HOUSEHOLD DEBT AND UNIVERSAL HEALTH COVERAGE IN THAILAND: EMPIRICAL EVIDENCE ON THE HOUSEHOLD SAVINGS

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**A Dissertation Submitted in Partial
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ABSTRACT

Title of Dissertation	HOUSEHOLD DEBT AND UNIVERSAL HEALTH COVERAGE IN THAILAND: EMPIRICAL EVIDENCE ON THE HOUSEHOLD SAVINGS
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Many studies have found that social security system such as pension system depresses household savings. The Universal Health Coverage (UHC) scheme is a type of social security system in Thailand, but it is questionable whether or not it is contributes to household debt. The two purposes of this paper are to theoretically analyze the pros and cons of implementing the UHC or Co-Payment Scheme (CPS) in a small open economy with the focus on Thailand by using a two-period Overlapping Generations Model (OLG), and to analyze the causal relationship between healthcare subsidy and household savings according to empirical evidence from Thailand. The theoretical results reveal that as long as the public debt level remains manageable, the UHC is recommended over the CPS for countries like Thailand, where people have a low Intertemporal Elasticity of Substitution (IES) since it promotes good health, GDP, consumption, savings, and even economic stability. The empirical evidence supports the theory that the income effect is more robust than the substitution effect in Thailand, and the healthcare subsidy unidirectionally Granger causes household savings to fluctuate in both the long and the short run.

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CHAPTER 1

INTRODUCTION

1.1 Statement of the Problems and Significance of the Study

Previous studies on the social security system such as pension system indicate that government policy has a negative impact on household savings (Attanasio & Brugiavini, 2003; Blau, 2016; Choi, 2010). Universal Health Coverage (UHC) in Thailand is guaranteed by the government. People who are not covered by any other social security system will receive help from the government with medical expenses in the event of sickness or an accident. However, the percentage of average household debt to Gross Domestic Product (GDP) in Thailand has increased from 42% in 2003 to approximately 80% in 2018 (Figure 1.1). The UHC scheme is similar to the Beveridge model, which was implemented by the UK in 1948. The savings rate in the UK is continuously decreasing because households, companies, and the government borrow money to offset their budget (Giles, 2019). Whereas other health systems, such as the Bismarck model (Japan), National Health Insurance model (Canada), and Out-of-Pocket model (USA) have positive saving rates (Figure 1.2). It is questionable whether UHC is the cause of household debt. This policy helps all people to have equal access to the medical services and keep themselves healthy. However, it comes with the cost of increased government spending, public debts, and perhaps other economic downfalls. This theoretical study explores the various aspects of replacing UHC with the Co-Payment Scheme (CPS) in a small open economy with a focus on Thailand, and empirical evidence concerning the effects of health subsidies on household savings.

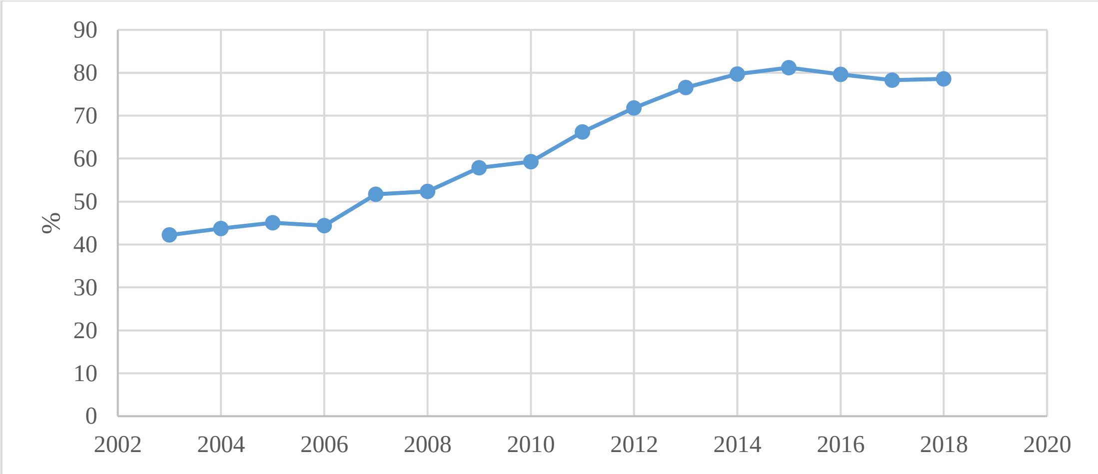


Figure 1.1 Household Debt to GDP in Thailand from 2003–2018

Source: Bank of Thailand

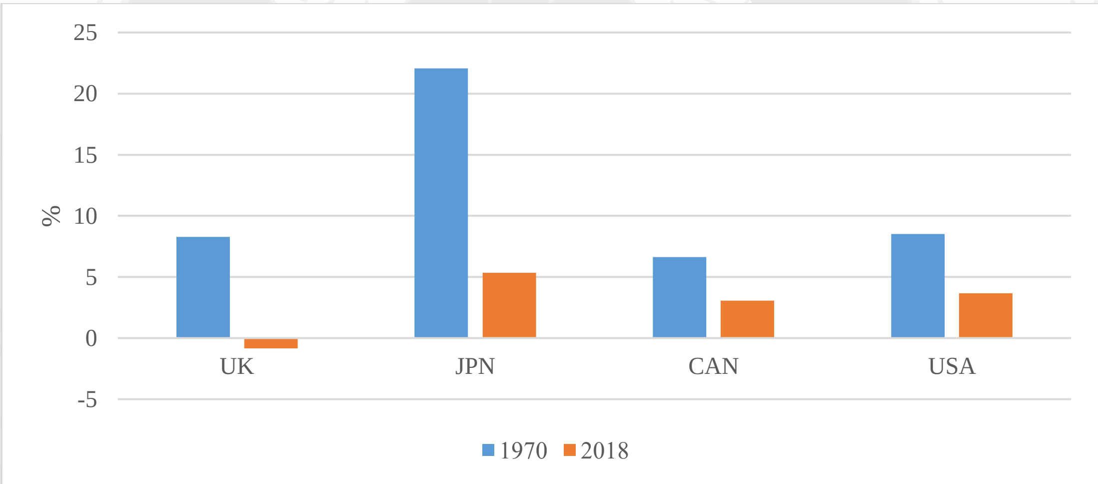


Figure 1.2 Savings Rate (total net savings to GDP) in 1970 and 2018

Source: OEDC

The UHC scheme was first implemented in 2002 by Thailand's then prime minister Thaksin Shinawatra, and known as the 30-baht health scheme, with the aim of improving the health quality of Thai people, especially the poor, by allowing greater access to medical services. Moreover, the program was intended to help Thai households financially with healthcare, giving them the chance to save more. According to Figure 1.3, since 2002, the real net savings per capita of Thailand has exhibited a positive trend with around 65% growth over 18 years. Moreover, Thailand has experienced an upward trend in its saving rate of around 2% over 18 years (Figure 1.4). This observation gives the impression that the UHC program is largely responsible for such a turnaround.

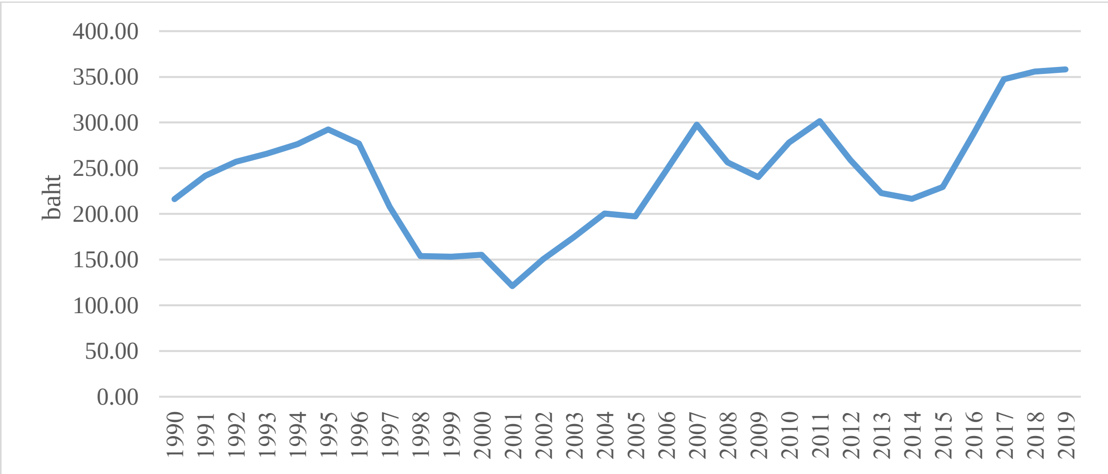


Figure 1.3 Real Net Savings per Capita

Source: Bank of Thailand

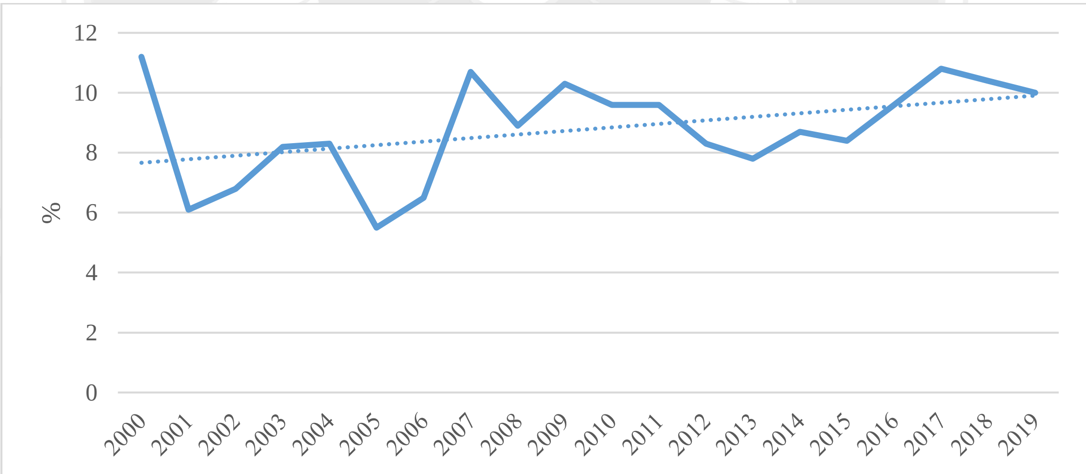


Figure 1.4 Savings Rate of Thailand

Source: Tradingeconomics.com/Bank of Thailand

However, the rich can also participate in the UHC scheme, causing congestion in healthcare provision and significantly increasing the amount of government subsidy for medical costs. Figure 1.5 shows the real cost of the UHC subsidy to the government per Thai citizen from 2002–2020. The real cost of the scheme has grown by 111% over 19 years. This fast-growing cost has inevitably placed a substantial burden on the government budget, partly resulting in significant pressure on public debt as shown in Figure 1.6. In particular, the real government debt per capita in Thailand rapidly increased to 193% from 2002–2020.

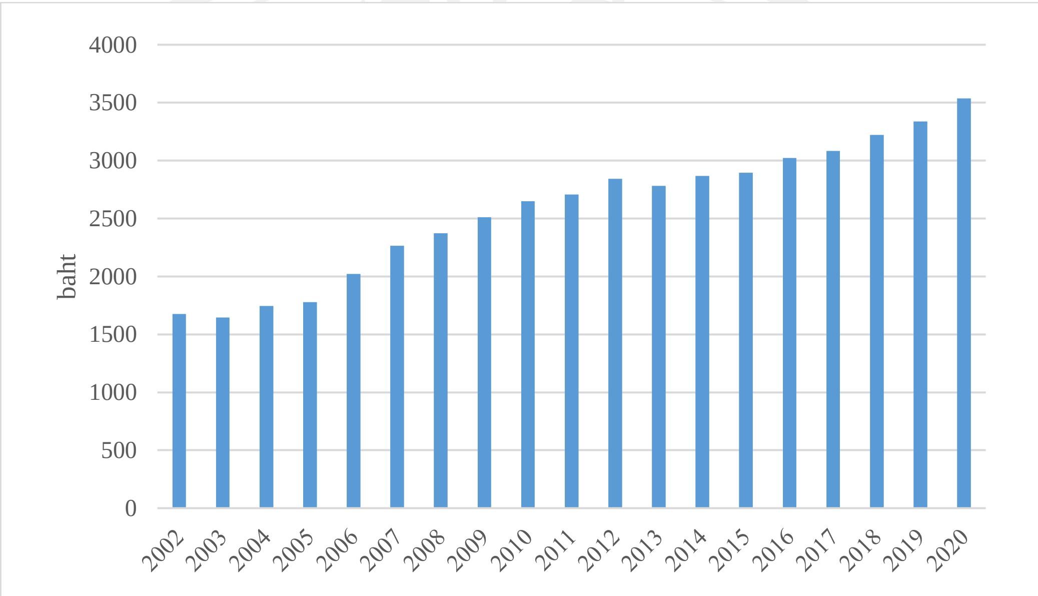


Figure 1.5 Real UHC Subsidy per Capita

Source: The National Health Security Office (NHSO)

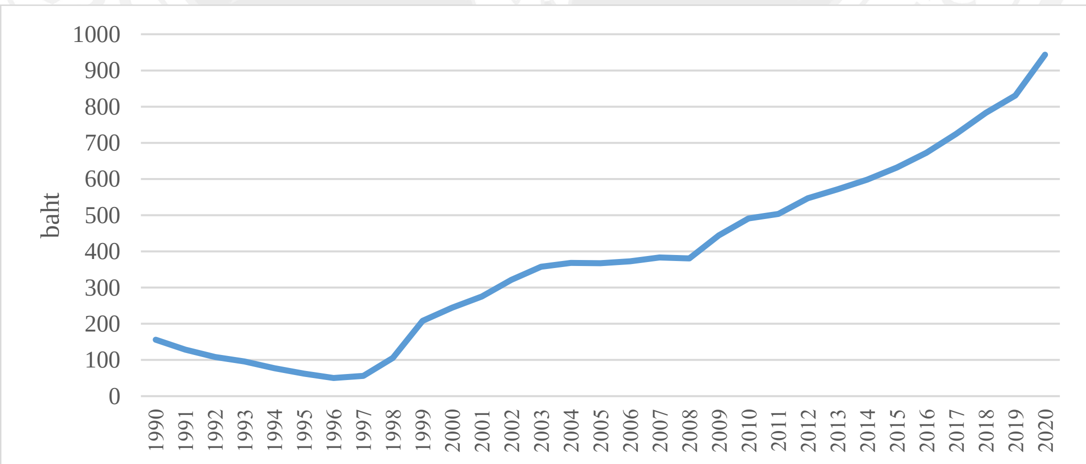


Figure 1.6 Government Debt per Capita

Source: Bank of Thailand

One year after the scheme was implemented, there were 444 unprofitable hospitals on average, equating to a loss of approximately 187,570 US dollars (Ngorsuraches & Sornlertlumvanich, 2006). It increased to 384 million US dollars in 2017, with 558 unprofitable government hospitals (Thai Publica, 2017).

In 2017, the UHC scheme covered approximately at 72% of the Thai population, while the Social Security Scheme (SSS) covered 18% and the Civil Servant Medical Benefit (CSMB) scheme covered 9% (Figure 1.7).

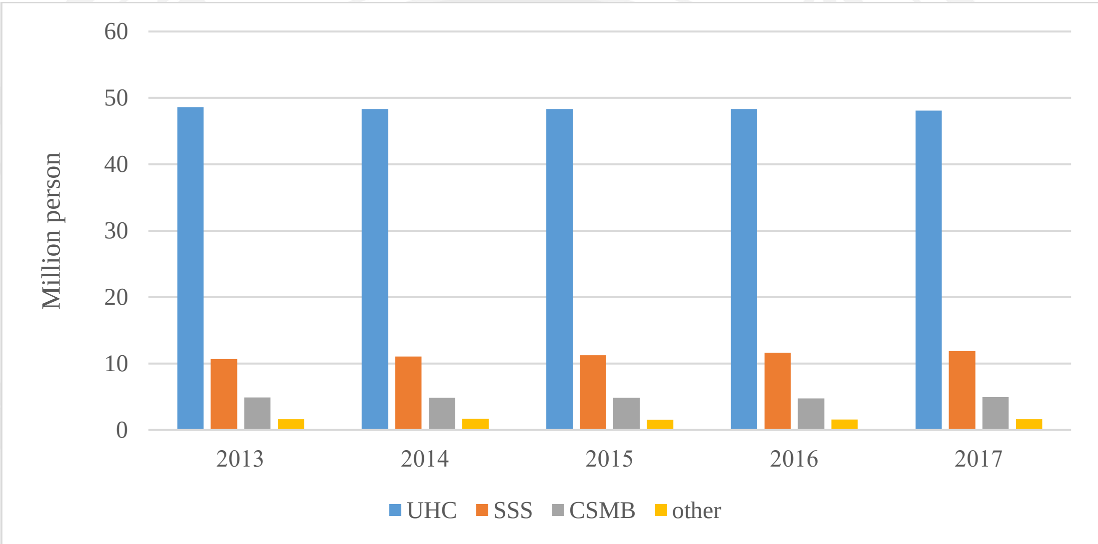


Figure 1.7 The Thai Health Care System.
Source: The National Health Security Office

Despite the considerable cost burden for the government to support public healthcare, the level of real household debt remains a puzzle (Figure 1.8). Although real net savings per capita have increased, the real average household debt of Thailand has risen continuously. The UHC subsidy should have alleviated the financial burden on households, and hence lowered or at least slowed down debt accumulation. Whether this puzzling trend is due to the UHC scheme calls for better theoretical understanding as to how the healthcare subsidy works in the context of a small open economy like Thailand. This would allow further analysis to establish whether the UHC is an optimal policy in theory or if the alternative CPS should be implemented. Notably, the CPS lowers the UHC the subsidy rate so that people must proportionally share the cost of medical services. The big question is not if the CPS can be expected to help lessen the public debt burden, but whether can it also lower household debt.

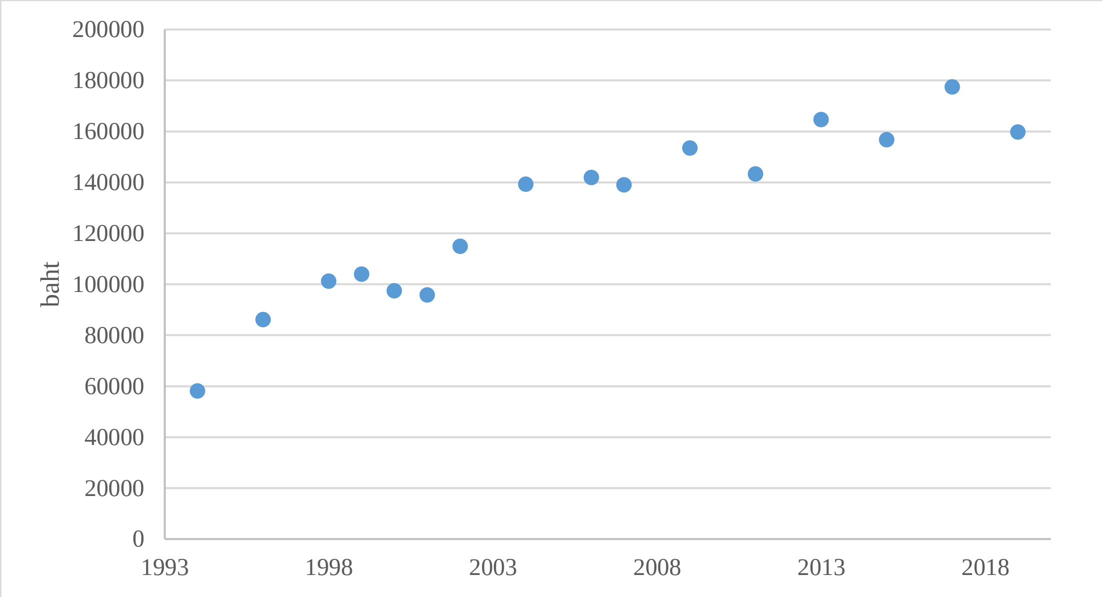


Figure 1.8 Real Average Household Debt
Source: Bank of Thailand

The average annual household debt was 68,279 baht in 2001, increasing to 178,994 baht in 2017. Household consumption in Thailand shows an increasing trend while investment decreased proportionately. Therefore, households spent more money on consumption compared to investment (Figure 1.9). Non-performing loans and interest will decrease the amount of consumption and investment during the next period due to the limited resources remaining. This decreases aggregate demand, ultimately creating an economic recession in the long run.

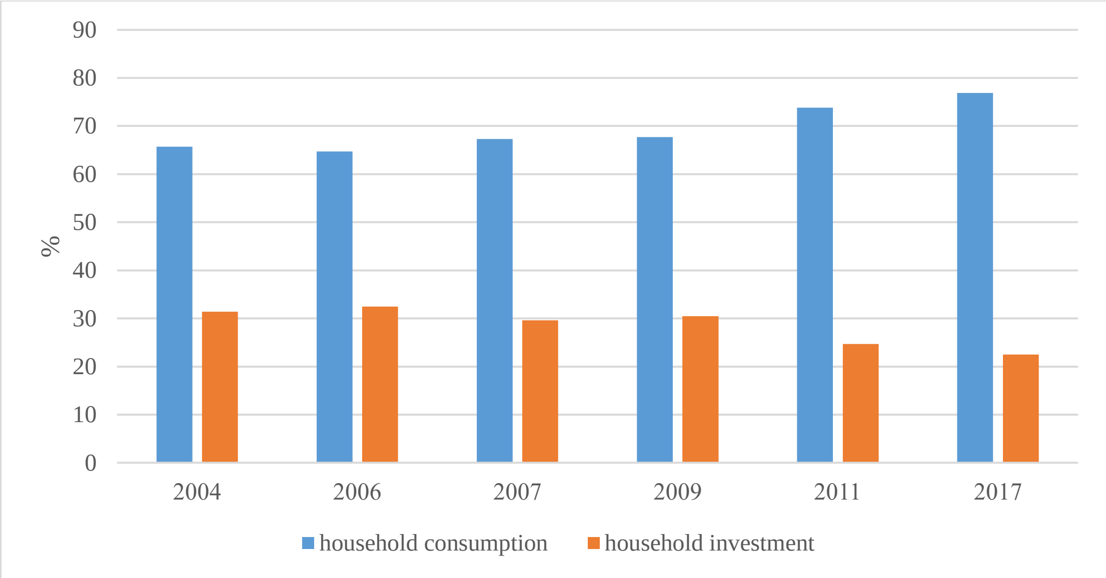


Figure 1.9 Household Expenditure in Thailand between 2004 and 2017
Source: National Statistical Office

In this study, a simple overlapping generations model of a small open economy embedded with the healthcare subsidy from the government is constructed. The reduction in healthcare subsidy reflects the change from the UHC scheme to the CPS. Although public debt is reduced in all cases, the results indicate that the effects on other variables depends on the household preference, namely the Intertemporal Elasticity of Substitution (IES). If the IES is high, the substitution effect dominates. Lower healthcare subsidies will encourage households to switch their spending to other goods and services, affecting future consumption. Hence, households are being urged to save more. An increase in savings also leads to more investment and less borrowing. Although, the medical services provided to the households may be reduced the resulting expenditure increases the labor supply. As the level of capital and labor rises, the lower healthcare subsidy rate will increase GDP.

On the other hand, Chakravarty, Chattopadhyay, Silber, and Wan (2016) suggest that Asian countries, including Thailand, have a low IES, implying that the income effect actually dominates. The lower subsidy rate cause households to feel relatively poor, hence reducing the demand for goods and services. Thus, households will save less for future consumption. Specifically, investment decreases, and household debt increases, suggesting that the CPS scheme is likely to exacerbate the household debt problem illustrated in Figure 1.8. Furthermore, households will make less use of medical services, thereby decreasing healthcare spending and the labor supply. Along with the potential fall in capital and labor, lowering the healthcare subsidy rate also suppresses GDP. Interestingly, it also makes the economy less stable against health technology shocks to households. One important point is that if the UHC subsidy is lower, the health status of households may decline at a slower rate than the level of medical services consumed, leading to a sharp decrease in public debt. In summary, the theoretical results of this study support the UHC over the CPS in the case of Thailand as long as the debt problem remains manageable. With a high IES, the rise in health subsidy increases public debt, and therefore the CPS is more suitable for controlling public debt than the UHC. In contrast, the UHC is more appropriate for a low IES, and the empirical evidence supports this theoretical result in that the income effect is stronger than the substitution effect in Thailand.

The purpose of this study is to explain the effect of UHC and CPS schemes using a two-period OLG model, along with an empirical analysis of the causal relationship between health subsidy and household savings in Thailand.

1.2 Research Questions

1.2.1 What are the effects of UHC and CPS on economic outcomes?

1.2.2 What empirical evidence links the theoretical developments concerning the impact of healthcare subsidies on household savings?

1.2.3 What is a suitable health policy for UHC and CPS to encourage households to save more?

1.3 Benefits of the Study

The contribution of this study is that it aids policymakers in implementing suitable health policies when household and public debt continue to be high.

A literature review is presented in chapter 2. The theoretical part is addressed in chapter 3 and the empirical studies presented in chapter 4. Finally, chapter 5 provides the conclusion.

CHAPTER 2

LITERATURE REVIEW

2.1 Health System

The classification of a health system is based on the source of funding and parties involved. The main parties are people, the government, organizations and health providers. There are currently four basic models (McCane, 2010). Firstly, in the Beveridge model (single-player model), the government supplies most health providers and finances the system though taxes. This model has been used in the United Kingdom since 1948 and is similar to the UHC. Secondly, the Bismarck model (social insurance model) has multiple health providers, with private hospitals being the main providers, financed by multi-player employers and employees through statutory health insurance. This model is used in Germany, France, Belgium, the Netherlands, Japan and Latin America. Thirdly, the National Health Insurance model has multiple health providers and is funded by statutory health insurance, but the insurance scheme is run by the government. This model is used in Canada, Taiwan and South Korea. Lastly, the Out-of-Pocket model is characterized by people paying the provider directly. This model is used in the United States, in cases where people have no private insurance.

Regarding the effect of good health on the economy, Alhowaish (2014) and Bedir (2016) reveal that health expenditure has a positive impact on GDP growth. De Freitas and Da Silva (2013) explain that such a positive effect is due to people having a longer life expectancy.

When comparing of healthcare security systems, Akaho, Coffin, Kusano, Locke, and Okamoto (1998) point out that the CPS has better cost control over health expenditure than the UHC. Most developing countries require an external budget when increasing health expenditure or pooled funding because the tax revenue is not adequate and raising income tax rates may lead to economic recession (Arnold et al., 2011;

Duran, Kutzin, & Menabde, 2014; Heller, 2006; Savedoff, de Ferranti, Smith, & Fan, 2012).

Kirdruang and Glewwe (2018) show that the UHC raises consumption, especially for durable goods, in the long run. Additionally, Awawda and Abu-Zaineh (2019) construct a general equilibrium model with health as a function of medical spending and leisure to investigate the healthcare social security scheme. Their findings reveal that lowering the healthcare subsidy does not affect consumption and labor supply. This result may be due to the application of a logarithmic utility function.

Several gaps have been identified in the literature. For instance, in the UHC study by Kirdruang and Glewwe (2018), the impact of UHC increasing household consumption is based on the theory of precautionary saving. However, the results were not clear because the authors provided no theories to support the models used in the estimation. Additionally, the theoretical framework proposed by Awawda and Abu-Zaineh (2019) states that households have an infinite life period, which affects human decision making, while the household utility function is in a logarithmic form which cannot study the income and the substitution effects that might have influenced the study by Kirdruang and Glewwe (2018).

2.2 The Dynamic Stochastic General Equilibrium OLG Model

The dynamic stochastic general equilibrium was first proposed by Lucas (1976). This model differs from the traditional approach in that it contains short-run equilibriums, which may differ from long-run equilibriums, and there are exogenous variables or shocks that may affect equilibrium (Wickens, 2008). Romer used the Diamond OLG model to explain the effect of pay as you go social security and fully funded social security on the efficiency of the economy (Romer, 2012). The assumption of this model is that old agents are dying while new agents are being born simultaneously in only two discrete periods of a lifetime. In the first period, the young agent works for a wage and uses it for consumption and saving. During the second period, the once young agent has now become the old agent and will consume the savings and not work. The utility of the agent assumes constant relative risk aversion. The capital stock during the second period is equal to the number of young agents in the first period.

2.3 Saving and Debt

In 1935, Keynes proposed that the concept of household saving should depend on the propensity to consume and the degree of liquidity preference. He divided the liquidity preference into three motives: transactional, speculative, and precautionary. The latter refers to the security of saving money for uncertainties, such as sickness or accidents. Households are motivated to borrow money to retain liquid cash. The cost of debt is interest. The household borrows money today and pays the debt in the long run. During the next period, the household saving will decrease or be negative. Consequently, negative saving is a proxy for household debt. The importance of household saving is that it creates economic growth (Jangili, 2011) in poor countries but not rich countries (Aghion, Comin, & Howitt, 2006).

The savings model was proposed by Leff (1969), derived from the standard of nation income. He explained that savings is money after consumption, spending for dependent agents, and the number of dependent expenditures relies on the number of dependent agents. The results are income per capita and income growth, both of which have a positive impact on savings per capita, whereas the proportion of dependent agents have a negative impact.

The Life Cycle Hypothesis (LCH) indicates that the level of household savings is different during each phase of life, population growth affects savings through structural change, and savings are low in the young period while nonexistent during the old period (Modigliani, 1966).

Jongwanich (2010) proposed a model for determining the level of household savings in Thailand based on the LCH. The results show that economic growth, inflation, and the ratio of exports to imports have a positive effect on household saving rates, while the young and old population had a negative impact on household savings and the availability of bank credit. However, real income was insignificant. Household debt increases consumption in the short run but decreases it in the middle and long run after four years (Suwanik & Peerawattanachart, 2017). High household debt poses the risk of payment default, especially in the event of economic crisis, high unemployment, or loan interest rate rises.

CHAPTER 3

THEORETICAL MODEL

The dynamic stochastic two-period OLG model of a small open economy is used as the framework of this study to find the relationship between government health expenditure and the economic outcomes of household savings and consumption. The household utility function is assumed to be the Constant Relative Risk Aversion (CRRA) for studying the income and the substitution effects.

This model follows Awawda and Abu-Zaineh (2019) with three modifications: a more general utility function, an overlapping generation structure, and a small open economy environment. Household utility is not a logarithmic function, the households have two periods, and the health fully depreciates because one period in a two-period OLG model is equal to 30 years.

There is a stochastic process in health technology for disease outbreaks, new drugs, etc. To simplify the explanation for household behavior in the allocation of resources, an agent receives a wage, pays labor income tax, consumes and invests for future consumption, and spends on medical services or investment. Agents can deposit money in a foreign country at international interest rates. Homogenous firms maximize profits by using household production factors. The production function involves constant returns to scale. The government budget is supported by personal income tax and borrowing from a foreign country for health or other policies.

3.1 The Household

The agent lives for two periods. The utility function is assumed to be the CRRA. When young, the agent enjoys consumption $c_{1,t}$ and leisure, $1\text{-}l_t$:

$$\frac{c_{1,t}^{1-\theta}}{1-\theta}+\frac{\gamma_1(1-l_t)^{1-\theta}}{1-\theta} \tag{1}$$

Where $c_{1,t}$ is the consumption in the young period at time t, l_t is the fraction of hours the agent spends at work, where the total available working time is normalized to 1, $(1\text{-}l_t)$ is leisure, γ_1 is the weight of leisure in relation to consumption.

When old, the agent earns utility from consumption, $c_{2,t+1}$ and their health condition, h_{t+1}:

$$\frac{c_{2,t+1}^{1\text{-}\theta}}{1\text{-}\theta}+\frac{\gamma_2 h_{t+1}^{1\text{-}\theta}}{1\text{-}\theta} \tag{2}$$

Where $c_{2,t+1}$ is the consumption in the old period at time t+1, h_{t+1} is the condition of health during the old period, γ_2 is the weight of health in relation to consumption in the old period. The agent maximizes the utility function:

$$\max_{c_{1,t},c_{2,t+1},l_t,k_{t+1},b_t} E_t\left[\frac{c_{1,t}^{1\text{-}\theta}}{1\text{-}\theta}+\frac{\gamma_1(1\text{-}l_t)^{1\text{-}\theta}}{1\text{-}\theta}+\beta\left[\frac{c_{2,t+1}^{1\text{-}\theta}}{1\text{-}\theta}+\frac{\gamma_2 h_{t+1}^{1\text{-}\theta}}{1\text{-}\theta}\right]\right] \tag{3}$$

Where β is the time discount factor. θ is the degree of relative risk aversion, $\theta > 0$ and $\theta \neq 1$. The IES is inverse to the degree of relative risk aversion, IES = 1/ θ. When $0 < \theta < 1$, the substitution effect is stronger than the income effect and the agent becomes more willing to substitute their consumptions across the type of goods and time.

When $\theta > 1$, the income effect is more robust than the substitution effect. Consequently, the agent's consumption is greater than their savings at time t. When $\theta = 1$, the substitution effect and the income effect cancel each other out, and the utility function changes into logarithmic form.

When young, the agent works, earns a wage, pays income tax, consumes, spends on medical services, invests in capital for future production, and lends to the rest of the world at the international interest rate. It should be noted that medical spending here is interpreted as health investment. Specifically, the more the young person spends on health, the healthier they are expected to become when old. Here, it is assumed that the cost of medical services is fixed in the rest of the world, which is equal to 1 unit of consumed goods. The young's budget constraint is as follows:

$$c_{1,t}= (1-\tau)w_t l_t - (1-\lambda)m_t - k_{t+1} - b_t \tag{4}$$

Where w_t is the wage at time t, τ is the labor income tax rate, k_{t+1} is the capital investment at time t, λ is the share of medical expenditure from the government, $(1-\lambda)m_t$ is the co-payment, b_t is lending to the rest of the world. Hence, the total savings, namely s_t in the first period, is written as follows:

$$s_t = k_{t+1} + b_t \tag{5}$$

When old, the agent rents out their capital to firms for production. It should be noted that, for simplicity, the capital is assumed to fully depreciate. The returns on savings from the young period are totally consumed. Therefore, the old's budget constraint is written as follows:

$$c_{2,t+1} = (1+r_{t+1})k_{t+1} + (1+r^f)b_t \tag{6}$$

where r_{t+1} is the rental price of capital at time t+1, and r^f_{t+1} is the international interest rate at time t+1.

Assuming that the young is healthy, and the health condition of the old is determined by the medical spending when young m_t, the leisure time when young in the Cobb-Douglas function can be written as follows:

$$h_{t+1} = H_{t+1} m_t^x (1-l_t)^{1-x} \tag{7}$$

Where m_t is the medical spending during the young period, $(1-l_t)$ is leisure, and x is the share of the medical spending on health, $(1-x)$ is the share of leisure for health, H_{t+1} is the shock of the old's health which has the following stochastic process:

$$ln\, H_t = (1-\rho_h)\, ln\, \overline{H} + \rho_h\, ln\, H_{t-1} + u_t \tag{8}$$

Where $|\rho_h|<1$, $u_t \sim N(0,\sigma_h^2)$, $\overline{H}$ is its steady state value. The constrained expected utility maximization of the household gives the following optimal conditions:

$$c_{1,t}^{-\theta} = \beta E_t\left[(1+r_{t+1})c_{2,t+1}^{-\theta}\right] \tag{9}$$

$$c_{1,t}^{-\theta} = \beta E_t\left[(1+r^f)c_{2,t+1}^{-\theta}\right] \tag{10}$$

$$(1-\tau)w_t c_{1,t}^{-\theta} = \gamma_1(1-l_t)^{-\theta} + \beta\gamma_2(1-x)E_t\left[\frac{H_{t+1}^{1-\theta}m_t^{x(1-\theta)}}{(1-l_t)^{x+\theta(1-x)}}\right] \tag{11}$$

$$(1-\lambda)c_{1,t}^{-\theta} = \beta\gamma_2 x\, E_t\left[\frac{H_{t+1}^{1-\theta}(1-l_t)^{(1-\theta)(1-x)}}{m_t^{\theta x+1-x}}\right] \tag{12}$$

3.2 The Firm

The firm uses capital and labor from the household to produce goods for consumption.

$$Y_t = F(K_t,L_t) \tag{13}$$

Assuming that the production function of the firm is a Cobb-Douglas function:

$$Y_t = AK_t^{\alpha}L_t^{1-\alpha} \tag{14}$$

Where Y_t is aggregate output at time t, K_t is aggregate capital at time t, L_t is aggregate labor hours at time t, α is the share of capital, and $(1-\alpha)$ is the share of labor. The firm maximizes its profits as follows:

$$\max_{\frac{K_t}{L_t},L_t} F(K_t, L_t) - (1+r_t)K_t - w_tL_t = L_t\left[F(\frac{K_t}{L_t}, 1) - (1-r_t)\frac{K_t}{L_t} - w_t\right] \tag{15}$$

The first order conditions for the firm are as follows:

$$1 + r_t = F_1(\frac{K_t}{L_t}, 1) \tag{16}$$

$$w_t = F(\frac{K_t}{L_t}, 1) - F_1(\frac{K_t}{L_t}, 1)\frac{K_t}{L_t} \tag{17}$$

or,

$$1+r_t = \alpha A_t K_t^{\alpha-1} L_t^{1-\alpha} \tag{18}$$

$$w_t = (1-\alpha) A_t K_t^{\alpha} L_t^{-\alpha} \tag{19}$$

3.3 The Government

The government runs the healthcare security system by subsidizing λ percent of the household's medical spending. The government receives revenue from income tax and borrows from abroad to balance its public debt budget within a certain period. The government budget constraints can be written as follows:

$$D_t = G - \tau w_t N_t l_t + \lambda N_t m_t + (1+r^f) D_{t-1} \tag{20}$$

or,

$$d_t = g - \tau w_t l_t + \lambda m_t + (\frac{1+r^f}{1+n}) d_{t-1} \tag{21}$$

Where D_t is the total debt, G is government spending, N_t is the population of generation t, and the lower figures are per-worker variables. It should be noted that the restriction $r^f < n$ is required for the convergence of public debt, while n is population growth.

3.4 Market-clearing Conditions and the Equilibrium System

Assuming there are unlimited supplies of loans and medical services to support this economy, the feasibility conditions for the capital market, labor market, and goods market must hold in accordance with the following equations:

$$L_t = N_t l_t \tag{22}$$

$$K_t = N_t l_t \tag{23}$$

$$F(K_t, L_t) = N_{t-1} c_{2,t} + N_t c_{1,t} + N_t m_t + N_t k_{t+1} + G + (1+r_t^f)(D_{t-1} - N_{t-1} b_{t-1}) - (D_t - N_t b_t)$$

or,

$$F\left(\frac{k_t}{1+n}, l_t\right) = \frac{c_{2,t}}{1+n} + c_{1,t} + m_t + k_{t+1} + g - d_t + \left(\frac{1+r_t^f}{1+n}\right) d_{t-1} + b_t - \left(\frac{1+r_t^f}{1+n}\right) b_{t-1} \tag{24}$$

The competitive equilibrium of this economy is defined by a set of 14 equations, (4), (6)– (12), (16), (17), (21)– (24).

3.5 The Steady State Analysis

This economy has no capital accumulation to allow for full depreciation. This implies that the transitional dynamics of all variables, except public debt per worker d, are driven by the autoregressive process of health technology H. Keeping H constant at its steady state $\overline{H}$, a change in any parameter or policy variable will result in the variables jumping to their new steady state values. This means that most of the insight can be drawn from the steady state analysis of the system, especially regarding how the decrease in healthcare subsidy λ affects the economy.

However, even such simplification cannot provide a closed-form general solution at the steady state. Therefore, in this section, a solvable benchmark case is presented where $\theta = 1$ to obtain the necessary intuition for numerical simulation.

In Equations (9) and (10), the steady state no-arbitrage condition suggests that the return of capital and lending abroad must be equal:

$$\bar{r} = r^f \tag{25}$$

The steady state wage $\bar{w}$, steady state capital-labor ratio $\frac{\bar{K}_t}{\bar{L}_t}$, steady state labor hours per worker $\bar{l}$, steady state medical service $\bar{m}$ per worker, and steady state young consumption $\bar{c}_1$ are as follows:

$$1 + \bar{r} = F_1(\frac{\bar{K}}{\bar{L}}, 1) \tag{26}$$

$$\bar{w} = F(\frac{\bar{K}}{\bar{L}}, 1) - F_1(\frac{\bar{K}}{\bar{L}}, 1)\frac{\bar{K}}{\bar{L}} \tag{27}$$

$$\frac{(1-\tau)\bar{w}\beta\gamma_2 x}{(1-\lambda)}\left[\bar{H}^{1-\theta}(1-\bar{l})\right] = \gamma_1(1-\bar{l})^{x(1-\theta)}\bar{m}^{\theta x+1-x} + \beta\gamma_2(1-x)\bar{H}^{1-\theta}\bar{m} \tag{28}$$

$$\left[\frac{\bar{m}^{\theta x+1-x}}{\bar{H}^{1-\theta}(1-\bar{l})^{(1-\theta)(1-x)}}\right]^{\frac{1}{\theta}} = \left(\frac{\beta\gamma_2 x}{1-\lambda}\right)^{\frac{1}{\theta}}\left[\frac{(1+r^f)}{1+r^f+\left[\beta(1+r^f)\right]^{\frac{1}{\theta}}}\right]\left[(1-\tau)\bar{w}\bar{l}-(1-\lambda)\bar{m}\right] \tag{29}$$

$$\bar{c}_1 = \frac{(1+r^f)\left[(1-\tau)\bar{w}\bar{l} - (1-\lambda)\bar{m}\right]}{1+r^f+\left[\beta(1+r^f)\right]^{\frac{1}{\theta}}} \tag{30}$$

Let θ be equal to 1 for the benchmark (logarithmic utility) case. The results for $\bar{l}$ and $\bar{m}$ are as follows:

$$\bar{l} = \frac{(1+\beta+\beta\gamma_2 x)\beta}{1+(1+\beta+\beta\gamma_2 x)\beta} \tag{31}$$

$$\bar{m} = \frac{\beta\gamma_2 x(1-\tau)\bar{w}}{(1-\lambda)[1+(1+\beta+\beta\gamma_2 x)\beta]} \tag{32}$$

The results are similar to those obtained by Awawda and Abu-Zaineh (2019) in that the healthcare subsidy does not have any impact on other variables except medical services. In other words, the household is spared the fixed amount of medical spending *((1-λ)*$\bar{m}$ which remains totally unaffected by the healthcare subsidy *λ*. If the government reduces the subsidy, the household will spend proportionally less on medical services and accept lower health quality in later life to maintain consumption, leisure, and savings. This is because in the logarithmic utility function when θ is equal to 1, the substitution and the income effects will cancel each other out. In fact, these two effects may not be equal. When the government decreases its healthcare subsidy, the household believes other goods will become cheaper than medical services. Thus, the household decreases its demand for medical services while increasing demand for consumable goods due to the substitution effect. In contrast, with the income effect, the household feels relatively poorer, reducing its demand for goods and medical services. Consequently, this creates a negative impact on the demand for medical services, while the impact on consumption, savings, and labor hours depends on the dominating effect.

3.6 Calibration

To compare the benchmark case for studying the substitution and income effect, the θ assigned is not equal to one. For θ <1, the substitution effect dominates, and consumption is expected to increase in both the young and old periods. Increased consumption by the old should raise the savings level. Labor hours are expected to increase for two reasons. Firstly, higher consumption calls for higher wages. Secondly, according to the health function (7), medical services and leisure are complementary and a significant drop in medical services leads to a sharp fall in the marginal product of leisure toward health which optimally calls for less leisure. Since the capital-labor ratio is determined by interest rate, (22) and (23) suggest that a rise in labor hours increases capital investment. However, the impact on household lending abroad $\bar{b}$ is ambiguous.

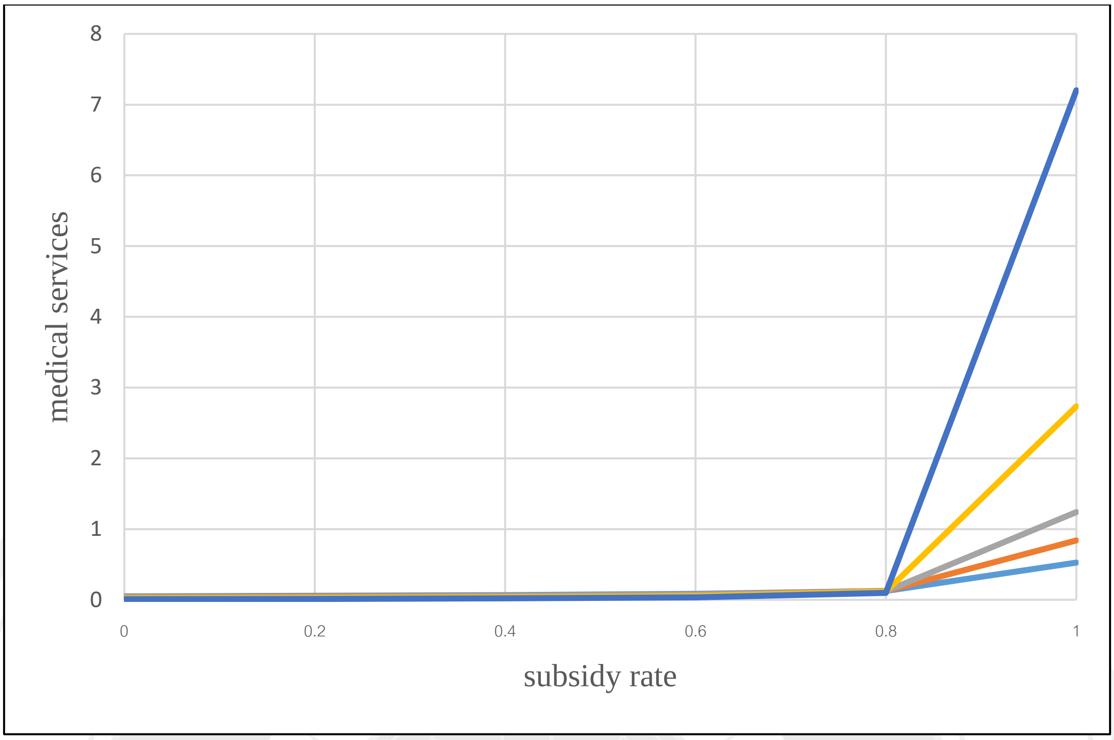
When θ>1, the income effect dominates, less consumption is expected and hence less saving. There should be a smaller decrease in demand for medical services than in the case θ<1 resulting in little impact from the marginal product of leisure on health. Therefore, the labor hours are expected to decrease in accordance with less household spending. Fewer labor hours lead to less capital investment. Again, household lending abroad is theoretically ambiguous.

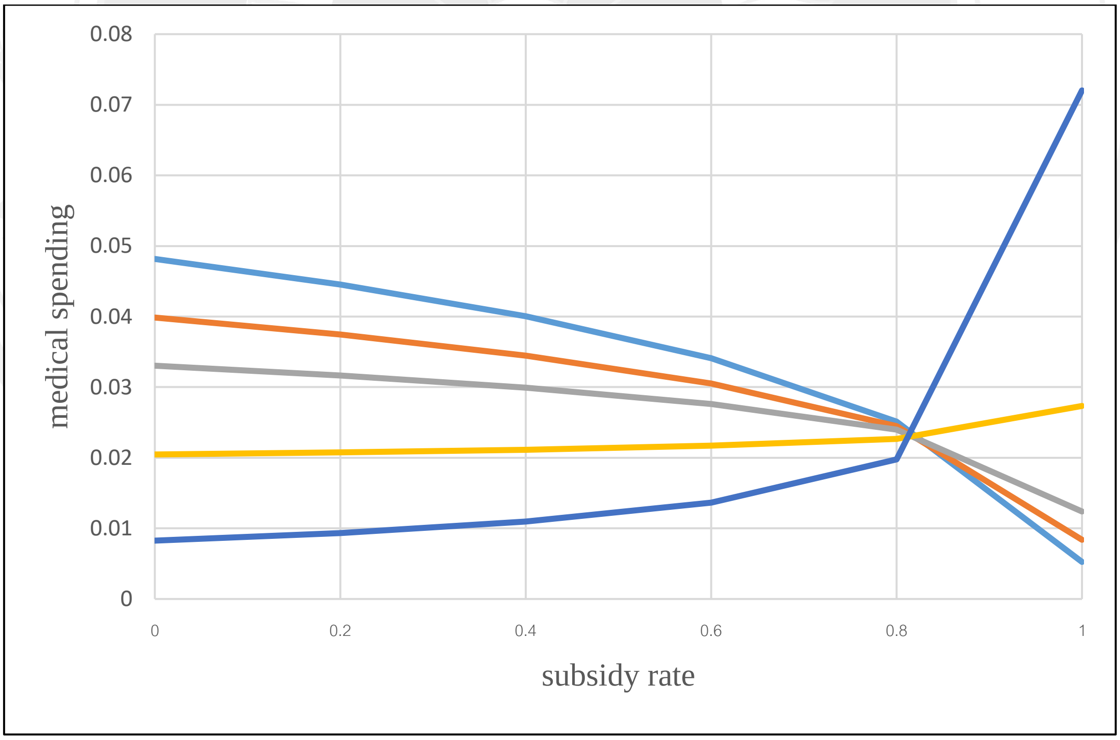
All parameter values are presented in Table 3.1. It should be noted that one period in the model is equal to 30 years and government spending, g is assumed to be zero. Focusing only on healthcare subsidies, the minimum income tax rate in Thailand is used for analysis, and some parameters in the stochastic process of health technology H_{t+1} are determined for impulse response analysis.

Table 3.1 Values of the Calibrated Parameters

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
α	0.34	$\bar{H}$	1	x	0.69	γ_1	0.15
γ_2	0.43	β	0.4	r^f	0.015	A	1
n	0.35	τ	0.05	g	0		

The parameters x, γ_1 and γ_2 are calibrated in accordance with the study by Awawda and Abu-Zaineh (2019). The labor share is 66% of Thailand's output between 1950 and 2019 (Feenstra, Inklaar, & Timmer, 2015), therefore the capital share is 34%. The annual time discount factor is equal to 0.97, and there are 30 years in each period; thus, α is equal to 0.97^30 ≈ 0.4. The effective federal funds rate is applied as a proxy for the international interest rate, namely 0.05% in 2020; thus, r^f is equal to (1.0005^30) - 1 ≈ 1.5%. The average population growth rate in Thailand from 1980–2019 is equal to 1.0015%; thus, n is equal to (1.010015^30) - 1 ≈ 35%.


8
7
6
5
4
3
2
1
0
medical services
0
0.2
0.4
0.6
0.8
1
subsidy rate


0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
medical spending
0
0.2
0.4
0.6
0.8
1
subsidy rate

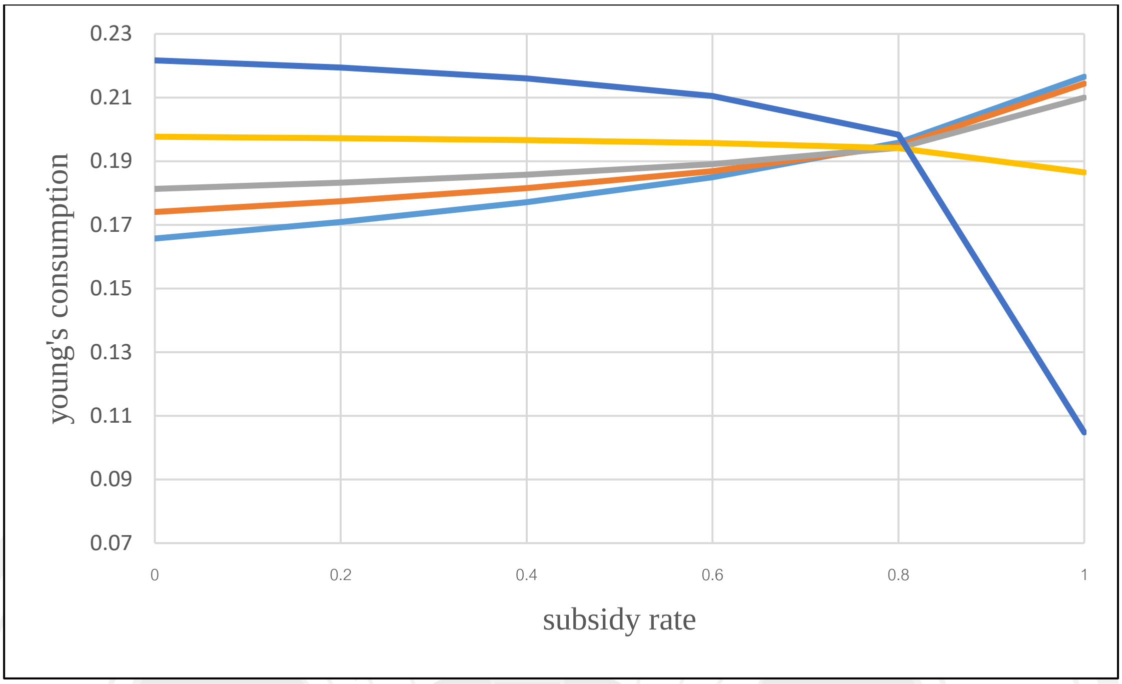
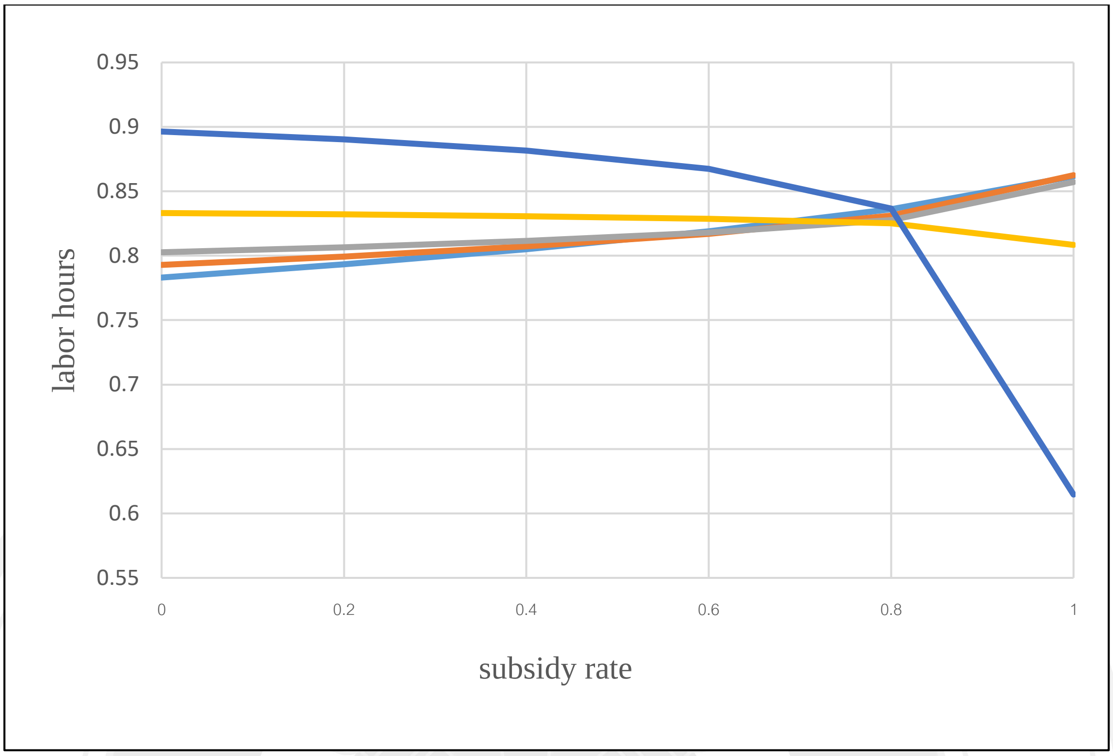
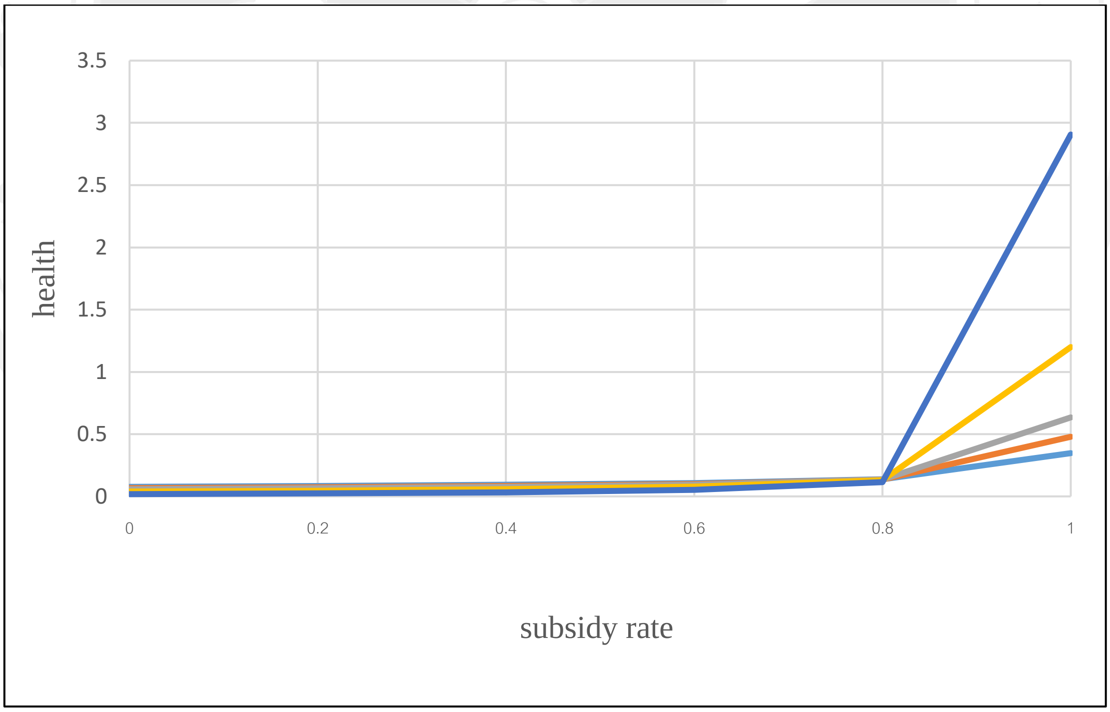


Figure 3.1 Calibrated Healthcare and Consumption Steady States

With this parameter set, the steady states are used to calculate all variables for different θ values and subsidy rates λ as shown in Figures 3.1–3.4.

Figure 3.1 confirms that when θ <1 which is IES >1, lowering the healthcare subsidy rate encourage households to substitute medical services for consumptions. In addition, it demonstrates that despite being more expensive, the household uses less of its budget for medical services. In contrast, for θ >1, which is IES<1, the household tends to be less willing to substitute medical services for consumption, causing the medical spending to rise. The dominant income effect then lowers consumption in both young and old periods.


0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
labor hours
0
0.2
0.4
0.6
0.8
1
subsidy rate


3.5
3
2.5
2
1.5
1
0.5
0
health
0
0.2
0.4
0.6
0.8
1
subsidy rate

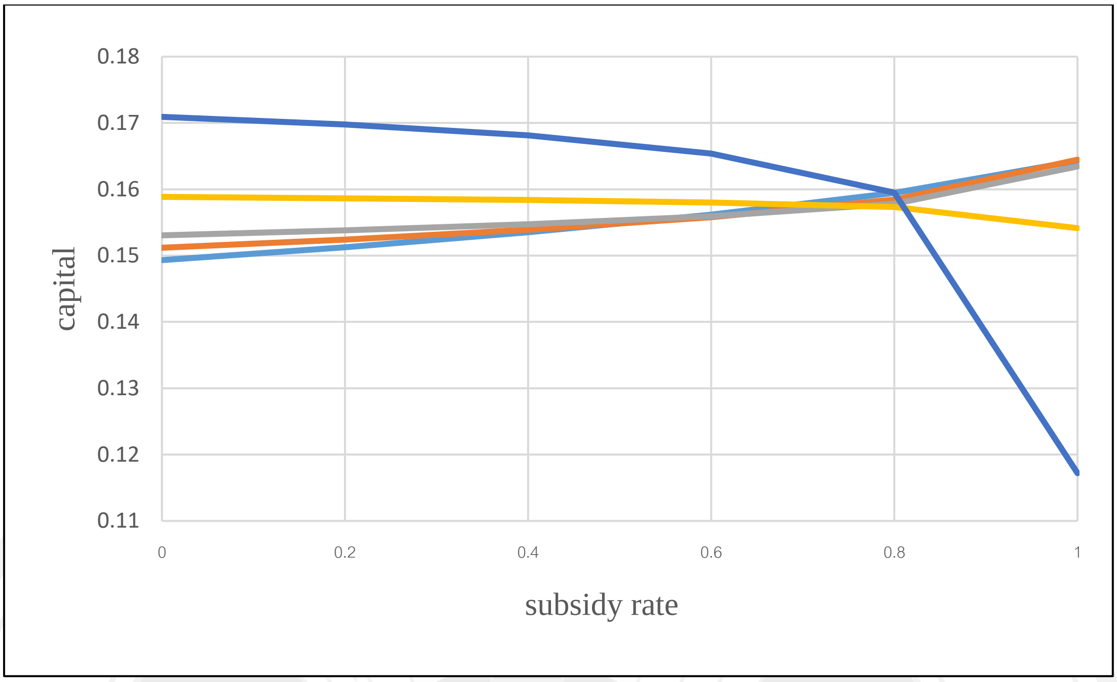
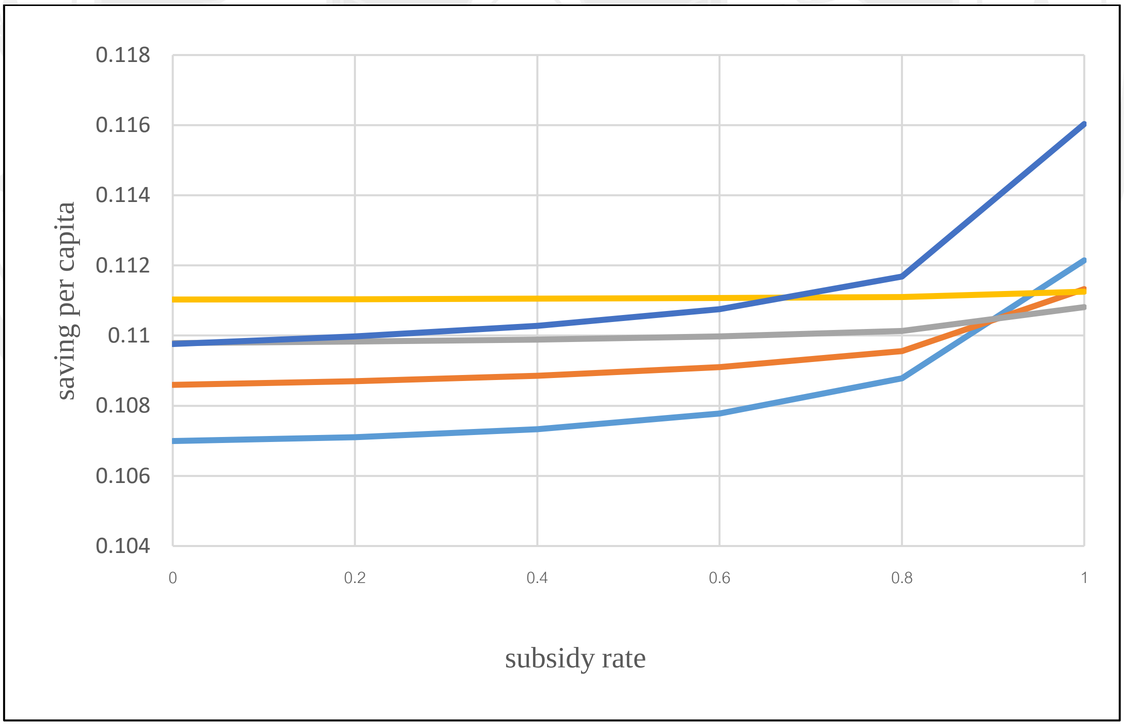


Figure 3.2 Calibrated Labor, Health, Capital Steady States



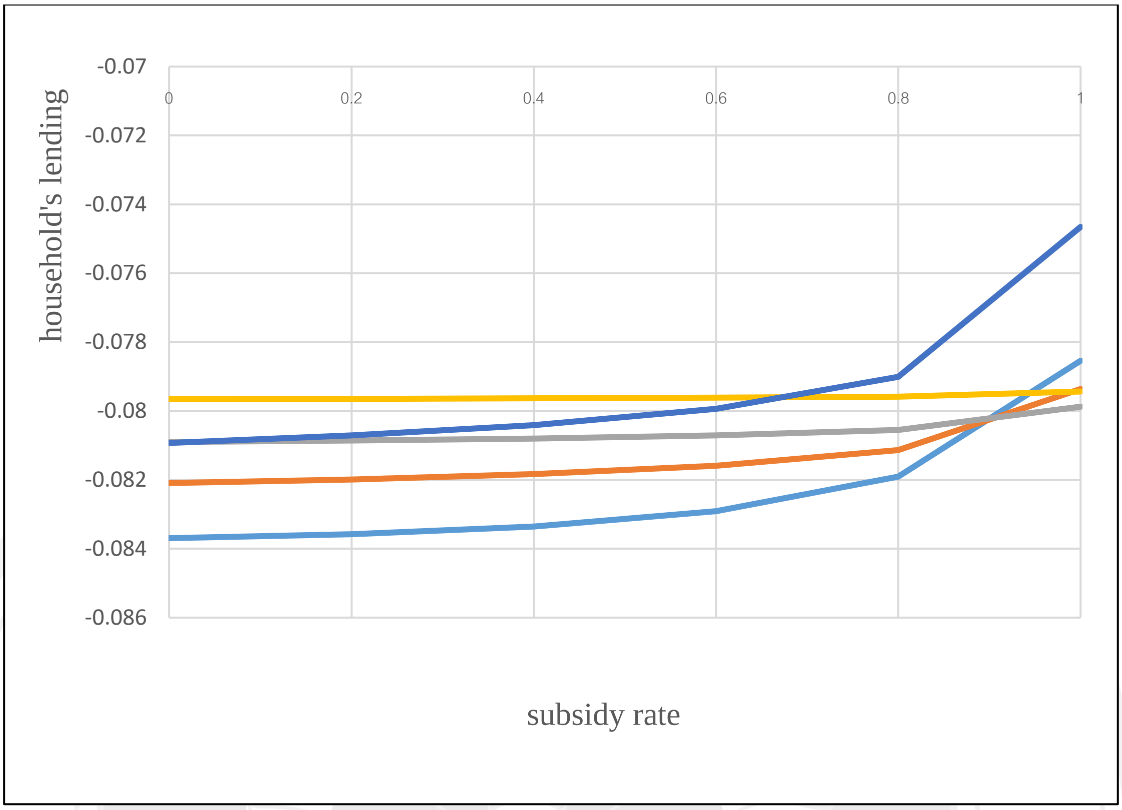


Figure 3.3 Calibrated Labor Saving, and Lending Steady States

As illustrated in Figure 3.2–3.3 confirms that in the case of high IES, increased demand for future consumption leads to a rise in capital investment and overseas savings. Therefore, households borrow less. On the other hand, households with low IES are confronted with a strong income effect and less likely to save for the future. This encourages more borrowing to cover expensive medical services.

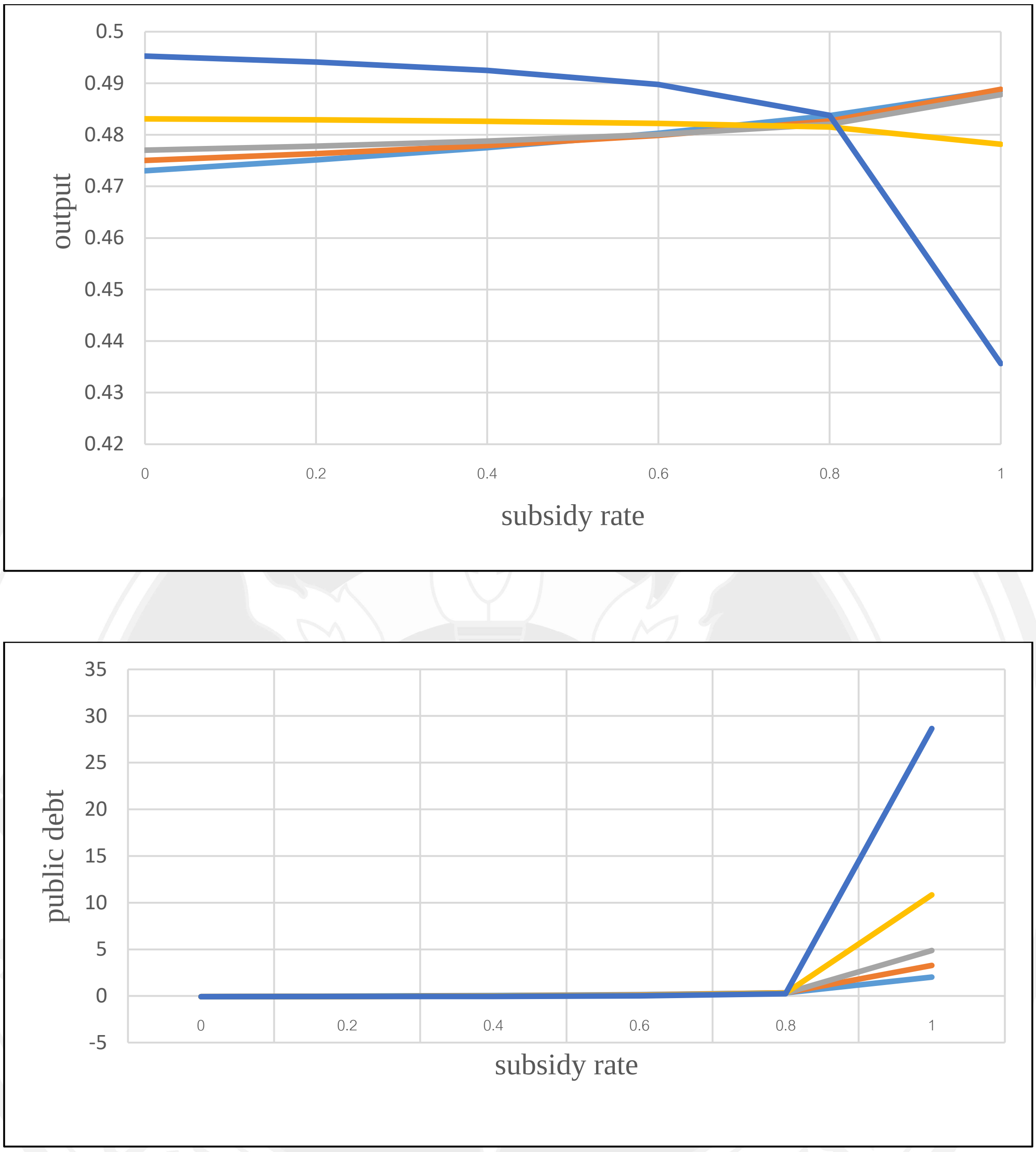
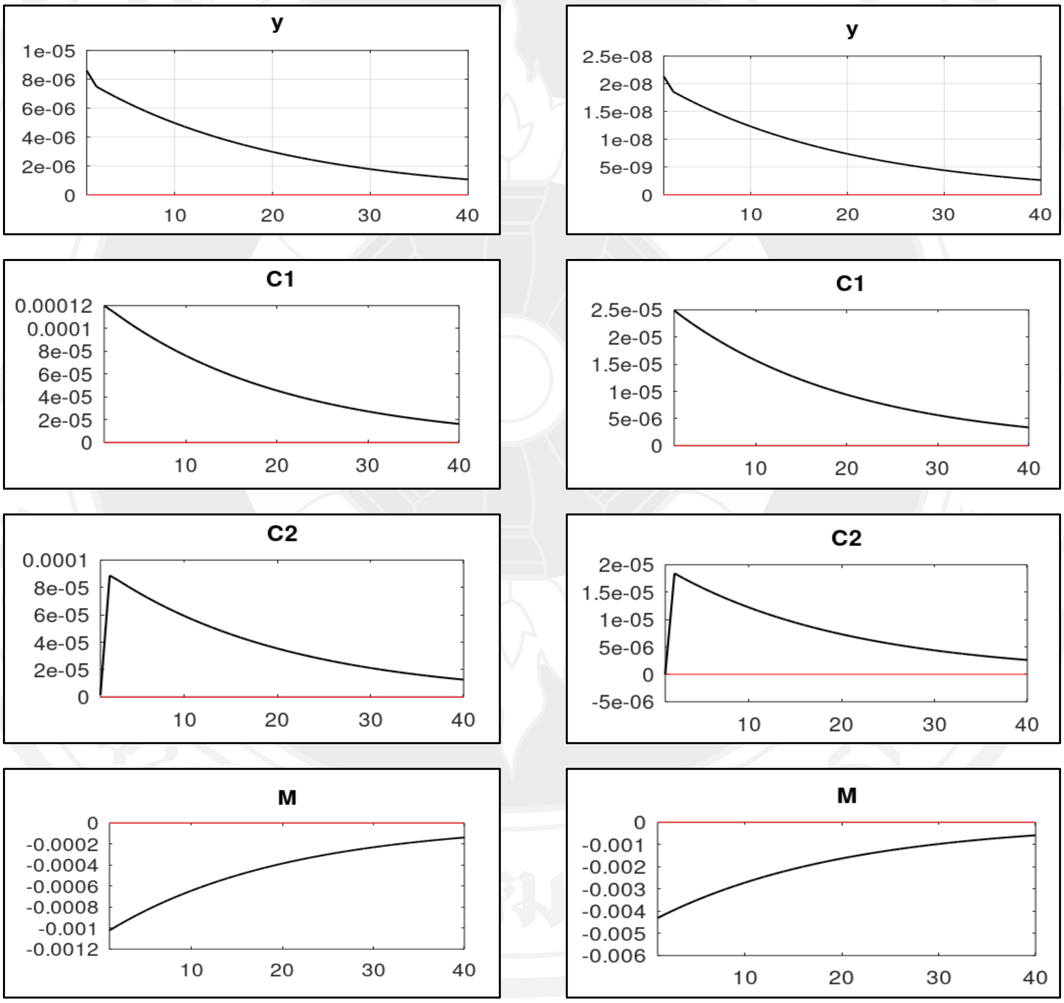


Figure 3.4 Calibrated Output and Public Debt Steady States

Figure 3.4 shows that the healthcare subsidy can either promote or suppress real GDP, depending on whether the IES is low or high, respectively. However, the use of subsidies always puts increased pressure on public debt, regardless of household preferences. However, most of the variables in Figures 3.1–3.4 indicates a more radical change toward the neighborhood of full subsidy or the UHC. This suggests that a small amount of co-payment can make a big difference to these variables, including public debt.

3.7 Impulse Response

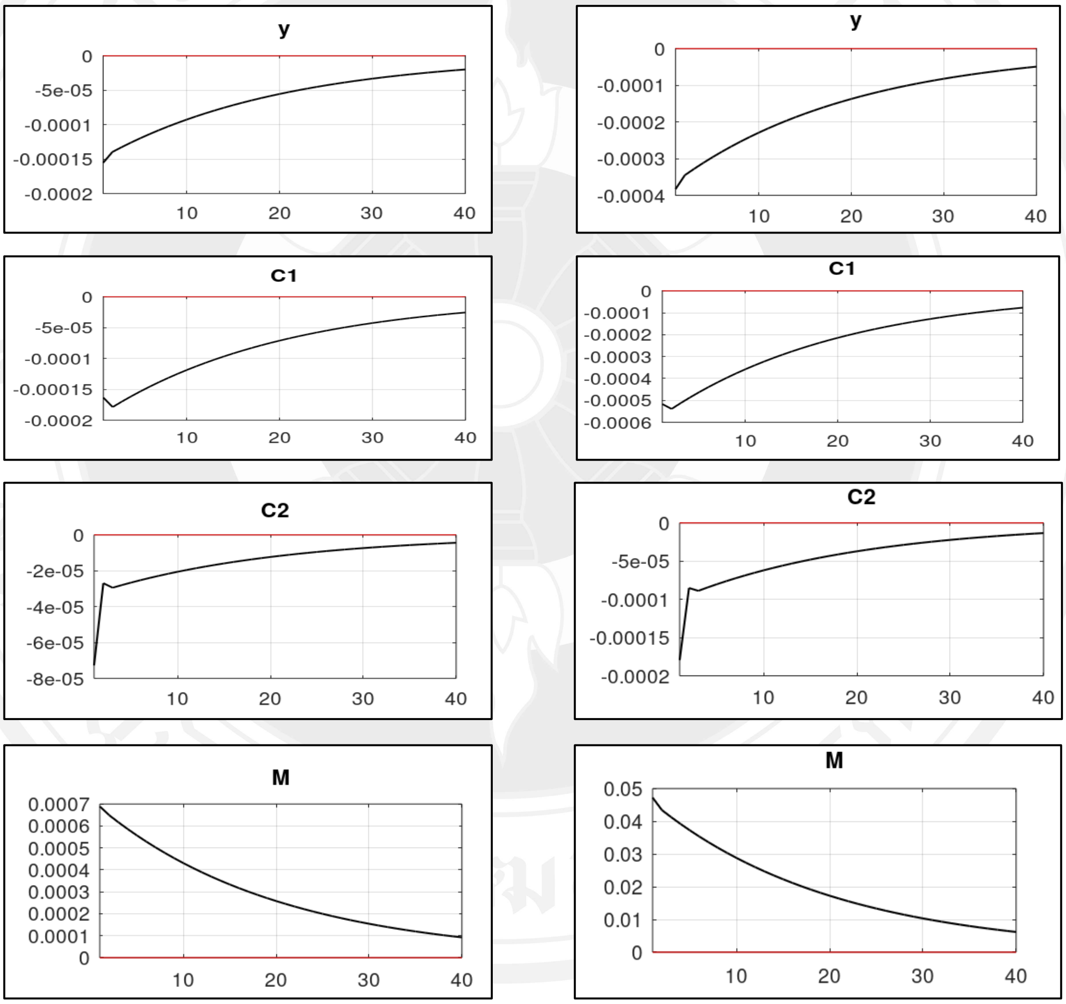
This section investigates the possibility of the healthcare subsidy scheme being an economic stabilizer. The impulse response is conducted to assess the shock on health technology *H*. under different levels of IES and healthcare subsidy: λ = 0.8, 0.99 and IES = 0.33, 2. It should be noted that this is a temporary shock, affecting the impact on health from medical services and leisure, such as a change in air quality, disease outbreak, etc.



(a) λ = 0.8 (b) λ = 0.99

Figure 3.5 Impulse Response for IES = 0.33

When the household has low IES. Figure 3.5 suggests that the economy is more stable with a higher rate of healthcare subsidy. The rationale is that low IES results in dominant the income effect. In the case of a positive shock on health technology, households may feel relatively richer and wish to raise their consumption and leisure. When the healthcare subsidy is high, reducing medical services has little effect on resources. Therefore, labor hours cannot be sufficiently reduced to raise consumption. This results in output being less volatile than the case of an economy with low healthcare subsidies.



(a) $\lambda = 0.8$ (b) $\lambda = 0.99$

Figure 3.6 Impulse Response for IES = 2

According to Figure 3.6, high healthcare subsidies destabilize the economy. A high IES implies that the substitution effect dominates. The positive shock on health technology results in good health becoming relatively cheaper. Thus, households try to move their resources from consumption to medical services while optimally adjusting leisure activities. Given the high healthcare subsidy, medical services are cheap and this greatly raises demand. The huge increase in the marginal product of leisure on health induces a significant drop in labor hours. Consequently, the output becomes relatively more volatile.

Universal Health Coverage vs. Co-Payment Scheme.

This theoretical investigation supports the highest possible level of healthcare subsidy for the economy with *IES<1* since it promotes real GDP, consumptions, health, and economic stability. However, the government must take a careful look at debt issues, especially public debts, to ensure they do not reach the maximum debt ceiling. Consequently, the UHC is preferred. For high IES, there is a trade-off between good health and low output/consumptions. Therefore, the CPS scheme may be more suitable.

In the case of Thailand, Chakravarty et al. (2016) reveal that $\theta=3$ results in low IES. The increasing level of net savings since 2002 (reported in Figure 1.3) supports these findings. However, the rising household debt in Figure 1.8 does not. More empirical studies are required on this issue to control the other potential factors involved which is outside the scope of this paper.

Since Thai people appear to be less willing to substitute medical services with consumptions, the introducing of the CPS would make healthcare expensive and absorb more household resources, reducing consumption and output. Moreover, Figure 3.4 predicts that output would be more volatile, which wound prove undesirable. Since the debt-to-GDP ratio of Thailand was 49.6 % in 2020, which is still considered to be relatively low worldwide, this theory supports the current UHC scheme in Thailand. In the future if the debt problem becomes more severe, a small amount of co-payment by households is recommended to reduce the fiscal burden and hence public debt.

The theoretical model is simple, although it has several limitations. The next step is to test the results empirically.

CHAPTER 4

EMPIRICAL EVIDENCE

4.1 Models

The household saving function in theoretical model is used to analyze the empirical evidence on the cause-effect relationship between healthcare subsidy and household savings using data from Thailand. This study assumes that moral hazard has no effect on the government healthcare subsidy. From Equations (4) and (5), household savings can be calculated as follows:

$$s_t = (1-\tau)w_t l_t - (1-\lambda)m_t - c_{1,t} \tag{33}$$

From the lending in Equation (5), b_t is a interest rate function. Therefore, household savings per capita in the long run can be written as follows:

$$s_t = \beta_0 + \beta_1 y_t + \beta_2 i_t + \beta_3 G_t^h + \mu_t \tag{34}$$

Where s_t is the real savings per capita at time t, y_t is real GDP per capita at time t, and a proxy for real household income per capita, i_t is the real deposit interest rate at time t, G_t^h is the percentages of health expenditure from the government compared to total health expenditure at time t, and a proxy for the share of medical expenditure from the government, β_0 is the intercept of the model, $\beta_1, \beta_2, \beta_3$ are the coefficients of the independent variables in the long run, and μ_t is an error term at time t.

4.2 Data Sources

Data for this study were obtained from the Office of the National Economic and Social Development Board (NESDB), National Health Security Office (NHSO), World Bank and Bank of Thailand (BOT).

4.3 Data Analysis

The time-series data for each variable are tested for stationarity by the Augmented Dickey-Fuller (ADF) test, and selecting the value of Akaike's Information Criterion (AIC) or Schwarz Information Criterion (SIC) as the lowest. As an alternative unit root test, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test will be considered, when the P-value of the ADF test ranges from more than 5 % to less than 10 %.

There are 39 observations, with the Autoregressive Distributed Lag model (ARDL) bounds testing (Pesaran, Shin, & Smith, 2001) used to test the empirical models due to the small sample sizes, while time-series data can be stationary at level, the first difference, or mixed.

The results of the unit root tests for each variable should be stationary at I(0) or I(1). If stationary at the second difference or more, the data will be transformed. The next step is the estimation for cointegration by the ARDL bounds test, using the critical values for the bounds F-statistics for 30 to 80 observation (Narayan, 2004). For model selection, the lowest AIC is considered, and no autocorrelation and heteroscedasticity exist. The autocorrelation will be tested by the Breusch-Godfrey test. If there is autocorrelation, more lagged variables will be added until there is no autocorrelation. The pure heteroscedasticity will be tested by the White test with no cross terms. The last step is to test for stability using the CUSUM test and CUSUM of squares test.

The ARDL method is chosen for causality testing in this study rather than the Toda-Yamamoto method due to the small sample sizes. If more lags exist when applying the Toda-Yamamoto method, additional data will be used for estimation. The framework of the Granger non-causality testing is shown in Figure 4.1.

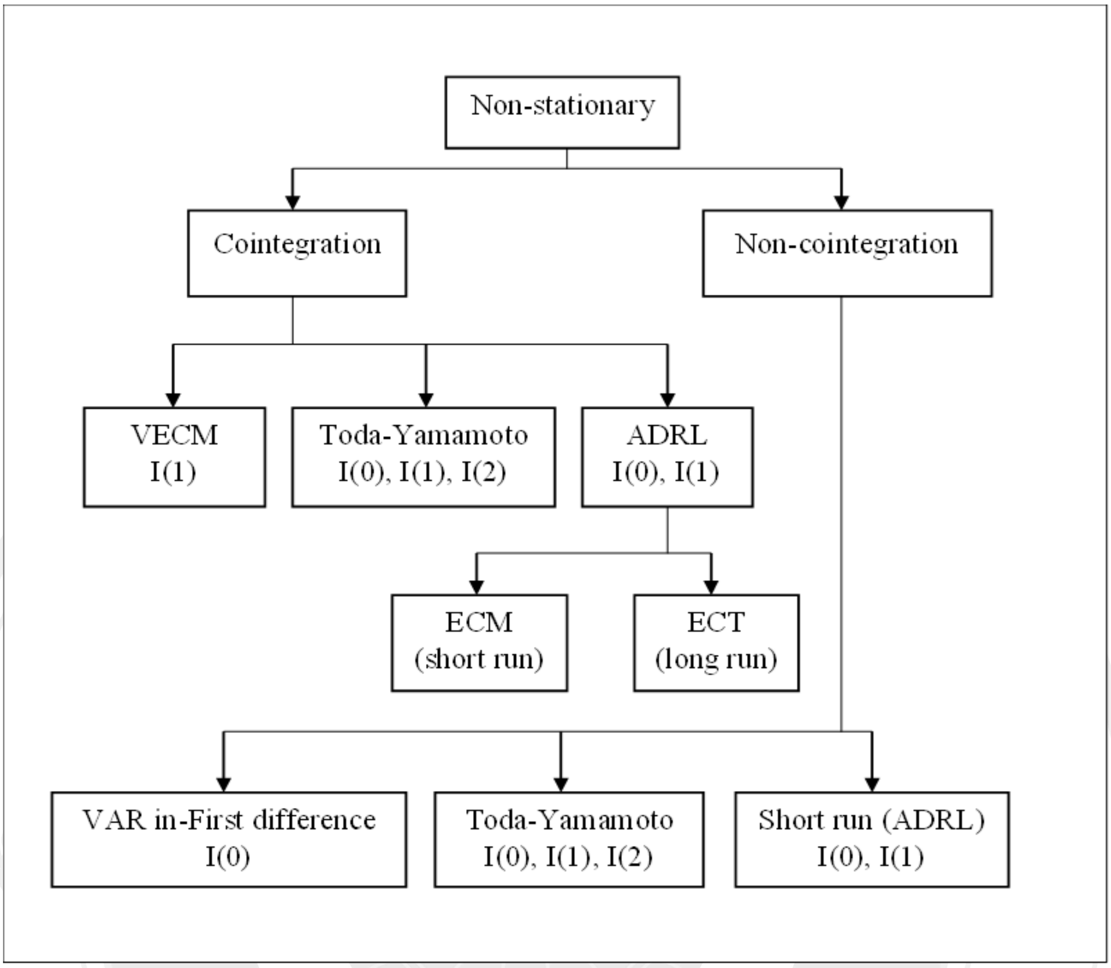


Figure 4.1 Framework of Granger Non-causality Testing

If cointegration exists, the Error Correction Model (ECM) will be used to estimate the causal relationship in the short run, as in the following equation:

$$\Delta s_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta s_{t-i} + \sum_{i=0}^{q1} \alpha_{2i} \Delta y_{t-i} + \sum_{i=0}^{q2} \alpha_{3i} \Delta i_{t-i} + \sum_{i=0}^{q3} \alpha_{4i} \Delta G_{t-i}^{h} + \alpha_5 \Delta n_t^{W} + \lambda ECT_{t-1} + \varepsilon_t \quad (35)$$

The error correction equation or Error Correction Term (ECT) is used to estimate the causal relationship in the long run, as follows:

$$ECT_{t-1} = s_{t-1} - \beta_0 - \beta_1 y_{t-1} - \beta_2 i_{t-1} - \beta_3 G_{t-1}^{h} \quad (36)$$

Where Δ is the first difference, n^W is the percentage of the working-age (15–64 years) to total population as a proxy for the ratio of the young agents to all agents from the theoretical perspective. This ratio can be exogenous variables as in the study by Leff (1969). Parameters $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ are the coefficients of the variables in the short run, and λ is the speed of adjustment to the long run. ε_t is the error term of ECM at time t.

If there is no cointegration, the ARDL short-run model will be used to estimate the causal relationship, as in the following equation:

$$\Delta s_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta s_{t-i} + \sum_{i=0}^{q1} \alpha_{2i} \Delta y_{t-i} + \sum_{i=0}^{q2} \alpha_{3i} \Delta i_{t-i} + \sum_{i=0}^{q3} \alpha_{4i} \Delta G^h_{t-i} + \alpha_5 \Delta n^W_t + \varepsilon_t \quad (37)$$

Autocorrelation and heteroscedasticity, including model stability will be tested after model selection.

The next step is to test whether or not cause and effect exists from s to G^h. If there is cointegration, the ECM will be used to estimate the causal relationship in the short run, as in the following equation:

$$\Delta G^h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta G^h_{t-i} + \sum_{i=0}^{q1} \alpha_{2i} \Delta y_{t-i} + \sum_{i=0}^{q2} \alpha_{3i} \Delta i_{t-i} + \sum_{i=0}^{q3} \alpha_{4i} \Delta s_{t-i} + \alpha_5 \Delta n^W_t + \lambda ECT_{t-1} + \varepsilon_t \quad (38)$$

The ECT is used to estimate the causal relationship in the long run, as in the following equation:

$$ECT_{t-1} = G^h_{t-1} - \beta_0 - \beta_1 y_{t-1} - \beta_2 i_{t-1} - \beta_3 s_{t-1} \quad (39)$$

If there is no cointegration, the ARDL short-run model will be used to estimate the causal relationship in short run, as in the following equation:

$$\Delta G^h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta G^h_{t-i} + \sum_{i=0}^{q1} \alpha_{2i} \Delta y_{t-i} + \sum_{i=0}^{q2} \alpha_{3i} \Delta i_{t-i} + \sum_{i=0}^{q3} \alpha_{4i} \Delta s_{t-i} + \alpha_5 \Delta n^W_t + \varepsilon_t \quad (40)$$

Autocorrelation and heteroscedasticity, including model stability will be tested after selecting either the ECM or ARDL short-run model.

4.4 Results and Discussion

From the theoretical perspective, when the relative risk aversion in Asia is equal to three (Chakravarty et al., 2016), the income effect dominates, and healthcare subsidy has a positive impact on household savings. Consequently, if the government increases the healthcare subsidy, households are likely to save more.

The time-series annual data in Thailand from 1980 to 2018 have been obtained from the NESDB, NHSO, World Bank, and BOT. The descriptive statistics of each variable are shown in Table 4.1.

Table 4.1 Descriptive Statistics

	s	y	i	G^h	n^W
Mean	5901.23	87814.87	2.69	35.00	67.46
Median	5202.00	85543.48	1.87	35.28	69.14
Std. Dev.	3066.10	36058.60	4.16	13.98	4.57
n	39	39	39	39	39

The results of unit root tests for each variable are presented in Table 4.2. As can be observed, they are stationary at level and first difference. Therefore, the ARDL bounds test is suitable for investigating the relationship between variables.

Table 4.2 Results of the Unit Root Tests

s	y	i	G^h	n^W
I(1)	I(1)	I(0)	I(1)	I(0)

The ECM in Equation (35) is estimated to find the optimal lags of each variable using the lowest value of AIC with unrestricted constant and no trend. Therefore, the optimal lags are ARDL (1, 2, 0, 3), and the variables then tested for cointegration. The results are shown in Table 4.3.

Table 4.3 ARDL Bounds Test for the Actual Sample Size of 36

	Value	**Significance**	**I(0)**	**I(1)**
F-statistic	5.655	10%	2.933	4.020
		5%	3.548	4.803
		1%	5.018	6.610

The values of the F-statistic (5.655) is greater than the value of I(1) at the 5% significance level (4.803); thus, the null hypothesis that there is no cointegration can be rejected. In other words, a long-run relationship exists between household savings per capita and at least one pair of independent variables in this model. The coefficients of the independent variables in the long run are shown in Table 4.4.

Table 4.4 Coefficient of Independent Variables

	$\boldsymbol{y}$	$\boldsymbol{i}$	$\boldsymbol{G^h}$
Coefficient	0.227	308.306	-353.885
Std. Error	0.066	169.015	176.563
t-Statistic	3.434	1.824	-2.004
P-value	0.002**	0.080.	0.056.

Significance Level: '***'0.001 '**'0.01 '*'0.05 '.'0.1

From the ECT in Equation (36), the long-run relationship can be written as follows:

$$s_t = 0.227\, y_t + 308.306\, i_t - 353.885\, G_t^h \tag{41}$$

The coefficient of y_t is positive at the 5% significance level. There is Granger causality from y to s in the long run, implying that when income per capita increases, households will save more. This is because an increase in income will have a permanent effect, thus enabling households to consume more and save for smooth future consumption in retirement (Modigliani, 1966). These results are similar to those reported by Garbinti and Lamarche (2014) and Leff (1969).

The coefficient of i_t is positive at the 10% significance level. There is Granger causality from i to s in the long run, implying that when the real deposit interest rate rises, households will save more. This is because as the value of current money decreases, households will save more. These results are similar to those reported by Athukorala and Sen (2004).

The coefficient of G_t^h is negative at the 10% significance level. There is Granger causality from G^h to s in the long run. This result differs from the conjecture that healthcare subsidy has a positive impact on household savings for low IES. There are two hypotheses to explain this phenomenon. One is that a small negative correlation exists between wealth and risk aversion according to the study by Chiappori and Paiella (2011). In the case of $\theta > 1$, the income effect dominates. When the government increases its healthcare subsidy, households feel richer. After that, the degree of relative risk aversion is reduced, and the substitution effect becomes more robust than the income effect. Consequently, consumption decreases. However, the consumption of households appears to continually increase (Figure 1.9), which does not support this hypothesis.

The second hypothesis is that households feel richer with the income effect, increasing their consumption and leisure, as shown by Equation (1). Leisure is a type of goods consumption, and the diminishing marginal utility of consumption is greater than that for leisure. As a result, households tend to reduce their working hours to have more leisure time rather than increasing labor hours to save for consumption in the next period of their lives. In other words, there is a backward-bending supply curve of labor. Consequently, income per capita declines along with household savings after two years of policy implementation.

The results indicate that both real income per capita and the real deposit interest rate have a significant positive cause-effects to real household savings per capita in the long run, whereas healthcare subsidy has a significant negative cause-effect to real household savings per capita.

From ARDL (1, 2, 0, 3), the short-run relationship can be written as follows:

$$\Delta s_t = \alpha_0 + \sum_{i=0}^{1} \alpha_{2i} \Delta y_{t-i} + \sum_{i=0}^{2} \alpha_{4i} \Delta G^h_{t-i} + \alpha_5 \Delta n^W_t + \lambda ECT_{t-1} + \varepsilon_t \tag{42}$$

Table 4.5 Results of the Error Correction Model

	Coefficient	**Std. Error**	**t-Statistic**	***P-value***
$\boldsymbol{C}$	-458.835	399.328	-1.149	0.261
$\boldsymbol{\Delta y_t}$	0.039	0.057	0.687	0.499
$\boldsymbol{\Delta y_{t-1}}$	-0.169	0.060	-2.831	0.009 **
$\boldsymbol{\Delta G^h_t}$	-55.006	46.966	-1.171	0.253
$\boldsymbol{\Delta G^h_{t-1}}$	133.583	45.765	2.919	0.007 **
$\boldsymbol{\Delta G^h_{t-2}}$	159.086	47.459	3.352	0.002 **
$\boldsymbol{\Delta n^W_t}$	446.993	199.746	2.238	0.034 *
$\boldsymbol{ECT_{t-1}}$	-0.503	0.100	-5.033	< 0.001 ***

Significance Level: '***'0.001 '**'0.01 '*'0.05 '.'0.1

The short-run relationship can be written as follows:

$$\Delta s_t = -0.169 \Delta y_{t-1} + 133.583 \Delta G^h_{t-1} + 159.086 \Delta G^h_{t-2} + 446.993 \Delta n^w_t - 0.503 ECT_{t-1} \tag{43}$$

The coefficient of Δy_{t-1} is negative at the 5% significance level. This means that there is cause-effect from y to s in the short run.

The coefficient of ΔG^h_{t-1} and ΔG^h_{t-2} are positive at the 5% significance level. This means that there is cause-effect from G^h to s in the short run. This implies that the income effect is stronger than the substitution effect, and the agent chooses to increase their consumption rather than have more leisure time during the young period in the short run. This result supports conjecture in the theoretical perspective.

The coefficient of Δn^W_t is positive at the 5% significance level, meaning that there is cause-effect from n^W to s in the short run. This implies that the working-age households do not have to bear the burden of caring for children and the elderly. These results are similar to those reported by Pradhan and Upadhyaya (2001). The current study shows that the agent in old period is motivated to save more to allow for uncertainties, precautionary saving, and for bequest motive (Deaton, 2005).

The speed of adjustment is negative (-0.518) at the 5% significance level. This implies that the speed of adjustment for long-run equilibrium is 51.8% of any movements within one period of time. These results confirm that y, i, and G^h Granger cause s in the long run.

The Breusch-Godfrey test is used to test for autocorrelation at lag 3, while the White test is applied for testing heteroscedasticity. The results in Table 4.6 reveal no autocorrelation or heteroscedasticity in this model.

Table 4.6 Residual Tests

Test	**Obs*R-squared**	**Prob. Chi-Square**
Breusch-Godfrey	6.608	0.086
White (no cross terms)	7.513	0.676

Significance Level: '***'0.001 '**'0.01 '*'0.05 '.'0.1

The CUSUM test and CUSUM of squares test are used to assess the stability of the model. The results in Figures 4.1 and 4.2 indicate that this model is stable.

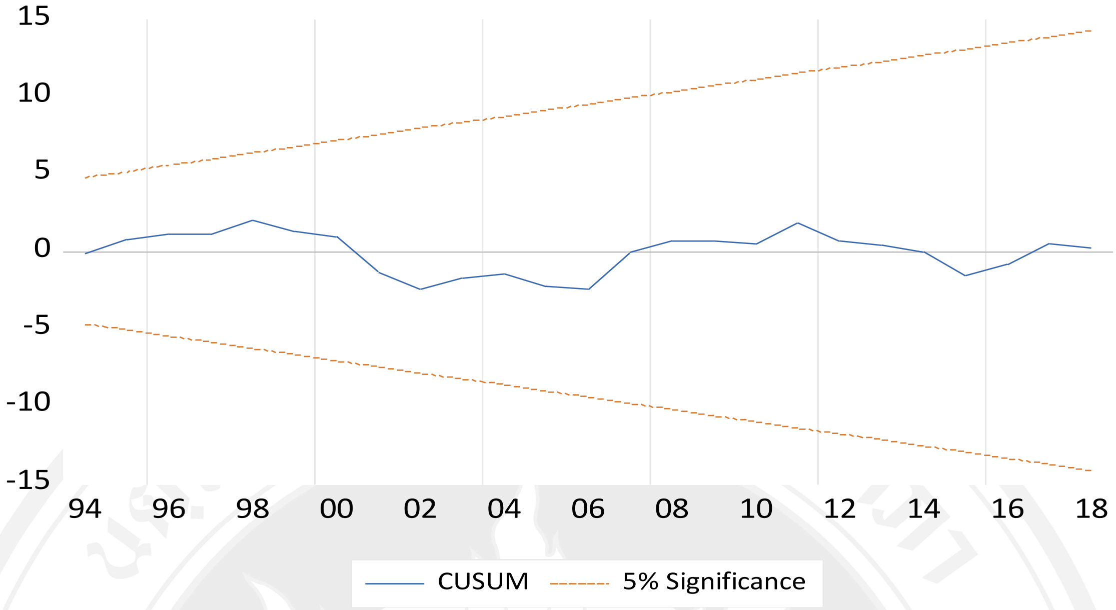


Figure 4.2 CUSUM Test

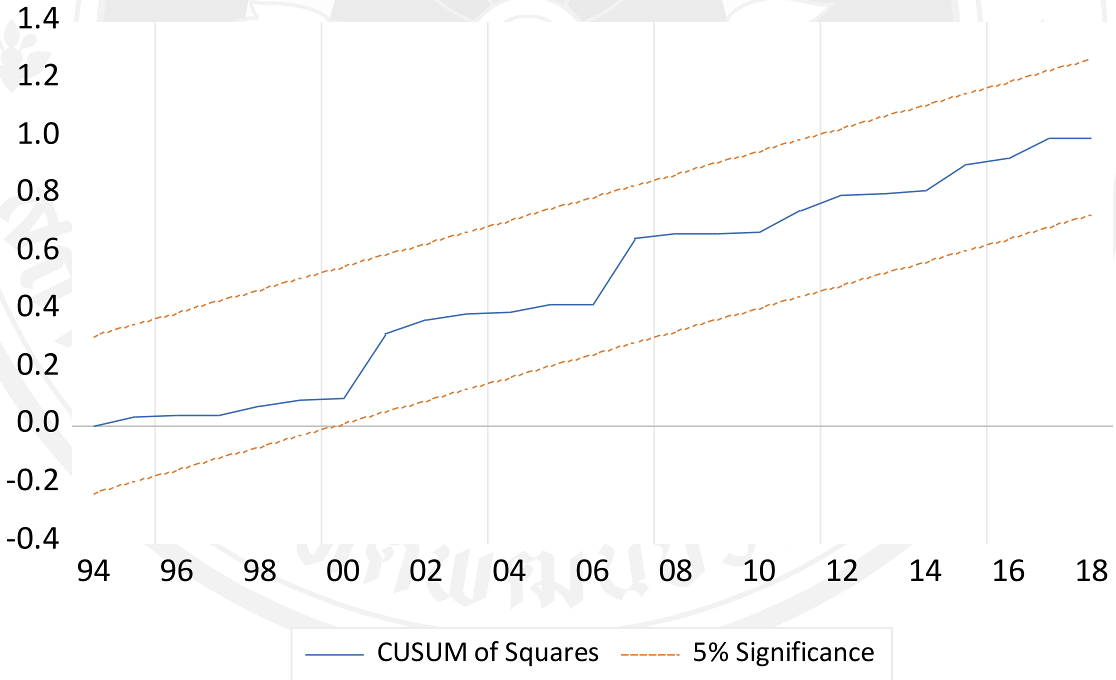


Figure 4.3 CUSUM of Squares Test

The next step is to estimate whether or not s Granger causes G^h. The ECM from Equation (38) is tested for cointegration, and the results shown in Table 4.7.

Table 4.7 ARDL (1, 3, 2, 1) Bounds Test for the Actual Sample Size of 36

	Value	**Significance**	**I(0)**	**I(1)**
F-statistic	5.144	10%	2.933	4.020
		5%	3.548	4.803
		1%	5.018	6.610

The ECM from Equation (38) shows cointegration at the 5% significance level, rejecting the null hypothesis. Although cointegration exists, the coefficients of *s* in Equation (39) are not significant, as indicated by the results in Table 4.8. The results for the coefficients of the short run from Equation (38) are presented in Table 4.9.

Table 4.8 Coefficients of Independent Variables

	y	***i***	***s***
Coefficient	<-0.001	-0.715	<0.001
Std. Error	<0.001	0.545	<0.001
t-Statistic	-0.541	-1.312	1.178
P-value	0.594	0.202	0.251

Significance Level: '***'0.001 '**'0.01 '*'0.05 '.'0.1

According to Table 4.9, the coefficient of *s* is not significant. Therefore, the variable *s* does not Granger cause G^h in either the long or short run. This model is stable and no autocorrelation or heteroscedasticity exists. The results of ECM residual test in Equation (38) are shown in Table 4.10, while Figures 4.3 and 4.4 present the stability test results for the model.

Table 4.9 Results of the Error Correction Model from Equation (38)

	Coefficient	**Std. Error**	**t-Statistic**	***P-value***
$\boldsymbol{C}$	35.502	7.681	4.622	<0.001***
$\Delta \boldsymbol{y_t}$	<-0.001	<0.001	-1.696	0.103
$\Delta \boldsymbol{y_{t-1}}$	<-0.001	<0.001	-0.420	0.678
$\Delta \boldsymbol{y_{t-2}}$	<0.001	<0.001	2.601	0.016**
$\Delta \boldsymbol{i_t}$	0.286	0.250	1.143	0.264
$\Delta \boldsymbol{i_{t-1}}$	0.731	0.252	2.895	0.008**
$\Delta \boldsymbol{s}$	<0.001	<0.001	0.668	0.510
$\Delta \boldsymbol{n_t^W}$	8.714	1.988	4.382	<0.001***
ECT_{t-1}	-0.718	0.149	-4.811	<0.001***

Significance Level: '***'0.001 '**'0.01 '*'0.05 '.'0.1

Table 4.10 Residual Tests on the Model from Equation (38)

Test	**Obs*R-squared**	**Prob. Chi-Square**
Breusch-Godfrey	6.755	0.080
White (no cross terms)	13.481	0.263

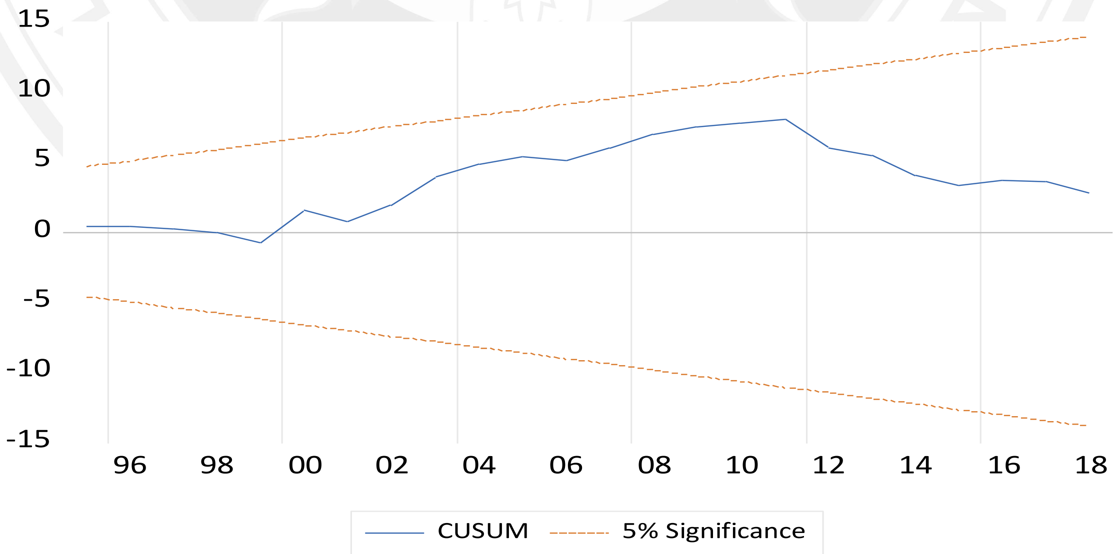


Figure 4.4 CUSUM Test on the Model from Equation (38)

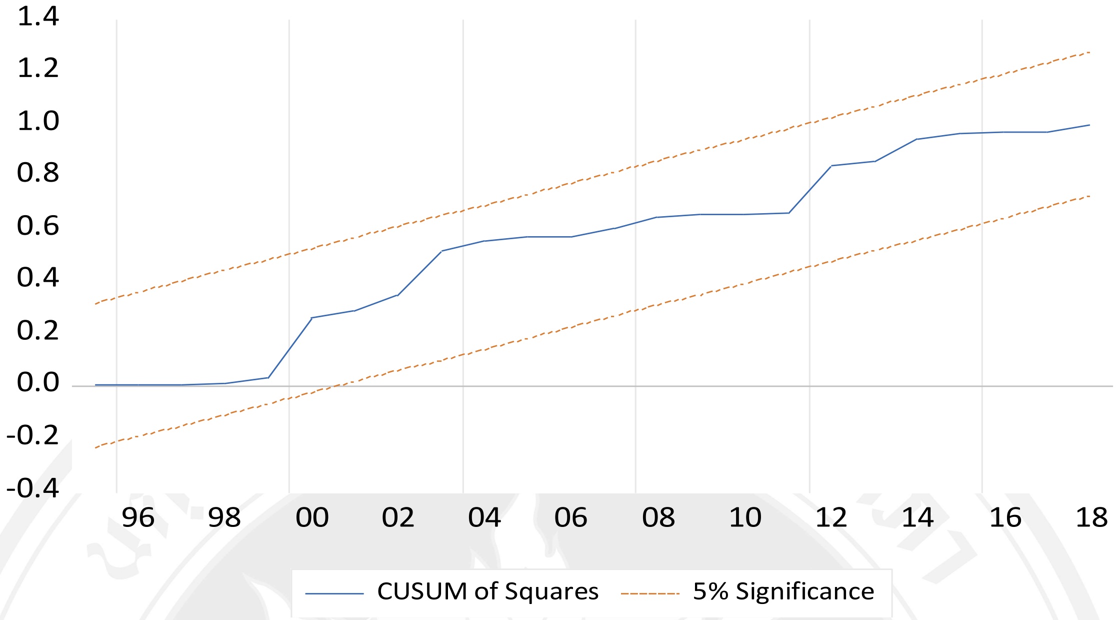


Figure 4.5 CUSUM of Squares Test on the Model from Equation (38)

Since the income effect dominates in Thailand, the relative risk aversion is equal to three. From the theoretical perspective, the UHC scheme is recommended over the CPS as it promotes good health, GDP, consumption, savings, and even economic stability under the limitation of public debt level. There is also empirical evidence to support that the UHC scheme in Thailand produces an income effect. The healthcare subsidy Granger causes household savings, in a negative direction in the long run, but a positive direction in the short run. Households choose to consume goods in the first two years; after that, they choose to have more leisure. Consequently, household savings decline. There is no evidence of the risk reduction effect in Thailand.

The health policy has a positive impact on household savings in Thailand. According to Equation (41) and the mean value of household savings in Table 4.1, household savings will rise by 60% if the government reduces the healthcare subsidy by 10%, thereby decreasing the income effect. This policy has a small negative impact on health, GDP and consumption (Figures 3.1–3.3).

CHAPTER 5

CONCLUSION

The theoretical general equilibrium model of a small open economy shows that the suitability of a health security system depends on IES or the degree of relative risk aversion for households. In cases such as Thailand, where the degree of relative risk aversion is more than one, the UHC scheme is recommended since it promotes GDP, consumption, savings, and even economic stability, depending on the condition of the public debt level. The public debt ceiling in Thailand is 60% (in 2020), but its optimal debt-to-GDP ratio is 42% (Tangkanjanapas, Thamma-Apiroam, & Dheera-aumpon, 2020). In contrast, the CPS is suitable for the countries where the degree of relative risk aversion is less than one.

The empirical evidence supports that the UHC scheme in Thailand exhibits the income effect. This effect has a greater impact on leisure than consumption once subsidized healthcare has been in operation for two years. After this time household savings are likely to decline, resulting in indebtedness in the long run.

The CPS is considered appropriate in situations where public debt has reached its ceiling, or policymakers want to solve the problem of high household debt. Schemes such as 10% Copay can encourage households to save up to 60% during their working lives. Full government subsidies (UHC) should be limited to disabled or retired persons because these groups are not involved in the labor supply and will therefore be exempt from the income effect.

This study has the following limitations. Firstly, the values of all parameters are calibrated from the literature, and secondly, the data on government health expenditure regarding the UHC scheme in Thailand is annual, which is not sufficient for testing. Therefore, the percentage of government health expenditure on total health expenditure is used as a proxy for the UHC scheme.

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APPENDICES

Appendix A

Mathematica Code (Wolfram Research, 2021) for Calibrated Steady States

```
alpha = 0.34; beta = 0.4; gamma1 = 0.15; gamma2 = 0.43; x = 0.69; rf = 0.015;
A = 1; H = 1; g = 0; tao = 0.05; n = 0.35; k1 = (A*alpha/(1 + rf))^(1/(1 - alpha));
w = A*k1^alpha - A*alpha*k1^alpha; theta = 0.5; u = 0;
sol = FindRoot[{((1 - tao)*w*beta*gamma2*x*(H^(1 - theta))*(1 - lsol)/(1 - u)) -
      gamma1*((1-lsol)^(x*(1- theta)))*(msol^(theta*x+1-x)) - beta*gamma2*(H^(1
      - theta))*msol == 0, ((beta*gamma2*x/(1 - u))^(1/ theta))*((1 + rf)/(1 + rf +
      (beta*(1 + rf))^(1/theta)))*((1 - tao)*w* lsol - (1 - u)*msol) - ((msol^(theta*x +
      1 - x))/((H^(1 - theta))*((1 - lsol)^((1 - theta)*(1 - x)))))^(1/theta) == 0},
      {msol,0.03, {lsol, 0.7805}083935661508393566 15ponG00}];
m = msol /. sol[[1]]; l = lsol /. sol[[2]];
c1 = (1 +  rf)*((1 - tao)*w*l - (1 - u)*m)/(1 +  rf + (beta*((1 + rf))^(1/theta)));
k = k1*l; b = (1 - tao)*w*l - ((1 - u)*m) - k - c1; c2 = (1 + rf)*k + (1 + rf)*b;
h = H*(m^x)*((1 - l)^(1 - x)); y = A*((k/(1 + n))^alpha)*(1^(1 - alpha));
d = (g + u*m - tao*w)*(1 + n)/(n - rf); s = k1+b;
{m, l, c1, c2, k, b, h, y, d}
```

Appendix B

Dynare Code (Adjemian et al., 2011) on Octave (Eaton, Bateman, Hauberg, & Wehbring, 2021) for Conduct the Impulse Response Over the Shock on Health Technology

```
var y, C1, C2, r, w, M, H, h, b, d, S, l, k;
varexo e, taul, n, rf, A, g, Gh;
parameters alpha, beta, gamma2, gamma1, rhoh, x, zeta;
alpha = 0.34; beta = 0.4; gamma1 = 0.15; gamma2 = 0.43; rhoh = 0.95; x = 0.69;
zeta = 3;
model;
beta*(1+r(+1))*(C2(+1)^(-zeta)) = C1^(-zeta);
beta*(1+rf(+1))*(C2(+1)^(-zeta)) = C1^(-zeta);
beta*(1-x)*gamma2*(H(+1)^(1-zeta))*(M^(x*(1-zeta)))/((1-l)^(x+(zeta*(1-x))))
        + gamma1*(1-l)^(-zeta) = (1-taul)*w*(C1^(-zeta));
beta*x*gamma2*(H(+1)^(1-zeta))*((1-l)^((1-zeta)*(1-x)))*(1/M^((zeta*x)+1-x))
        = (1-Gh)*(C1^(-zeta));
w = A*(1-alpha)*(k(-1)^alpha)*(l^(-alpha));
1+r = A*alpha*(k(-1)^(alpha-1))*(l^(1-alpha));
d - ((1+rf)*(1/(1+n)))*d(-1) = g -(taul*w*l)+ (Gh*M);
C1 = (1-taul)*w*l - (1-Gh)*M - b - k; C2 = (1+r)*k + (1+rf)*b(-1); S = k+b;
ln(H) = rhoh*ln(H(-1))+ e; h= H*(M(-1)^x)*((1-l(-1))^(1-x));
y = (1/1+n)*C2 + C1 + k + M + g - d + ((1+rf)*(1/(1+n)))*d(-1) + b
        - (1+rf)*b(-1)*(1/1+n);
end;
initval;
C1 = 0.2; C2 = 0.05; l = 0.8; k = 0.15; taul = 0.05;  Gh = 0.99; g = 0; w = 0.4;
r = 0.02; M = 0.1; y = 0.5; H = 1; e = 0.001; A = 1; b = 0; rf = 0.015; d = 0;
h = 0.05; n = 0.35;
 end;
resid(1);
```

```
steady(solve_algo= 0 , maxit=1000);
check;
shocks;
var e; stderr 0.01;
end;
stoch_simul(order=1, periods = 400);
```

BIOGRAPHY

Name-Surname	Mr.Pongsak Thaweesatidsatean
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Experience	Working as a medical physician at the Veterans General Hospital, Bangkok, Thailand in 1994, and then at the Metropolitan Administration Lat-Krabang Hospital, Bangkok, Thailand from 2010 to 2017. Subsequently, working as a professional-level medical physician at Khlong-Sam-Wa hospital, Bangkok, Thailand.