses testing results (column 5 and 6)

| **Variables** | **Fail to Reject $H_0$ $H_0: \beta_x = 0$** | **Reject $H_0$ $H_1: \beta_x \neq 0$** |
|---|---|---|
| Hypothesis 7: Average years of schooling affect Thailand's economic development. | | ✓ |
| Hypothesis 8: The growth rate of the population with non-communicable diseases to the total population affects Thailand's economic development. | | ✓ |



**Source: Author**

#### 4.1.4 Empirical result for the overall model for Models 7 and 8 (columns 7 and 8)

Model 7 includes all of the independent variables, except for Model 8, which introduces time trends. The independent variables include 1) the lagged youth dependency ratio ($YDR_{t-1}$), 2) the lagged old-age dependency ratio ($ODR_{t-1}$), 3) the lagged labor productivity ($LPRO_{t-1}$), 4) the lagged employment level ($EMPLOY_{t-1}$), 5) the lagged share of the working-age population ($WPOP_{t-1}$), 6) the lagged share of the active labor

force (ALABOR $_{t-1}$), 7) the lagged average years of schooling (SCHOOL $_{t-1}$), and 8) the growth rate of population with non-communicable disease (DISEASE).

According to the fixed effects estimates illustrated in columns 7 and 8, this study revealed that the labor productivity, the employment level, and the share of the active labor force are positively associated with economic development. However, the youth population is found to be negatively related to economic development. Other factors, such as the old-age dependency, the share of the working-age population, and the average years of schooling, are not statistically significant.

The results of the testing of the hypotheses are illustrated in the following table.

Table 4.5 The overall model: hypotheses testing results (columns 7 and 8)

| **Variables** | **Fail to Reject $H_0$** $H_0: \beta_x = 0$ | **Reject $H_0$** $H_1: \beta_x \neq 0$ |
|---|---|---|
| Hypothesis 1: Youth dependency affects Thailand's economic development. | | ✓ |
| Hypothesis 2: The old-age dependency affects Thailand's economic development. | ✓ | |
| Hypothesis 3: Labor productivity affects Thailand's economic development. | | ✓ |
| Hypothesis 4: Employment level affects economic development. | | ✓ |
| Hypothesis 5 The working-age population affects Thailand's economic development. | ✓ | |

| Variables | Fail to Reject $H_0$ $H_0: \beta_x = 0$ | Reject $H_0$ $H_1: \beta_x \neq 0$ |
|---|---|---|
| Hypothesis 6: The share of the active labor force affects Thaliana's economic development. | | ✓ |
| Hypothesis 7: Average years of schooling affect Thailand's economic development. | ✓ | |
| Hypothesis 8: The growth rate of the population with non-communicable diseases to the total population affects Thailand's economic development. | ✓ | |

**Source: Author**

In conclusion, when all variables in this study are combined into one model, it can be strongly confirmed that there are only three variables that will affect Thailand's economic development: Labor productivity, employment level, and share of active labor force. These variables have a statistical significance and strongly positive effect on Thailand's economic development. In addition, when the model is controlled by time trends, an additional variable is added which has a significant and strongly negative impact on Thailand's economic development. That variable is youth dependency ratio. As a result, model 7 and 8 will be use for further discussion for policy implication in the next chapter.

Regardless, when separating variables into three models: demographic dividend model, Solow-Swan Model, and Human Capital model, it can be weakly confirmed that 1) the demographic dividend model and youth dependency ratio are significant and have a negative effect on Thailand's economic development. At the same time, old age dependency ratio, labor productivity, and employment level have a significant and positive effect on Thailand's economic development. It does not matter whether or not these variables have been controlled by time trend. 2) Solow-swan model show that the

share of working age population and the share of active labor force are the same; they are significant and have a positive effect ton Thailand's economic development. 3) Human capital model show that the average year of schooling is significant and has a positive effect on Thailand's economic development while the growth rate of the population with non-communicable diseases to the total population is significant and has a negative effect on Thailand's economic development.

# CHAPTER 5
# Conclusion and Policy Implications

This chapter comprises of three sections: 1) the empirical results from the previous chapters, which will be summarized at the beginning of this chapter; 2) the policy implications and recommendations are also given to ensure the sustainability of Thailand's economic development; 3) policy implications and recommendations are pointed out at the end of this chapter.

## 5.1 The Effect of Thailand's Demographic Change on its Economic Development

The study confirms that old-age dependency positively affects economic development while youth dependency negatively affects economic development. In other words, the higher ratio of youth dependency seems to affect economic development adversely, but such a negative effect is not observed for the case of old-age dependency. This result is consistent with David E. Bloom and Williamson (1998)'s finding for a negative effect of youth dependent on economic development. As a result, this study shed light that only youth dependents can be an obstacle to the demographic dividend. The second point is that the rate of economic development in Thailand has grown but at a slower rate.



However, this finding is inconsistent with David E. Bloom and Williamson (1998), highlighting that the old-aged dependents are not likely to contribute to economic growth since they are not the source for the demographic dividend. Their dependency prevents the working-age population from contributing the demographic dividend. While the positive effects of labor productivity and employment level on economic development confirm the study of A. Mason and Lee (2007), these factors play an essential role in stimulating economic development since these variables have a positive effect on Thailand's real GPP per capita.

According to the empirical results, this study can conclude: First, youth dependents adversely affect economic development, as measured by real GPP per capita. This result is in line with all previous studies such as Navaneetham and Dharmalingam (2012)and Cai (2020). For instance, this finding is consistent with Lee and Mason (2006), who pointed out that youth are still too young to contribute to economic development. Thus, economic development tends to deteriorate if the country has a young population since they are not laborious.

Furthermore, in terms of the impact of the old-age dependency on economic development, the findings from this research are contrary to David E. Bloom and Williamson (1998) that highlighted that the higher level of youth and old-age dependents negatively impacts economic development. However, this study found that during 2007 – 2019, the increase in old-age dependency positively affected Thailand's economic development. The reverse finding may be caused by the changes in working patterns compared to the past. Some recent studies found that the elderly population continue to work after their retirement (Teerawichitchainan, Prachuabmoh, and Knodel, 2019). Empirical evidence which shows that changing work patterns following retirement appear in the report entitled *Thailand's Older Persons and Their Well-being.* The average percentage of older persons who have employment or desire to be employed between 1994 and 2017 was around 38 percent. However, upon closer inspection, it can be seen that there is an upward tendency among those between the ages of 60-64, 65-69 and 70-74 who were in employment and desired to be employed. Having employment or the desire to be employed will being to decline among those between the ages of 75-79 and 80+. Such empirical evidence demonstrate that Thailand's current elderly population play an increasingly significant role in contributing to Thailand's economy (Teerawichitchainan, Pothisiri, Knodel, & Prachuabmoh, 2019).

If considering dependency between the elderly population and working age population, it can be seen that there is a possibility that the elderly population being dependent on the working age population will decline. Empirical evidence from the aforementioned report also showed this to be true. In terms of financial independence, there is an

increasing tendency that the elderly population will rely on savings, old age allowance and/or pension along with income they earn from their own employment. On the contrary, they will depend less and less on their children (Teerawichitchainan, Pothisiri, et al., 2019). All of the data show the reasons to explain why the dependency ratio of Thailand has significant and positive effect to Thailand's economic development.

As a result, this elderly population does not rely economically on the working-age population.

Second, this study revealed that labor productivity and employment level have a positive effect on economic development. These findings are consistent with previous research that suggested that a large share of the working-age population does not lead to a demographic dividend by default; appropriate policies are required to increase labor force productivity (Ahmed et al., 2016; D. E. Bloom et al., 2017; Oosthuizen, 2015; Salvia, Robles, & Fachal, 2018; Ssewamala, 2015). Moreover, economic development relies on the employment level rather than the working-age population (Van Der Gaag & de Beer, 2015).

Although Thailand's economic development appears to be positive at the current moment, this study reveals that the rate of development has gradually and continuously declined over the past decades. As a result, the government has expressed concerns over this downward trend. If we consider this issue from the perspective of demographic change, particularly the crude birth rate, the declining growth is linked with Thailand's Total Fertility Rate which has also experienced a continuously downward trajectory. According to Office of the National Economic and Social Development Council (2019), Thailand's population will begin to decline in 2028 due to the low TFR. Therefore, the government must introduce an appropriate policy to cope with and address the demographic change issue that may adversely affect the nation's economic development.

Apart from quantitatively considering the labor force issue, the quality of the labor force is also a vital factor when it comes to economic development. It can be seen from the

labor productivity variable which has the most potent explanatory power (highest coefficient) among other variables. Thus, attempts to increase economic development in the country must also consider the quality of the workforce in the labor market, taking into account their skills and abilities to carry out various tasks.

Furthermore, this study found the labor productivity is the most potent factor due to the highest magnitude of its estimated coefficient. This result implies that Thailand should promote labor productivity in the labor market, considering workers' skills and abilities to carry out various tasks. Although labor productivity has a positive effect on Thailand's economic development, the descriptive statistics (a maximum of 2308822, a minimum of 32109, and a mean of 258422) clearly show that there are some issues with labor productivity in Thailand. It can be seen that the problems dealing with labor productivity in particular areas of Thailand when it comes to inequality in the country. In some areas there is a high level of labor productivity while in others there are few or non-existing. As a result, the impact of this trend is that economic development does not uniformly occur in all part of the country, but can only be found in certain parts of areas.

In conclusion, the data between 2017 and 2019 shows that all predictors for Thailand's economic development still point to positive trends. However, when controlling the time trends, it was found that the economic growth rate decreased continually. This finding is linked with the population trends. For instance, TRF declined rapidly, the old-age population overgrew, and the working-age population shrank. All of these indicators are implications of economic decline. Nevertheless, when it comes to labor quality, namely labor productivity, it is still a predictor which can best forecast economic development. Hence, if policymakers cannot control demographic changes, it is imperative that approaches to improve labor productivity be identified to protect the country from negative impacts in terms of its economic development.

## 5.2 The Effect of Thailand's Labor Supply on Its Economic development

This study adopted two independent variables into the estimated models: the share of the working-age population and the active labor force. The fixed effects estimate results showed that the share of the working-age population has a significant and negative effect on Thailand's economic development, as measured by real GPP per capita. In contrast, the share of the active labor force has a significant and positive effect on Thailand's economic development.

Solow (1956) proposed that aggregate income (Y) is a function of aggregate capital stock (K) and aggregate labor (L). This implies that a higher level of capital stock and level of labor supply would stimulate aggregate income at a specific period. However, when the economic development is measured by the GDP per capita (GPP per capita in this research), there is rapid growth in the labor supply while the aggregate income remains constant leading to a smaller GDP or GPP per capita.

In this study, the negative effect of the share of the working-age population on Thailand's economic development reverse the ideas of Solow (1956) and H. J. Chen and Miyazaki (2020). As aforementioned, Solow (1956) posited the rapid growth in the share of the working age population while the aggregate income remains constant consequence in smaller GDP or GPP per capita. In contrast, H. J. Chen and Miyazaki (2020) revealed that the relationship between the level of the labor force and economic development might not be linear when the labor supply consists of old workers. This is because the older individuals' work raises overall wages.

The research results show that a share of the active labor force has a significant and positive effect on Thailand's economic development. Fortunately, the active labor force in Thailand is at a high level. In other words, the ratio of the active labor force and that of the inactive labor force is almost 100 percent (max = 0.995, min = 0.92034, mean = 0.9859) of the total labor force in the country.

The reason for the share of working age population has a negative effect on Thailand's economic development may possibly be due to the age cohort that Thailand uses to calculate the number of working age population. At present, Thailand uses the standard used around the world: working age population consists of those who are between 15 and 59 years of age. However, in Thailand, free basic education covers 12 years. Thus, a portion of those between 15 and 20 years should be part of the working age population. However, the reality is that many of these individuals are studying and not working. For this reason, the impact is that the working age population has a negative effect on economic development. If we look at it from the perspective of active labor force, which is the actual labor force consisting of people working in the labor market, we can see that an increase of this group of people will lead to a positive effect on economic development. We can say clearly that it is more sensible to use the share of the active labor force to predict economic development rather than share of working age population.

## 5.3 The Effect of Thailand's Human Capital on its Economic Development

To investigate Thailand's human capital influence on economic development, this study adopted two independent variables into the estimated models: average year of schooling and the growth rate of the population with non-communicable disease.



Human capital is an idea proposed by Mankiw et al. (1992) based on an extension of findings presented by Solow (1956). The main idea is that the quantity of the labor force stimulates economic growth, but the quality of the labor force also plays an important role. According to the World Bank (2017), human capital development is an essential factor in improving the knowledge and health conditions of the labor force. Therefore, the average years of schooling of the labor force and the growth rate of the population with the non-communicable disease were included in the analysis.

The fixed effects estimate results showed that the average years of schooling have a significant and positive effect on Thailand's economic development (or real GPP per capita). In addition, the growth rate of the population with the non-communicable disease also has a significant and positive effect on Thailand's economic development.

The average years of education play a vital role in stimulating Thailand's economy. Human capital, as measured by the average years of schooling, helps develop the quality of the labor force—the higher level of average years of schooling influence economic development in various ways. Ketsawa (2019) suggested that a labor force equipped with a higher average year of schooling tends to have a better skill set for their work; thus, their income would rise accordingly. Teerawichitchainan, Prachuabmoh, et al. (2019) revealed that the elderly population who hold higher levels of educational attainment tend to engage in the labor market longer than those who have lower levels of educational attainment. In addition, elderly individuals who are part of the labor market can assist their families. Thus, human capital is likely to increase an individual's lifetime security.

In Thailand, the average years of schooling among the population have been significantly improving for many decades. According to the Office of the National Economic and Social Development Board (2021), the average years of schooling among Thais aged between 15 – 39 is around three years higher than those aged between 40 – 59 years old. For instance, Thais aged between 15 – 39 years old have 10.8 average years of schooling in 2019. In comparison, those aged between 40 – 59 years old have only 8.3 average years of schooling in 2019.



Considering the average years of schooling in the same age cohort, this study observes a slight change in their average year of schooling. For example, the average years of schooling of those aged between 15 – 39 years old increased from 10.5 years in 2009 to 10.8 years in 2019. In contrast, the average years of schooling of those aged between 40 – 59 years old increased from 7.3 years in 2009 to 8.3 years in 2019. These figures suggested that the younger labor force tends to have better human capital since they have higher levels of education. As a result, the younger generation would be able to stimulate Thailand's economy faster than those labor forces in an older age cohort.

In terms of the health conditions of the labor force that influence Thailand's economy, the research findings suggested that the growth rate of the population with the non-

communicable disease also has a significant and positive effect on the country's economic development. It implies that the poorer the people's health, the less they can contribute to society. In other words, people who are sick and unable to work will be less productive. As a result, they are likely to be unemployed, eventually not contributing to economic development via paying taxes. Thus, a healthy population is in a condition to carry out their professional tasks without any hindrances. Therefore, many governments are likely to invest their budget in healthcare and their citizens' mental and physical well-being.

## 5.4 Policy Implication and recommendations

### 5.4.1 Policy Implication and recommendations on labor productivity

The results of the study on labor productivity show that labor productivity has a positive effect on Thailand's economic development. Overall, there does not seem to be any issues for Thailand. The country should benefit from labor productivity and enjoy benefits from this. However, from the details and data collected, there are some concerns. Based on descriptive statistics, going back to 2007-2019, the 874 samples show that there are significant discrepancies among the maximum, minimum and mean. The maximum is 2,308,822.0000, the minimum is 32,109.4500 and the mean is 258,422.4000. The discrepancies point to significant inequality of the highest and lowest labor productivity. It may be implied that the figures for positive labor productivity because there are fewer people but with a high maximum. These people will contribute to the value of the labor productivity of those who are at the lower scale of labor productivity. Apart from equality, the figures point to a concentration of labor, one which is not distributed throughout the country. Finally, overall it may appear to be good; however, when examining such trends in a detailed manner, there may be some negative impacts.

To develop labor productivity, this may be achieved through training, lifelong learning and education among other means. Nevertheless, when looking at the average years of schooling of the Thai population, which can be divided into two age cohorts: 15-38 and 40-59, it can be seen that the latter has, on average, ten years of fewer years of schooling

than the former. Since we do not have labor productivity based on year of age, we do not know which group needs to be developed. If it is assumed that better average years of schooling would facilitate better labor productivity, then it can be assume that the labor productivity of the older group should be developed because they have fewer years of average schooling. This would equip them with more skills and knowledge so that they can enhance their own labor productivity.

### 5.4.2 Policy Implication and recommendations on dependency ratio

The research findings suggested that the reduction of youth dependency ratio would lead to a better economic development. However, the decrease in youth dependency ratio also implies the lower number of labor force who will enter into the labor market in the future. This will also negatively impact Thailand's economic development. Therefor the problem will become loops.

Firstly, the problem relating to low fertility which will lead to lower number of labor force entering to the labor market. A rapid decline in both fertility and mortality has largely impacted Thailand's population structure. Thailand's total fertility rate has dramatically declined from 6.14 children per woman in 1960 to below replacement level, 1.52 children per woman in 2000. Moreover, there are no signs that Thailand's total fertility rate will bounce back any time soon. In terms of Thailand's mortality rate, Thailand's crude death rate (per 1,000) declined from 13.18 per 1,000 in 1960 to 7.29 per 1,000 population in 1980. The crude death rate (per 1,000) continued to decline to the lowest crude death rate (per 1,000) in 1989, when the crude death rate (per 1,000) was 5.66 per 1,000 population. The crude death rate has slightly bounced back to around 7.00 per 1,000 population since that time.



There are various reason causing women to produce smaller size of the family. women's participation in the labor market is not a new phenomenon, there have been changes in the family institution. The trend has been away from male domination, accompanying female subordination, to one featuring more female domination (Soriano, 1991). In the past, most women had less participation in the labor market because they were responsible for domestic work and taking care of their children

(Scanzoni, 1975). The increase in the number of women participating in the labor market has shown a positive correlation with a decline in total fertility in many countries, such as in Canada, the United States of America, Australia, Japan, the United Kingdom, Germany, and many others (Brewster & Rindfuss, 2000; Goedele Van Den & Miet, 2015; Soriano, 1991). This is because the women in the labor market are more likely to postpone motherhood than those not in the labor market (Davia & Legazpe, 2014). After a certain period, these women prefer not to have children due to their old age. Hence, they would ultimately decide not to have offspring (Billingsley & Ferrarini, 2014; Fehr & Ujhelyiova, 2013).

To reduce the risk of having problem with economic development due to the labor supply as a result of decline in fertility, the government should promote labor force policy such as maternity leave policy, paternity leave policy, compensation policy, brestfeeding facility in the work place policy, and policy assuring women's career goals (Satayu Pattarakijkusol, 2019). These policies would ensure the life stability to those women who hesitate to have more children.

On the contrary, the labor force policy will generate a greater number of fertilities that will lead to the raise in youth dependency ratio which this finding reveal negative effects to Thailand's economic development. According to the Life cycle deficit theory, the reason why youth dependency has a negative effect on Thailand's economic development is because during childhood, children consume a great deal but lack income. Thus, these children are not able to contribute to the economy. Finally, if there youth dependency ratio is high, there would be a detrimental impact on the country's economic development.

To address this issue, the government should introduce policies to help alleviate the burden parents have when taking care of their children such as child subsidies, education subsidies or health subsidies especially for children. These measures would allow parents who are labor forces in the labor market will have to be less responsible financially to their children and be able to work without having to worry about their children. Doing so, the country's economic development would be enhanced.

Regardless, the study by S Pattarakijkusol and NaRanong (2020) found that the level of subsidies for each individual and groups of people differs. Groups of people include those who receive the following benefits: civil servant benefits, state enterprise benefits, or social security benefits. The fourth group are those who do not receive the three aforementioned benefits. Subsidies can be divied into four differen types: childbearing subsidies, child education assistance, child healthcare assistance and child subsidies (monetary allowance for children between the ages of 0 and 6). For this reason, universal subsidies would not help address this issue in a positive manner. The government should study thoroughly the exact level of subsidies appropriate for each group of people, for who, how much and how the subsidies should be provided.

In order to mitigate these adverse consequences on Thailand's economic development, There are simultaneously advantages and disadvantages to fertility decline. In the short run, fertility decline reduces the youth dependency ratio, which will cause the working-age population to engage more in the labor market since they will not have to spend time raising newborn children. This productivity will help increase the economic activities of the country. However, in the long-run, fertility decline may adversely impact economic development. This is because the decrease in the birthrate will affect the supply of new labor to be introduced to the labor market. With fewer children, there will be fewer adults working. As a result, this trend may yield a labor shortage. Alternatively, the country may have to depend on migrant workers from other countries, which will not help in the country's economic development. This is because foreign workers will send remittances back to their own countries.



Lastly, As for the issue of the increase in the ratio of the elderly population, studies have revealed that there are still positive impacts in the increase of the elderly population. In other words, Thailand still enjoys and is in the third demographic dividend. Moreover, the elderly population plays a role in influencing and enhancing the country's economic development.

However, there are still issues that are of concern. The rate of the increase in the elderly population is climbing rapidly. In addition, there is a tendency that this rate will

continue to increase more and more in the coming years. At the moment, the rate of the elderly population is good for the economy. However, from existing data, the optimal point can not be forecast – the point when the rate of the elderly population will no longer be positive for the economy. This is because the elderly will use and rely on the country's scarce healthcare resources and depend on the government for their care at nursing homes, etc. Thus, the government should introduce policies to support the elderly population, which will continue to grow, namely healthcare expenditures. Another consideration is the inclusion of the elderly population in employment after retirement. By doing so, the government can maintain this group of people in the labor market to still contribute to the country's productivity and not rely solely on the country's limited resources

The policy implication is that the government must pay more attention to the fertility policy because a good fertility policy will increase the birth rate, which will impact the country's future labor supply. This policy must strike a balance between the short- and the long-run. If there are too many births, this will increase dependency. On the contrary, without enough births, there would be a shortage of labor. Both situations are not ideal. Fertility policy should retain the female labor force in the labor market since most of the females who have children tend to withdraw themselves from the labor market, impacting the labor supply in the labor market.

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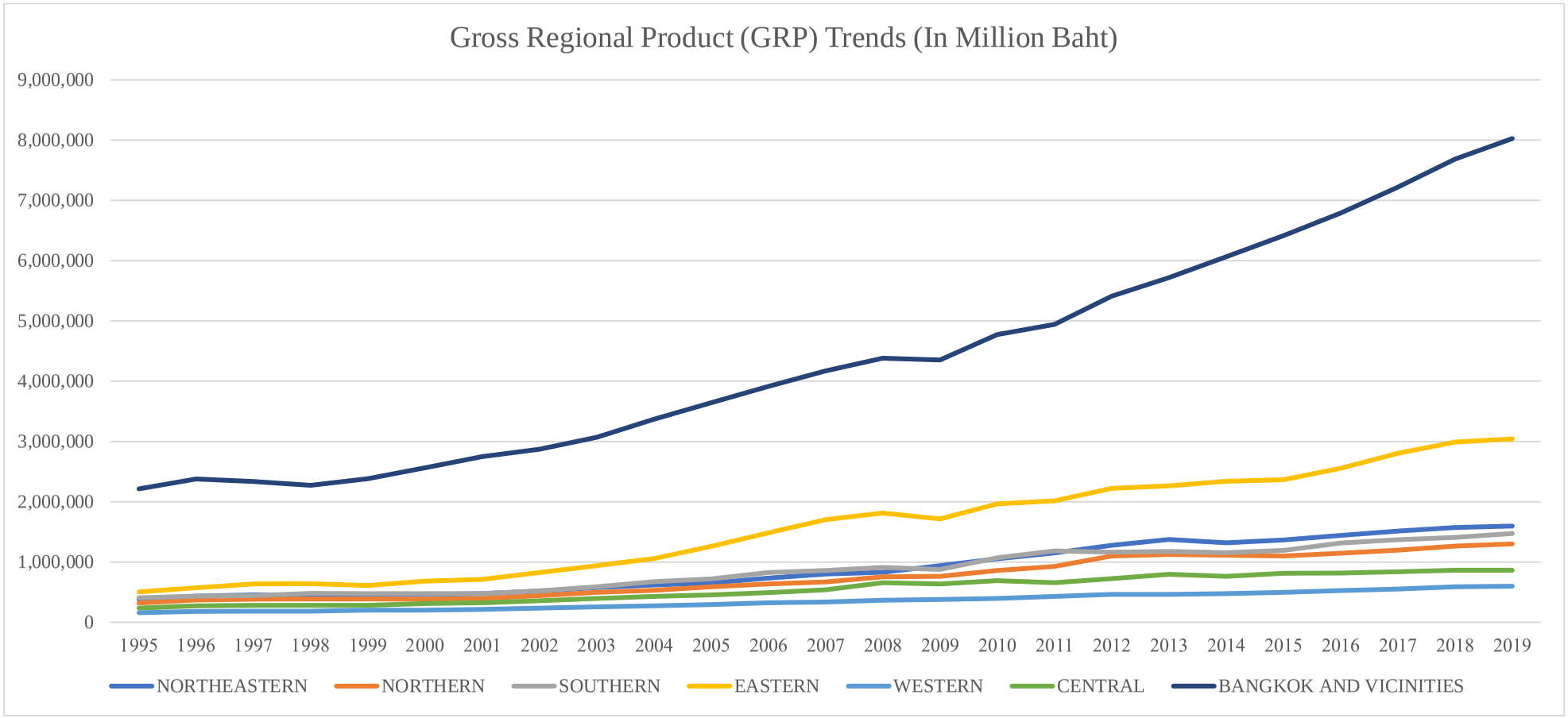
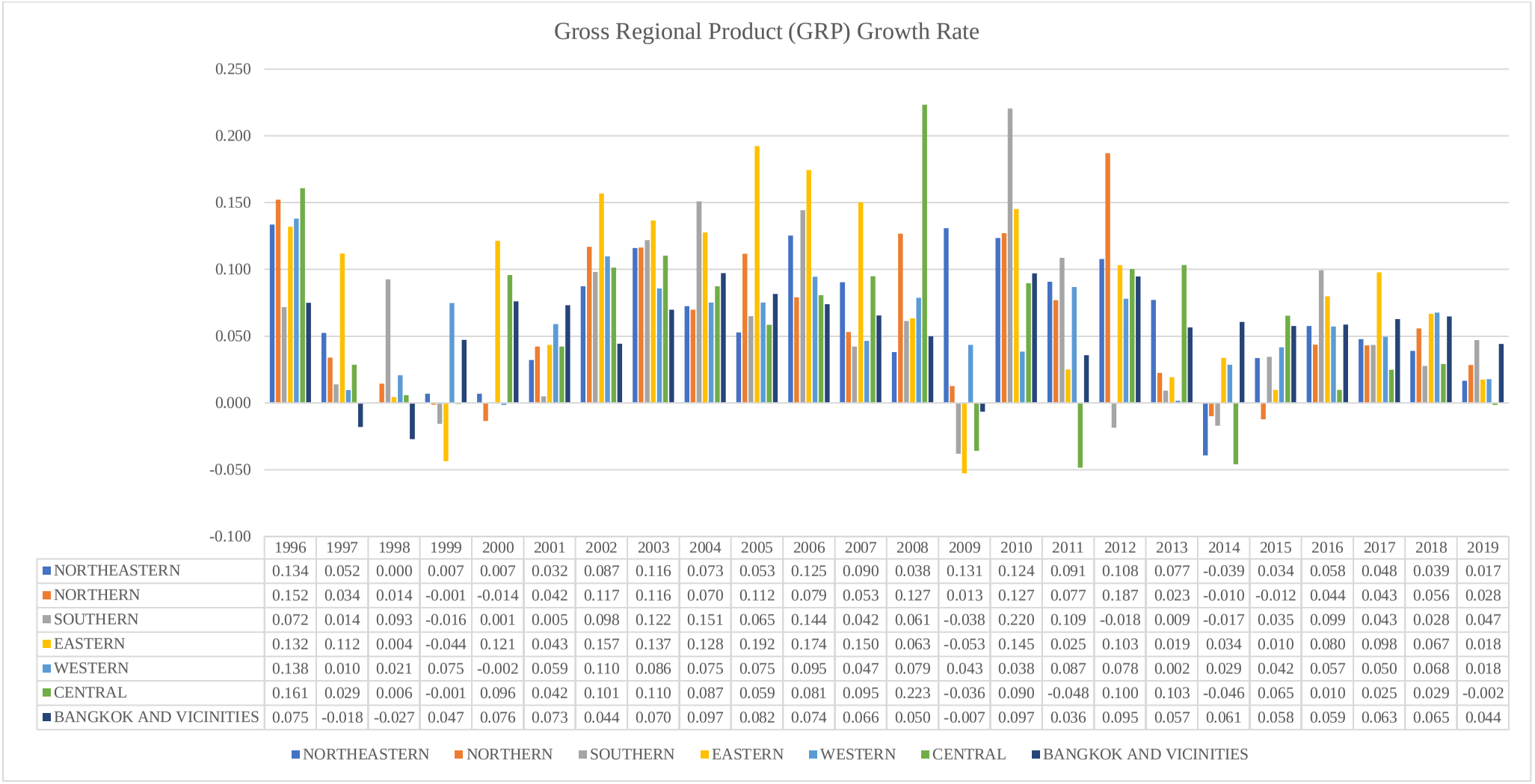
# Appendix A

## Economic Development and Population Data in Regional Level

Gross Regional Product (GRP) Trends

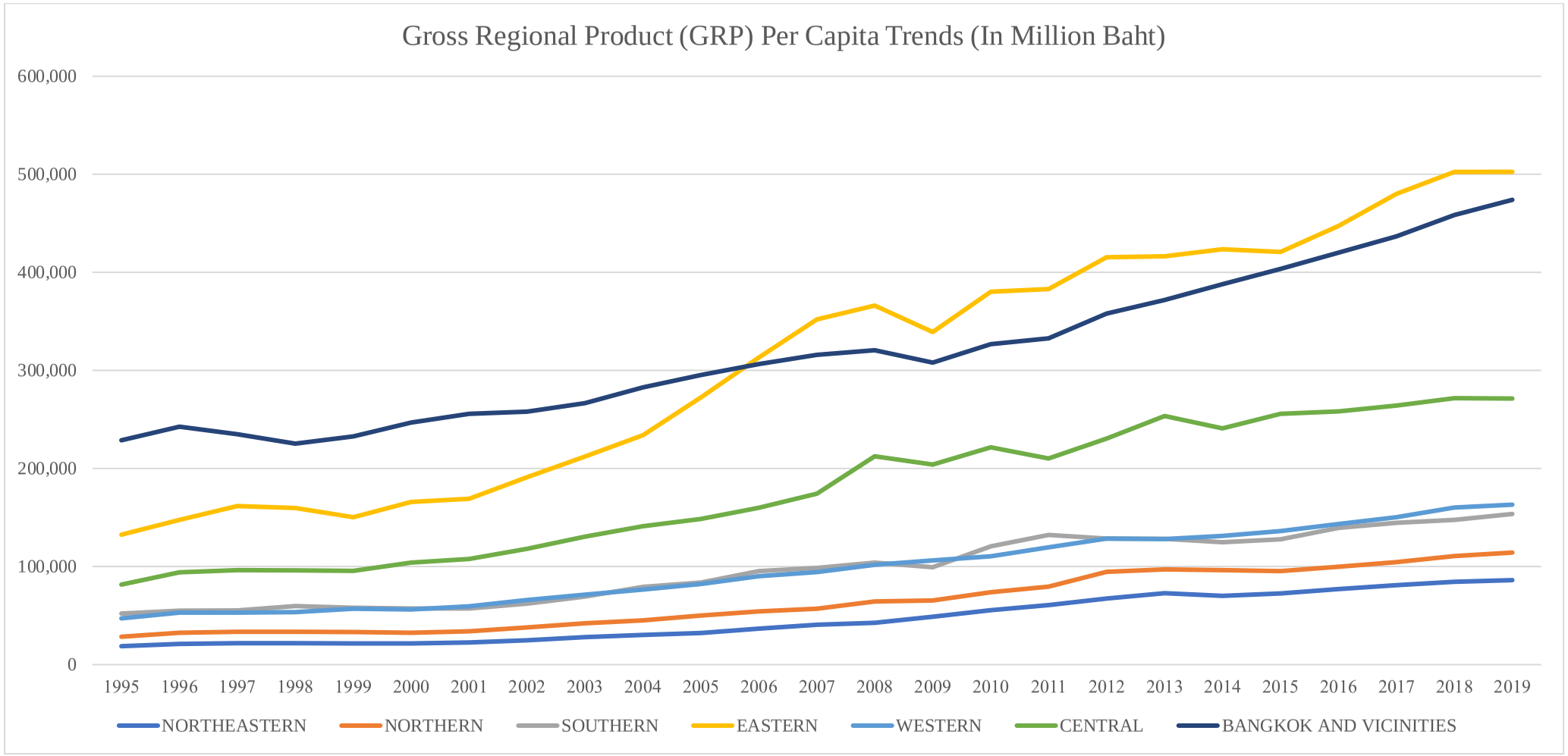


Gross Regional Product (GRP) Growth Rate

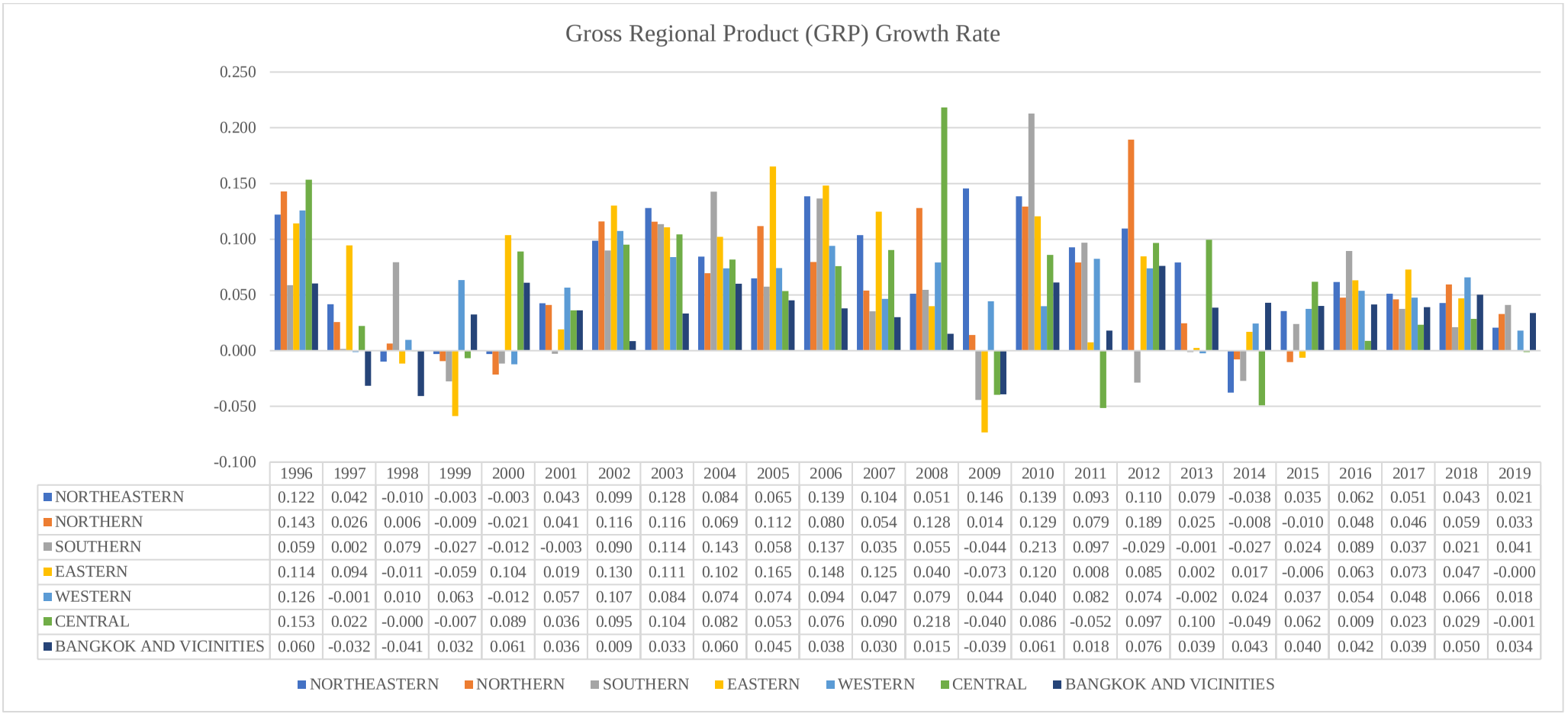



| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NORTHEASTERN | 0.134 | 0.052 | 0.000 | 0.007 | 0.007 | 0.032 | 0.087 | 0.116 | 0.073 | 0.053 | 0.125 | 0.090 | 0.038 | 0.131 | 0.124 | 0.091 | 0.108 | 0.077 | -0.039 | 0.034 | 0.058 | 0.048 | 0.039 | 0.017 |
| NORTHERN | 0.152 | 0.034 | 0.014 | -0.001 | -0.014 | 0.042 | 0.117 | 0.116 | 0.070 | 0.112 | 0.079 | 0.053 | 0.127 | 0.013 | 0.127 | 0.077 | 0.187 | 0.023 | -0.010 | -0.012 | 0.044 | 0.043 | 0.056 | 0.028 |
| SOUTHERN | 0.072 | 0.014 | 0.093 | -0.016 | 0.001 | 0.005 | 0.098 | 0.122 | 0.151 | 0.065 | 0.144 | 0.042 | 0.061 | -0.038 | 0.220 | 0.109 | -0.018 | 0.009 | -0.017 | 0.035 | 0.099 | 0.043 | 0.028 | 0.047 |
| EASTERN | 0.132 | 0.112 | 0.004 | -0.044 | 0.121 | 0.043 | 0.157 | 0.137 | 0.128 | 0.192 | 0.174 | 0.150 | 0.063 | -0.053 | 0.145 | 0.025 | 0.103 | 0.019 | 0.034 | 0.010 | 0.080 | 0.098 | 0.067 | 0.018 |
| WESTERN | 0.138 | 0.010 | 0.021 | 0.075 | -0.002 | 0.059 | 0.110 | 0.086 | 0.075 | 0.075 | 0.095 | 0.047 | 0.079 | 0.043 | 0.038 | 0.087 | 0.078 | 0.002 | 0.029 | 0.042 | 0.057 | 0.050 | 0.068 | 0.018 |
| CENTRAL | 0.161 | 0.029 | 0.006 | -0.001 | 0.096 | 0.042 | 0.101 | 0.110 | 0.087 | 0.059 | 0.081 | 0.095 | 0.223 | -0.036 | 0.090 | -0.048 | 0.100 | 0.103 | -0.046 | 0.065 | 0.010 | 0.025 | 0.029 | -0.002 |
| BANGKOK AND VICINITIES | 0.075 | -0.018 | -0.027 | 0.047 | 0.076 | 0.073 | 0.044 | 0.070 | 0.097 | 0.082 | 0.074 | 0.066 | 0.050 | -0.007 | 0.097 | 0.036 | 0.095 | 0.057 | 0.061 | 0.058 | 0.059 | 0.063 | 0.065 | 0.044 |

Gross Regional Product (GRP) Per Capita Trends

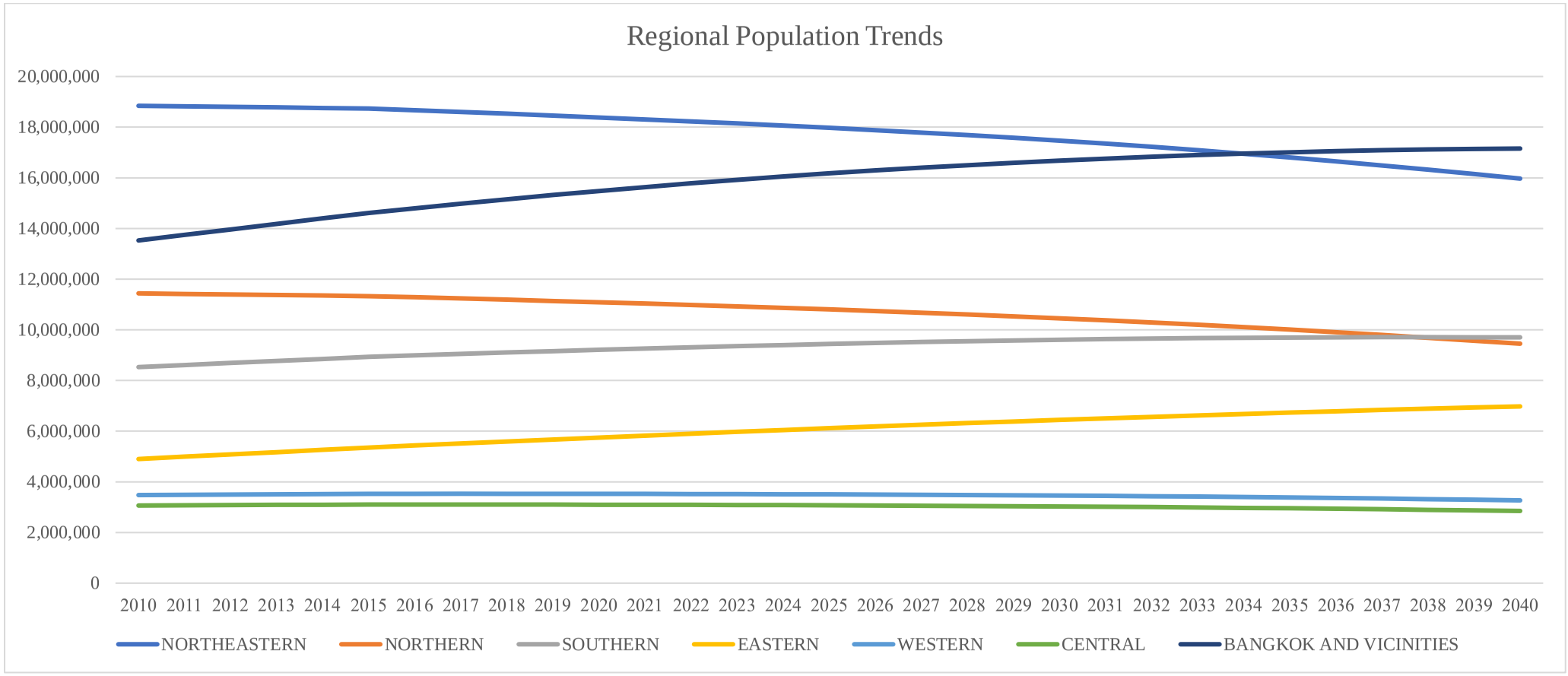


Gross Regional Product (GRP) Growth Rate

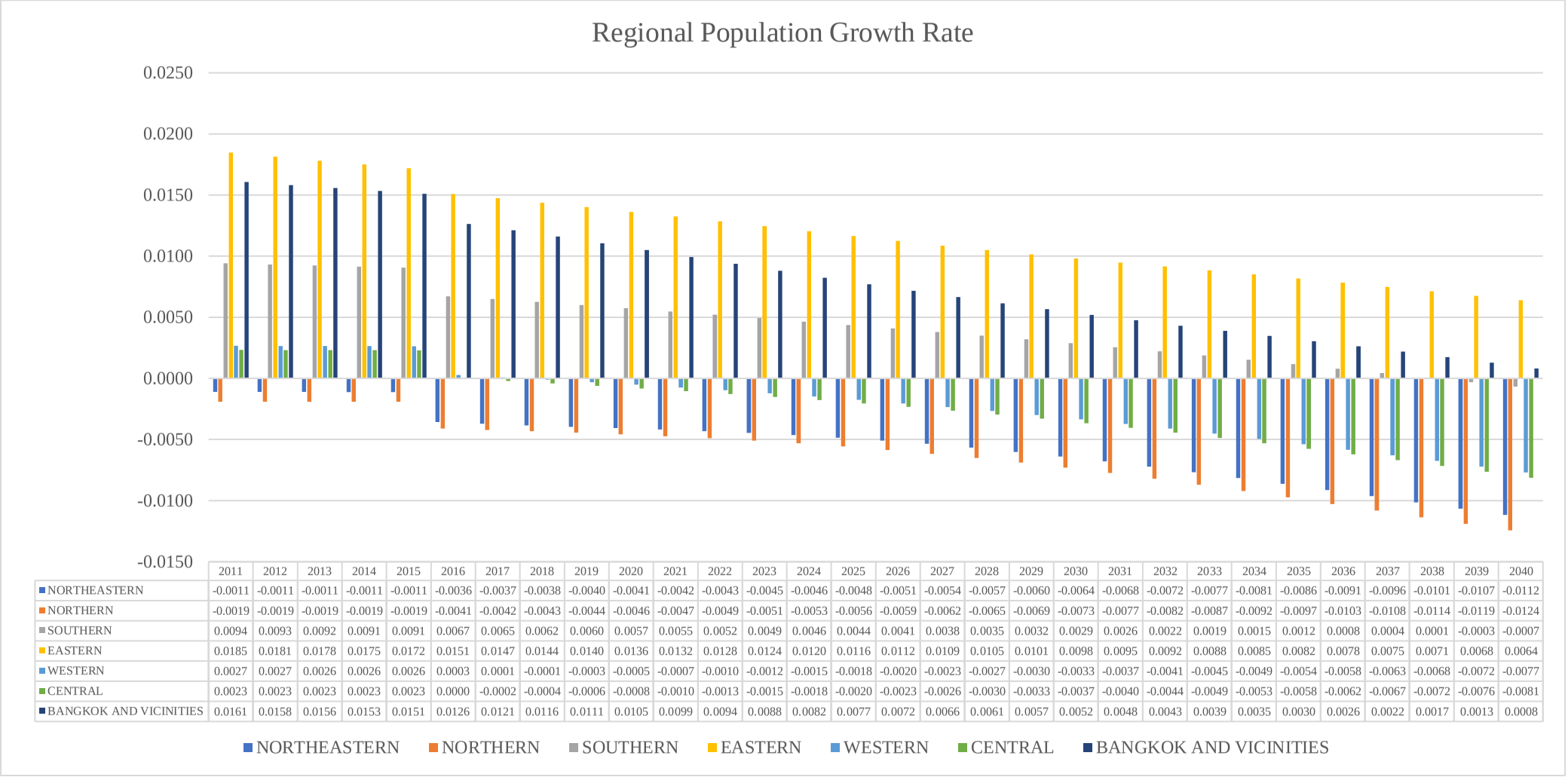



| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NORTHEASTERN | 0.122 | 0.042 | -0.010 | -0.003 | -0.003 | 0.043 | 0.099 | 0.128 | 0.084 | 0.065 | 0.139 | 0.104 | 0.051 | 0.146 | 0.139 | 0.093 | 0.110 | 0.079 | -0.038 | 0.035 | 0.062 | 0.051 | 0.043 | 0.021 |
| NORTHERN | 0.143 | 0.026 | 0.006 | -0.009 | -0.021 | 0.041 | 0.116 | 0.116 | 0.069 | 0.112 | 0.080 | 0.054 | 0.128 | 0.014 | 0.129 | 0.079 | 0.189 | 0.025 | -0.008 | -0.010 | 0.048 | 0.046 | 0.059 | 0.033 |
| SOUTHERN | 0.059 | 0.002 | 0.079 | -0.027 | -0.012 | -0.003 | 0.090 | 0.114 | 0.143 | 0.058 | 0.137 | 0.035 | 0.055 | -0.044 | 0.213 | 0.097 | -0.029 | -0.001 | -0.027 | 0.024 | 0.089 | 0.037 | 0.021 | 0.041 |
| EASTERN | 0.114 | 0.094 | -0.011 | -0.059 | 0.104 | 0.019 | 0.130 | 0.111 | 0.102 | 0.165 | 0.148 | 0.125 | 0.040 | -0.073 | 0.120 | 0.008 | 0.085 | 0.002 | 0.017 | -0.006 | 0.063 | 0.073 | 0.047 | -0.000 |
| WESTERN | 0.126 | -0.001 | 0.010 | 0.063 | -0.012 | 0.057 | 0.107 | 0.084 | 0.074 | 0.074 | 0.094 | 0.047 | 0.079 | 0.044 | 0.040 | 0.082 | 0.074 | -0.002 | 0.024 | 0.037 | 0.054 | 0.048 | 0.066 | 0.018 |
| CENTRAL | 0.153 | 0.022 | -0.000 | -0.007 | 0.089 | 0.036 | 0.095 | 0.104 | 0.082 | 0.053 | 0.076 | 0.090 | 0.218 | -0.040 | 0.086 | -0.052 | 0.097 | 0.100 | -0.049 | 0.062 | 0.009 | 0.023 | 0.029 | -0.001 |
| BANGKOK AND VICINITIES | 0.060 | -0.032 | -0.041 | 0.032 | 0.061 | 0.036 | 0.009 | 0.033 | 0.060 | 0.045 | 0.038 | 0.030 | 0.015 | -0.039 | 0.061 | 0.018 | 0.076 | 0.039 | 0.043 | 0.040 | 0.042 | 0.039 | 0.050 | 0.034 |

Regional Population Trends



Regional Population Growth Rate




| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NORTHEASTERN | -0.0011 | -0.0011 | -0.0011 | -0.0011 | -0.0011 | -0.0036 | -0.0037 | -0.0038 | -0.0040 | -0.0041 | -0.0042 | -0.0043 | -0.0045 | -0.0046 | -0.0048 | -0.0051 | -0.0054 | -0.0057 | -0.0060 | -0.0064 | -0.0068 | -0.0072 | -0.0077 | -0.0081 | -0.0086 | -0.0091 | -0.0096 | -0.0101 | -0.0107 | -0.0112 |
| NORTHERN | -0.0019 | -0.0019 | -0.0019 | -0.0019 | -0.0019 | -0.0041 | -0.0042 | -0.0043 | -0.0044 | -0.0046 | -0.0047 | -0.0049 | -0.0051 | -0.0053 | -0.0056 | -0.0059 | -0.0062 | -0.0065 | -0.0069 | -0.0073 | -0.0077 | -0.0082 | -0.0087 | -0.0092 | -0.0097 | -0.0103 | -0.0108 | -0.0114 | -0.0119 | -0.0124 |
| SOUTHERN | 0.0094 | 0.0093 | 0.0092 | 0.0091 | 0.0091 | 0.0067 | 0.0065 | 0.0062 | 0.0060 | 0.0057 | 0.0055 | 0.0052 | 0.0049 | 0.0046 | 0.0044 | 0.0041 | 0.0038 | 0.0035 | 0.0032 | 0.0029 | 0.0026 | 0.0022 | 0.0019 | 0.0015 | 0.0012 | 0.0008 | 0.0004 | 0.0001 | -0.0003 | -0.0007 |
| EASTERN | 0.0185 | 0.0181 | 0.0178 | 0.0175 | 0.0172 | 0.0151 | 0.0147 | 0.0144 | 0.0140 | 0.0136 | 0.0132 | 0.0128 | 0.0124 | 0.0120 | 0.0116 | 0.0112 | 0.0109 | 0.0105 | 0.0101 | 0.0098 | 0.0095 | 0.0092 | 0.0088 | 0.0085 | 0.0082 | 0.0078 | 0.0075 | 0.0071 | 0.0068 | 0.0064 |
| WESTERN | 0.0027 | 0.0027 | 0.0026 | 0.0026 | 0.0026 | 0.0003 | 0.0001 | -0.0001 | -0.0003 | -0.0005 | -0.0007 | -0.0010 | -0.0012 | -0.0015 | -0.0018 | -0.0020 | -0.0023 | -0.0027 | -0.0030 | -0.0033 | -0.0037 | -0.0041 | -0.0045 | -0.0049 | -0.0054 | -0.0058 | -0.0063 | -0.0068 | -0.0072 | -0.0077 |
| CENTRAL | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0000 | -0.0002 | -0.0004 | -0.0006 | -0.0008 | -0.0010 | -0.0013 | -0.0015 | -0.0018 | -0.0020 | -0.0023 | -0.0026 | -0.0030 | -0.0033 | -0.0037 | -0.0040 | -0.0044 | -0.0049 | -0.0053 | -0.0058 | -0.0062 | -0.0067 | -0.0072 | -0.0076 | -0.0081 |
| BANGKOK AND VICINITIES | 0.0161 | 0.0158 | 0.0156 | 0.0153 | 0.0151 | 0.0126 | 0.0121 | 0.0116 | 0.0111 | 0.0105 | 0.0099 | 0.0094 | 0.0088 | 0.0082 | 0.0077 | 0.0072 | 0.0066 | 0.0061 | 0.0057 | 0.0052 | 0.0048 | 0.0043 | 0.0039 | 0.0035 | 0.0030 | 0.0026 | 0.0022 | 0.0017 | 0.0013 | 0.0008 |

# VITA

| | |
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