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Causality among Savings, Income and Longevity: Empirical Evidence from Thailand

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Savings is very important to Thailand's economic opportunity in an ageing society since it is considered to be an intergenerational transfer to finance the older population's consumption after retirement. This study examines the causal relationship among savings, income and longevity in Thailand during 1960 – 2012 by employing Vector Autoregression Analysis and the Granger Causality Test. In this study, savings is measured by two indicators, real gross domestic savings per capita and gross domestic savings rate, whereas income and longevity are measured by real gross domestic product per capita and life expectancy at birth, respectively. The findings reveal that there is a unidirectional causality running from income and longevity to savings per capita in Thailand while there is a unidirectional causality running from only longevity to the savings rate of Thai people. Additionally, there is evidence of a bi-directional causality between income and longevity. However, there seems to be no causality running from savings per capita to either income or longevity and no causality between the savings rate and income.

Keywords: *savings, income, longevity, granger causality, Vector Autoregression*

Introduction

In an ageing society, the older population (60 years old and over)—who are considered to be dependent—grows faster than the working age population (15 – 59 years old), who are considered to be economic producers. This demographic change leads to an increasing proportion of older people and, in contrast, a decreasing proportion of the working age population. Based on the UN's World Population Prospect, Thailand's proportion of the working age population started to decline after 2010, when it reached its peak at 67.7 percent of the total population (United Nations, 2014). Additionally, Thailand's proportion of the working age population is expected to decrease to 66.8, 65.0 and 62.4 percent of the total population in 2015 2020 and 2025, respectively, whereas its proportion of the older population is expected to increase from 12.9 percent of the total population in 2010 to 15.8, 19.3 and 23.1 in 2015, 2020 and 2025, respectively (United Nations, 2014).

Such a demographic shift implies that Thailand's opportunity to capitalize on the first demographic dividend[2] is already depleted. Consequently, Thailand's economic opportunity

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[2]The first demographic dividend is an economic benefit from the increasing proportion of working age population and the decreasing dependent population, including young population (0 – 14 years old) and older population. It takes place when the nation's fertility is falling while mortality is already low, causing working age population to grow faster than dependent population in both groups (Lee & Mason, 2006).

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under an ageing society depends heavily on the economic contribution of the older population. That is, the older population should have sufficient wealth accumulation to finance their consumption after retirement so that they are not considered to be dependent. If Thailand's older population can have sufficient wealth accumulation and significant economic contributions through consumption and investment, Thailand will have a good opportunity for constant economic growth and an improving standard of living, despite the decreasing proportion of working age people. This opportunity to capitalize on the increasing proportion of the older population is considered as the second demographic dividend (Lee & Mason, 2006)

In order to have sufficient wealth accumulation to finance their consumption after retirement, it is very crucial for older people to prepare in advance economically. That is, they are expected to have significant savings during their working age since this savings will be the primary source of funds to support themselves after they retire. In other words, this savings is considered as an intergenerational transfer from the working age population to themselves as they age (Mason, Lee, An, Mun & Miller, 2006). Thus, Thailand is likely to have a better opportunity to achieve the second demographic dividend.

Based on several previous studies, income and longevity are considered as two major determinants of savings. In addition, these three factors are also found to determine one another. However, the causal relationships among these three factors are different among different countries, causing difficulty in utilizing findings from previous studies to formulate and implement appropriate policies to promote savings among Thai people. Consequently, this study aims to examine the causal relationship among savings, income and longevity of Thailand during 1960 – 2012, by employing Vector Autoregression Analysis (VAR) and the Granger Causality Test. Savings in this study is measured by two indicators, including real gross domestic savings per capita and the gross domestic savings rate, whereas income and longevity are measured by real gross domestic product per capita and life expectancy at birth, respectively.

The findings from this study will benefit policy formulation and implementation to capitalize on the greater income and longevity of Thai people by promoting savings among Thailand's working age population. With these policies, Thailand is hopefully expected to have a better opportunity to achieve the second demographic dividend and constant economic growth and development under an ageing society.

Literature Review

Based on the literature review, wealth accumulation as measured by domestic savings is found to be one of the vital determinants of economic growth and improvements in the standard of living (Guest & McDonald, 2001; Ciftcioglu, Karaaslan & Demir, 2004; Mohan, 2006; Aghion, Comin, Howitt & Tacu, 2009; Chansarn, 2010). Thanks to its importance to economic opportunity in countries which are encountering a decreasing proportion of the working age population and the increasing proportion of the older population, there have been several studies focusing on savings. These reveal that savings is determined by both economic and demographic factors (Kwack & Lee, 2005; Mason & Kinugasa, 2005; Kim & Lee, 2008). Nevertheless, many studies find that economic factors such as income and demographic factors such as longevity are also determined by savings (Singh, 2010), while many studies find that income and longevity are bi-directionally related and indirectly affect savings (Park

& Rhee, 2005). As a result, understanding of the causal relationship among savings, income and longevity is very necessary for the effective policy formulation and implementation to promote savings in the country.

According to the literature, there are several studies which focus on the causal relationship among income, savings and longevity. However, the results vary among different countries and among studies. For instance, Paxson (1996) investigated the effect of household earnings on savings in the United States, Great Britain, Taiwan and Thailand during 1976 – 1992 and found that earnings growth led only to a small increase in savings rates in these four countries. Based on Paxson (1996), people were unlikely to consume more as they earned greater income, at least in the short run, leading to greater savings. However, in long run, greater income was likely to lead to greater consumption, leading to only a small increase in savings. Additionally, Sinha and Sinha (1998) examined the causal relationship between GDP growth and savings in Mexico during 1960 – 1996; they found a positive causality running from GDP growth to both private savings and public savings but no causality running from savings to GDP growth.

Moreover, Kwack and Lee (2005) found that savings was positively affected by income growth in case of South Korea during 1975 – 2002. Singh (2010) examined the causality between gross domestic savings and income as measured by gross domestic product (GDP) in India during 1950 – 2002 and found the positively bi-directional causality between these two variables. Furthermore, Gu and Tam (2013), who investigated the causal relationship among GDP growth, savings and inequality in China during 1978 – 2006, found that GDP growth was positively affected by savings but savings had only a weak effect on GDP growth. Moreover, Ismail and Rashid (2013) also found that GDP per capita and GDP per capita growth positively determined household savings in Pakistan during 1975 - 2011.

There are also several studies focusing on the causal relationship between savings and longevity. For instance, Bloom, Canning and Graham (2003) found that the higher life expectancy lead to the higher savings at every age based on data from 69 countries during 1960 – 1997 while Park and Rhee (2005) also found that economic growth combined with dependency ratio and life expectancy at birth has the positive impact on savings in Korea during 1970 – 1999. Li, Zhang and Zhang (2007) found the positive causality running from life expectancy to savings based on data from 149 countries worldwide during 1963 - 2003. They also found the positive influence of GDP per capita on savings. Additionally, Kinugasa and Mason (2007) investigated the impact of life expectancy on savings in Sweden, the United Kingdom, the United States, Japan, Italy, Taiwan and India and found that life expectancy positively affected savings in these countries.

In addition, the causal relationship between longevity and income are also widely studied. Preston (1975) relied on the cross-country data in 1900s, 1930s and 1960s to examine the relationship between income as measured by GDP per capita and longevity as measured by life expectancy. He found that as GDP per capita increased, life expectancy tended to rise at a decreasing rate. Moreover, Breyer and Marcus (2010) found that earnings and household income have the positive effect on life expectancy in Germany during 1994 – 2005. Hansen (2012) utilized panel data from 119 countries for the 1940–1980 periods and analyzed the impact of life expectancy on GDP per capita. He found a U-shaped relationship between these two variables.

Chen, Clarke and Roy (2012) investigated the dynamic causal linkage between health as measured by the infant mortality rate and income as measured by GDP per capita based on data from 58 developing countries worldwide during 1960 – 2005. They found a negative bi-

directional relationship between these two variables in both medium and low income counties. This finding implies a positive bi-directional relationship between life expectancy at birth and GDP per capita, since the infant mortality rate and life expectancy are negatively related. In addition, Pop, Van Ingen and Van Oorschot (2013) analyzed a dataset covering 140 countries and 2,360 country-year observations between 1987 and 2008; they found that higher GDP per capita led to longer life expectancy, especially in developing countries.

A review of the literature finds that studies on the causal relationship among savings, income and longevity in Thailand are very limited. That is, previous studies in Thailand (Agrawal, 2001; Rasmidatta, 2011) focused only on the causal relationship between savings and income as measured by GDP and found a uni-directional causality from income to savings. However, they did not focus on the relationship among savings, income and health altogether. Moreover, the findings from different studies and different countries vary greatly. As a result, these findings can hardly be utilized by Thailand to formulate and implement appropriate public polices to promote savings in the country. Therefore, this study is believed to provide more insight about the causal relationship among savings, income and longevity in Thailand, leading to effective policy recommendations to promote savings in Thailand.

Research Methodology

This section is divided into two parts. The first part presents data and sources of data analyzed in this study whereas the latter part presents the econometric models employed in this study.

Data and sources

This study utilizes Thailand's economic and demographic data in annual format during 1960 – 2012, a total of 53 years, obtained from the World Bank's World Development Indicators. They include (1) gross domestic savings (current US dollars) (2) the gross domestic savings rate (percent) (3) gross domestic product (current US dollars) (4) life expectancy at birth (years) (5) total population and (6) consumer price index (base year 2005). Gross domestic savings and gross domestic product in current US dollars are thereafter transformed into real terms by employing the consumer price index.

Econometric models

As outlined above, this study measures savings by two indicators, real gross domestic savings per capita and gross domestic savings rate. Additionally, income is measured by real gross domestic product (GDP) per capita and longevity is measured by life expectancy at birth. Vector Autoregression (VAR) Analysis and the Granger Causality Test are employed to investigate the casual relationship among these three factors.

Vector Autoregression Analysis (VAR), developed by Sims (1980), is utilized to investigate the causal relationship among savings, income and longevity in Thailand. Based on Sims (1980), the VAR model is an n-variable, n-equation linear model in which each variable is explained by its own lags and lags of the other variables in the analysis. The primary objective of VAR is to capture the dynamic reactions of each variable. In other words, VAR Analysis aims to

examine whether or not the past values of each variable affect the current value of a particular variable and the other variables.

However, before VAR analysis can be performed, the unit root problem in all four variables mentioned above will be investigated by employing Augmented Dickey-Full (ADF) Test in attempt to test whether or not these variables are stationary. Although the stationarity of time series data is not required for VAR analysis, Sims (1980) suggested that it is required for the Granger Causality Test. Hence, the general form of the ADF Test (Said & Dickey, 1984) with constant term and trend can be expressed as the follows:

$$\Delta y_t = \alpha + \beta t + \theta y_{t-1} + \sum_{i=1}^{k} \gamma_k \Delta y_{t-i} + e_t \qquad (1)$$

The null hypothesis of the ADF Test is that the variable is non-stationary, implying integrated of order 1 while the alternative hypothesis is that the variable is stationary, implying integrated of order 0. If the variables are non-stationary, containing unit root, they will be first differenced to eliminate the unit root problem.

Thereafter, VAR analysis will be performed to examine the causal relationship among savings, income and longevity. The VAR model analyzed in this study can be expressed as the following.

$$\Delta SAVE1_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i \Delta SAVE1_{t-i} + \sum_{i=1}^{m} \beta_i \Delta GDP_{t-i} + \sum_{i=1}^{m} \gamma_i \Delta LIFE_{t-i} + \eta_1 CR + \mu_{1t} \qquad (2)$$

$$\Delta GDP_t = \lambda_0 + \sum_{i=1}^{m} \lambda_i \Delta SAVE1_{t-i} + \sum_{i=1}^{m} \delta_i \Delta GDP_{t-i} + \sum_{i=1}^{m} \omega_i \Delta LIFE_{t-i} + \eta_2 CR + \mu_{2t} \qquad (3)$$

$$\Delta LIFE_t = \phi_0 + \sum_{i=1}^{m} \phi_i \Delta SAVE1_{t-i} + \sum_{i=1}^{m} \varphi_i \Delta GDP_{t-i} + \sum_{i=1}^{m} \psi_i \Delta LIFE_{t-i} + \eta_3 CR + \mu_{3t} \qquad (4)$$

Where SAVE1 = savings as measured by real gross domestic savings per capita in natural logarithm, GDP = income as measured by real GDP per capita[3] in natural logarithm, and LIFE = longevity as measured by life expectancy at birth in natural logarithm. Moreover, Δ indicates first difference. CR is an exogenous variable in the VAR model to capture the impact of the economic crisis happening in 1997. That is, CR = 1 after 1997 and 0 in 1997 and before 1997.

Moreover, in order to check the validity of the study results, the VAR model presented above will be re-analyzed. However, SAVE1 (real gross domestic savings per capita) will be replaced by SAVE2, another indicator of savings, which is the gross domestic savings rate[4]. That is,

[3] The reason that GDP per capita is employed to measure income in this study rather GNP (gross national product) per capita or GNI (gross nation income) per capita is the availability of the data. That is, only data of GDP per capita are available for the entire study period, 1960 – 2012.

[4] Although savings per capita and the savings rate are both indicators of savings in this study, they do have different implications. That is, the savings per capita model examines change in the amount of savings induced by the increase in income whereas the savings rate model investigates change in savings per capita as percentage of GDP of capita induced by the increase in income. It is possible that people save more as they earn more income but the increase in savings is smaller than the increase in income, leading to the decrease in savings as a percentage of income.

$$\Delta SAVE2_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i \Delta SAVE2_{t-i} + \sum_{i=1}^{m} \beta_i \Delta GDP_{t-i} + \sum_{i=1}^{m} \gamma_i \Delta LIFE_{t-i} + \eta_1 CR + \mu_{1t} \quad (5)$$

$$\Delta GDP_t = \lambda_0 + \sum_{i=1}^{m} \lambda_i \Delta SAVE2_{t-i} + \sum_{i=1}^{m} \delta_i \Delta GDP_{t-i} + \sum_{i=1}^{m} \omega_i \Delta LIFE_{t-i} + \eta_2 CR + \mu_{2t} \quad (6)$$

$$\Delta LIFE_t = \phi_0 + \sum_{i=1}^{m} \phi_i \Delta SAVE2_{t-i} + \sum_{i=1}^{m} \varphi_i \Delta GDP_{t-i} + \sum_{i=1}^{m} \psi_i \Delta LIFE_{t-i} + \eta_3 CR + \mu_{3t} \quad (7)$$

Where SAVE2 =savings as measured by the gross domestic savings rate.

Furthermore, Akaike's Information Criterion (AIC), Hannan–Quinn Information Criterion (HQIC) and Schwarz's Baysian Information Criterion (SBIC) are employed to choose the optimal number of lags for VAR analysis in this study.

Thereafter, the Granger Causality Test will be performed to examine whether or not one variable Granger causes the other variables. In other words, the Granger Causality Test aims to test whether or not one variable can predict the other variables (Granger, 1969). To test whether x Granger causes y, the first step is running two regression equations as follows:

Unrestricted regression: $$\Delta y_t = \sum_{i=1}^{m} \alpha_i \Delta y_{t-i} + \sum_{i=1}^{m} \beta_i \Delta x_{t-i} + \mu_t \quad (8)$$

Restricted regression: $$\Delta y_t = \sum_{i=1}^{m} \alpha_i \Delta x_{t-i} + \mu_t \quad (9)$$

The second step is testing the null hypothesis that "x does not Granger cause y". In other words, the null hypothesis is $H_0 : \Sigma\beta_i = 0$, indicating that lagged x terms do not belong to the regression. Based on the concept of the Granger Causality Test and the VAR model presented above, Granger Causality in this study can be summarized as the follows:

- Income is said to Granger cause savings if the regression coefficients of the lagged ΔGDP are statistically different from zero as a group ($\Sigma\beta_i \neq 0$).
- Longevity is said to Granger cause savings if the regression coefficients of the lagged ΔLIFE are statistically different from zero as a group ($\Sigma\gamma_i \neq 0$).
- Savings is said to Granger cause income if the regression coefficients of the lagged ΔSAVE are statistically different from zero as a group ($\Sigma\lambda_i \neq 0$).
- Longevity is said to Granger cause income if the regression coefficients of the lagged ΔLIFE are statistically different from zero as a group ($\Sigma\omega_i \neq 0$).
- Savings is said to Granger cause longevity if the regression coefficients of the lagged ΔSAVE are statistically different from zero as a group ($\Sigma\phi_i \neq 0$).
- Income is said to Granger cause longevity if the regression coefficients of the lagged ΔGDP are statistically different from zero as a group ($\Sigma\varphi_i \neq 0$).

Empirical Results

Table 1 summarizes the situation regarding savings, income and longevity in Thailand during 1960 – 2012. The findings reveal the upward trend of savings as measured by real gross domestic savings per capita and income. That is, real gross domestic savings per capita in Thailand increased from 139.12 US dollars in 1960 to 1,601.21 US dollars in 1995. However, the economic crisis in 1997 caused an economic slump in Thailand, causing real gross domestic

savings per capita to decrease to 801.05 US dollars in 2000. Thereafter, Thailand's real gross domestic savings per capita gradually increased to 1,582.09 US dollars in 2012. Additionally, Thailand's real GDP per capita seems to have the same pattern as real gross domestic savings per capita. That is, it increased from 988.33 US dollars in 1960 to 4,529.25 US dollars in 1995, before the economic crisis caused it to sharply drop to 2,545.50 US dollars in 2000. Thereafter, Thailand's real GDP per capita gradually increased to 5,124.22 US dollars in 2012.

However, looking at savings as measured by the gross domestic savings rate, the findings reveal that it exhibited an upward trend only during 1960 – 1990. That is, the gross domestic savings rate in Thailand increased from 14.08 percent of GDP in 1960 to 33.84 percent in 1990. Thereafter, it remained moderately constant, ranging from 30.32 – 35.35 percent of GDP during 1995 – 2012. Moreover, the gross domestic savings rate was 30.87 percent of GDP in 2012, the lowest rate since 2005. Additionally, in terms of longevity, the findings reveal that Thailand's life expectancy at birth constantly increased from 55.2 years in 1960 to 74.2 years in 2012, implying increasing longevity of Thai people during the study period.

Table 1: Savings, income and longevity in Thailand during 1960 – 2012

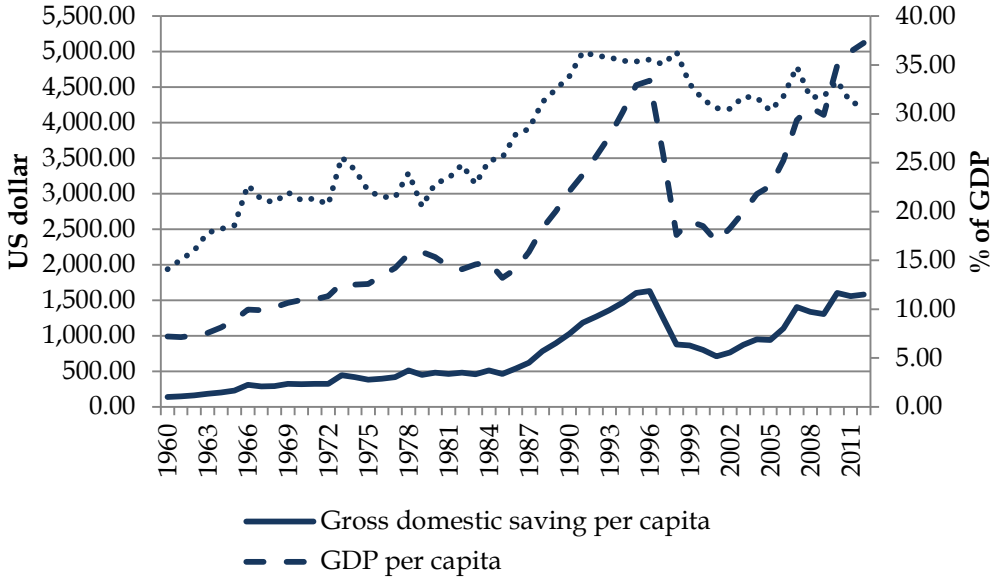
Year	SAVE1	SAVE2	GDP	LIFE	Year	SAVE1	SAVE2	GDP	LIFE
1960	139.12	14.08	988.33	55.24	**2005**	942.43	30.32	3,107.97	72.33
1965	226.72	18.57	1,221.11	57.52	**2006**	1,103.25	31.79	3,470.74	72.68
1970	318.43	21.17	1,504.39	59.53	**2007**	1,405.65	34.82	4,036.68	73.02
1975	382.17	22.12	1,727.45	61.86	**2008**	1,336.31	31.69	4,217.19	73.32
1980	482.73	22.89	2,109.28	64.18	**2009**	1,306.16	31.79	4,109.10	73.59
1985	463.57	25.52	1,816.73	67.85	**2010**	1,602.41	33.37	4,802.66	73.81
1990	1,025.85	33.84	3,031.91	70.41	**2011**	1,558.66	31.16	5,001.62	74.01
1995	1,601.21	35.35	4,529.25	70.53	**2012**	1,582.09	30.87	5,124.22	74.19
2000	801.05	31.47	2,545.50	70.92	**Mean**	744.10	27.14	2,520.74	66.26

Remarks: SAVE1 = real gross domestic savings per capita (US dollar), SAVE2 = gross domestic savings rate (% of GDP), GDP = real GDP per capita (US dollar) and LIFE = life expectancy at birth (years).

Source: Author calculation based on the data obtained from the World Bank World Development Indicators database.

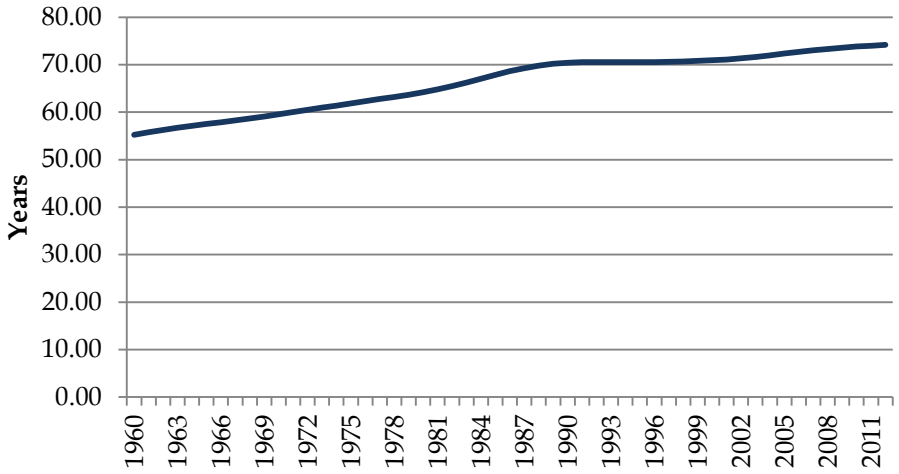
Figure 1 illustrates the consecutive adjustment of real gross domestic savings per capita, GDP per capita and the gross domestic savings rate in Thailand over the study period. It clearly presents the upward trend of real gross domestic savings per capita and real GDP per capita during 1960 – 2012. However, Thailand's real gross domestic savings per capita and real GDP per capita sharply decreased during 1997 – 1998 due to Thailand's economic crisis. Looking at the gross domestic savings rate, Figure 1 shows that it obviously exhibited an upward trend during 1960 – 1990 while exhibiting a downward trend during 1990 – 2012. These findings imply lower savings of Thai people compared to the increase in income during the later period. Moreover, based on Figure 2, life expectancy at birth of Thai people exhibited an upward trend during 1960 – 2012, indicating the better health and greater longevity of Thai people.

Figure 1: Trends of savings and income in Thailand during 1960 – 2012



Source: Author calculation based on the data obtained from the World Bank World Development Indicators database.

Figure 2: Life expectancy at birth (years) in Thailand during 1960 – 2012



Source: Author calculation based on the data obtained from the World Bank World Development Indicators database.

Table 2 presents the growth rate of real gross domestic savings per capita, real GDP per capita, the gross domestic savings rate and life expectancy at birth in Thailand during the study period. The findings reveal that the average growth rate of real gross domestic savings per capita equaled 4.68 percent per year during 1961 – 2012. However, looking at the period 2001 – 2012, the average growth rate of real gross domestic savings per capita equaled 5.67 percent per year, indicating an impressive growth of savings among Thai people. In addition, the average growth rates of savings per capita were negative during 1981 – 1985, 1996 – 2000, 2007 – 2009 and 2010 – 2011.

Table 2: Growth rates of savings, income and longevity in Thailand (percent per year)

Year	SAVE1	SAVE2	GDP	LIFE	Year	SAVE1	SAVE2	GDP	LIFE
1961-65	9.77	0.90	4.23	0.81	**2005-06**	15.76	1.46	11.04	0.49
1966-70	6.79	0.52	4.17	0.69	**2006-07**	24.22	3.03	15.11	0.46
1971-75	3.65	0.19	2.77	0.77	**2007-08**	-5.06	-3.13	4.37	0.42
1976-80	4.67	0.15	3.99	0.74	**2008-09**	-2.28	0.10	-2.60	0.36
1981-85	-0.81	0.53	-2.99	1.11	**2009-10**	20.44	1.58	15.60	0.31
1986-90	15.89	1.66	10.24	0.74	**2010-11**	-2.77	-2.20	4.06	0.26
1991-95	8.90	0.30	8.03	0.03	**2011-12**	1.49	-0.29	2.42	0.24
1996-00	-13.85	-0.78	-11.52	0.11	**1961-12**	4.68	0.32	3.16	0.57
2001-05	3.25	-0.23	3.99	0.39	**2001-12**	5.67	-0.05	5.83	0.38

Remarks: SAVE1 = real gross domestic savings per capita, SAVE2 = gross domestic savings rate, GDP = real GDP per capita and LIFE = life expectancy at birth.

Source: Author calculation based on the data obtained from the World Bank World Development Indicators database

In terms of income, the findings reveal that the average growth rate of real GDP per capita was 3.16 percent per year during 1961 – 2012, somewhat lower than the average growth rate of savings. However, during 2001 – 2012, the average growth rate of real GDP per capita was 5.83 percent per year which was greater than that of savings during the same period. Moreover, the average growth of real GDP per capita became negative in only three time periods, 1980 – 1985, 1996 – 2000 and 2008 – 2009. In addition, Table 2 reveals that the average growth of the gross domestic savings rate in Thailand during 1961 – 2012 equaled 0.32 percent per year. However, during 2001 – 2012, the average growth of the gross domestic savings rate became negative at -0.05 percent, indicating a downward trend in the savings rate of Thai people after 2000.

Looking at longevity, the average growth rate of life expectancy at birth was 0.57 percent per year during 1961 – 2012. Nevertheless, it seems that life expectancy at birth of Thai people grew slowly during 2001 – 2012 as the average growth rate of life expectancy during this period was only 0.38 percent per year. Additionally, the average growth rates of life expectancy were very high, higher than 0.7 percent per year during 1961 – 1990. Thereafter, they fell below 0.5 percent per year, ranging from 0.03 – 0.49 percent per year during 1991 – 2012.

The results from the Augmented Dickey-Fuller Test for the unit root problem are presented in Table 3. The table reveals that the time series of all four variables in this study, including real gross domestic savings per capita, the gross domestic savings rate, real GDP per capita and life expectancy at birth contain unit root, implying that these variables are non-stationary. As a result, all four variables are first differenced to eliminate the unit root problem. After first differencing these variables, there appears to be no statistically significant evidence of the unit root problem anymore.

Table 3: Results from Augmented Dickey-Fuller (ADF) Test for unit root

	Level	SAVE1	SAVE2	GDP	LIFE
ADF	**Intercept**	-1.640	-1.915	-1.144	-2.088
	Intercept & Trend	-2.321	-1.186	-2.649	-1.419
	First Difference	**ΔSAVE1**	**ΔSAVE2**	**ΔGDP**	**ΔLIFE**
ADF	**Intercept**	-5.923***	-5.412***	-4.505***	-4.704***
	Intercept & Trend	-5.954***	-5.685***	-4.460***	-7.703***

Figures in the table present the Augmented Dickey-Fuller Test statistics for unit root problem in each variable.

*, ** and *** indicate $p < 0.10$, $p < 0.05$ and $p < 0.01$, respectively.

SAVE1 = real gross domestic savings per capita, SAVE2 = gross domestic savings rate, GDP = real GDP per capita and LIFE = life expectancy at birth.

Δ indicates First Difference.

The results from the Vector Autoregression (VAR) Analysis with real gross domestic savings per capita as the indicator of savings are presented in Table 4. Looking at the savings model, the findings reveal that real gross domestic savings per capita are positively affected by one-year lagged and three-year lagged real GDP per capita. However, it is negatively determined by one-year lagged life expectancy at birth but positively determined by two-year lagged life expectancy at birth. Nevertheless, it seems that the positive effect of two-year lagged life expectancy at birth is far greater than the negative effect of one-year lagged life expectancy at birth, consequently life expectancy at birth is more likely to positively determine savings.

Table 4: Results from Vector Autoregression (VAR) Analysis with real gross domestic savings per capita as the indicator of savings

Model	**ΔSAVE1**		**ΔGDP**		**ΔLIFE**	
Variable	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
$\Delta SAVE1_{t-1}$	-0.7241***	0.2474	-0.2054	0.1883	-0.00033	0.00037
$\Delta SAVE1_{t-2}$	-0.4956*	0.2724	-0.1722	0.2073	-0.00075*	0.00041
$\Delta SAVE1_{t-3}$	-0.3455	0.2701	-0.2039	0.2056	-0.00013	0.00040
$\Delta SAVE1_{t-4}$	0.1263	0.2393	0.0153	0.1822	0.00001	0.00036
ΔGDP_{t-1}	1.0925***	0.3200	0.5886**	0.2435	0.00000	0.00048
ΔGDP_{t-2}	0.1931	0.3475	-0.2021	0.2645	0.00113**	0.00052
ΔGDP_{t-3}	0.6562*	0.3486	0.4372*	0.2653	-0.00076	0.00052
ΔGDP_{t-4}	-0.3141	0.3298	-0.2278	0.2510	0.00062	0.00049
$\Delta LIFE_{t-1}$	-172.1132*	90.8940	-130.0715*	69.1810	2.5928***	0.1358
$\Delta LIFE_{t-2}$	439.7815*	251.8949	366.2927*	191.7215	-2.2319***	0.3763
$\Delta LIFE_{t-3}$	-417.2347	271.2296	-392.4817*	206.4375	0.4799	0.4052
$\Delta LIFE_{t-4}$	171.4769	114.0450	171.5901**	86.8016	0.1706	0.1704
CR	0.0356	0.0644	0.0521	0.0490	0.0001	0.0001

*, ** and *** indicate $p < 0.10$, $p < 0.05$ and $p < 0.01$, respectively.

SAVE1 = real gross domestic savings per capita, GDP = real GDP per capita, LIFE = life expectancy at birth and CR = 1 after 1997

Δ-indicates-First Difference.

Based on Table 4, real gross domestic savings per capita does not have any influence on real GDP per capita. In addition, the findings reveal that real GDP per capita is negatively affected by one-year lagged and three-year lagged life expectancy at birth but positively affected by two-year lagged and four-year lagged life expectancy. However, based on the comparison of

the marginal effect of these four variables, the combined positive effect of two-year lagged and four-year lagged life expectancy is greater than the combined negative effect of one-year lagged and three-year lagged life expectancy, therefore real GDP per capita is more likely to be positively determined by life expectancy at birth.

Looking at the longevity model, the findings reveal that life expectancy at birth is negatively affected by two-year lagged real gross domestic savings per capita. Nevertheless, the effect is very weak. Moreover, the findings reveal that two-year lagged real GDP per capita has a positive influence on life expectancy at birth.

Table 5 presents the results from the VAR Analysis with the gross domestic savings rate as the indicator of savings. The findings reveal that neither real GDP per capita nor life expectancy at birth has a significant influence on the gross domestic savings rate. These findings imply that income and longevity have no effect on the savings rate of Thai people. Looking at the income model, the findings show that real GDP per capita is not statistically affected by the gross domestic savings rate. Nevertheless, it is significantly influenced by life expectancy at birth. That is, real GDP per capita is negatively determined by one-year lagged and three-year lagged life expectancy at birth but positively determined by two-year lagged and four-year lagged life expectancy, causing ambiguity of the impact of life expectancy on real GDP per capita.

Table 5: Results from Vector Autoregression (VAR) Analysis with gross domestic savings rate as the indicator of savings

Model	**ΔSAVE2**		**ΔGDP**		**ΔLIFE**	
Variable	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
$\Delta SAVE2_{t-1}$	-0.5305***	0.1452	-0.0097	0.0078	-0.00002	0.00002
$\Delta SAVE2_{t-2}$	-0.4262***	0.1628	-0.0087	0.0088	-0.00004**	0.00002
$\Delta SAVE2_{t-3}$	-0.2406	0.1608	-0.0091	0.0087	-0.00002	0.00002
$\Delta SAVE2_{t-4}$	0.0596	0.1443	0.0007	0.0078	-0.00001	0.00002
ΔGDP_{t-1}	-0.8996	2.5660	0.3773***	0.1386	-0.00036	0.00027
ΔGDP_{t-2}	2.5708	2.6987	-0.3674**	0.1458	0.00037	0.00029
ΔGDP_{t-3}	2.7489	2.7900	0.2391	0.1507	-0.00088***	0.00030
ΔGDP_{t-4}	1.3149	2.7422	-0.1899	0.1481	0.00072**	0.00029
$\Delta LIFE_{t-1}$	-1677.565	1267.991	-129.920*	68.489	2.5803***	0.1341
$\Delta LIFE_{t-2}$	3198.316	3508.599	358.655*	189.513	-2.2222***	0.3710
$\Delta LIFE_{t-3}$	-1762.530	3780.923	-380.497*	204.222	0.4774	0.3998
$\Delta LIFE_{t-4}$	449.643	1590.454	167.290*	85.906	0.1780	0.1682
CR	-0.3578	0.9055	0.0509	0.0489	0.0001	0.0001

*, ** and *** indicate $p < 0.10$, $p < 0.05$ and $p < 0.01$, respectively.

SAVE2 = gross domestic savings rate, GDP = real GDP per capita, LIFE = life expectancy at birth and CR = 1 after 1997

Δ-indicates-First Difference.

However, by comparing the marginal effect of all four variables, life expectancy at birth is more likely to have a positive influence on real GDP per capita since the combined positive effect of two-year lagged and four-year lagged life expectancy is greater than the combined negative effect of one-year lagged and three-year lagged life expectancy. Looking at the longevity model, the findings suggest that life expectancy at birth is negatively affected by two-year lagged real gross domestic savings per capita, but the effect is very weak. Moreover, life expectancy at birth is also significantly affected by real GDP per capita. That is, it is

negatively determined by three-year lagged real GDP per capita but positively determined by four-year lagged real GDP per capita.

Table 6 presents the results from the Granger Causality Test. In the case that savings is measured by real gross domestic savings per capita, the findings reveal that

1. There is a unidirectional causality running from real GDP per capita to real gross domestic savings per capita. Therefore, real GDP per capita Granger causes real gross domestic savings per capita.

2. There is a unidirectional causality running from life expectancy at birth to real gross domestic savings per capita. Therefore, life expectancy at birth Granger causes real gross domestic savings per capita.

3. There is a bi-directional causality between real GDP per capita and life expectancy at birth. Therefore, real GDP per capita Granger causes life expectancy at birth and life expectancy at birth Granger causes real GDP per capita.

However, as savings is measured by the gross domestic savings rate, the findings reveal that:

1. There is no causality between the gross domestic savings rate and real GDP per capita.

2. There is a unidirectional causality running from life expectancy at birth to the gross domestic savings rate. Therefore, life expectancy at birth Granger causes the gross domestic savings rate.

3. There is a bi-directional causality between real GDP per capita and life expectancy at birth. Therefore, real GDP per capita Granger causes life expectancy at birth and life expectancy at birth Granger causes real GDP per capita.

Table 6: Results from Granger Causality Test

	Independent Variable				**Independent Variable**		
	ΔSAVE1	**ΔGDP**	**ΔLIFE**		**ΔSAVE2**	**ΔGDP**	**ΔLIFE**
ΔSAVE1	-	14.518***	15.113***	**ΔSAVE2**	-	3.654	10.055***
ΔGDP	2.121	-	10.344**	**ΔGDP**	2.627	-	10.584**
ΔLIFE	4.028	8.399*	-	**ΔLIFE**	4.851	11.278**	-

Figures in the table present F-statistics from Granger Causality Test. The null hypothesis is that there is no Granger Causality between endogenous variables.

*, ** and *** indicate $p < 0.10$, $p < 0.05$ and $p < 0.01$, respectively.

Based on the findings from VAR analysis and the Granger Causality test, it is noticeable that the results from two VAR models (the real gross domestic savings per capita model and the gross domestic savings rate model) are slightly different. That is, real GDP per capita clearly has a positive influence on real gross domestic savings per capita but no effect on the gross domestic savings rate. These findings imply that as GDP increases, people are likely to save more, but in the same proportion as the increase in GDP, causing the savings rate (as a percentage of GDP) to remain unchanged. Despite such differences, the causal relationship among savings, income and health in this study is considered valid thanks to the consistent causal relationships between the other variables.

Discussion

Based on the empirical results described in the previous section, there is reason to state that income has a positive influence on the amount of savings in Thailand. That is, the increase in income per capita in the current year, implying the greater ability to save, will lead to an increase in savings per capita in the next year. Nevertheless, income per capita does not seem to have a significant impact on the savings rate of Thai people. This finding can be explained by Paxson's (1996) study, which suggested that in the long run, greater income was likely to lead to greater consumption, leading to only a small increase in the savings rate.

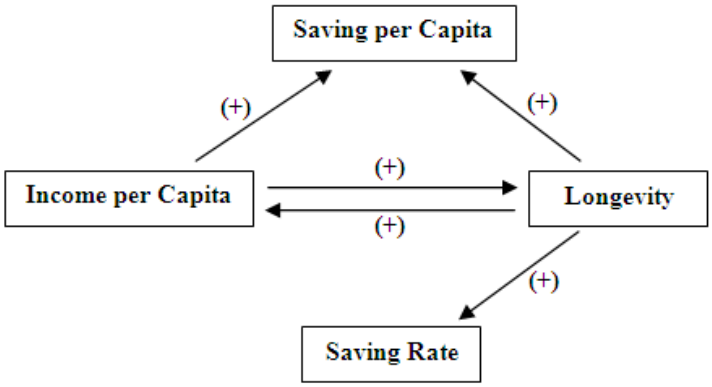
On the contrary, the increase in savings per capita will not affect income per capita in Thailand. These findings are somewhat surprising since savings is the source of investment spending and capital accumulation which leads to the economic growth. However, the finding complies with the studies by Sinha and Sinha (1998) Kwack and Lee (2005) and Ismail and Rashid (2013), implying that savings in the country has not been efficiently capitalized. For example, savings is the source of funds for portfolio investment and financial speculation rather than for investment in industrial facilities and infrastructure. That is why greater savings could not lead to significant growth in capital accumulation and, of course, economic growth.

In addition, longevity is also considered to have a positive impact on both savings per capita and the savings rate. Although the increase in longevity in the current year will lead to both an increase and decrease in savings per capita and savings rate in the later periods, the increase in savings per capita and savings rate are far greater than the decrease in both variables, finally resulting in an increase in savings per capita and the savings rate. Nevertheless, savings is found to have no impact on longevity. These results comply with the studies by Bloom, Canning and Graham (2003), Li, Zhang and Zhang (2007) and Kinugasa and Mason (2007).

Moreover, longevity and income are considered to be bi-directionally related. Longevity is found to have a positive impact on income per capita. That is, the increase in longevity in the current year will lead to both an increase and decrease in income per capita in the later periods. However, the increase in income per capita is greater than the decrease in it, therefore the increase in longevity is more likely to lead to an increase in income. Additionally, the increase in income per capita in the current year also leads to both an increase and decrease in longevity in the later periods. Nevertheless, it is more likely to lead to an increase in longevity since the increase in longevity is greater than the decrease in it. These results comply with the studies by Chen, Clarke and Roy (2012) and Pop, Van Ingen and Van Oorschot (2013). Figure 3 summarizes the causal relationship among savings, income and longevity in Thailand.

Note that the relationship between income and longevity changes from a positive relationship to a negative relationship as the dependent variable changes from savings per capita to the savings rate. These findings imply that both savings per capita and the savings rate are mediating variables which have different effects on the relationship between income and longevity. In other words, income influences savings per capita and the savings rate, which in turn influence longevity. However, based on the Granger Causality Test, it seems that the effects of savings per capita and the savings rate on longevity are not statistically significant.

Figure 3: Causal relationship among savings, income and longevity in Thailand



Conclusion and Recommendations

Based on the findings from this study, it is reasonable to conclude that people tend to save more as they have higher income and higher longevity. Consequently, public policies to promote Thailand's economic growth and Thai people's longevity are needed. Such policies include human capital development, capital- and knowledge-intensive industries development, labor market restructuring, international trade promotion, public health service promotion and the improvement of accessibility to public health services. With these policies, income and longevity in Thailand will constantly increase over time, leading to the greater domestic savings. However, as they gain higher income, people tend to have higher consumption, causing no increase in the savings rate. Therefore, in order to promote both the amount of savings and the savings rate among the working age population in Thailand, strong public policies to encourage savings are vitally needed.

Based on the literature review, there is no national compulsory pension system in Thailand, causing low incentives for the working age population to save more as they earn more income. Consequently, it is very necessary for the government to set up the national compulsory fully-funded pension system. With such a pension system, the working age population is likely to have more savings during their working period, giving them greater wealth accumulation.

In addition, a substantial and constant tax benefit for retirement savings, as well as a strong and effective public campaign to promote the working age population's realization of the necessity of saving during the working period to prepare for their longer period of retirement, is also needed. This will promote both the amount of savings and the savings rate. Moreover, public policies to enhance the utilization of savings in the country are also essential. For instance, financial incentive plans, such as cash rebates or tax refund schemes, are suggested to encourage the private sector to invest more on facilities or infrastructure, leading to greater demand for loanable funds. With this policy, greater income in the country will be able to lead to significant economic growth.

By doing so, the older population in Thailand in the future is likely to have sufficient wealth accumulation to support living costs after their retirement. This will reduce their dependency and contribute to constant economic growth and development of Thailand despite its ageing society.

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