The Impact of Monetary and Fiscal Policies on Poverty Incidence Using Financial Computable General Equilibrium (FCGE): Case Evidence of Thailand

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Abstract

Purpose: The main objective of this paper is to analyze the impact of monetary and fiscal policies on poverty line and income distribution of the bottom 20 percentile to the top 20 percentile. The worsening or improvement of poverty incidence is then determined by the relative dominance of these two factors: poverty line and income distribution.

Design/Methodology/Approach: To analyze these impacts, we used Financial Computable General Equilibrium (FCGE) model, a model that merge Social Accounting Matrix (2005) and Flow-of-Funds (2005) of Thailand. This approach integrates the real sector and financial sector within an economy and offers economic wide impact when a shock is transmitted.

Findings: Firstly, we conclude that in a short run the expansionary fiscal policy (increase in government spending) is more effective than the expansionary monetary policy in narrowing the income distribution and improving the income of the bottom 20% of the population. Using expansionary monetary policy such as decreasing the interest rate or the reserve requirement in the hope that easy credit will entice businesses to invest in human capital will no longer work due to the alternatives that businesses have such as investment in financial instruments. Secondly, expansionary monetary policies in a short run would improve the income distribution and income of the bottom 20% of the population only until certain threshold before the effects are reversible. In the long run, monetary policy that aimed at low inflation and stable aggregate demand would permanently improve poverty incidence.

Practical Implication: Policy makers should take into account both poverty line and income distribution when analyzing a poverty incidence of a country. A decline in poverty line is not necessarily a positive news when this is accompanied by a large gap in income distribution, vice versa, an increase in poverty line is not necessarily a negative news when the income gap narrows.

Originality: This paper analyzes the economic wide impact of monetary and fiscal policies on poverty incidence using simultaneous equations modelling (FCGE) that look at propagation of shocks transmission through the real sector and financial sector

Keywords: Poverty Incidence, Income Distribution, Poverty Line, Financial Computable General Equilibrium

1. ***Introduction***

This research paper is looking at the impact of Thailand's macroeconomic policies – both monetary and fiscal policies on the poverty line and income of the poor households. A lot of studies have shown that economic growth is an important factor in reducing poverty. In order to achieve the economic growth, it is necessary for a country to have macroeconomic stability. While, we agree that macroeconomic stability promotes growth, we find it rather ambiguous to conclude that this will also improve a country's poverty situation. There is another factor that is often being overlooked in describing the poverty and that is income of the poor households. Due to this, when macroeconomic stability impacts GDP growth and price, the implication on poverty is uncertain since poverty is critically determined by both income of the poor households and the poverty line.

In Figure 2.1, when there is either a positive monetary shock such as Fed moves to lower the interest rate or a fiscal shock such as government increases its spending, then the AD curve will shift up, to the right. This will increase the GDP (stimulate growth) and increase the price (higher inflation). The poverty line will increase since the poverty line is a function of price but the magnitude will depend on the elasticity of the curve. An increase in poverty line ceteris paribus would mean an increase in the number of people that fall below the poverty threshold. Simultaneously, an increase in GDP will increase the income of the poor but the magnitude of the shift depends on the elasticity of income. In this situation, we have growth that improves the income of the poor but at the same time increase the country's poverty line. A favorable situation is reflected by the darker line in the third quadrant where we have a small increase in poverty line but higher increase in average income of the poor.

<Insert Figure 2.1>

In Figure 2.2 below, if we have contractionary economic policy that resulted in the shift of AD curve down, then the GDP (growth) and price (inflation) will decline. As a result, the poverty line will decline but income of the poor households will also decrease. The magnitude of change varies depending on the elasticity of these curves. The worst situation is depicted by the darker shaded line whereby the decrease in income of the poor dominates the small decrease of poverty line implying that most likely more households will fall below the poverty line.

<Insert Figure 2.2>

From this broad conceptual framework, we extend our investigation on the impact of fiscal and monetary shocks on poverty line and income distribution using Financial Computable General Equilibrium (FCGE) model. In FCGE we could trace the channel of a shock before it hit our final target and our aim is to calculate whether the percentage change in income distribution (relative income of the poor households to the rich households) or the percentage change in the poverty line has greater effect as a result of fiscal or monetary policies. Furthermore, we will illustrate in detail the data used and the construction of the FCGE. As we had mentioned earlier, any growth policy should take into account two aspects: income inequality/ income distribution and poverty line. By examining the impact using FCGE, we will have a solid conclusion on the changes in poverty line versus changes in income distribution.

2. Literature Review

A lot of studies have been done on growth and its impact on poverty. Dollar and Kray (2000) in their study of 92 countries in the past four decades have shown that growth on average benefits the poor as much as others in the society and so standard growth enhancing policies should be at the center of any effective poverty reduction strategy. However, they don't deny the effect on the

income share of the poorest quantile but were unable to relate them to any changes across countries and over time. Ames, Brown, Devarajan and Izquierdo (2001) argued that economic growth is the single most important factor influencing poverty and macroeconomic stability is essential for high and sustainable growth. Nevertheless, according to them this will work effectively in some situation than others depending on the impact of growth on poverty measured by distributional income and sectoral composition of growth. Another study by Lin (2003) argued that the selection of growth policies should maximize the sum of income and inequality using a new poverty reduction index. By drawing an example of China, she showed that although the economic growth implemented between 1985 and 2001 has successfully reduced the poverty, the effectiveness of poverty reduction was declining due to the rising in income inequality. Bourguignon (2004) established the poverty-growth-inequality triangle and acknowledge that the real challenge in establishing development strategy to reduce poverty is the interactions between growth and distributions and not the interactions between growth and poverty or poverty and inequality separately. This implies that the mechanism of linking growth to poverty and inequality is more complex and not direct. Fan et.al (2004) research on government spending and poverty reduction in Vietnam has shown that government investment in agricultural research followed by roads and education has the largest poverty reduction. The same conclusion was reached for rural Uganda by Fan et.al (2004). In investigating the contractionary policy such as the reduction in government spending, Buiter (1988) has shown the importance in distinguishing between the cuts in public consumption expenditure and public sector capital formation since they would have different effect on deficit.

Azis (2009) has linked hypothetically the macroeconomic policies that stimulate growth to poverty line and income of the poor households. He further used Indonesia Financial Computable General

Equilibrium (FCGE) model to illustrate the possible impact on poverty line and income of the poor households when there is a macroeconomic shock. In his model, the economic growth has caused the poverty incidence to rise due to the higher decline in income distribution that dominates the slight increase in poverty line. The usage of Computable General Equilibrium (CGE) model is one of the most popular approaches in investigating the impact of economic shocks such as policy changes and exogenous events on poverty and inequality. Robinson and Lofgren (2005) were among the two leading scholars in developing/extending the approaches of using FCGE in macro models and poverty analysis. In their specifications, they cautioned that the ability of CGE to analyze at macro-end depended on its macro closures and due to limited data and information on the processes that underlie the portfolio choices and expectations formation, the impact on short run equilibrium and its distributional impact remained limited. Earlier study for instance by Cockburn (2001) used CGE to model all the households from the national representative households survey data in investigating the impact of fiscal reforms and trade liberalization on poverty and inequality. Another study by Mahjabeen (2008) that have refined the specification in CGE model investigated the impact of microfinancing in Bangladesh and concluded that microfinance institutions indeed help to increase the income and the consumption of households, enhance the welfare and reduce inequality. Finally, Taylor and Resensweig (1984) were among the earliest study to use the Thailand CGE to analyze the effect of exchange rate, fiscal and monetary policies on economic growth, investment and national income. In addition to Hazledine (1992) various usage of CGE/FCGE in investigating the economy-wide impact, one still has to be cautioned of the limitation that such model imposed. In particular, as mentioned by Hazledine (1992), among the weaknesses of CGE/FCGE are shortages of data, micro foundations and the macro closures defined in closing the big aggregated model. Another critique by Devarajan and

Robinson (2002) has outlined several arguments in which the CGE model has enlightened the debate on policy analysis but at the same time they considered the misuse of CGE in policy analysis. One of the interesting points that they mentioned was the 'Black Box' syndrome in which the results of the policy changes are not transparent/opaque.

Nevertheless, our research will contribute further to existing literatures that have used FCGE by testing Azis (2009) claim empirically using Thailand as our case study. As mentioned earlier, it is not a straight-forward solution in determining the impact of growth on poverty line and average income of the poor. These effects are inter-related and occur simultaneously and sometimes due to limited data and information underlying our portfolio choices, the short run equilibriums obtained may be limited. However, the choice of using FCGE is still the best option in looking at growth and poverty analysis that requires using the multi-sectoral, multi class model and here we accompanied our FCGE approach with the graphical approach described earlier.

5. Data and Methodology:

The data used in constructing our FCGE is Thailand's Financial Social Accounting Matrix (FSAM). We will use the FSAM to develop the Financial Computable General Equilibrium (FCGE) model. The FSAM is a combination of Flow-of-Funds and Social Accounting Matrix (SAM).

5.1. A 2004 Social Accounting Matrix (SAM) for Thailand

In this paper, we will be using the SAM 2004 shown in Table 2.1. SAM is a snapshot of an economic activity for one particular year and all the values shown are the aggregated amount of transactions taken place from one sector to another. The SAM was constructed by Thailand Development Research Institute (TDRI) and it included 114 production factors, two types of

factors of production (labor and capital), the private sector (households and enterprise), the government, and the rest of the world. Puttanapong (2008) compressed the 114 production factors into 3 main sectors, agricultural, manufacturing and services and using this, we disaggregated the household sector into five categories of households based on their income level: HHH5 referred to the top 20% of households with the highest income, HHH4 referred to the next top 20% of households with the second highest income, HHH3 referred to the next top 20% of households with the third highest income, HHH2 referred to the next top 20% of households with the fourth highest income and finally HHH1 referred to the bottom 20% of households with the lowest income in the economy. The main objective of disaggregating the household sector is to see the impact of any shocks on income distribution – defined as the ratio of HHH1 to HHH5. Table 2.1 below shows the SAM of Thailand for the year of 2004 along with the interpretation of each cell.

<Insert Table 2.1>

5.2. A 2004 Flow-of-Funds (FoF) Accounts of Thailand

The flow-of-fund is constructed using the balance sheet for 10 institutions, 13 financial assets and one fixed asset. Since flow-of-funds represent the changes in assets and liabilities, we have to take the difference of the balance sheet items in 2004 and 2003 to construct it. These values are then categorized into two separate tables; sources of funds (liabilities) and users of funds (assets). Take note that in the flow-of-funds accounts, the demand and supply of each asset are equal. Table 2.2 shows the standard flow-of-funds table publicly available on the website of Thailand Office of National Economic and Social Development Board (NESDB). However, for the households' accounts, we have disaggregated them into five separate categories similar to our approach in the SAM table. In addition, we have combined the account for the central government and the local government into one account (government) and combined the account for incorporated business

(BINC) and state enterprise business (BSE) into one account (enterprise) to make it compatible with the institutions that we have in our SAM table.

<Insert Table 2.2>

5.3. A 2004 Financial Social Accounting Matrix (FSAM) of Thailand

Using both the data from our SAM table and flow-of-funds table, we can construct the FSAM table which will be the basis of our FCGE model. The row and column 17th of Table 2.1 earlier shows the capital account (KA) which is the saving and investment of each institution in the economy. This account will be disaggregated into capital account for each institution, in other words we will add more rows and columns to our standard SAM table (Table 2.1) to include the assets and institutions data obtained from our flow-of-funds (Table 2.2). Each transaction in flow-of-funds are then being filled in its own corresponding cells of the 'new extended' SAM, producing our 2004 Financial Social Accounting Matrix or FSAM. The FSAM shows the inter-connection between the real sector activities and the activities in the financial market via saving-investment account. When an institution saves, the income that they have obtained from the activities in the real sector such as profit and wages will be used to acquire financial assets or to invest in productivity activities. The transfer of these savings from real sectors activities to investment in the financial assets or the fixed asset is the linkage of SAM and Flow-of-Funds. Table 2.3 shows an example of FSAM table depicting the transactions between the standard SAM table and the data obtained from the flow-of-funds accounts.

<Insert Table 2.3>

5.4. A 2004 Financial Computable General Equilibrium (FCGE) Model of Thailand

The financial computable general equilibrium (FCGE) is a combination of computable general equilibrium (CGE) model and flow-of-funds transactions. Our construction of FCGE will follow

closely the models developed by Azis (2002), Manopiniwes (2005) and Puttanapong (2008) with exception that we had extended our model to include the block of poverty line and income distribution between the rich and the poor households. Azis (2002) has developed the FCGE model for Indonesia followed by Manopiniwes (2005) who developed one for Thailand using 1998 financial SAM as its base data. Manopiniwes (2005) was looking at the impact of environmental policies in Thailand's economy that has incorporated both financial market and real sectors. Puttanapong (2008) then proposed a structural FCGE that used 2004 financial SAM as its data in looking at the economic wide impact of shocks to foreign and domestic interest rate in addition to applying Monte-Carlo simulation technique to examine the volatilities in both financial and real markets. Our model is nevertheless an extension of what have been developed by Manopiniwes (2005) and Puttanapong (2008). We extended the existing model by incorporating poverty line and income distribution in order to analyze the impact of macroeconomic shocks such as government spending, interest rate, reserve requirement and wages on different categories of households. We illustrate here the basic equations used which are taken from Puttanapong (2008). Following his approach, we will divide the equations into two main categories, core module and financial module. The core module consists of all the activities and transactions that would essentially exist in the CGE model while the financial module shows the transactions in the flow-of-funds. At the end of both modules, we introduce our extension that is the poverty block which consists of poverty line equations and income distribution.

5.5. Core Module of FCGE

The key specifications in the core model are:

1. Three production sectors (agricultural, manufacturing and services), two factors of production (labor and capital), four types of taxes (direct tax, indirect tax, tariff and

subsidy), nine institutions (government, rest of the world, enterprise and another five categories of households described earlier – HHH1, HHH2, HHH3, HHH4, HHH5).

2. The exchange rate and the current account balance are endogenous variables (FSAV).
3. The government spending is an exogenous variable while the government saving is an endogenous variable.
4. The marginal propensity to save (MPS) is an endogenous variable while the investment (invest) is an exogenous variable.
5. Labor and capital are mobile and while capital is at full capacity, the labor is not fully employed.

The equations in the core model can be divided into five separate blocks: price block, production block, income block, expenditure block, and system constraint block. All the equations used in this FCGE model are listed in Appendix 2.

5.5.1. Price Block

The price block shows the equations for prices used in the model. Equations (1) and (2) define the domestic import price and the domestic export price that are affected by the world import price (PWM_{im}) and the world export price (PWE_{ie}) along with endogenous exchange rate and taxes. Equation (3) shows the total amount of composite goods/goods in the domestic market (PQ_i*Q_i) for each sector as the summation of total goods produced locally and total goods imported. Equation (4) shows the value of total output produced as the summation of total goods produced domestically (consumed domestically) and total goods exported abroad. Equation (5) shows the price of value added as the difference of after-tax price of output and the share price of composite goods. The price index in Equation (6) is defined as the ratio of value-added GDP to the real GDP.

Finally in Equation (7), we have the price of capital goods by sector of destination to be the share of price of composite goods.

5.5.2. Production Block

The production block shows the activities for each production sector and represents the supply side of our CGE model. The production process of Armington composite goods is described using the constant elasticity of substitution (CES) function and the transformation of the gross domestic output into goods consumed domestically or goods exported abroad is described using constant elasticity of transformation (CET) function. In Equation (8) we have the total output produced by sector i as a Cobb-Douglas function of labor and capital. In Equation (9) we have derived the factor demand for labor and capital from our cost minimization of Cobb-Douglas function. The optimal demand for labor and capital depends on wage rate and cost of capital. In Equation (10), the quantity of intermediate input goods is the share of input output coefficient on the total output produced by sector i. Equation (11) is based on the assumption of imperfect substitution/imperfect transformation between exports and domestic goods supply in addition to the assumption that the firms can transform their domestically produced goods into goods that are sold abroad (export) and sold domestically. The transformation process in Equation (11) is the CET function. Equation (12) shows the supply ratio that is the relative demand of our exported goods to the domestically sold goods as a function of their prices, share parameters and parameter defined by elasticity of transformation. In Equation (13), we have the quantity of goods exported determined by the relative sectoral price of world exports and the sectoral price of world exports substitutes. Equation (14) is a production process using CES function that shows the quantity of Armington composite goods as a combination of imported and domestic goods. Finally, in Equation (15), the ratio of

imported goods over the goods sold domestically is determined by their relative prices, input share coefficients and parameter defined by the elasticity of substitutions.

5.5.3. Income Block

The income block consists of equations that show the total income and the total saving of the economic players in our model. The income flows from value added (labor and capital) to the institutions and finally into the hands of households. Equation (16) shows the factor income for each labor and capital as the summation of the product of the demand for each factor across sector and their average wages or cost of capital. Equation (17) defines the total income for private institutions (households and enterprise) as the summation of income received from the supply of their labors (wages), capital (rent) and transfer from the government (e.g. subsidies) and the rest of the world (remittance) along with other inter-institutional transfers. In Equation (18), the tariffs collected are defined as the proportion of imported tariff rate across sectors on aggregated value of imported goods. Equation (19) defines the aggregated indirect tax as a function of tax rate and aggregated total output. In Equation (20), the aggregated tax collected from the household sector is a summation of income tax rate across each category of households on their respective total income. Equation (21) shows the total private saving that depends on their marginal propensity to save and its disposable income. In Equation (22), we have the total government revenue as the summation of tariff, indirect tax, household tax and other transfers from other institutions to the government. Finally, in Equation (23) we define the aggregated saving as the summation of private saving and government saving less the saving from overseas.

5.5.4. Expenditure Block

The expenditure block completes the cycle of the core module by showing the equations that represent the consumption and investment of each economic player. Equation (24) defines the household consumption on good i that depends on marginal propensity to consume off their disposable income and the price of composite goods. In Equation (25), we have the total income of each private institution as the summation of their expenditure/consumption, saving, tax payment and inter-institutional transfers. Equation (26) defines the government consumption for each sector as a fixed proportion of government total expenditure. Equation (27) shows the government revenue that depends on the government saving, transfer from the government to other institutions (e.g. subsidies, benefits) and the total value of government consumption on each sector. In Equation (28), we have the changes in inventories for each sector as a ratio of inventory investment to its output on the total output produced for each sector. In Equation (29), the aggregated fixed investment is defined as the total investment in the economy less the summation of the changes in inventory for each sector. Equation (30) defines the investment in each destination sector as a fixed proportion of total fixed investment. Finally, Equation (31) shows the amount of capital goods i used for investment that depends on the capital matrix coefficients and the volume of investment in each destination sector.

5.5.5. System Constraints Block

The system constraints block shows the balance of supply and demand side for each market in the economy. In Equation (32) we have the equilibrium in the composite good i market as the summation of demand for intermediate inputs i, households consumption on good i, governments consumption on good i, the amount of good i used for investment and the capital inventory of good i. Equation (33) shows the total factor demand employed as the summation of the demand for each

factor across the sectors. Equation (34) shows the current account balance (FSAV) which is the difference between capital flowing in via exports and foreign transfers with the capital flowing out. The assumption of saving-investment balance is represented in Equation (35) where the total saving equals to total investment and a slack variable for correcting the model since the equilibrium price vector may not cleared all the markets. Equation (36) defines the nominal GDP using the value-added approach and finally in Equation (37), we have the real GDP computed using conventional way of summing across the consumption, investment, government expenditure and trade balance.

5.6. Financial Module of FCGE[1]

The equations in the financial module show the behavioral specifications of six institutions[2] we have in the flow-of-funds, precisely the use and the source of their funds. The main assumption is that there is a market clearing mechanism in which total quantity supplied of each asset equals to its total quantity demanded (quantity clearing concept). Furthermore, there exist exogenous factors that would determine the quantity supplied and quantity demanded and the market will clear with at least one endogenous variable. In Figure 2.20, we have the linkage of core module and financial module through saving and investments transactions while Table 2.4 shows the structure of financial module and its corresponding equations available in Appendix 2.

<Insert Table 2.4>

[1] There are variables in the equations that have bar/line above it indicating that these are exogenous variables.
[2] The six institutions are Bank of Thailand (BOT), government, Rest-of-the-World (ROW), households (HHH), banks and enterprise.

5.6.1. Households' Behavioral Specifications

In Equation (38), we defined the households' portfolio (*HHPORTS)* as its allocation in equities and bonds[3]. Due to imperfect substitutions between the financial assets, the main assumption in portfolio decision is that it is based on hierarchical process. In other words, households need to make pairwise comparisons between one particular assets vis-a-vis other assets. Equations (39) to (42) calculate the relative return of investing in different types of bonds and using these, one can establish the weighted average return of investing in each asset. For instance, in Equation (43), *GH1* illustrates the proportion of households' portfolio invested in equity assets based on its return on equity versus its weighted average return of investing in the other five bonds. Similarly for Equations (44) to (47), the proportions of households' investment in a particular financial asset is based on its return from that asset versus its weighted average return of investing in others (hierarchical process). In Equations (48) to (53), we have households demand for these assets financed by bank loans ($SOF\_S_{LO,HH}$ in Equation 54), non-listed equities ($SOF\_S_{EQNL,HH}$ in Equation (55)) that include household savings, income from the interest rate ($INTEXPADJ_{HH}$ in Equation (56)) and capital gains from the investment in foreign assets ($EXRADJ_{HH}$ in Equation (57)). Equations (58) to (60) show the households demand for foreign assets induced by the exchange rate, real GDP and interest rate differential between domestic interest rate and foreign interest rate. In Equation (61) we have the households demand for fixed assets ($UOF\_F_{FIXED,HH}$) and in Equation (62) is its cash holding ($UOF\_F\_D_{CH,HH}$).

[3] There are five type of bonds in our module: Government Bonds (GB), Bank of Thailand Bonds (BOTB), Financial Institutional Development Fund Bond (FIDFB), State-Owned Enterprise Bond (SOEB) and Corporate Bond (CBOND).

5.6.2. Enterprise' Behavioral Specifications

The enterprise demands for financial assets are specified in Equations (63) for fixed assets *(UOF_S$_{FIXED,\ ENTP}$),* in Equation (64) for deposit *(UOF_S$_{DE,\ ENTP}$),* in Equations (75) to (76) for foreign assets *(UOF_S$_{FA,ENTP}$)* and in Equation (78) for cash *(UOF_S$_{CH,ENTP}$).* The source of financing comes from loans (*SOF_S$_{LO,\ ENTP}$* in Equation (65)), listed equities (*SOF_S$_{EQL,ENTP}$* in Equation (66)), bonds (*SOF_S$_{SOEB,\ ENTP}$* in Equation (68) and *SOF_S$_{CBOND,\ ENTP}$* in Equation (71)), non-listed equities (*SOF_S$_{EQNL,\ ENTP}$* in Equation (72)), net interest on its financial investment (*INTEXPADJ$_{ENTP}$* in Equation (73)) and capital gains on foreign assets (*EXRADJ$_{ENTP}$* in Equation (74)). The price of equity listed in Equation (67) and the price of bonds in Equations (68) and (69) are set as endogenous variables that equilibrate the supply and the demand for each asset.

5.6.3. Banks' Behavioral Specifications

In Equation (79), we have the banks' portfolio defined as the summation of the banks demand/investment in equity and bonds. Following the structure of households' behavioral specifications, we defined the relative return of investing in combination of assets to its total value (Equations (80) to (83)). Using these, we can construct the proportion/weighted average of return on banks allocation to each asset defined in Equations (84) to (88). In Equation (89) to (94), the banks will make pairwise comparison of investing in a particular asset vis-à-vis other assets. For instance in Equation (90), *UOF_S$_{GB,\ BANK}$* specifies the banks investment in government bonds that are influenced by the return on government bonds itself (GB2) and the weighted average of return from investing in other available assets other than equity (1-GB1). The source of banks financing comes from non-listed equity (SOF_S$_{EQNL,BANK}$ in Equation (95)) , net interest on banks investment (*INTEXP$_{ADJBANK}$* in Equation (96)) and capital gains from investing in foreign assets (*EXRADJ$_{BANK}$*

in Equation (97)). Finally, Equations (98) to (100) specify the total amount of banks investment in foreign assets as a function of exchange rate, interest rate differential and real GDP.

5.6.4. Government's Behavioral Specifications

The main function of the government is in policy-making and in order to investigate the effect of fiscal policies in our model, we have to set the policy instruments such as government spending and taxes as exogenous variables. In Equations (101) and (103), we have defined the source of government funds in the financial market that come mainly from issuing bonds. There are two types of bonds that Thailand government issues: government bonds and Financial Institution Development Fund Bonds (FIDFB). The government bonds are issued to finance the government expenditures while FIDFB are issued to inject capital into financial institutions that are affected from the 1997 Asian Financial Crisis. These equations are derived by equalizing the total supply and the total demand while the prices of these bonds in Equations (102) and (104) govern the market equilibrium for the bond market. Other source of government funds come from non-listed equities that include the net interest income from holding various financial assets ($INTEXPADJ_{GOV}$) and the net capital gain on foreign assets ($EXRADJ_{GOV}$). Finally in Equation (107), the cash that the government holds come from its own saving and net interest on its financial assets.

5.6.5. Bank of Thailand (BoT)'s Behavioral Specifications

In Equation (108), we have the total supplied of BoT bonds that is equals to its total demand. One of the sources of BoT's funds come from issuing bonds and in Equation (109), we have defined the prices of these bonds that provide equilibrium in the bond markets. In Equation (110) to (112), we have other sources of funds for BoT that come from its non-listed equities ($SOF\_F_{EQNL,BOT}$) ,

net interest from the return of its assets ($INTEXPADJ_{BOT}$) and capital gain from foreign assets ($EXRADJ_{BOT}$). The deposit held in Equation (116) comes from the banks deposit with BoT and this includes reserve requirements and other type of deposits. In Equations (117) to (120), we constructed the money multiplier that determines the money supply, M2 in Equation (121). One of the objectives of monetary authority is to control inflation through price stabilization. Hence, the amount of cash that BoT decides to hold in Equation (122) will be determined by the loan interest rate and the real GDP in the economy. Any inflation targeting policy is done through bond repurchased market in Equation (123).

5.6.7. Rest of the World (RoW)'s Behavioral Specifications

In our model, the RoW is linked to other domestic institutions through capital account. The demand for Thailand's domestic assets for the year of 2004 in Equations (124) to (128) depends on the expected exchange rate and the interest rate differential, that is the difference between interest earned from holding that particular asset and foreign interest rate[4]. Finally, in Equation (129) to (133), we have the total stocks of financial assets that are held by RoW as the summation of its current year (2004) investment and the aggregated investment from the previous year.

5.6.8. System Constraint Specifications

In Equations (134) and (135), we have aggregated assets and liabilities stocks for the current year as the summation of previous year stocks and the current year flows. Equations (136) and (137) showed the equilibrium for each institution uses and sources of its funds. In Equation (138), we defined total investment as the aggregated investment in fixed assets across all the institutions. Equation (139) shows the uncovered interest parity (UIP) relation in which the interest rate

[4] In Puttanapong (2008), the foreign interest rate is set as the average Fed Funds Rate in 2004.

differentials depend on the expected exchange rate and exchange rate itself. Equation (140) defined the interest rate spread as the difference between the loan interest rate and the deposit interest rate while in Equations (141) to (145), we have the relative return of investing in each financial asset over depositing the cash with the banks. If the relative return is positive, then investors would choose the alternative than to save their cash. Equations (146) and (147) provide the linkage between the core module and the financial module through savings of both households and enterprises that depend on marginal propensity to save, income and direct tax. The government saving in Equation (148) depends on government income and its expenditure. Finally, the current account balance (*FSAV*) and the exchange rate influence the rest of the world saving in Thailand's economy (Equation 149).

5.6.7. Poverty Block Specifications

The main reason of introducing the poverty block is to calculate the poverty line and the income distribution. In Equation (150), we first defined the average price of domestic goods (*PDAVG*) and in Equation (151), we constructed the poverty line as a function of average price of domestic goods, price index, sectoral share parameter and the aggregated domestic prices for the sectors used in our model. Finally, Equation (152) showed the income distribution as the relative income of the lowest 20% of household in the economy to the top 20% of households in the economy.

6. Results and Analysis

6.1. Shock 1: Increase in Government Expenditure

In this shock, we increased the government expenditure (*GDTOT*) to see its impact on poverty line and income distribution. In Figure 2.22, we have the poverty line that increases as the government expenditure increases. As expected, when the government increases its spending, the

aggregate demand curve would shift to the right (outward) leading to an increase in price and GDP. Since the poverty line is a function of price, an increase in price leads to an increase in poverty line which is shown below (Figure 2.22).

<Insert Figure 2.22>

In Figure 2.23, we have the income distribution of the bottom 20% of the population to the top 20% of the population and since income of the bottom 20% of the population increases at a rate higher than income of the top 20% of the population, the income distribution improves. Take note that the impact of initial percentage of shock (up to 5%) causes steeper changes to these variables than the subsequent increments. This is because in CGE model, our baseline model has exogenized certain variables and when we shock the model, some of these initial exogenized variables are being endogenized. This is one of the critiques of CGE model as mentioned by authors such as Hazledine (1992) about the macro issues that arise when closing the model in aggregate.In Figure 2.24, we have the income of the bottom 20% of the population and the level of RGDP (Figure 2.25) that increase as the government increases its expenditure.

<Insert Figure 2.23>

<Insert Figure 2.24>

<Insert Figure 2.25>

Since our main goal is to investigate the poverty incidence, we now look at Figures 2.26, 2.27 and 2.28. The trend lines for these graphs show that a 1% increase in RGDP leads to 0.1998% increase in the income of the bottom 20% of the population (Figure 2.28) but only 0.0008% increase in the price index (Figure 2.26). The increase in the price index is almost negligible that it almost has no effect on the increase in the poverty line (Figure 2.27).

<Insert Figure 2.26>

<Insert Figure 2.27>

<Insert Figure 2.28>

Since our two approaches of using elasticity has shown significant improvement of income distribution to the increase in government spending and an almost negligible response of poverty line to the same shock, we conclude that the poverty incidence has improved.

The results show that in our FCGE model, when the government increases its total expenditure (*GDTOT*), the final demand of government consumption for agricultural, manufacturing and services sectors' products will also increase (GD_i in Equation (26)) which will affect the total domestic consumption (Q_i in Equation (32)). An increase in total domestic consumption will affect the prices (Equation (3)), the composition of imported goods (*M*) and domestic goods (*D*) (Equations (13) and (14)) and the total output for each sector (*PX*X* in Equation (4)). The increase in the prices will also affect the household consumption (Equation (24)). This will ultimately affect the real GDP (Equation (36)) and the value added GDP (Equation (37)). Since the price index (*PINDEX*) is the ratio of value added GDP over the real GDP (Equation (6)), the change in this ratio affects the price index and the poverty line (Equation (151)). The effect on the total output of each sector (X_i) will affect the wages and the rent (Equation (9)) which means affecting the factor income for labor and capital ($YFCTR_f$ in Equation (16)). Some of these factor incomes would be saved and some will be invested back into the productivity sector (*Invest* in Equation (29)). The amount that will be saved and invested in these real sectors will then be linked to our financial sector (Equations (137) and (138)). This will affect the enterprise portfolio ($UOF\_S_{FIXED,ENTP}$ in Equation (63)) and households portfolio ($UOF\_F_{FIXED,HH}$ in Equation (61)). The change in their

portfolio will finally determine the total income of domestic institutions (YH_{dprivt} in Equation 25). From this, we could determine the income distribution as the ratio of total income of the bottom 20% of the population to the total income of the top 20% of the population (Equation (152)). Finally, take note that the income of the bottom 20% of the population in Figure 2.24 is converging to a certain level (diminishing marginal return) as the government keeps on increasing its expenditure.

6.2. Shock 2: Decrease in Government Expenditure

One of the contractionary fiscal policies that we have in the model is to reduce the government spending. In Figure 2.29 below, we have the poverty line declining as the government decreases its expenditure. In the standard economic theory, any contractionary fiscal policy would shift the aggregate demand curve to the left (downward) resulting in the decrease of price and GDP. Since poverty line is defined as a function of price, a decrease in price leads to a decrease in poverty line.

<Insert Figure 2.29>

In Figure 2.30, our model shows that the income distribution improves although the income of the bottom 20% of the population is declining (Figure 2.31). Unlike in Shock 1, whereby the increase in government expenditure would benefit the income of the bottom 20% of the population, the contractionary fiscal policy however, would lower their total income. The income distribution improves because the declined in the income of the top 20% of the population is greater than the declined in the income of the bottom 20% of the population.

<Insert Figure 2.30>

<Insert Figure 2.31>

Our next step is to calculate the poverty incidence as a result of this shock. In Figure 2.32, the trend line shows that a 1% increase in the RGDP leads to 0.0022% increase in the price index, which means that the change in the poverty line would almost surely is negligible as well (Figure 2.33). Similarly, the elasticity of income to the output in Figure 2.34 also shows a very insignificant change. A 1% increase in the RGDP leads to null (0.0000%) increase in the income of the bottom 20% of the population.

<Insert Figure 2.32>

<Insert Figure 2.33>

<Insert Figure 2.34>

In our FCGE model, when the government decreases its total expenditure (*GDTOT*), the final demand of government consumption for agricultural, manufacturing and services sectors' products will also decrease (GD_i in Equation (26)) which will affect the total domestic consumption (Q_i in Equation (32)). A decrease in total domestic consumption will affect the prices (Equation (3)), the composition of imported goods (*M*) and domestic goods (*D*) defined in Equations (13) and (14) and the total output for each sector (*PX***X* in Equation (4)). The decrease in the prices will also affect the household consumption (Equation (24)). This will ultimately affect the real GDP (Equation (36)) and the value added GDP (Equation (37)). Since the price index (*PINDEX*) is the ratio of value added GDP over the real GDP (Equation (6)), the change in this ratio affects the price index and the poverty line (Equation (151)). The effect on the total output of each sector (X_i) will affect the wages and the rent (Equation (9)) which means affecting the factor income for labor and capital ($YFCTR_f$ in Equation (16)). Some of these factor incomes would be saved and some will be invested back into the productivity sector (*Invest* in Equation (29)). The amount that will

be saved and invested in these real sectors will then be linked to our financial sector (Equations (137) and (138)). This will affect the enterprise portfolio ($UOF\_S_{FIXED,ENTP}$ in Equation (63)) and households portfolio ($UOF\_F_{FIXED,HH}$ in Equation (61)). The change in their portfolio will finally determine the total income of domestic institutions (YH_{dprivt} in Equation (25)). As in the earlier shock, the income of the bottom 20% of the population in Figure 2.31 is converging to a certain level (diminishing marginal return) as the government keeps on decreasing its expenditure.

6.3. Shock 3: Increase in Interest Rate

Our third shock that is an increment in the interest rate is one of the contractionary monetary policies. We would expect that an increase in the interest rate would shift the aggregate demand curve to the left (downward) resulting in lower GDP and lower price. Since the poverty line is a function of price index, a decrease in price index leads to a decrease in poverty line (Figure 2.35). In Figure 2.36, we can see that the income distribution worsens before diminishing to a constant level and income of the bottom 20% of the population in Figure 2.37 also drops significantly as a response to the initial shock before converges/diminishes to a constant level. This shows that unlike contractionary fiscal policy described earlier, contractionary monetary policy has negative effect on both income distribution and income of the bottom 20% of the population.

As the interest rate increases by 100 basis points (1 percent), the RGDP decreases. A decrease by $1 billion in RGDP leads to a declined in Price Index by 0.2639 (slope in Figure 2.38) and income of the bottom 20% of the population (Y^{Poor}) to decrease by $2.4732 billion of bath for the steeper part of the graph as indicated by its slope in Figure 2.40 and a declined to $137 billion of bath which is a drop by $42 billion bath for the flatter part of the same graph. A declined in Price Index by 0.2639 leads to a decline in Poverty Line by 0.2315 (Figure 2.39). Due to this, we conclude that

the poverty incidence worsens since the bottom 20% of the population will lose significant amount of income compares to a small number of people that will be above the poverty line.

<Insert Figure 2.35>

<Insert Figure 2.36>

<Insert Figure 2.37>

<Insert Figure 2.38>

<Insert Figure 2.39>

<Insert Figure 2.40>

In our model, any changes in the level of targeted interest rate (*RRN "Lo"*) would affect the amount of money supply (*M2*) in the economy defined in Equations (118) and (122). The amount of money ($SOF\_S_{CH,BOT}$ in Equation (122)) coming from Bank of Thailand (BoT) declines and hence M2 will also decline. In addition, the loan interest rate also affects the amount of bank loans that households and enterprises could borrow from the banks defined in Equations (54) and (65). Since the interest rate is rising, the demand for bank loans declines and the deposit interest rate also increases (Equation (140)) due to the fixed interest spread that we have set in our model. The relative return from investing in other financial assets will decrease since the deposit interest rate increases (Equations (141) to (145)). The exchange rate appreciates (Equation (139)) but the demand for Thai's loan from the rest of the world will decline (Equation (129)). At the same time, the changes in the interest rate would also determine the households and enterprises' decisions to invest in the fixed assets (Equations (61) and (63)) and the net return that they will obtain from their investment across different financial assets (Equations (56) and (96)). Since the compositions of their portfolio have changed, the total amount invested in the real sector has also changed (Equation (138)). The share distribution of investing in these real sectors is defined in Equation

(29) and the effect on the prices and the quantities are defined in Equations (7) and (31). Finally, these changes will affect the RGDP in Equation (37) and the value added GDP in Equation (36). Furthermore, we have assumed that the wages are fixed but the labor supply is unlimited due to migration. However, the rent is an endogenous variable but it is operating at full capacity. As described earlier, the increase in interest rate affects the prices and the quantities of goods in the economy. The total output for each sector (X_i) and the prices decline (Equation (7)) causing the labor supply (*FDSC*) and the rent to decrease ($WF_{capital}$) in Equation (9). The decrease in the rent causes the income of the enterprises to decrease (Equation (17)). As income of the enterprises is reduced, its transfer (*DTRANS*) to households and government is reduced as well. The reduction in the transfer from enterprises, the lower cost of capital and the lower labor supply causes the income of the households to reduce as well (Equation (17)). Since the effect of this reduction depends on the share parameter of each household (*FSHARE*), some households would have more impact than others, explaining the income distribution between the two groups of households. Finally, it is to be noted that similar to the previous two shocks, the highest impact arises at the beginning of the shocks (first 1%) was due to endogeneizing certain variables that we have initially exogenized in the baseline model. Furthermore, the effect exhibits diminishing marginal return as the shock continues consistent with the economic theory and Azis (2009) framework.

6.4. Shock 4: Decrease in Interest Rate

In this shock, we are looking at one of the expansionary monetary tools, decreasing the interest rate. One would expect that when the level targeted interest rate decreases, the aggregate demand curve will shift to the right (upward) resulting in an increase in the price index and GDP. In Figure 2.41, the poverty line increases as the interest rate decreases since the poverty line is defined as an increasing function of price. The income distribution improves when interest rate decreases up

until 150 basis points before declining and eventually level out when the interest rate reaches 250 basis points (Figure 2.42). The income of the bottom 20% of the population follows the similar pattern of income distribution (Figure 2.43). This intuitively suggests that decreasing the interest rate while does improve the income distribution in an economy will eventually have diminishing effect as the shock continues.

Analysis I: Increasing part of the Graph in Figure 2.46

We assume that the interest rate decreases only up to 150 basis points. A $1 billion increase in RGDP leads to Price Index increases by 0.2578 and income of the bottom 20% of the population to increase by $2.0977 billion bath. The increase in the Price Index by 0.2578 leads to an increase in the Poverty Line by 0.2194.

Analysis II: Decreasing part of the Graph in Figure 2.46

We assume that the interest rate continues to decrease more than 150 basis points. A $1 billion increase in RGDP leads to a decline in Price Index by 0.2578 and income of the poor (Y^{Poor}) decreases by $6.2458 billion bath.

Analysis III: Level Part of the Graph in Figure 2.46

Now we assume that the interest rate continues to decrease above 250 basis points. The only change here is the drop in the income of the bottom 20% of the population to a level $179.080 billion bath, which is its initial level prior to the shocks.

<Insert Figure 2.41>

<Insert Figure 2.42>

<Insert Figure 2.43>

<Insert Figure 2.44>

<Insert Figure 2.45>

<Insert Figure 2.46>

In our model, when the level of targeted interest rate decline, it increases the amount of Bank of Thailand money supply in Equations (121) and (122). It also increases the amount of loan demand by enterprise in Equation (65) and by households in Equation (54). At the same time, the amount of investment in the fixed assets will increase (Equations (61) and (63)). Since the fixed assets is defined as the investment in agricultural, manufacturing and services sectors, Equation (138) relates this changes in financial market to the real sector. Equation (30) shows the impact of an increase in fixed investment to the composite prices in the economy and since the interest rate is lower, there is a higher demand for Thai's export and a decline in their import which subsequently will affect the real GDP in Equation (37) and value-added GDP in Equation (36). The rise in investment leads to higher transfer from enterprises to households. As the interest rate continues to decrease, the cost of borrowing becomes cheaper for enterprises (Equation (65)) and for households (Equation (54)) and there will be a continuous rise in the demand for fixed assets. However, since we have defined in our model that the capital is utilized at its maximum capacity (Equation (63)), the decline in the interest rate will be offset by the decline in the fixed assets investment by the enterprise due to the crowding out effects. Up until 150 basis points, the income of the bottom 20% of the population is increasing because of an increase in the labor supply and the cost of capital along with higher transfers from the enterprises (Equation (9)). However, as the interest rate continues to decline beyond 150 basis points, the decline in the fixed assets investment causes the labor supply to decrease and the income of the bottom 20% of the population to decrease as well until eventually it converges to an equilibrium level which is the level before the shocks.

6.5. Shock 5: Increase in Reserve Requirement

One of the contractionary monetary tools that we tested in our model was an increased in the reserve requirement. An increase in reserve requirement shifts the aggregate demand curve leftward, resulting in a decrease in price index and real GDP. As mentioned in our earlier analysis, the poverty line will decrease since it is a function of price index (Figure 2.47). The income distribution improves gradually (Figure 2.48) although there is no change in the income of the bottom 20% of the population (Figure 2.49). This is because the income of the top 20% of the population is declining while the income of the bottom 20% of the population is unchanged. Our model has shown that a decrease by $1 billion bath of RGDP leads to a decline in Price Index by 0.2516 (Figure 2.50) and no impact on the income of the bottom 20% of the population. Since the Price Index declines by 0.2516, the Poverty Line will decline by 0.21881 (Figure 2.51), implying that the improvement is too small that in our conclusion for this shock, the impact on poverty incidence is negligible (Figure 2.52).

<Insert Figure 2.47>

<Insert Figure 2.48>

<Insert Figure 2.49>

<Insert Figure 2.50>

<Insert Figure 2.51>

<Insert Figure 2.52>

Our model has shown that a decrease by $1 billion bath of RGDP leads to a decline in Price Index by 0.2516 and no impact on the income of the bottom 20% of the population. Since the Price Index

declines by 0.2516, the Poverty Line will decline by 0.21881, implying that the improvement is too small that in our conclusion for this shock, the impact on poverty incidence is negligible.

When the reserve requirement is increased, the deposit by banks ($Uof\_F_{DE,BANK}$) with BOT will increase but the source of deposit ($Sof\_F_{DE,BANK}$) with the banks will decrease (Equation (153)). It also affects the amount of money supply in Equations (119) to (120). Since the amount of deposit with BOT by banks has increased in Equation (116), this leads to a decline in the loans available for households and enterprises (Equations (54) and (65)). From Equation (137), the used of flows of assets must equals to the source of the flows of assets and the aggregated saving. Hence, the change in the composition of these sources flows due to lower sources of loans (SOF_S_{LO}) will also change the amount invested in the fixed assets (Equation (138)). The amount invested in the fixed assets will then affect the volume of investment by sector of destination (DK) and the prices of capital goods (PK) by sector of destination in Equation (30). These effects will further impact the amount of capital goods in each sector used for investment (ID) and the prices of composite goods (PQ) before reaching the value added GDP in Equation (36) and real GDP in Equation (37). Although the income of other groups of households decline, the income of the bottom 20% of the population is unchanged (Figure 2.49) because the increase in the transfer from enterprises to households 1 offsets the decline in the labor supply and the cost of capital in Equation (9). One possible explanation for the increase in the transfer from enterprises to households 1 is that there is an increase in the domestically produced goods from agricultural sector (labor intensive) and manufacturing sector (capital intensive) while the services sector shows a significant drop. Since the agricultural and manufacturing sectors employed mostly households 1, we can see a greater transfer from enterprises to this group but a drop in the services sector output lead to a decline in the labor demand for this group resulting in the unchanged of households 1 level of income.

6.6. Shock 6: Decrease in Reserve Requirement

Another shock that we have tested in this model is to decrease the reserve requirement. Since this is an expansionary monetary policy, a decrease in reserve requirement will shift the aggregate demand rightward and increase the money supply. In Figure 2.53, we have the level of poverty line that is increasing as the reserve requirement decreases since poverty line is a function of price index. In Figure 2.54, it shows the income distribution declines as the reserve requirement continues to decrease and gradually converges to a lower level. Although the income of the bottom 20% of the population is unchanged due to the shock (Figure 2.55), the increase in the income of the top 20% of the population causes the income distribution to declines to a level where the marginal effect diminishes. From this model, a $1 billion increase in the RGDP leads to an increase in Price Index by 0.216 (Figure 2.56) and an unchanged amount in the income of the bottom 20% of the population. An increase in the Price Index by 0.216 leads to an increase in the Poverty Line by 0.1851 (Figure 2.57). In our point of view, the impact on poverty incidence is significantly very small that it is almost negligible (Figure 2.58).

<Insert Figure 2.53>

<Insert Figure 2.54>

<Insert Figure 2.55>

<Insert Figure 2.56>

<Insert Figure 2.57>

From this model, a $1 billion increase in the RGDP leads to an increase in Price Index by 0.216 and an unchanged amount in the income of the bottom 20% of the population. An increase in the Price Index by 0.216 leads to an increase in the Poverty Line by 0.1851. In our point of view, the impact on poverty incidence is significantly very small that it is almost negligible.

In this model, when we decrease the reserve requirements, the deposits by banks ($Uof\_F_{DE,BANK}$) with BOT will decrease and the source of deposits ($Sof\_F_{DE,BANK}$) with the banks will increase (Equation (153)). The amount of money supply will also be affected as defined in Equations (118) to (121). Since the amount of required deposits with BOT by banks has declined in Equation (116), the amount of loans supply to the households and enterprises will increase (Equations (54) and (65)). The higher increase in the amount of loans available will affect the investment in the fixed assets (Equation (138)). The amount invested in the fixed assets will then affect the volume of investment by sector of destination (*DK*) and the prices of capital goods (*PK*) by sector of destination in Equation (30). These effects will further impact the amount of capital goods in each sector used for investment (*ID*) and the prices of composite goods (*PQ*) before reaching the value added GDP in Equation (36) and real GDP in Equation (37).

In Figure 2.55, we have the income of the bottom 20% of the population that is unchanged. This is because the decrease in the transfer from enterprises to households offsets the increase in the labor supply and the cost of capital in Equation (9). Unlike the increase in reserve requirement that shows an increase in the domestic consumption of agricultural and manufacturing sectors, the decrease in reserve requirements on the other hands shows an increase in domestic output (X) of services sectors. This increase include an increase in domestic sales and exports of services products (Equation (4)) which least employed the bottom 20% of the population. Hence, the transfers from enterprises to this group of households in agricultural and manufacturing sectors decline but the rise of labor supply in services sectors (since the wages is fixed) and the rise of cost of capital due to the higher demand for investment in the fixed assets will offset one another.

7. Conclusion

7.1 Concluding Remarks

We started this paper with a claim that growth is not necessarily good for economic development especially when taking into account the poverty incidence. Our definition of poverty incidence looks at two factors: income inequality and poverty line. Motivated by Azis (2009) framework in dealing with such issues, we have taken FCGE approach to validate our claim. In our approach, we extend the FCGE model developed by Puttanapong (2008) by introducing different group of households in the economy and defining new equations that will capture the poverty line and income distribution. The choice of using FCGE over CGE is more realistic in depicting the current economy in which any changes in the financial sector will have significant impact on the real sector. The FCGE can be used to analyze the interactions between real sectors and financial sectors via saving-investment linkages, for e.g. how monetary policy affects the behavioral of different economic agents while CGE only look at the interactions within the real sectors.

Next, we shocked our FCGE model with government and central bank policies to analyze the poverty incidence in the economy. Specifically, we looked at government spending (fiscal policy), interest rate and reserve requirement (monetary policies). Our results have shown that the impact on the poverty line as a function of price is as expected – when there are contractionary policies that reduce the price, the poverty line will also be reduced, and vice versa. However, the poverty line is relatively insensitive to the price suggesting that the magnitude of the effect is little. This is as expected since the effect on the prices take effect in the long run as a result of short run stabilization policies (Calmfors, 1982).

The increase in government expenditure (expansionary fiscal policy) will improve both the income of the bottom 20% of the population and the income distribution in Thai's economy. The result is as expected since many recent and earlier studies have argued that government investments contribute to poverty reduction. Fan et al. (2004) research on government spending

and poverty reduction in Vietnam has shown that government investment in agricultural research followed by roads and education has the largest poverty reduction. The same conclusion was reached for rural Uganda by Fan et.al (2004). We concluded that an increase in government spending policy would improve the poverty incidence since it contributed additional $3 billion bath to the income of the bottom 20% of the population while the response of poverty line to price was almost negligible in our model, suggesting that the additional number of people that fall below the poverty line is insignificant.

On the other hand, it is interesting to note that decreasing the government spending (contractionary fiscal policy) do not have the reverse effect to increasing the government spending. Both the effect on poverty line and income of the bottom 20% of the population are very small that it is negligible. The income distribution does improve due to the fact that income of the top 20% of the population is declining more than the income of the bottom 20% of the population. Since the impact on income and poverty line are relatively very small, we conclude that the impact on poverty incidence is inconclusive. In our model, we have shocked the aggregated government expenditure while according to Buiter (1988), distinguishing between the government cuts in different activities would have different repercussion on deficit.

Now, in investigating the two monetary policies, we found that decreasing the interest rate up to 150 basis points would improve the income distribution and income of the bottom 20% of the population. However, continuous shock beyond 150 basis points would cause the positive impact to decline and eventually converge to the baseline level. Hence, decreasing interest rate only up to a certain level would improve the poverty incidence but eventually it will worsen the welfare in an economy. On the other hand, increasing the interest rate as expected would worsen the income of the bottom 20% of the population and also widen the income distribution as higher interest rate

would most likely benefits those that have financial assets. Under the shock of increasing the interest rate, we conclude that the poverty incidence worsens.

Another monetary policy that we have shocked in our model is decreasing the reserve requirement which has no effect on income of the bottom 20% of the population but income distribution widens after 100 basis points due to an increase in the income of the top 20% of the population. On the other hand, increasing the reserve requirement would gradually improve the income distribution despite no impact on the income of the bottom 20% of the population.

In looking at the monetary policy, Romer & Romer (1998) have argued that its effect on output, unemployment and inflation are temporary and although expansionary monetary policy will lead to temporary boom and temporary reduction in poverty and income distribution, this effect will be reversible as the inflation continues to rise or unemployment returning to its natural rate of unemployment. They suggested that comprehensive monetary policy that aims at low inflation and stable aggregate demand will most likely improve the conditions of the poor in long run. Some theories that have make comparison between the effectiveness of fiscal policies and monetary policies would argue in favor of one over the other in affecting the aggregate demand. The standard theory of Keynesian model argued that fiscal policy is more effective regardless of the exchange rate regime while Mundell-Fleming model that integrated flexible exchange rate into multi-market equilibrium argued in favor of monetary policy. A recent study by Weeks (2008) using empirical evidence of trade shares and interest rate differentials showed that fiscal policy is more effective than monetary policy for most countries in affecting aggregate demand. Weeks (2008) assumed flexible exchange rate but unlike Mundell and Fleming model, he included the price effect. Another support for this is Yao (2010) that argued on the effectiveness of fiscal policy than monetary policy in stimulating the economy as a response to the current financial crisis.

Hence, in concluding our results, we have to ask ourselves "Which policy-making is effective in improving the poverty incidence?" Admittedly, it is risky to derive an implications of each policy based solely on this model, but nevertheless we believe that three conclusions about the interaction between the fiscal and monetary policies with poverty incidence is warranted. Ideally, we would want to narrow the gap between the top 20% of the population and the bottom 20% of the population while improving the level of income for the bottom 20% of the population and ensuring that the number of people that falls below the poverty line is at acceptable level.

First, we conclude that in a short run the expansionary fiscal policy (increase in government spending) is more effective than the expansionary monetary policy in narrowing the income distribution and improving the income of the bottom 20% of the population. As mentioned by Weeks (2008), the effectiveness of monetary policy depends on the trade elasticity and interest rate differentials under the assumption of perfect capital mobility. Using expansionary monetary policy such as decreasing the interest rate or the reserve requirement in the hope that easy credit will entice businesses to invest in human capital will no longer work due to the alternatives that businesses have such as investment in financial instruments.

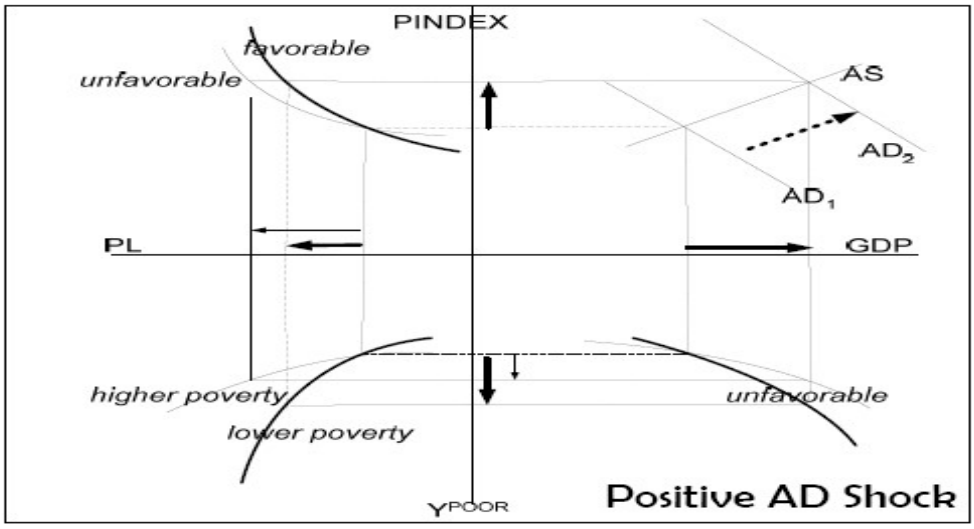
Secondly, using expansionary monetary policies in a short run would improve the income distribution and income of the bottom 20% of the population only until certain threshold before the effects are reversible. We have suggested one possible explanation for this reversible effect in our model is due to disproportionate transfer to agricultural, manufacturing and services sectors that would affect the income distribution. Romer & Romer (1998) agreed that the expansionary monetary policy improved the conditions of the poor in the short run due to the temporary cyclical boom but this effect is not permanent. In the long run, monetary policy that aimed at low inflation and stable aggregate demand would permanently improve their conditions. Although our model

provides only short run equilibrium, it is to note that excessive expansionary monetary policy shocks is detrimental to the welfare of the bottom 20% of the population.

Finally, our analysis suggests that if monetary policy were to be pursued for instance in curbing the inflation, it should be accompanied by other policies that ensure the effect to the bottom 20% of the population is not worsens. For instance, although the interest rate is increased, the government effectiveness in terms of its investment in the sectors that targeted the poor or investment in human capital will narrow the income distribution.

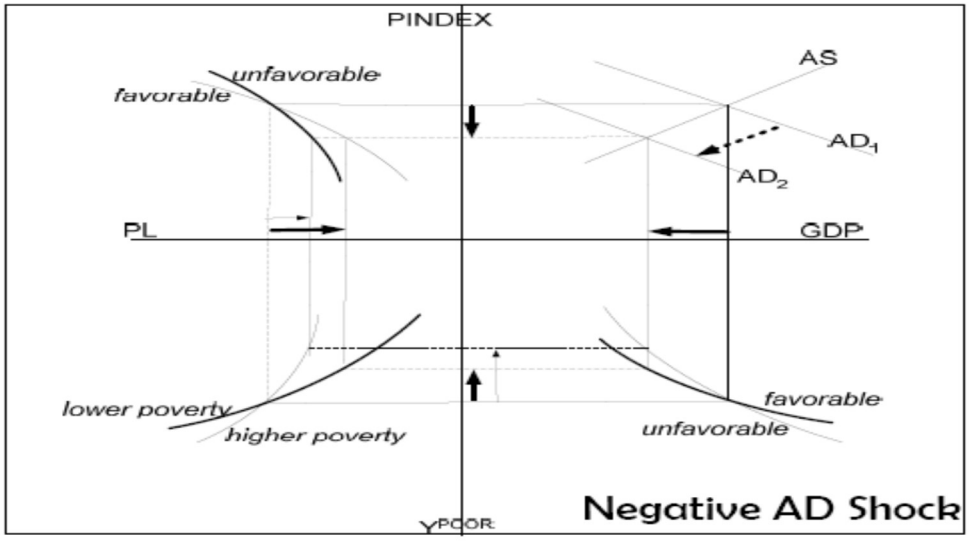
APPENDIX

Figure 2.1: The Impact of Positive Aggregate Demand Shock on Poverty Line and Income of the Poor



Source: Azis (2009)

Figure 2.2: The Impact of Negative Aggregate Demand Shock on Poverty Line and Income of the Poor



Source: Azis (2009)

Table 2.1: Thailand's Social Accounting Matrix in 2004 (billions of bath)

		Thailand Social Accounting Matrix (2007)																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		AGRI	MANU	SERVICE	LABOR	CAP	HHH1	HHH2	HHH3	HHH4	HHH5	ENTP	GOV	DIRTAX	INDTAX	TARIFF	SUBSIDY	KA	ROW
1	AGRI	84.274744	471.540458	78.794234	0	0	9.919662	17.292070	30.028021	67.891606	142.798697	0	1.578735	0	0	0	0	1.358319	66.185458
2	MANU	160.133455	4479.596924	1384.850347	0	0	59.928313	104.467736	181.410281	410.158081	862.699278	0	66.026459	0	0	0	0	1094.215672	3838.969818
3	SERVICE	96.178828	1455.457117	3537.715760	0	0	60.222464	104.980504	182.300711	412.171292	866.933733	0	653.708806	0	0	0	0	666.296011	682.704724
4	LABOR	431.282409	423.216932	1468.128171	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	CAP	125.307077	1677.361946	1684.386782	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	HHH1	0	0	0	85.991395	22.839473	0	0	0	0	0	79.053156	0	0	0	0	0	0	-8.774931
7	HHH2	0	0	0	149.901206	39.814967	0	0	0	0	0	137.805454	0	0	0	0	0	0	-15.296562
8	HHH3	0	0	0	260.306395	69.139474	0	0	0	0	0	239.301884	0	0	0	0	0	0	-26.562780
9	HHH4	0	0	0	588.537600	156.320324	0	0	0	0	0	541.047625	0	0	0	0	0	0	-60.056899
10	HHH5	0	0	0	1237.890916	328.793793	0	0	0	0	0	1138.003679	0	0	0	0	0	0	-126.319696
11	ENTP	0	0	0	0	2810.361774	0	0	0	0	0	0	0	0	0	0	0	0	0
12	GOV	0	0	0	0	59.786000	1.319104	2.299478	3.993088	9.028140	18.989214	0	0	422.622000	600.221880	93.582681	0	0	4.874009
13	DIRTAX	0	0	0	0	0	7.483229	13.044852	22.652642	51.216304	107.724973	220.500000	0	0	0	0	0	0	0
14	INDTAX	0	386.539758	213.682122	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	TARIFF	1.220490	92.355241	0.006950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	SUBSIDY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	KA	0	0	0	0	0	40.236321	70.140425	121.800230	275.383227	579.222797	454.649976	495.401594	0	0	0	0	0	-274.964560
18	ROW	73.265001	3656.387988	351.105584	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ABBREVIATIONS: AGRI: Agricultural, MANU: Manufacturing, SERVICE: Service, LABOR: Labor, CAP: Capital, HHH1: Households with income at the lowest 20% of income scale, HHH5: Households with income at the highest 20% of income scale, ENTP: Enterprise, GOV: Government, DIRTAX: Direct Tax, INDTAX: Indirect tax, TARIFF: Tariff, SUBSIDY: Subsidy, KA: Capital Account, ROW: Rest of the World

Table 2.2: Flow-of-Funds Account of Thailand in 2004

FLOW OF FUNDS ACCOUNTS OF THAILAND, 2004P

(MILLIONS OF BAHT)

	HH	BINC	GC	GL	BSE	RW	FINCON	TOTAL
A. NON FINANCIAL ACCOUNT								
1. GROSS SAVING	324,212	764,255	301,303	99,458	217,970	(265,812)	347,234	1,788,620
2. TRANSFER								0
3. GROSS CAPITAL FORMATION	137,360	1,143,724	117,363	102,113	216,474		44,836	1,761,870
4. PURCHASE OF LAND (NET)	(29,193)	13,410	7,240	995	5,136		2,412	0
5. STATISTICAL DISCREPANCY		49,564					(22,814)	26,750
6. TOTAL SURPLUS OR DEFICIT (-) (1+2-3-4-5)	216,045	(442,443)	176,700	(3,650)	(3,640)	(265,812)	322,800	0
B. FINANCIAL ACCOUNT								
I. ACQUISITION OF FINANCIAL ASSETS	**553,318**	**215,390**	**132,276**	**28,628**	**148,401**	**4,782**	**1,031,115**	**2,108,910**
1. CURRENCY	53,051	5,634	(14,903)		(800)			42,982
2. DEPOSITS	142,798	88,346	21,991	28,517	55,875		(13,640)	323,887
3. PUBLIC AUTHORITY SECURITIES	96,062	71,974	26,716		(17,290)		46,474	223,936
4. GOVERNMENT NON-BUDGETARY ACCOUNTS	890	8,008		(20)	(263)		(373)	8,242
5. CREDIT AND CAPITAL MARKET INSTRUMENTS	260,517	41,428	98,472	131	105,879	4,782	998,654	1,509,863
5.1 SHORT-TERM LOANS	819	120	22,831	(9)	39		16,816	40,616
5.2 LONG-TERM LOANS	5	7	(10,073)	(99)	3,924		515,260	509,024
5.3 COMMERCIAL BILLS	(35,544)	(45,542)	1,187		50,176		130,450	100,727
5.4 SHARE CAPITAL	209,824	78,484	20,816	6	37,351		(22,363)	324,118
5.5 DEBENTURES	(3,343)	8,497					31,338	36,492
5.6 LIFE ASSURANCE AND PENSION FUNDS	90,873							90,873
5.7 MORTGAGES							171,812	171,812
5.8 DEBTORS	3,564	18,404	17		24,915		261	47,161
5.9 HIRE PURCHASE DEBTS		73,720			(173)		46,896	120,443
5.10 INTERNATIONAL RESERVE POSITION							229,927	229,927
5.11 FOREIGN DEBTS AND CLAIMS		11,686	(1,289)		(9,475)	4,782	(11,751)	(6,047)
5.12 OTHERS	(5,681)	(103,948)	64,983	233	(878)		(109,992)	(155,283)
II. INCURRENCE OF LIABILITIES	**492,685**	**372,582**	**170,751**	**970**	**144,509**	**219,098**	**708,315**	**2,108,910**
1. CURRENCY			2,342				40,640	42,982
2. DEPOSITS			(13,640)				337,527	323,887
3. PUBLIC AUTHORITY SECURITIES			195,894		15,658		12,384	223,936
4. GOVERNMENT NON-BUDGETARY ACCOUNTS			8,242					8,242
5. CREDIT AND CAPITAL MARKET INSTRUMENTS	492,685	372,582	(22,087)	970	128,851	219,098	317,764	1,509,863
5.1 SHORT-TERM LOANS	(3,719)	(11,255)	14,379	305	21,611		19,295	40,616
5.2 LONG-TERM LOANS	172,877	316,411	6,037	323	20,738		(7,362)	509,024
5.3 COMMERCIAL BILLS	21,702	84,968	20,095		3,701		(29,739)	100,727
5.4 SHARE CAPITAL		111,635			22,645		189,838	324,118
5.5 DEBENTURES		27,291			8,747		454	36,492
5.6 LIFE ASSURANCE AND PENSION FUNDS					2,987		87,886	90,873
5.7 MORTGAGES	144,540	27,272						171,812
5.8 CREDITORS	9,128	15,666	382		19,888		2,147	47,161
5.9 HIRE PURCHASE DEBTS	111,708	8,735						120,443
5.10 INTERNATIONAL RESERVE POSITION						229,927		229,927
5.11 FOREING DEBTS AND CLAIMS		(63,843)	(59,989)		(9,797)	(10,829)	138,411	(6,047)
5.12 OTHERS	36,449	(144,298)	(2,991)	342	38,381		(83,166)	(155,283)
III. FINANCIAL SURPLUS OR DEFICIT (I-II)	60,633	(157,192)	(38,475)	27,658	(1,108)	(214,316)	322,800	0
C. SECTOR DISCREPANCY (A6-BIII.)	155,412	(285,251)	215,175	(31,308)	(2,532)	(51,496)	0	0

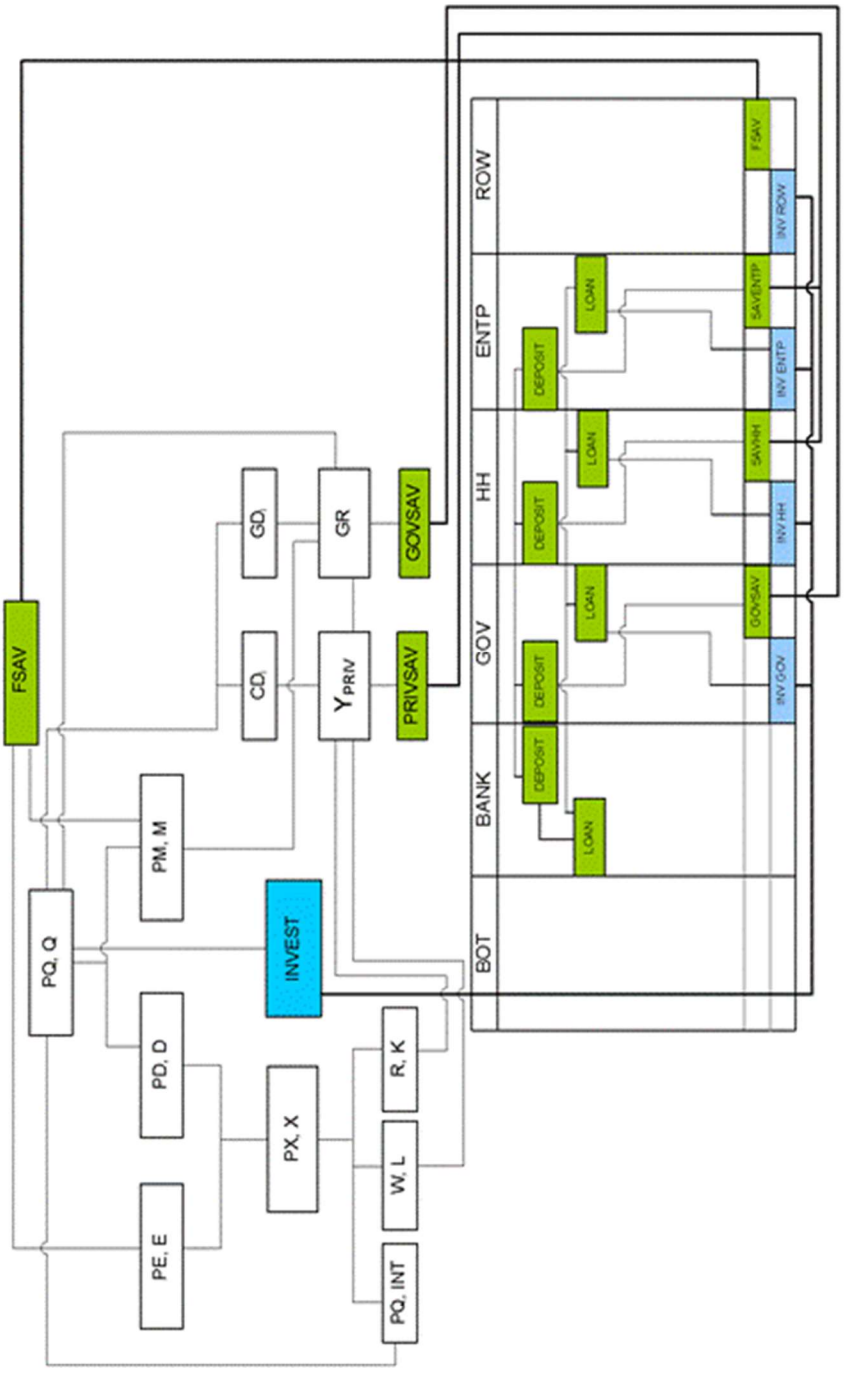
Abbreviations: HH : Households, GC: Central Government, GL: Local Government, RW: Rest of the World, Fin. Con: Financial Corporation, BSE: State Enterprise, Binc: Incorporated Business

Table 2.3: Structure of Financial SAM (FSAM)[5]

	Productions	Factors	HH	ENTP	Gov	ROW	Tariff	Taxes	KA.BOT	KA.BANK	KA.HH	KA.ENTP	KA.GOV	KA.ROW	Fixed Asset	Financial Assets
Productions	Intermediate Inputs		HH comsumption		Gov Consumption										Investment	
Factors	Value Added															
HH		Factor Income	Institutional Transfers													
ENTP																
Gov							Tariff Revenue	Tax Revenue								
ROW	Imports															
Tariff	Tariff															
Taxes	Indirect Taxes		Income Tax	Income Tax												
KA.BOT																BOT ΔLiabilities
KA.BANK																Bank ΔLiabilities
KA.HH			HH Saving													HH ΔLiabilities
KA.ENTP				ENTP Saving												ENTP ΔLiabilities
KA.GOV					Gov Saving											Gov ΔLiabilities
KA.ROW						ROW Saving										ROW ΔLiabilities
Fixed Asset											HH Investment	ENTP Investment	Gov Investment	Foreign Investment		
Financial Assets									BOT ΔAsset Portfolio	Bank ΔAsset Portfolio	HH ΔAsset Portfolio	ENTP ΔAsset Portfolio	Gov ΔAsset Portfolio	ROW ΔAsset Portfolio		

[5] (Source: Puttanapong (2008))

Figure 2.20: Connecting Core CGE Module and Financial Module [1]



[1] source: Puttanapong (2008)

	BOT		BANK		HH		ENTP		GOV		ROW		
	UoF	SoF	UoF	SoF	UoF	SoF	UoF	SoF	UoF	SoF	UoF	SoF	TOTAL
CH		Eq. 122	Endo		Endo		Eq. 78		Eq. 107				Eq. 136
DE		Eq. 116	Eq. 117	Eq. 118	Endo		Eq. 64		Endo		Eq. 125		Eq. 136
LO	Fixed		Endo			Eq. 54		Eq. 65	Fixed		Eq. 124		Eq. 136
RP		Eq. 123	Endo										Eq. 136
GB	Fixed		Eq. 90		Eq. 49					Eq. 101	Eq. 126		Eq. 136
BOTB		Eq. 108	Eq. 91		Eq. 50								Eq. 136
FIDFB			Eq. 92		Eq. 51					Eq. 103			Eq. 136
SOEB	Fixed		Eq. 93		Eq. 52			Eq. 68	Fixed				Eq. 136
CBOND			Eq. 94		Eq. 53			Eq. 70			Eq. 127		Eq. 136
EQL			Eq. 89		Eq. 48			Eq. 66			Eq. 128		Eq. 136
FA	Eq. 113		Eq. 98		Eq. 58		Eq. 75					Endo	Eq. 136
EQNL		Eq. 110		Eq. 95		Eq. 55		Eq. 72		Eq. 105			Eq. 136
OTH	Endo		Fixed			Endo		Endo			Fixed		
SAVING						Eq. 144		Endo		Eq. 148		Eq. 149	
INV					Eq. 61		Eq. 63		Fixed		Fixed		
TOTAL	Eq. 137		Eq. 137		Eq. 137		Eq. 137		Eq. 137		Eq. 137		

Table 2.4: Financial Module Equations

Figure 2.22: Level of Poverty Line (Index) in Thailand

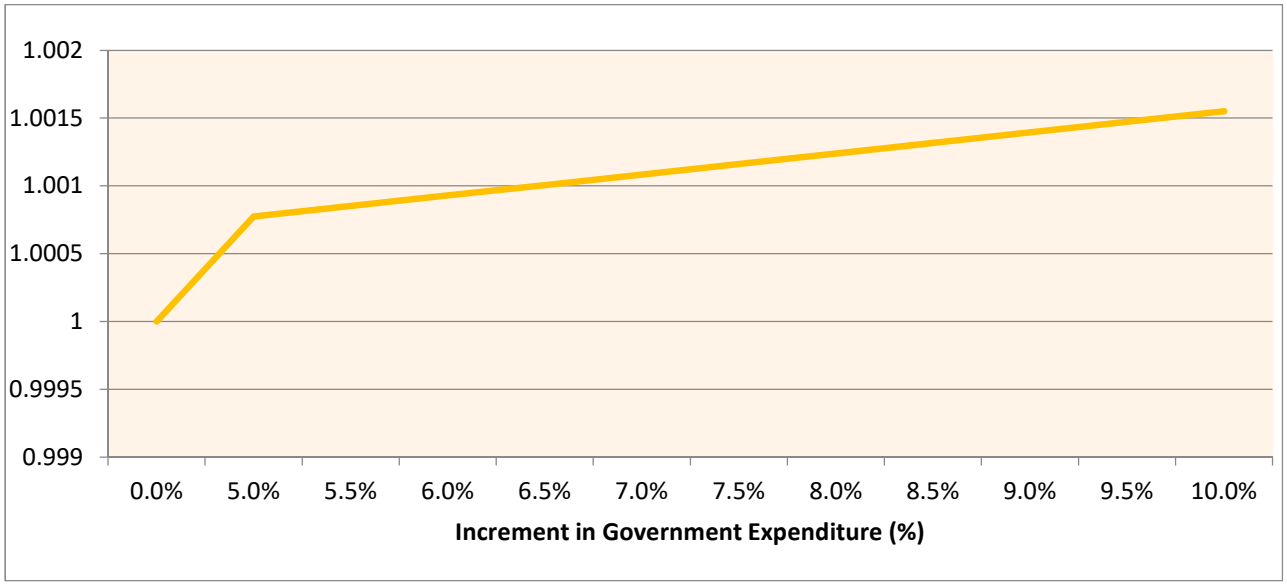


Figure 2.23: Income Distribution of the Bottom 20% of the Population to the Top 20% of the Population - Thailand (%)

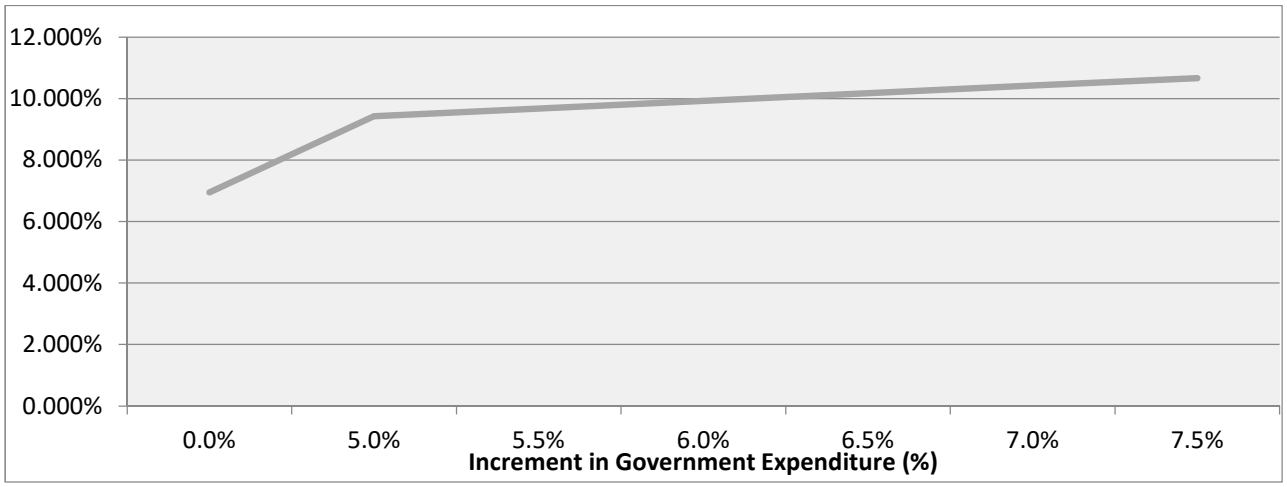


Figure 2.24: Income of the Bottom 20% of the Population - Thailand (billions of bath)

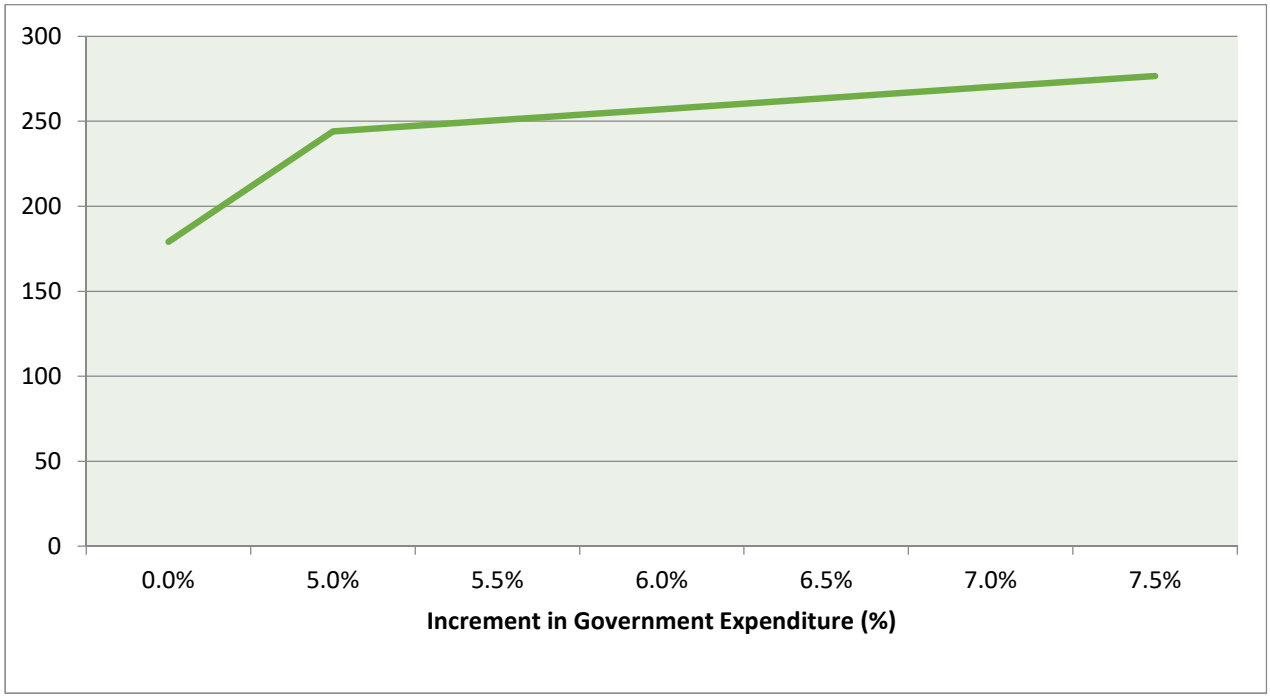


Figure 2.25: The Level of RGDP as the Government Increases its Spending - Thailand (billions of bath)

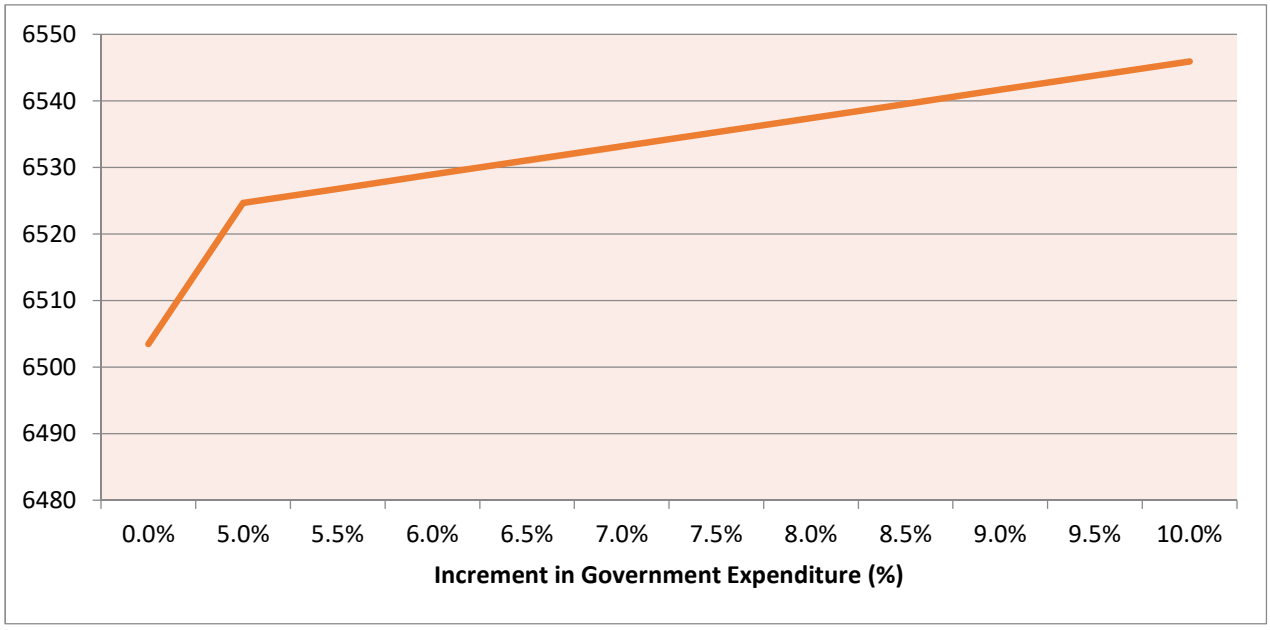


Figure 2.26: Price Index across the RGDP – Thailand

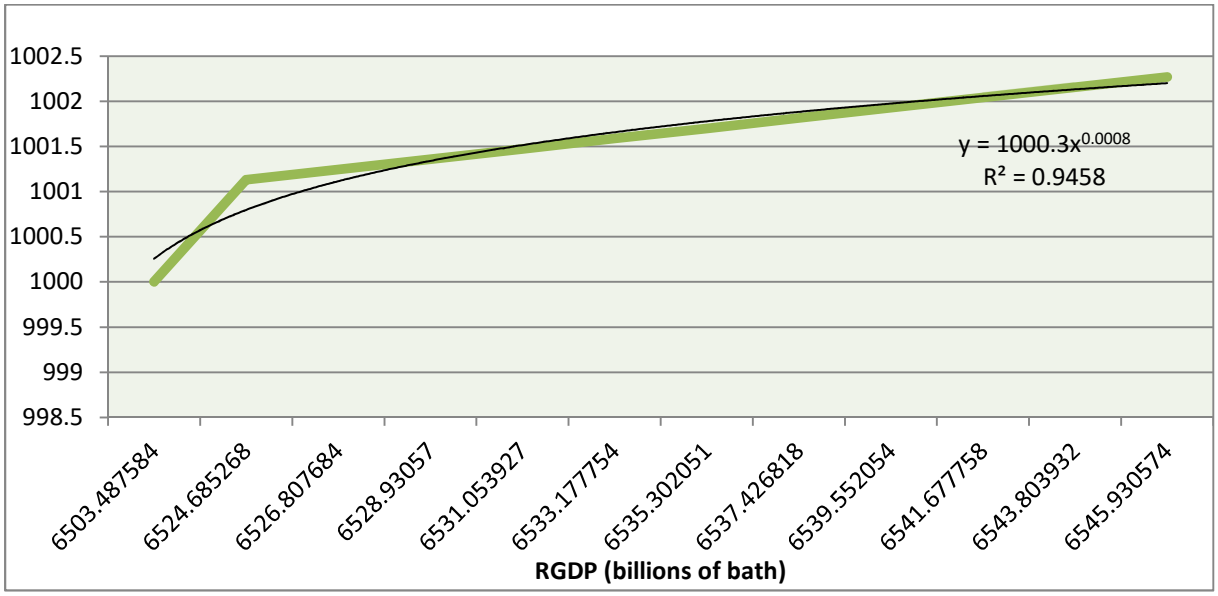


Figure 2.27: (Construction of Quadrant – 2) Price Index across the Poverty Line – Thailand

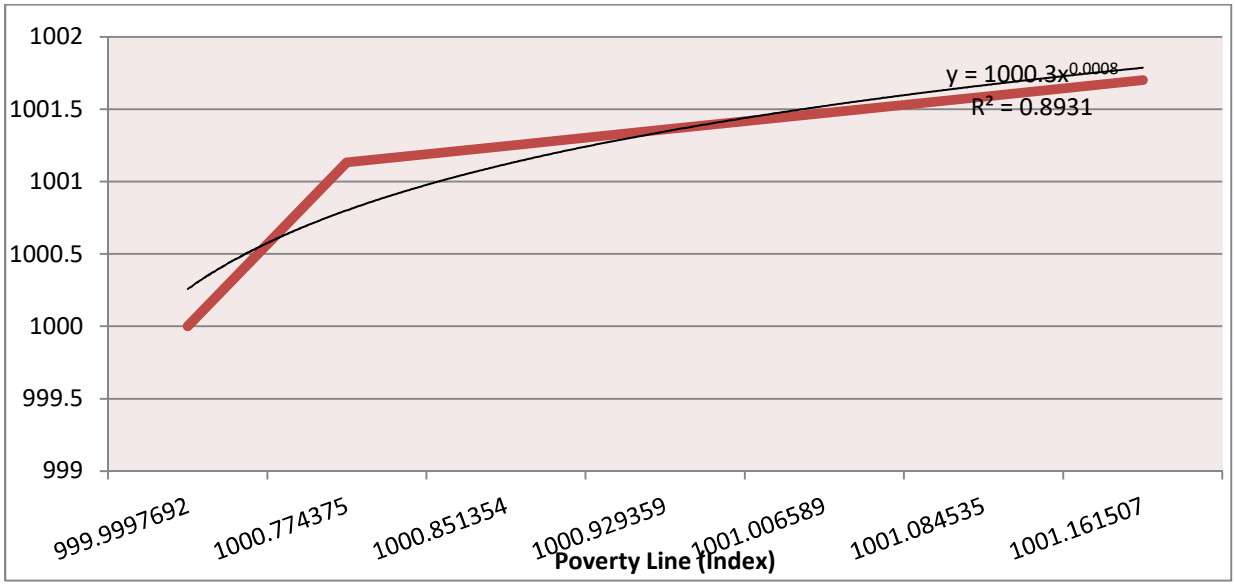


Figure 2.28: (Construction of Quadrant – 4) Income of the Bottom 20% of the Population across RGDP - Thailand (billions of bath)

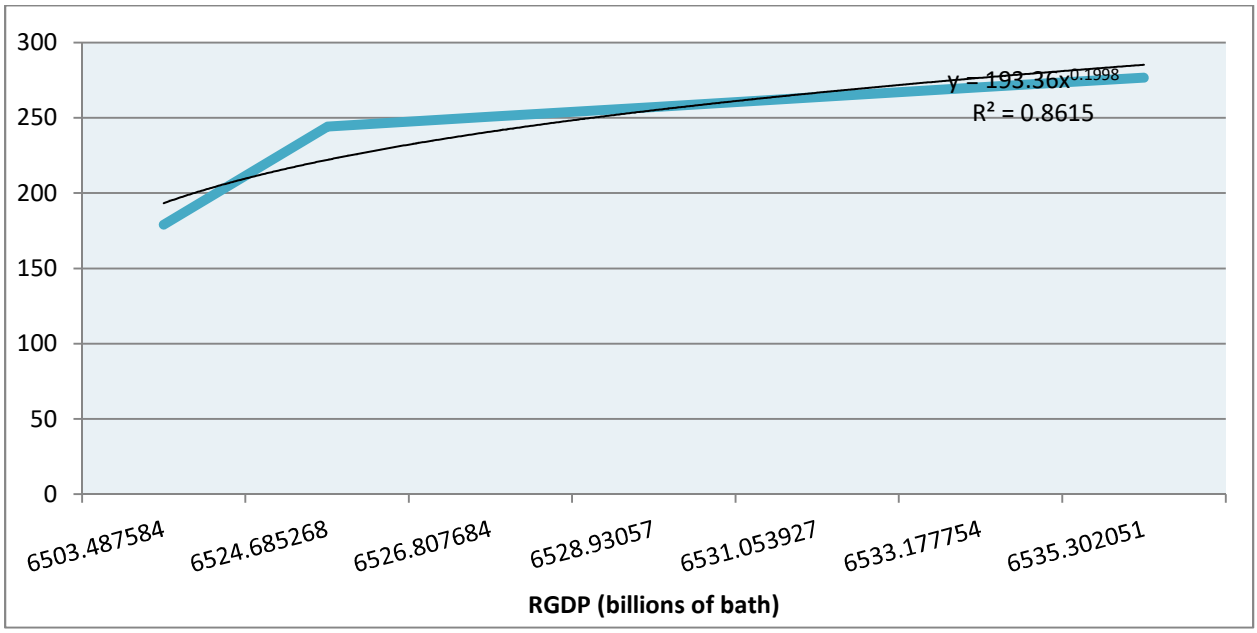


Figure 2.29: Level of Poverty Line (Index) in Thailand

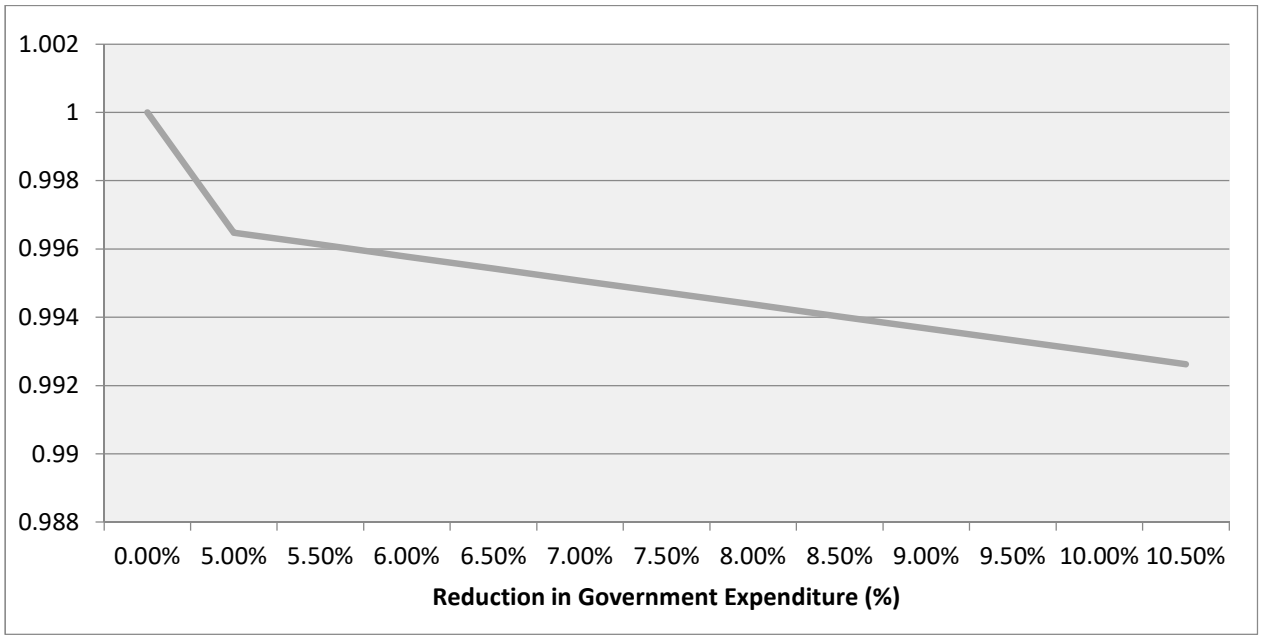


Figure 2.30: Income Distribution of the Bottom 20% of the Population to the Top 20% of the Population - Thailand (%)

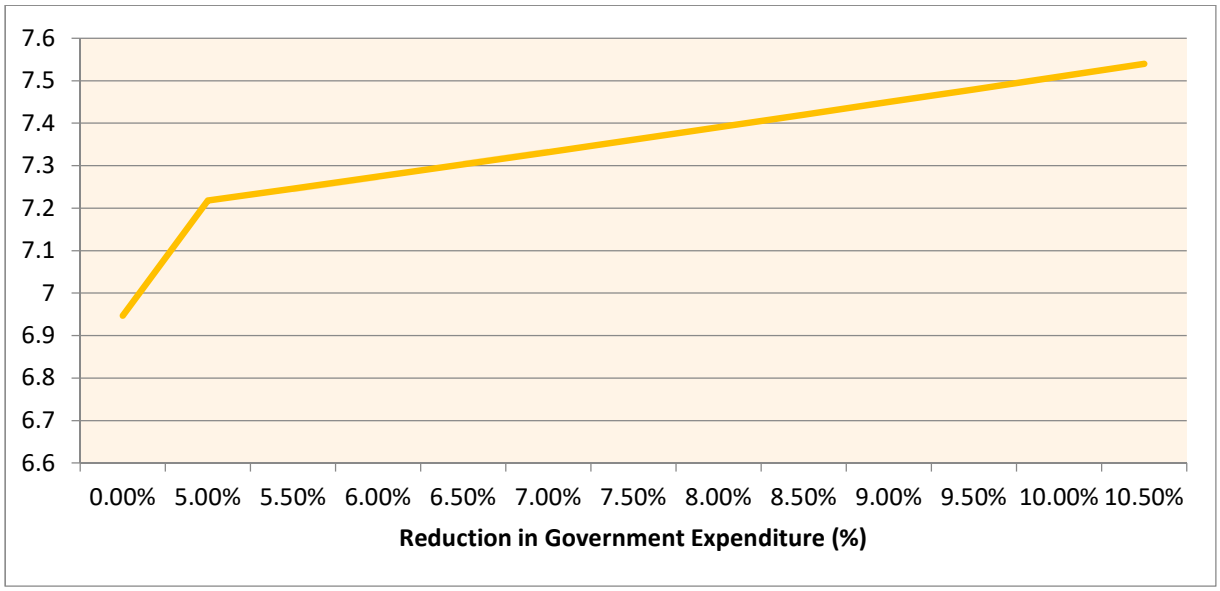


Figure 2.31: Income of the Bottom 20% of the Population - Thailand (billions of bath)

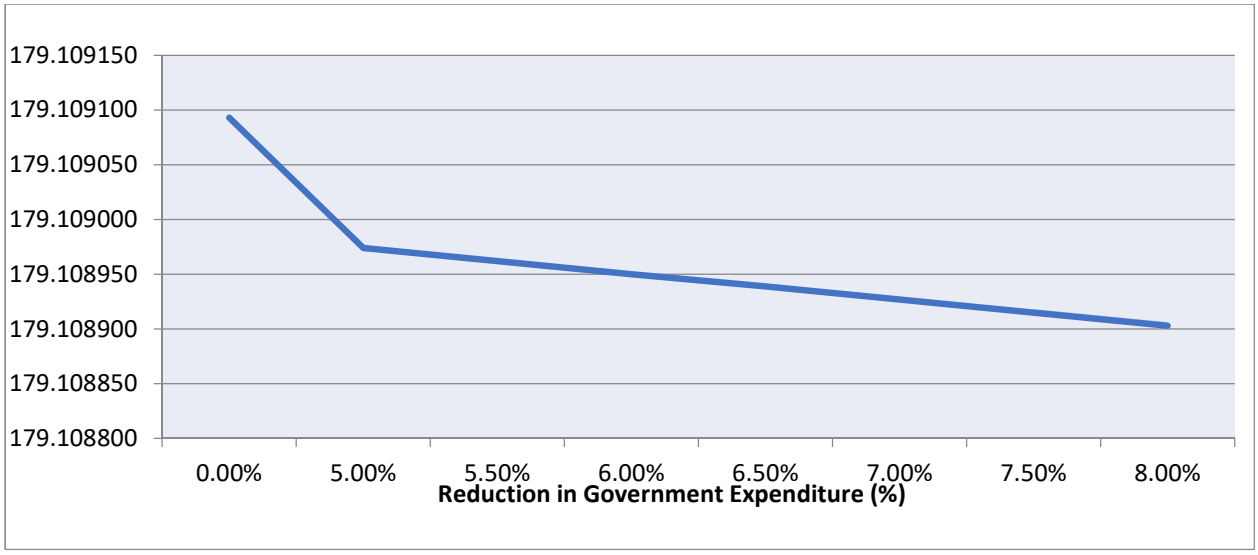


Figure 2.32: Price Index across the RGDP – Thailand

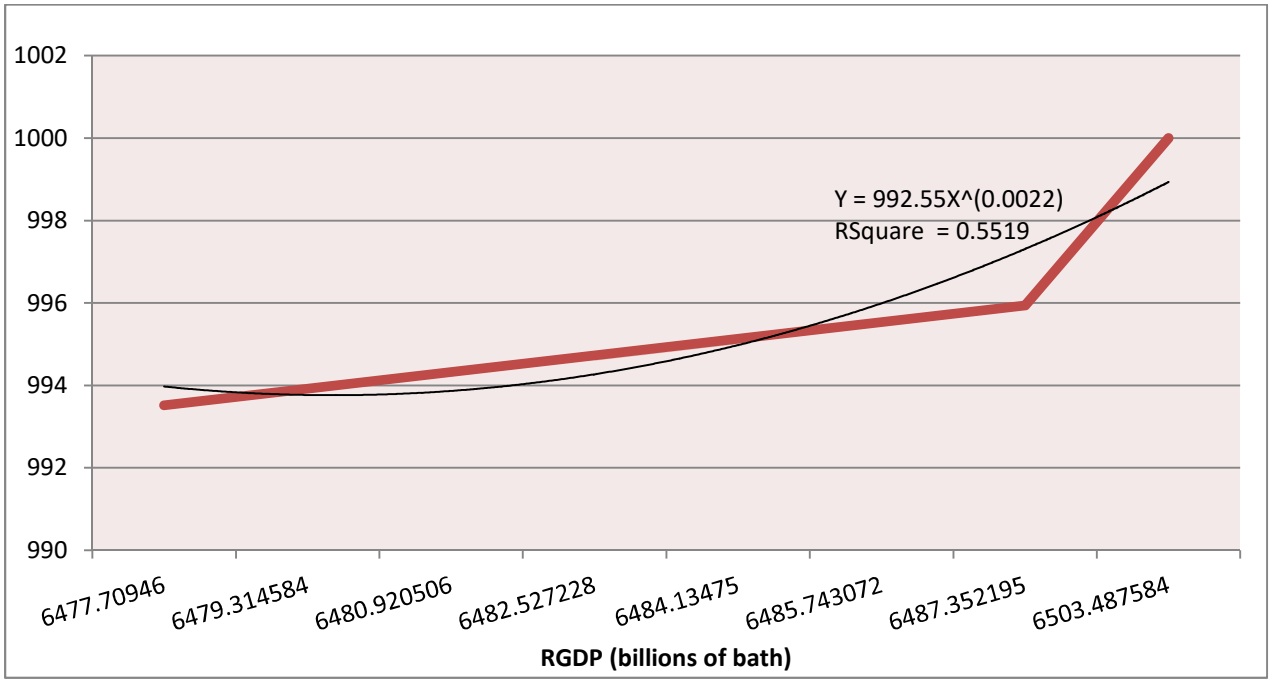


Figure 2.33: (Construction of Quadrant – 2) Price Index across the Poverty Line – Thailand

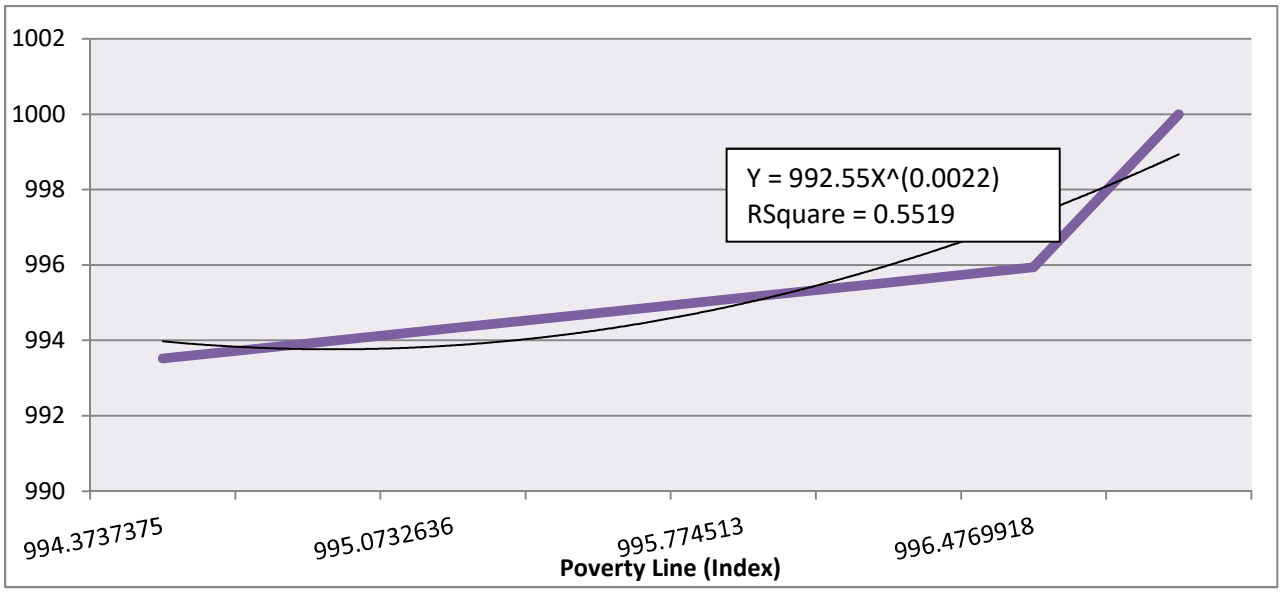


Figure 2.34: (Construction of Quadrant – 4) Income of the Bottom 20% of the Population across RGDP - Thailand (billions of bath)

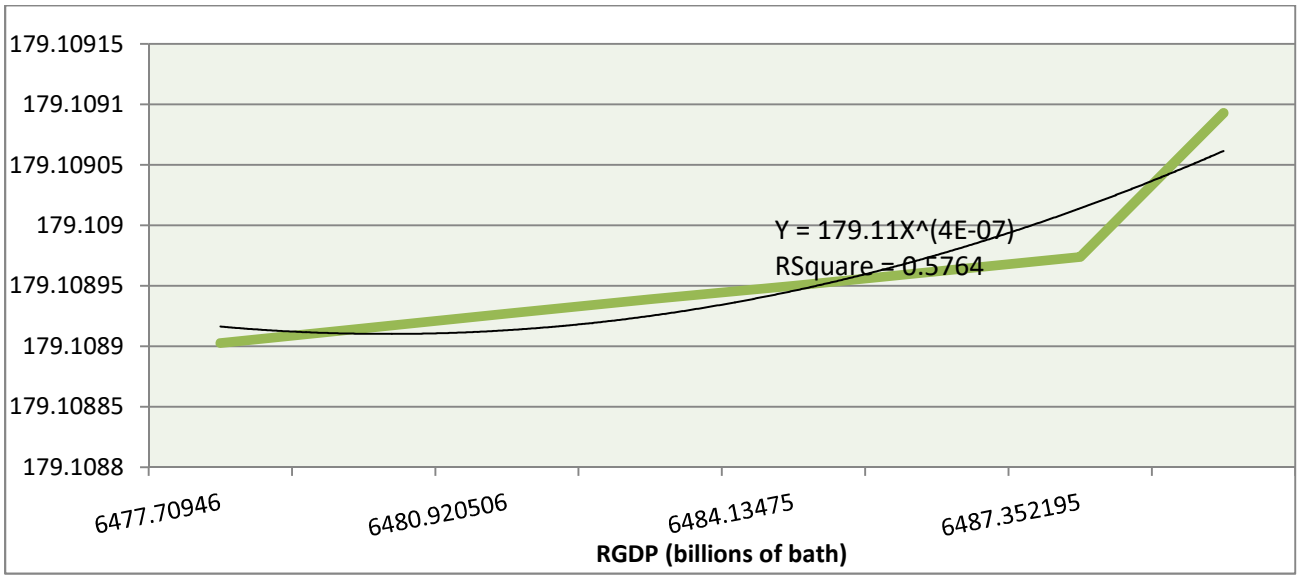


Figure 2.35: Level of Poverty Line (Index) in Thailand

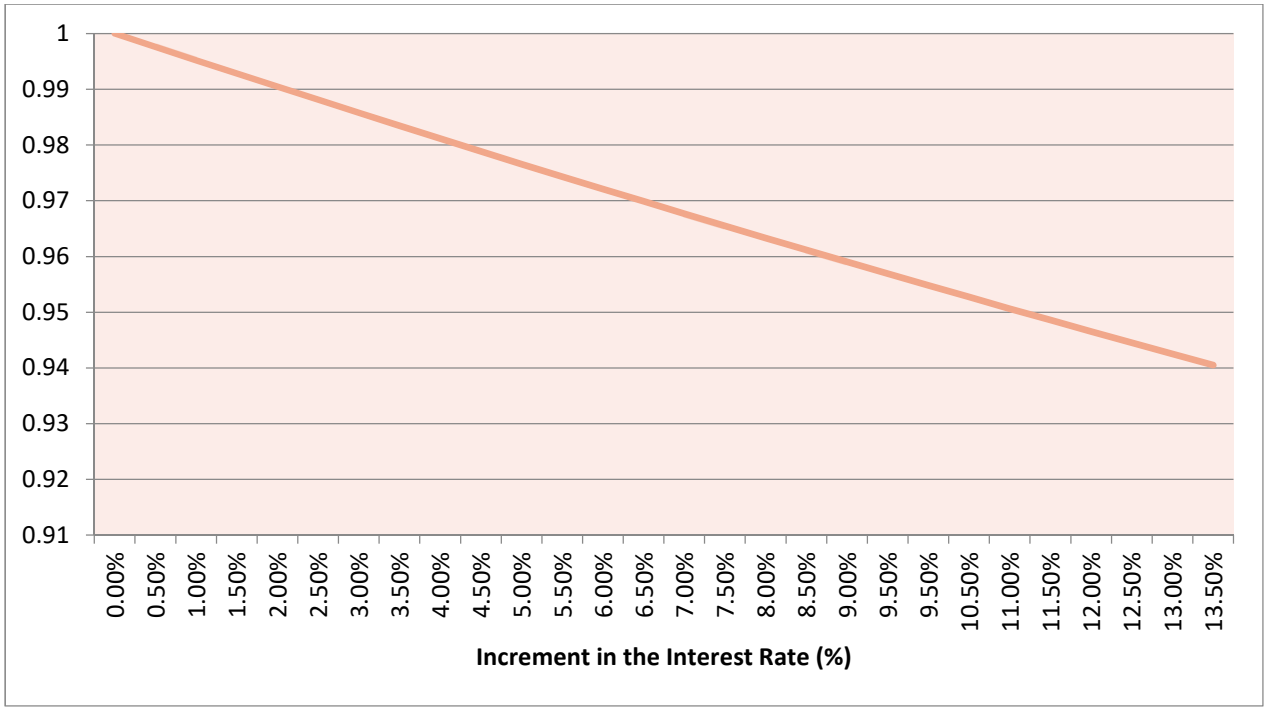


Figure 2.36: Income Distribution of the Bottom 20% of the Population to the Top 20% of the Population - Thailand (%)

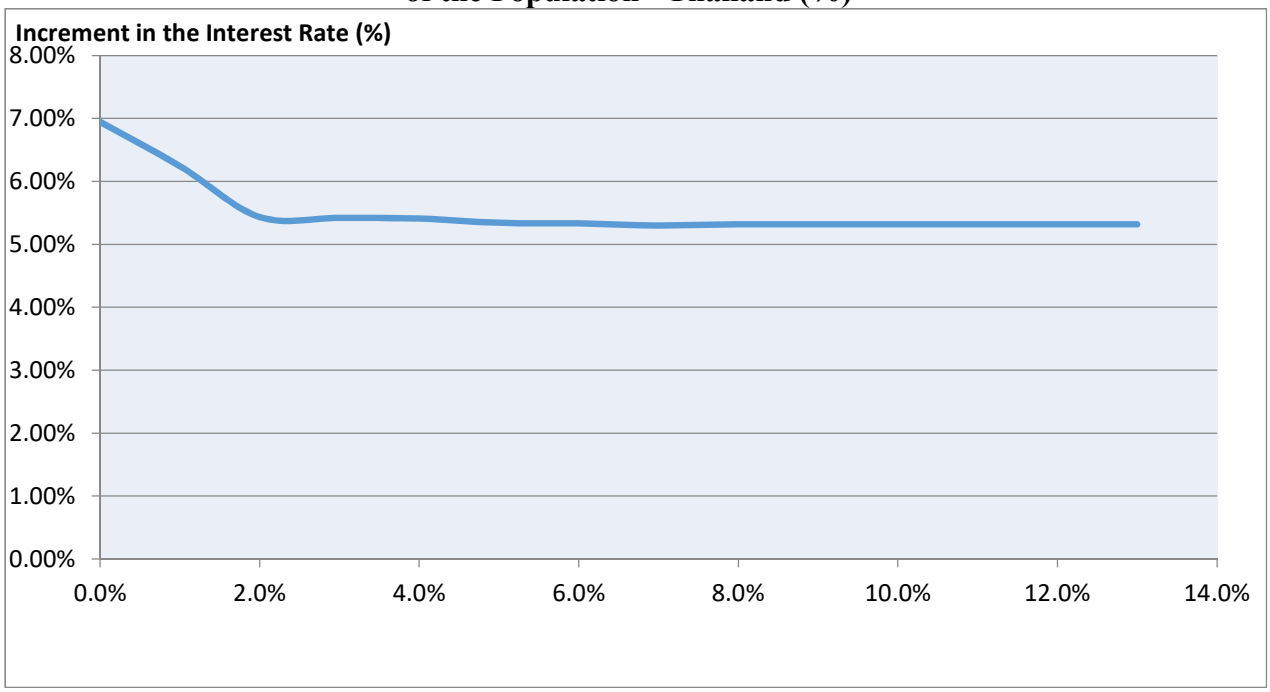


Figure 2.37: Income of the Bottom 20% of the Population - Thailand (billions of bath)

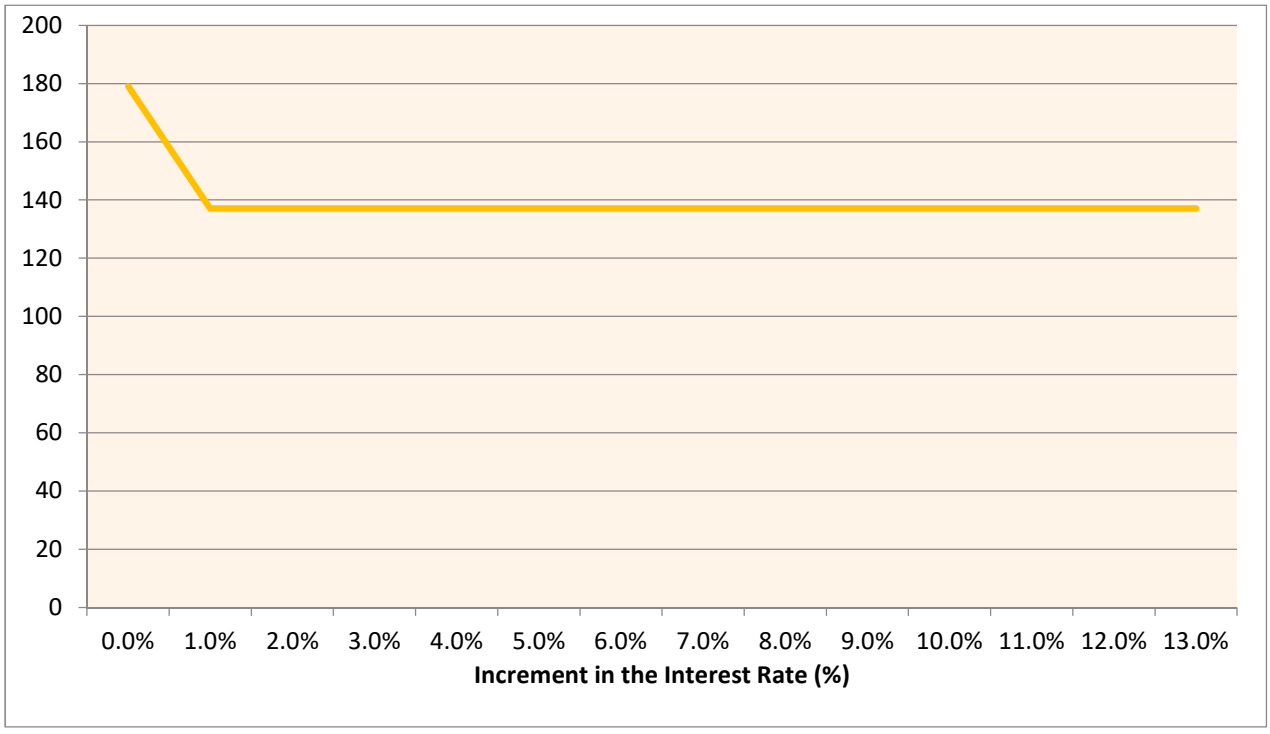


Figure 2.38: Price Index across the RGDP – Thailand

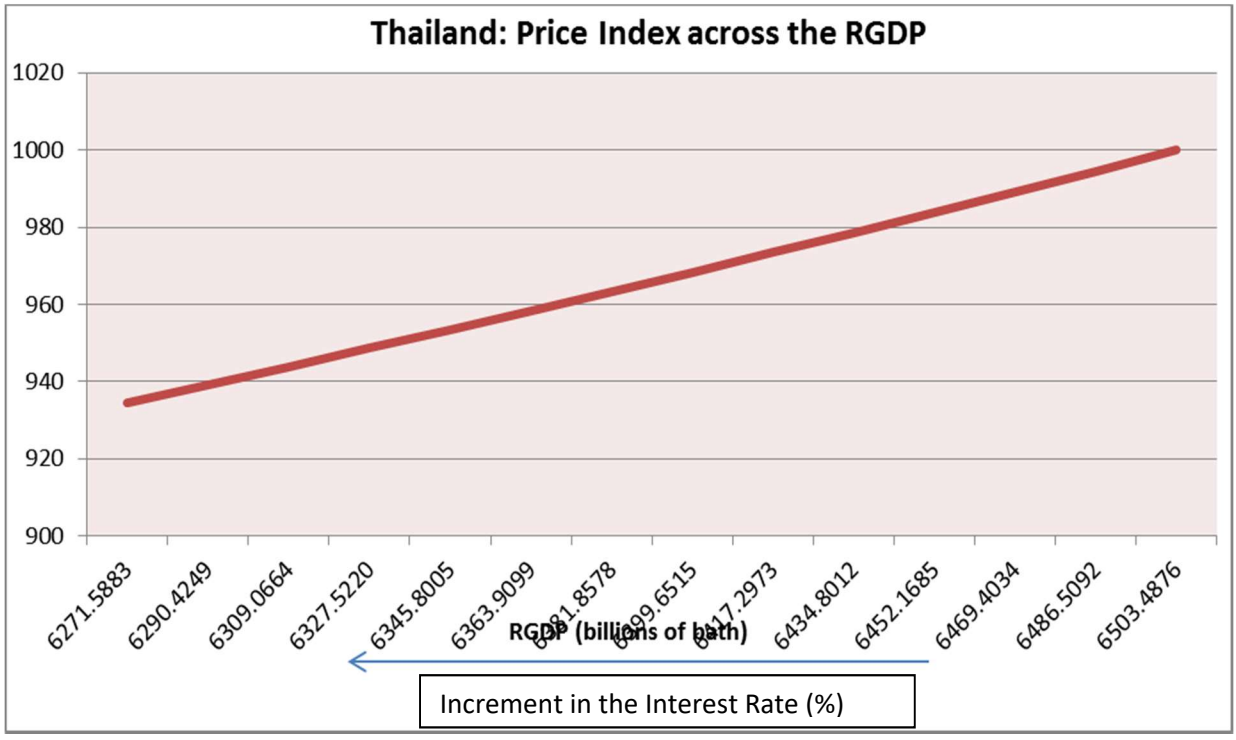


Figure 2.39: (Construction of Quadrant – 2) Price Index across the Poverty Line – Thailand

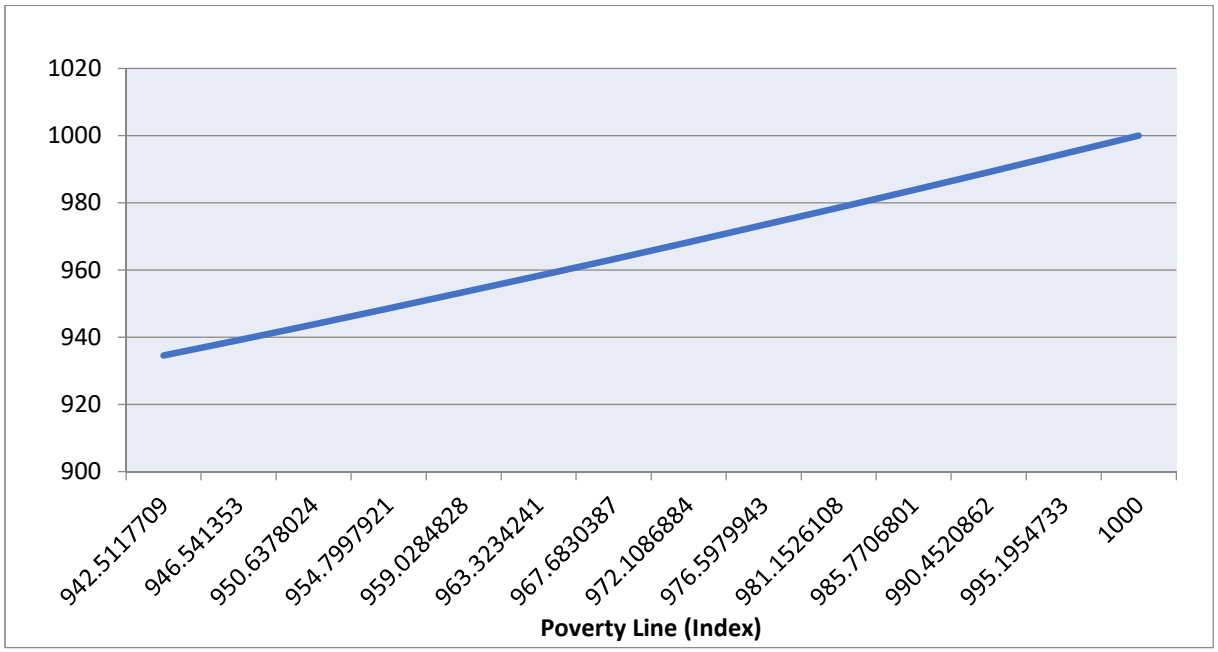


Figure 2.40: (Construction of Quadrant – 4) Income of the Bottom 20% of the Population across RGDP - Thailand (billions of bath)

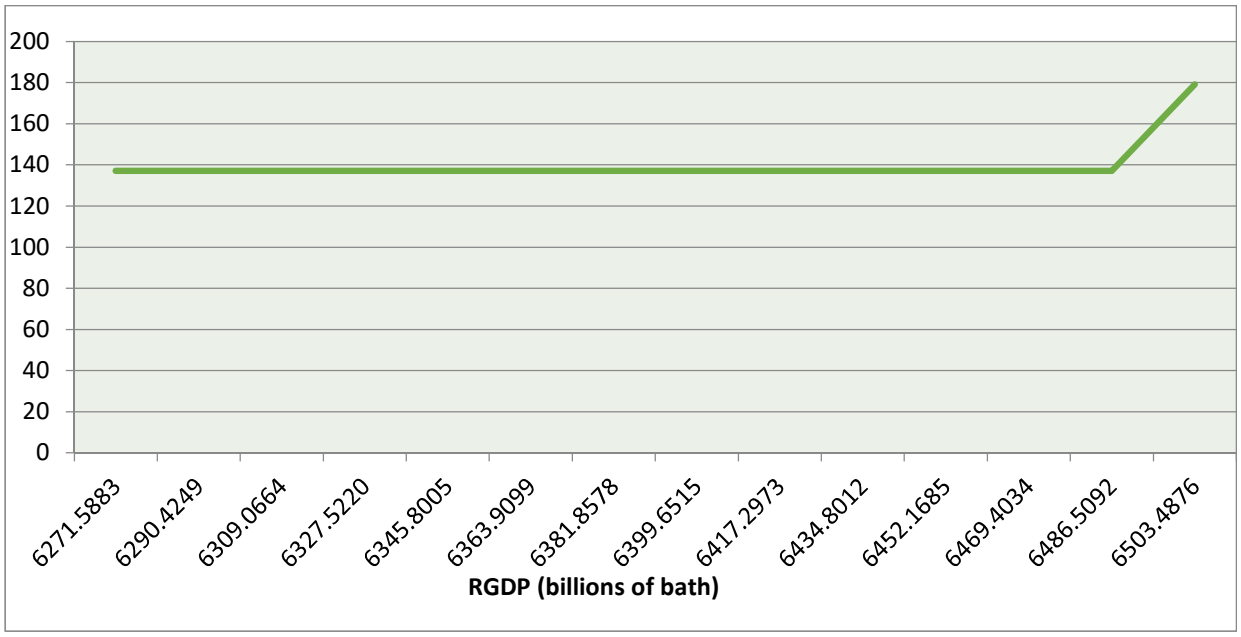


Figure 2.41: Level of Poverty Line (Index) in Thailand

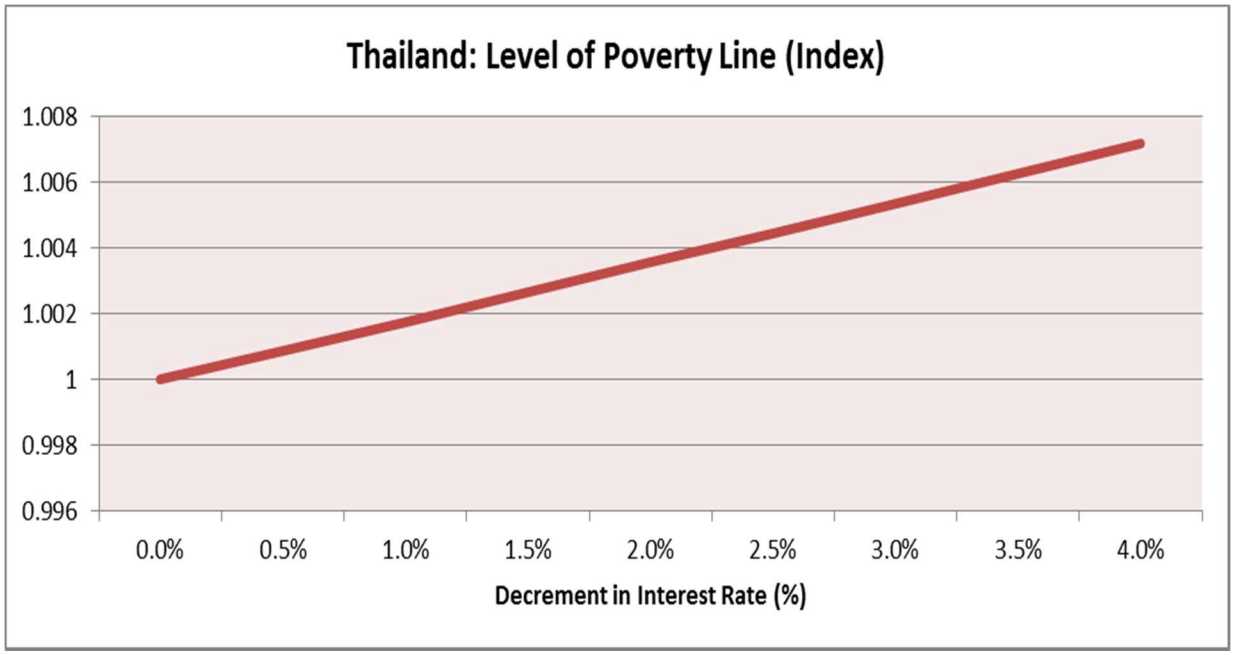


Figure 2.42: Income Distribution of the Bottom 20% of the Population to the Top 20% of the Population - Thailand (%)

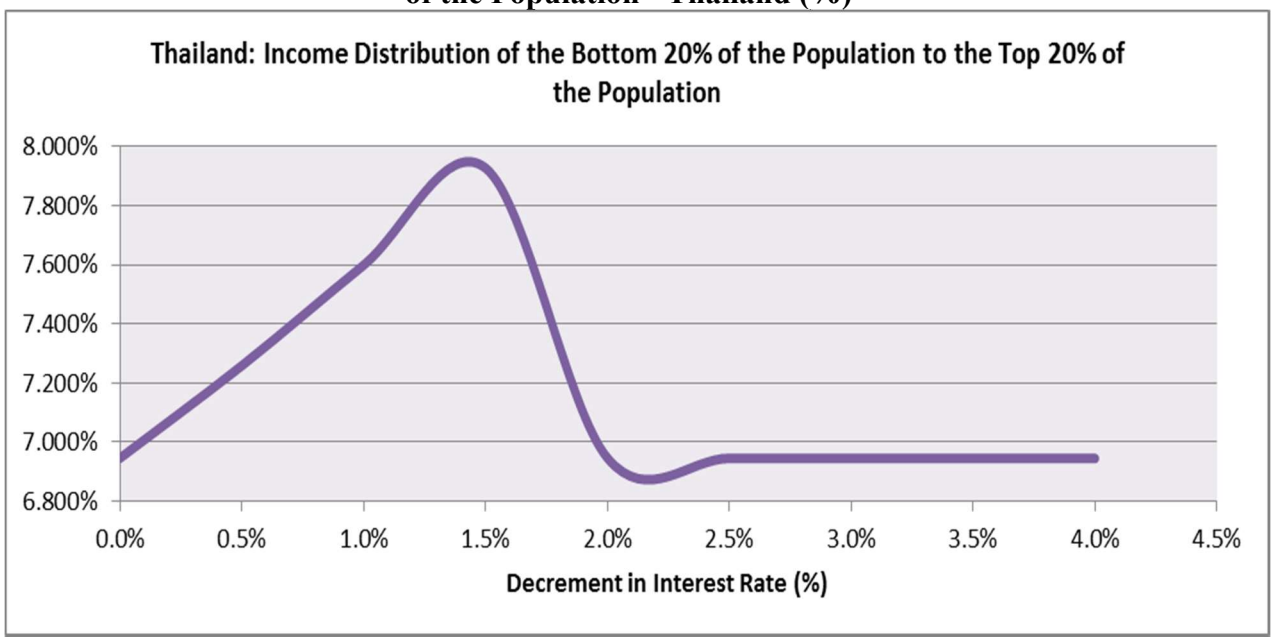


Figure 2.43: Income of the Bottom 20% of the Population - Thailand (billions of bath)

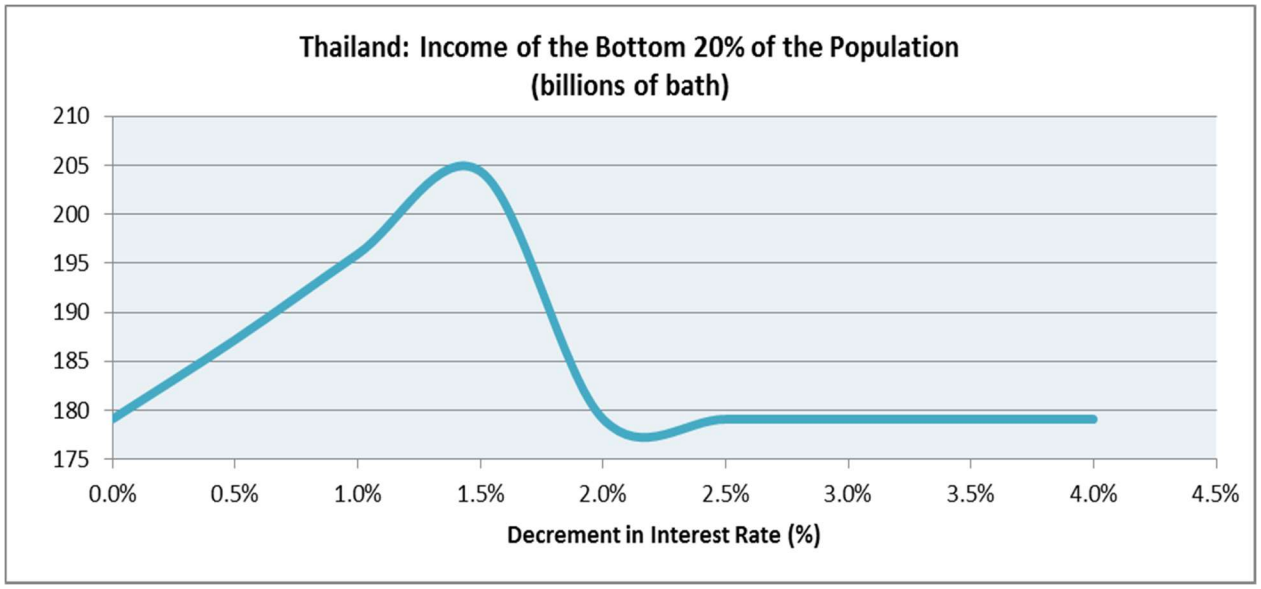


Figure 2.44: Price Index across the RGDP – Thailand

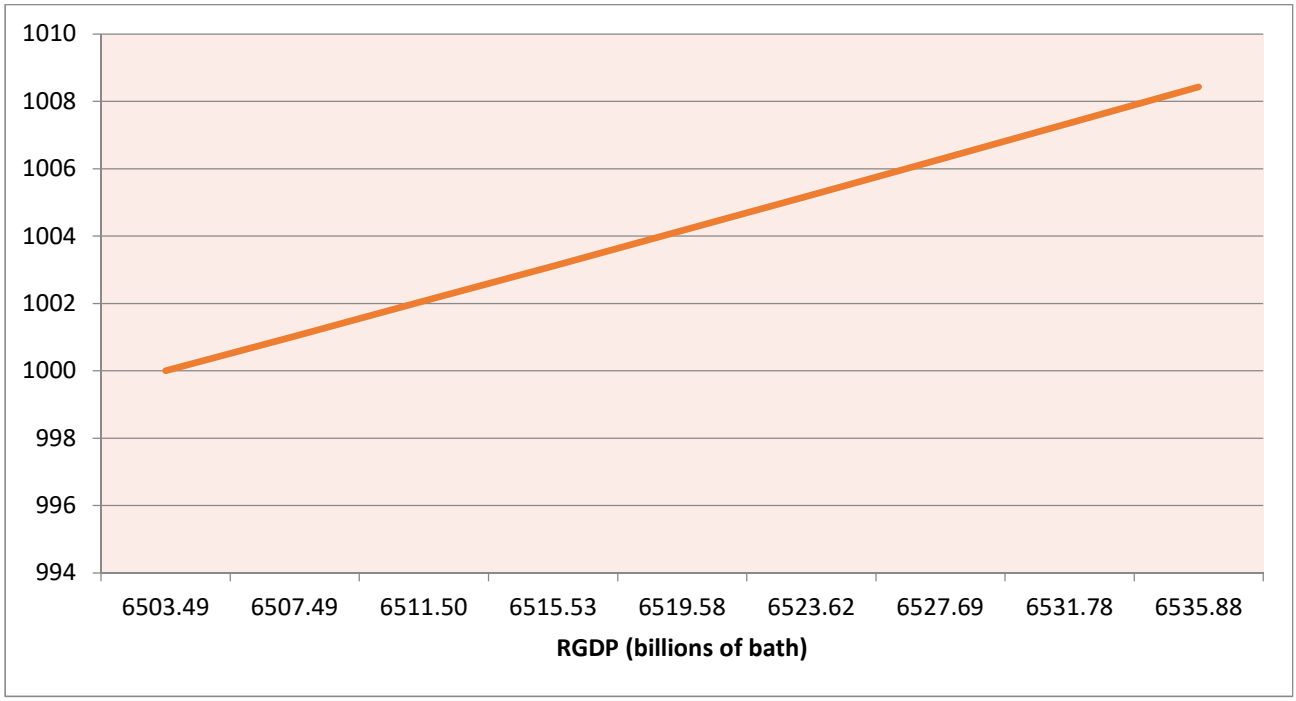


Figure 2.45: (Construction of Quadrant – 2) Price Index across the Poverty Line – Thailand

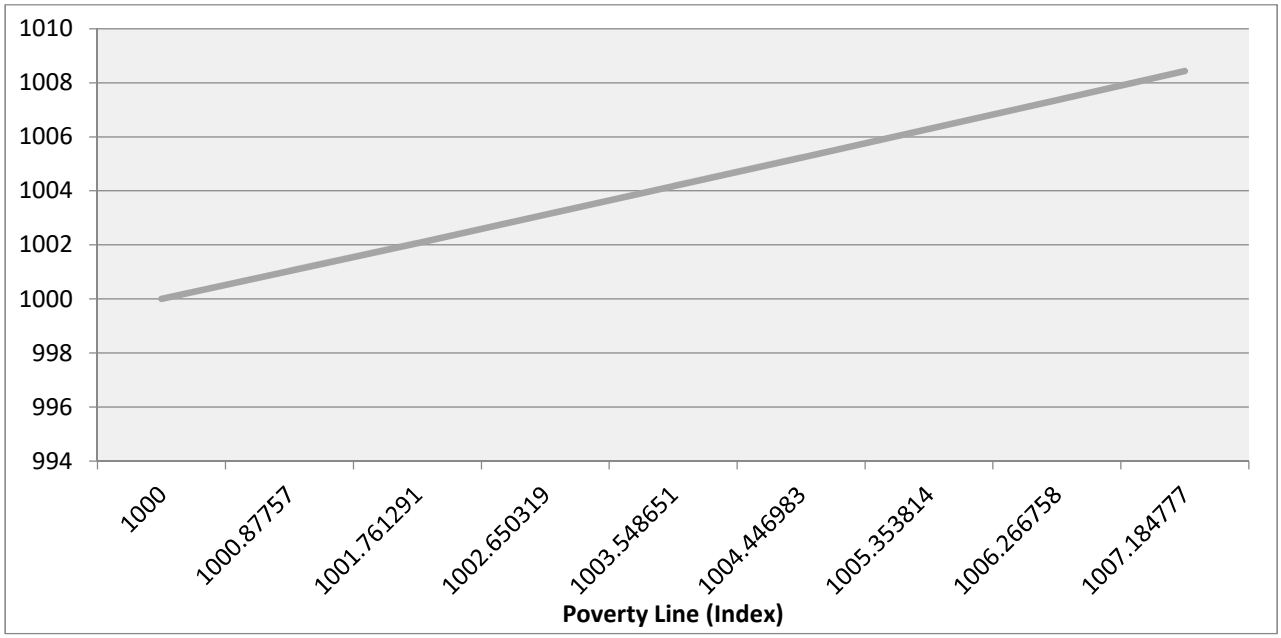


Figure 2.46: (Construction of Quadrant – 4) Income of the Bottom 20% of the Population

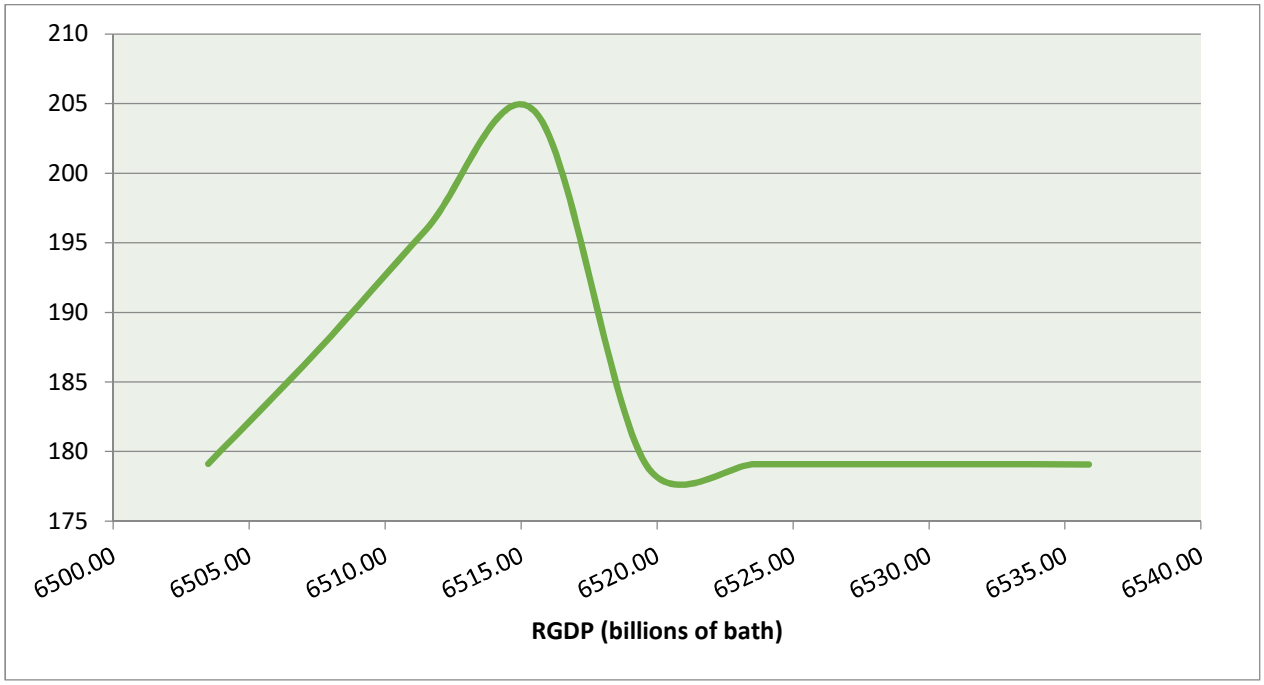


Figure 2.47: Level of Poverty Line (Index) in Thailand

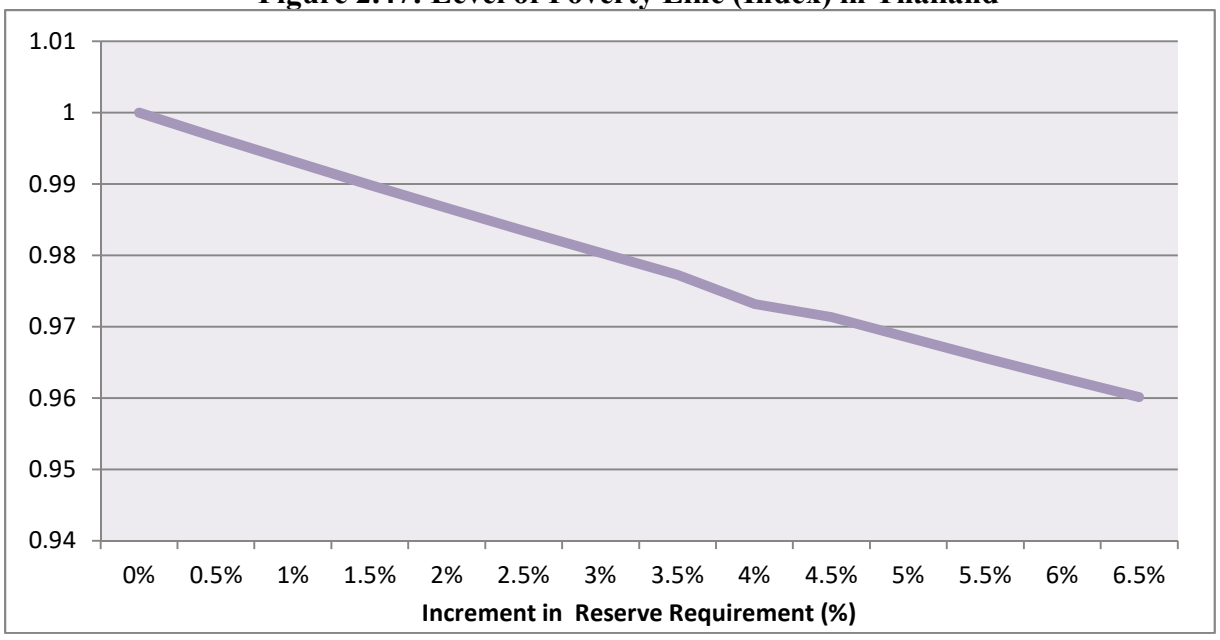


Figure 2.48: Income Distribution of the Bottom 20% of the Population to the Top 20% of the Population - Thailand (%)

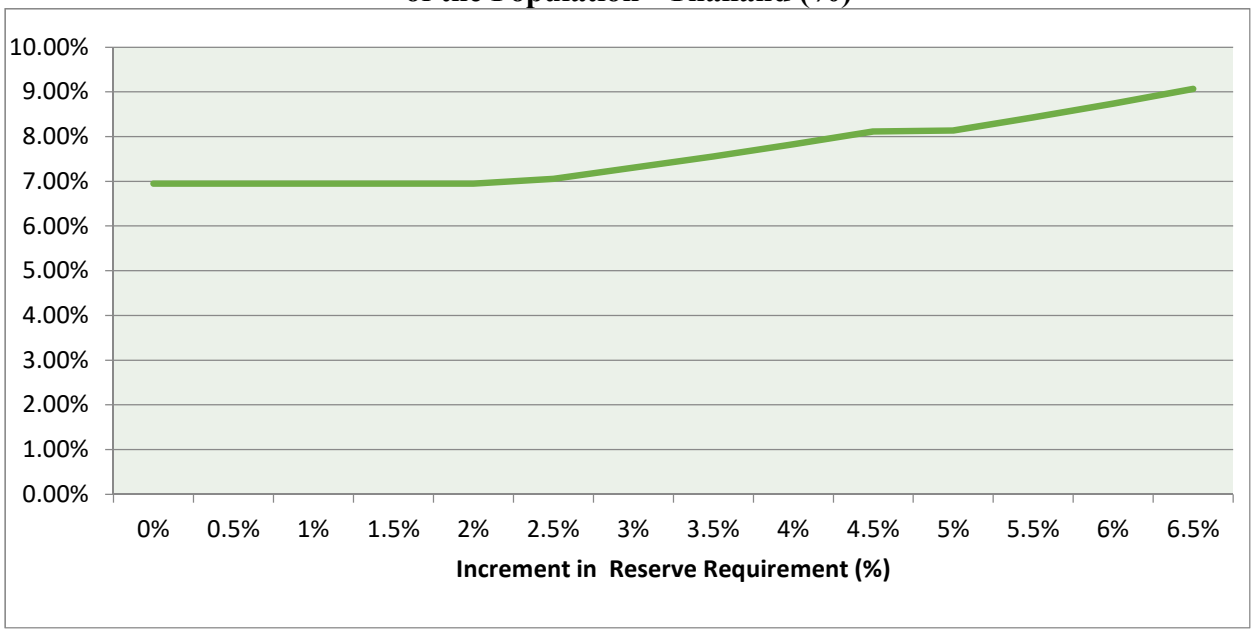


Figure 2.49: Income of the Bottom 20% of the Population - Thailand (billions of bath)

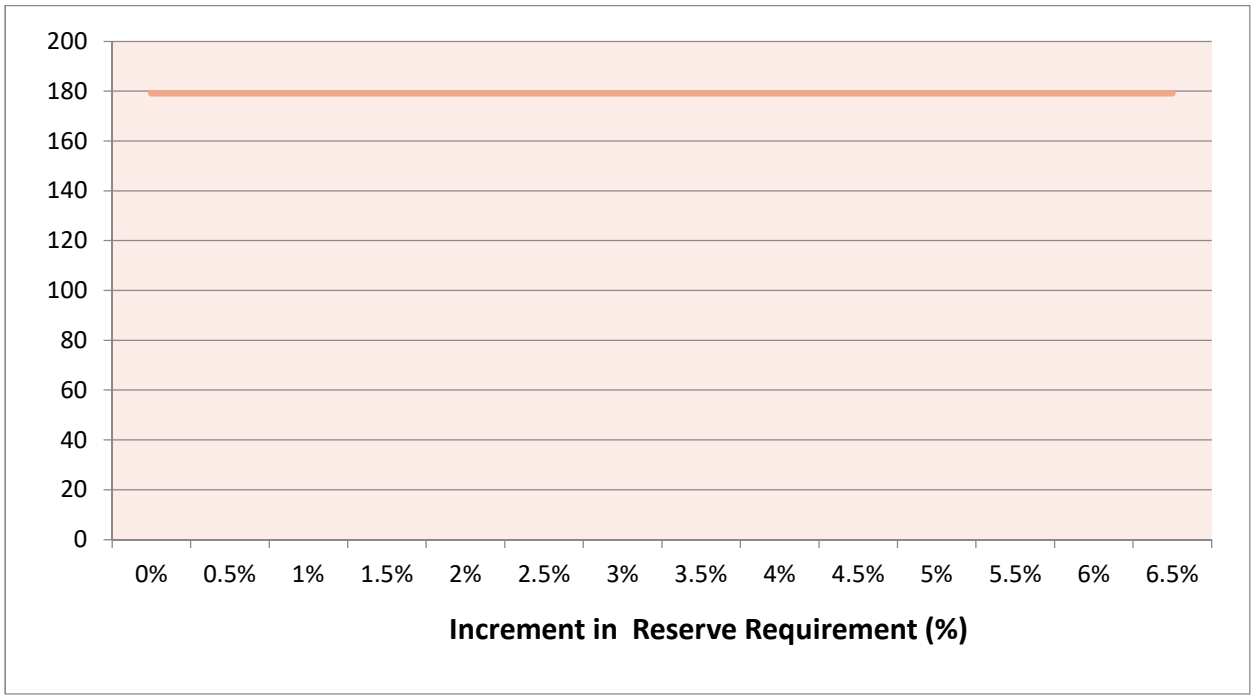


Figure 2.50: Price Index across the RGDP – Thailand

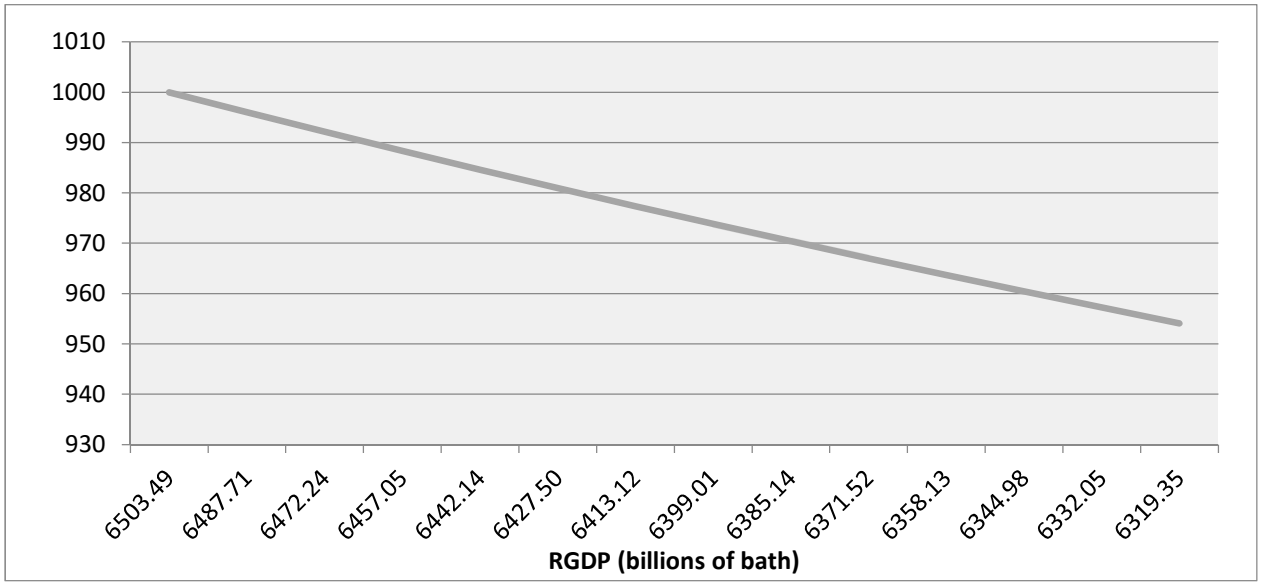


Figure 2.51: (Construction of Quadrant – 2) Price Index across the Poverty Line – Thailand

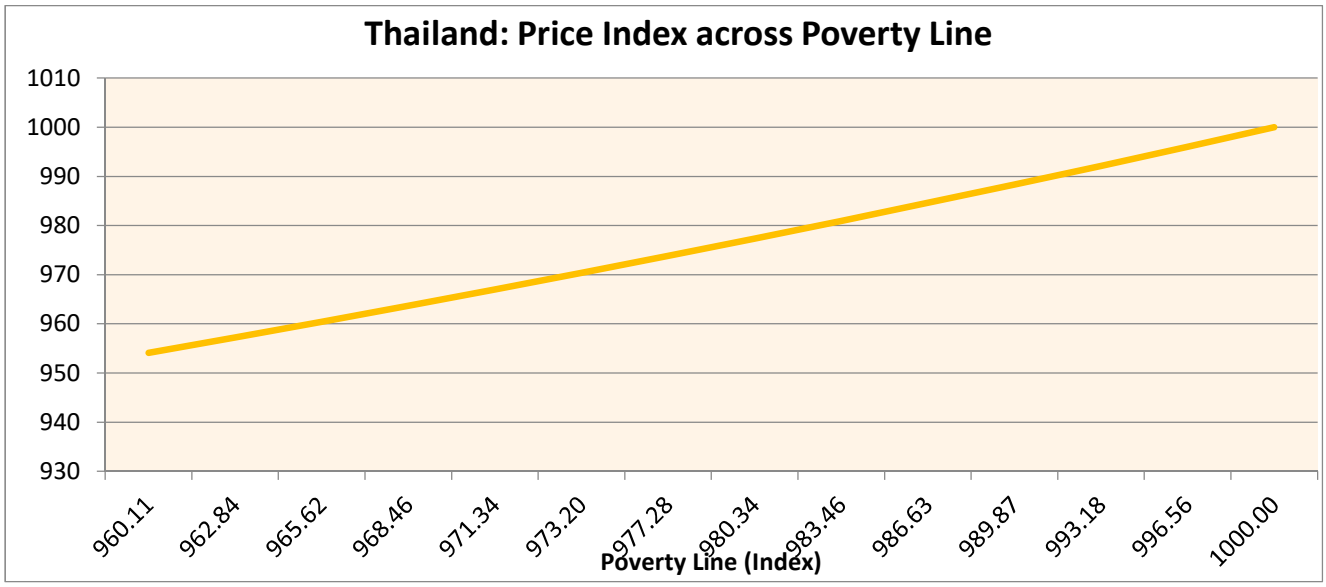


Figure 2.52: (Construction of Quadrant – 4) Income of the Bottom 20% of the Population across RGDP - Thailand (billions of bath)

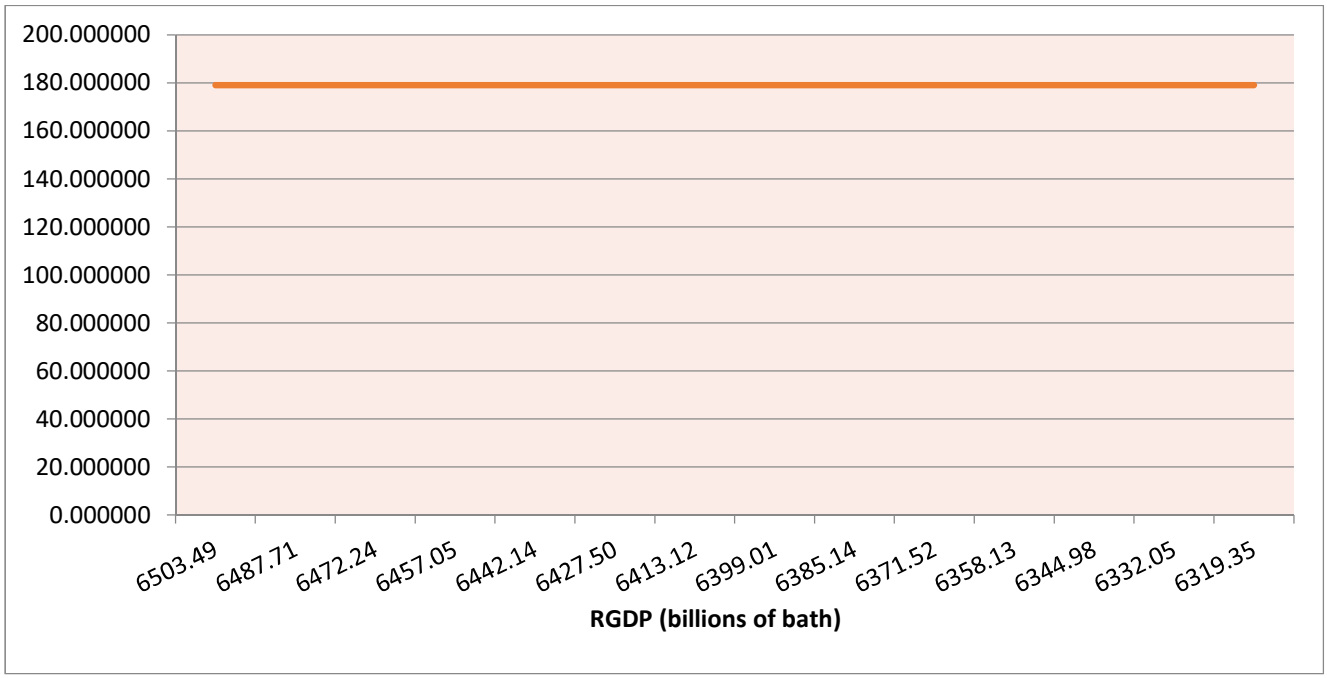


Figure 2.53: Level of Poverty Line (Index) in Thailand

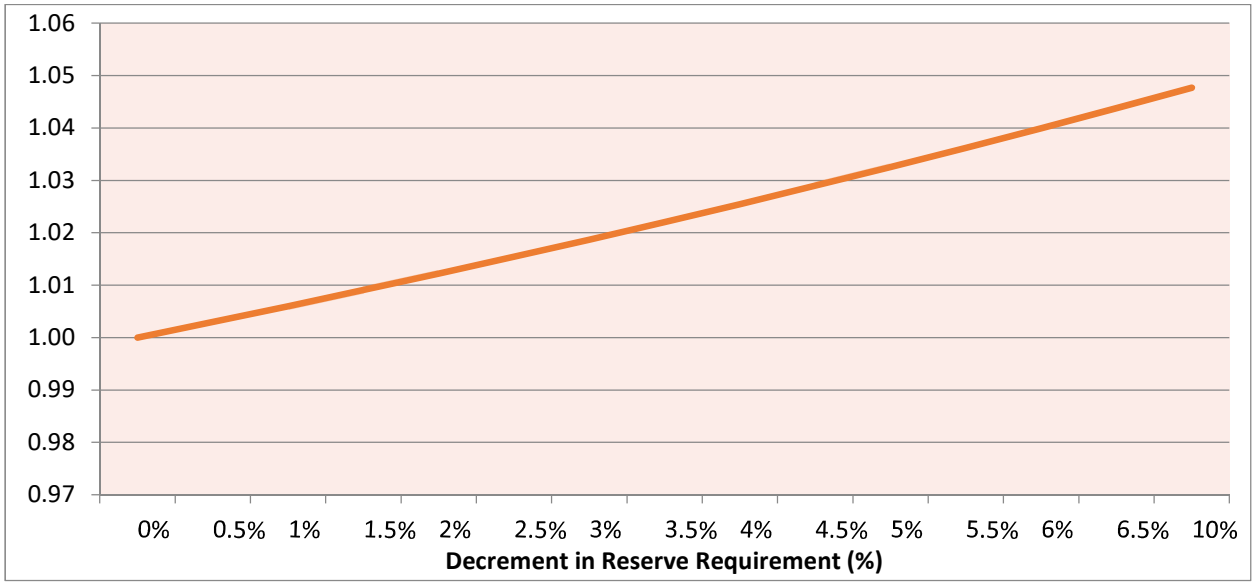


Figure 2.54: Income Distribution of the Bottom 20% of the Population to the Top 20% of the Population - Thailand (%)

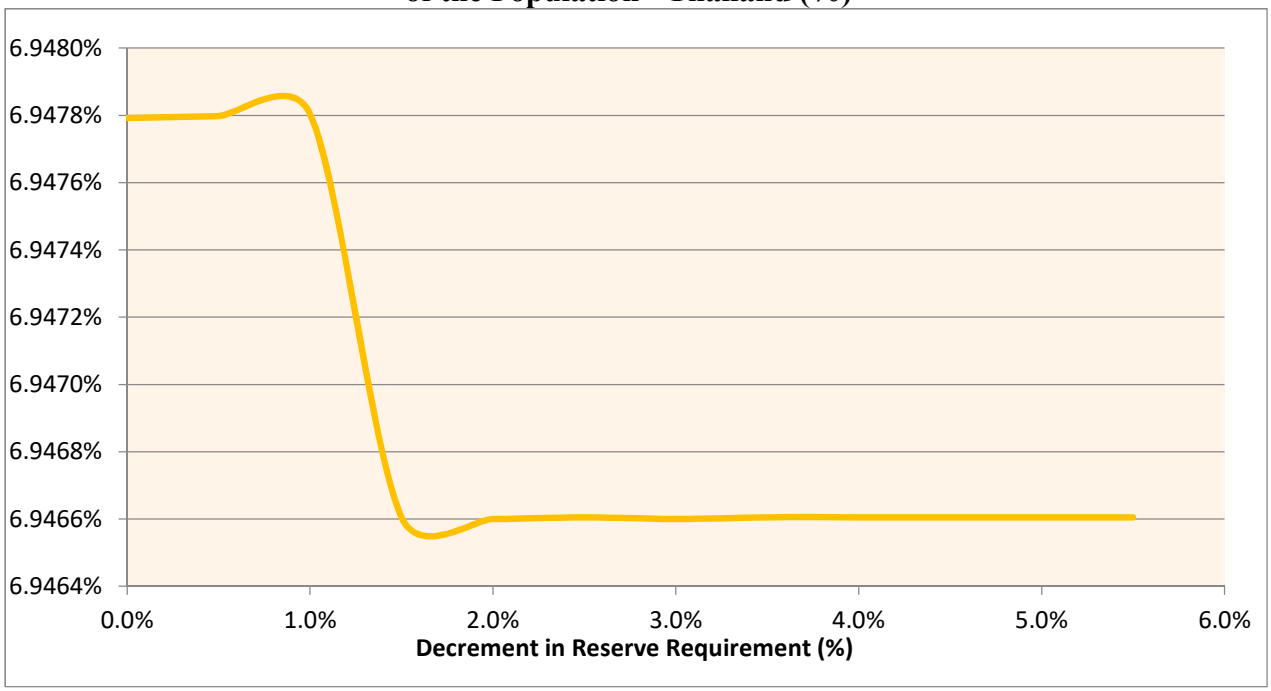


Figure 2.55: (Construction of Quadrant – 4) Price Index across the RGDP – Thailand

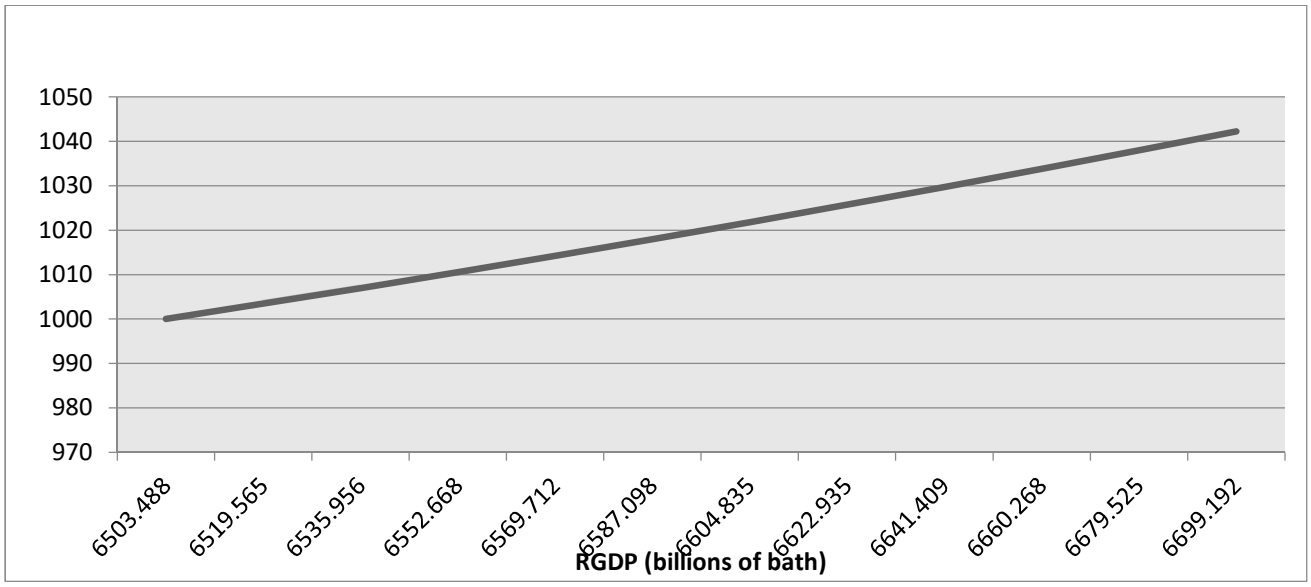
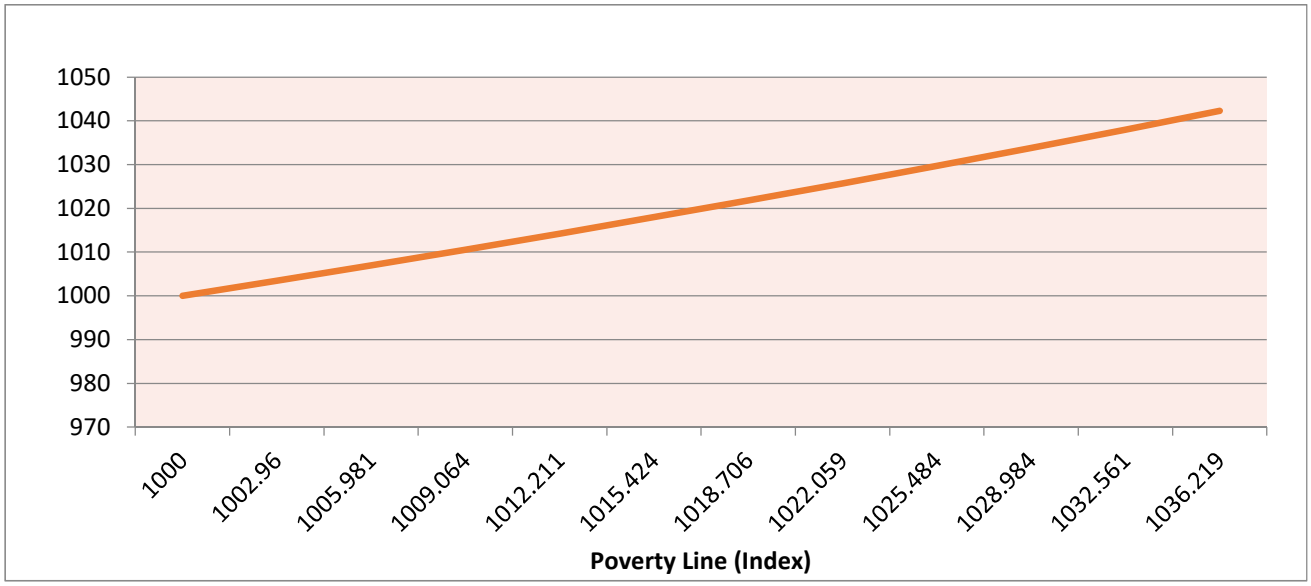


Figure 2.56: (Construction of Quadrant – 2) Price Index across the Poverty Line – Thailand



Appendix 2

The model is an extension from Azis (2002), Manopiniwes (2005) and Puttanapong (2008); hence most of the notations and equations used are similar. This model contributes to the existing model by introducing poverty index and income distribution involving different categories of households.

I. Set of Notations

Core CGE module

Set of Production Sectors *(i)*

i = {AGRI, MANU, SERVICE}

AGRI: Agriculture

MANU: Manufacturing

SERVICE: Service sectors

Set of Factors of Production *(f)*

f = {labor, cap}

labor: Labor

cap: Capital

Set of Domestic Institutions *(dinst)*

dinst = {HHH1,HHH2,HHH3,HHH4,HHH5, ENTP, GOV}

HHH1: Households in the lowest income quintile (the lowest 20% of the economy)

HHH2: Households in the second lowest income quintile (the second lowest 20% of the economy)

HHH3: Households in the third lowest income quintile (the third lowest 20% of the economy)

HHH4: Households in the second highest income quintile (the second highest 20% of the economy)

HHH5: Households in the highest income quintile (the top 20% of the economy)

ENTP: Enterprise (including state-owned enterprise)

Gov: Government

Subset of *dinst*

dprivt = {HHH,HHH2, HHH3, HHH4, HHH5,ENTP} $\in$ *dinst*

dprivt: Domestic private institutions

HHH = {HHH, HHH2, HHH3, HHH4, HHH5} $\in$ *dinst*

HHH: Households institutions

Set of Foreign Institution *(finst)*

finst = {ROW}

Financial module

Set of Institutions *(inst)*

dinst = {BOT, Bank, HHH1, HHH2, HHH3, HHH4, HHH5, ENTP, GOV, ROW}

HHH1: Households in the lowest income quintile (the lowest 20% of the economy)

HHH2: Households in the second lowest income quintile (the second lowest 20% of the economy)

HHH3: Households in the third lowest income quintile (the third lowest 20% of the economy)

HHH4: Households in the second highest income quintile (the second highest 20% of the economy)

HHH5: Households in the highest income quintile (the top 20% of the economy)

ENTP: Enterprise (including state-owned enterprise)

Gov: Government

Subset of *inst*

dominst {BOT, Bank, HHH1, HHH2, HHH3, HHH4, HHH5, ENTP, GOV} $\in$ *inst*

dominst: Domestic institutions

Set of Assets *(asset)*

asset = {CH,LO,DE,RP,GB,BOTB,FIDFB,SOEB,CBOND,EQL,FA,OTH,EQNL,FIXED}

CH: Cash

LO: Loan

DE: Deposit

RP: Bond-repurchased market

GB: Government bond

BOTB: Bank of Thailand bond

FIDFB: Financial Institution Development Fund bond

SOEB: State-owned enterprise bond

CBOND: Corporate bond

EQL: Listed equity

FA: Foreign asset

OTH: Other asset

EQNL: Non-listed equity

FIXED: Fixed asset

Subset of *asset*

asset_a = {CH,LO,DE,RP,GB,BOTB,FIDFB,SOEB,CBOND,EQL,OTH, FIXED} $\in$ *asset*

asset_a: A set of assets for equation (132)

asset_l = { CH,LO,DE,RP,GB,BOTB,FIDFB,SOEB,CBOND,EQL,OTH} $\in$ *asset*

asset_l: A set of assets for equation (133)

asset_nf = { CH,LO,DE,RP,FA ,EQL,OTH} $\in$ *asset*

asset_nf: A set of assets for equation (134)

II. List of Coefficients

Core CGE model

$a_{i,j}$	IO table coefficients
ac_i	Armington function shift parameter
ad_i	Production function shift parameter
$\alpha_{i,f}$	Factor share parameter-production function
at_i	CET function shift parameter
δ_i	Armington function share parameter
$econ_i$	Export demand constant
γ_i	CET function parameter
$fshare_{dinst,f}$	Share of each type of factor
$cles_{i,dprivt}$	Private consumption share
$dstr_i$	Ratio of inventory investment to gross output
η_i	Export demand price elasticity
$gles_i$	Government consumption shares
$kshr_i$	Shares of investment by sector of destination
ρ_{ci}	Armington function exponent
ρ_{ti}	CET function exponent

te_i	Export tax rate
th_{dprivt}	Household tax rate
tm_i	Tariff rates on imports
$b_{i,j}$	Capital share
tx_i	Indirect tax rate
mps_{dprivt}	Marginal propensity to consume
alphapov	Poverty share

Financial Module

τ_{h1}	Household's share of composite asset [level 1]
τ_{h2}	Household's share of composite asset [level 2]
τ_{h3}	Household's share of composite asset [level 3]
τ_{h4}	Household's share of composite asset [level 4]
τ_{h5}	Household's share of composite asset [level 5]
σ_{h1}	Household's elasticity of composite asset [level 1]
σ_{h2}	Household's elasticity of composite asset [level 2]
σ_{h3}	Household's elasticity of composite asset [level 3]
σ_{h4}	Household's elasticity of composite asset [level 4]
σ_{h5}	Household's elasticity of composite asset [level 5]
ph0	Shift parameter (household’s demand for loan)
ph1	Elasticity to bank’s total deposit (household’s demand for loan)
ph2	Elasticity to loan interest rate (household’s demand for loan)
fh0	Shift parameter (household’s demand for fixed asset)
fh1	Elasticity to loan interest rate (household’s demand for fixed asset)
ch0	Shift parameter (household’s demand for cash)

ch1	Elasticity to saving (household's demand for cash)
ch2	Elasticity to deposit interest rate (household's demand for cash)
fahh0	Shift parameter (household's demand for foreign asset)
fahh1	Elasticity to interest rate differential (household's demand for foreign asset)
fahh2	Elasticity to real GDP (household's demand for foreign asset)
pf0	Shift parameter (enterprise's demand for fixed asset)
pf1	Elasticity to interest rate differential (household's demand fixed asset)
pf2	Elasticity to real GDP (household's demand fixed asset)
de0	Shift parameter (enterprise's demand for deposit)
de1	Elasticity to saving (enterprise's demand for deposit)
pp0	Shift parameter (enterprise's demand for loan)
pp1	Elasticity to bank's total deposit (enterprise's demand for loan)
pp2	Elasticity to loan interest rate (enterprise's demand for loan)
ce0	Shift parameter (enterprise's demand for cash)
ce1	Elasticity to saving (enterprise's demand for loan)
ce2	Elasticity to deposit interest rate (enterprise's demand for loan)
faent0	Shift parameter (enterprise's demand for foreign asset)
faent1	Elasticity to interest rate differential (enterprise's demand for foreign asset)
faent2	Elasticity to real GDP (enterprise's demand for foreign asset)
τ_{b1}	Bank's share of composite asset [level 1]
τ_{b2}	Bank's share of composite asset [level 2]
τ_{b3}	Bank's share of composite asset [level 3]
τ_{b4}	Bank's share of composite asset [level 4]
τ_{b5}	Bank's share of composite asset [level 5]
σ_{b1}	Bank's elasticity of composite asset [level 1]

σ_{b2}	Bank's elasticity of composite asset [level 2]
σ_{b3}	Bank's elasticity of composite asset [level 3]
σ_{b4}	Bank's elasticity of composite asset [level 4]
σ_{b5}	Bank's elasticity of composite asset [level 5]
fabnk0	Shift parameter (Bank's demand for foreign asset)
fabnk1	Elasticity to interest rate differential (Bank's demand for foreign asset)
fabnk2	Elasticity to real GDP (Bank's demand for foreign asset)
govch	Fixed ratio of government's cash
fabot0	Shift parameter (BOT's demand for foreign asset)
fabot1	Elasticity to interest rate differential (BOT's demand for foreign asset)
fabot2	Elasticity to real GDP (BOT's demand for foreign asset)
botdeoth	Deposit at BOT - which is a not a reserve requirement
rratio	Ratio of reserve requirement to total deposit
cratio	Ratio of cash to total deposit
botc0	Shift parameter (BOT's demand for cash)
botc1	Elasticity to interest rate (BOT's demand for cash)
botc2	Elasticity to real GDP (BOT's demand for cash)
rwde0	Shift parameter (ROW's demand for deposit)
rwde1	Elasticity to interest rate differential (ROW's demand for deposit)
rwde2	Elasticity to expected exchange rate (ROW's demand for deposit)
rwlo0	Shift parameter (ROW's preference to lend to Thai institution)
rwlo1	Elasticity to interest rate differential (ROW's preference to lend to Thai institution)
rwlo2	Elasticity to expected exchange rate (ROW's preference to lend to Thai institution)

rwgb0	Shift parameter (ROW's demand for Thai government bond)
rwgb1	Elasticity to interest rate differential (ROW's demand for Thai government bond)
rwgb2	Elasticity to expected exchange rate (ROW's demand for Thai government bond)
rwcbond0	Shift parameter (ROW's demand for Thai government bond)
rwcbond1	Elasticity to interest rate differential (ROW's demand for Thai government bond)
rwcbond2	Elasticity to expected exchange rate (ROW's demand for Thai government bond)
rweql0	Shift parameter (ROW's demand for equity listed in Thai stock market)
rweql1	Elasticity to interest rate differential (ROW's demand for equity listed in Thai stock market)
rweql2	Elasticity to expected exchange rate (ROW's demand for equity listed in Thai stock market)

III. List of Variables

Endogenous variables

X_i	Total output of sector *i*
INT_i	Sector *i's d*emand for intermediate inputs
D_i	Domestically produced good
Q_i	Domestic Good Supply (Composite Good)
E_i	Exports
M_i	Imports
PINDEX	Price index (GDP deflator)
GDPVA	Value-added (in market price) GDP
RGDP	Real GDP

PX_i	Price of output
PD_i	Price of domestic good
PQ_i	Price of composite good
PE_i	Domestic price of export
PM_i	Domestic price of import
PV_i	Price of Value-Added
PWE_{ie}	World export price (in US$)
PK_i	Price of capital goods by sector of destination
WF_{cap}	Return on capital
YH_{dprivt}	Total income of *dprivt*
$YFCTR_f$	Total factor income rewarded from employing *f*
$FDSC_{i,f}$	Sector *i*'s demand for factor *f*
GR	Government's total revenue
PRIVSAV	Saving of private sector
DIRTAX	Total direct tax
TARIFF	Total amount of tariff
INDTAX	Total indirect tax
GOVSAV	Government saving
FSAV	Foreign saving
EXR	Exchange rate
SAVING	Total saving
CD_i	Household's consumption on good *i*
GD_i	Government's consumption on good *i*
ID_i	Capital good *i* used for investment
GOVSAV	Government saving

DST_i	Inventory investment
DKi	Volume of investment by sector of destination
FXDINV	Fixed capital investment
INVEST	Total investment
FS_{labor}	Total labor employed
WALRAS	Slack variable for Walras's law
HHPORTS	Household's portfolio of bonds and listed-equity
$UoF\_S_{asset,inst}$	Stock of *asset* which is a use of fund of *inst*
$SoF\_S_{asset,inst}$	Stock of *asset* which is a source of fund of *inst*
$UoF\_F_{asset,inst}$	Flow of *asset* which is a use of fund of *inst*
$SoF\_F_{asset,inst}$	Flow of *asset* which is a source of fund of *inst*
RRH1	Weighted average return of assets in level 1 (Household's portfolio decision)
RRH2	Weighted average return of assets in level 2 (Household's portfolio decision)
RRH3	Weighted average return of assets in level 3 (Household's portfolio decision)
RRH4	Weighted average return of assets in level 4 (Household's portfolio decision
GH1	Proportion of equity in household's portfolio
GH2	Proportion of government bond in household's portfolio
GH3	Proportion of BOT bond in household's portfolio
GH4	Proportion of FIDF bond in household's portfolio
GH5	Proportion of SOE bond in household's portfolio
RRN_{DE}	Deposit interest rate
RRN_{GB}	Gap between the return of government bond and deposit interest rate

RRN_{BOTB}	Gap between the return of BOT bond and deposit interest rate
RRN_{FIDFB}	Gap between the return of FIDF bond and deposit interest rate
RRN_{SOEB}	Gap between the return of SOE bond and deposit interest rate
RRN_{CBOND}	Gap between the return of corporate bond and deposit interest rate
$UOF\_F\_D_{inst}$	Flow of foreign asset demanded by *inst*
SAV_{inst}	Saving of *inst*
$EXRADJ_{inst}$	Adjustment in net worth of *inst* due to a change in exchange rate
$INTEXPADJ_{inst}$	Adjustment of net interest income due to a change in interest rate
PEQ	Price index of listed equity
PGB	Price index of government bond
PBOTB	Price index of BOT bond
PSOEB	Price index of SOE bond
PCBOND	Price index of Corporate bond
BANKPORTS	Bank's portfolio of bonds and listed-equity
RRB1	Weighted average return of assets in level 1 (Bank's portfolio decision)
RRB2	Weighted average return of assets in level 2 (Bank's portfolio decision)
RRB3	Weighted average return of assets in level 3 (Bank's portfolio decision)
RRB4	Weighted average return of assets in level 4 (Bank's portfolio decision
GB1	Proportion of equity in bank's portfolio
GB2	Proportion of government bond in bank's portfolio
GB3	Proportion of BOT bond in bank's portfolio
GB4	Proportion of FIDF bond in bank's portfolio
GB5	Proportion of SOE bond in bank's portfolio
BM	Base money (or high-power money)
M2	Broad money supply

EXPEXR	Expected exchange (i.e. the forward rate)
PDAVG	Average price of domestic goods
RSRVRQRM	Reserve Requirement

Exogenous variables

$WFDIST_i$	Sector *i*'s distortion on return on factor *f*
WF_{labor}	Average wage
$PWSE_i$	World price of export substitute
PWM_{im}	World import price (inUS$)
$DTRANS_{dinst,dinst1}$	Domestic transfers (from *dinst1* to *dinst*)
$FTRANS_{dinst,finst}$	Foreign transfers (from *finst* to *dinst*)
CAPUTILZT	Capacity utilization
RNF	Return on foreign asset (the Fed Fund rate)
RRN_{LO}	Loan interest rate
INTSPREAD	Spread between the deposit interest rate and the loan rate
POVLINE	Poverty Line
INCDIST	Income distribution

IV. List of Equations

Core CGE model

Price block

$$PM_{im} = PWM_{im} \cdot EXR \cdot (1 + tm_{im}) \quad (1)$$

$$PE_{ie} = PWE_{ie} \cdot EXR \cdot (1 + te_{ie}) \quad (2)$$

$$PQ_i \cdot Q_i = PD_i \cdot D_i + PM_i \cdot M_i \quad (3)$$

$$PX_i \cdot X_i = PD_i \cdot D_i + PE_i \cdot E_i \quad (4)$$

$$PV_i = PX_i \cdot (1.0 - tx_i) - \sum_j a_{i,j} \cdot PQ_j \quad (5)$$

$$PINDEX = \frac{GDPVA}{RGDP} \quad (6)$$

$$PK_i = \sum_j b_{i,j} \cdot PQ_j \quad (7)$$

Production block

$$X_i = ad_i \prod_f FDSC_{i,f}^{\alpha_{i,f}} \quad (8)$$

$$WF_f \cdot WFDIST_{i,f} = \left(X_i \cdot PV_i \cdot \alpha_{i,f}\right) / FDSC_{i,f} \quad (9)$$

$$INT_i = \sum_j a_{i,j} X_j \quad (10)$$

$$X_{ie} = at_{ie}\left(\gamma_{ie} E_{ie}^{\rho_{ie}^t} + (1-\gamma_{ie}) D_{ie}^{\rho_{ie}^t}\right)^{1/(\rho_{ie}^t - 1)} \quad (11)$$

$$\frac{E_{ie}}{D_{ie}} = \left(\frac{PE_{ie}}{PD_{ie}}\right)\left(\frac{1-\gamma_{ie}}{\gamma_{ie}}\right)^{1/\left(\rho_{ie}^t - 1\right)} \quad (12)$$

$$E_{ie} = econ_{ie}\left(\frac{PWE_{ie}}{PWSE_{ie}}\right)^{(-\eta_{ie})} \quad (13)$$

$$Q_{im} = ac_{im}\left(\delta_{im} M_{im}^{-\rho_{im}^c} + (1-\delta_{im}) D_{im}^{-\rho_{im}^c}\right)^{-1/\rho_{im}^c} \quad (14)$$

$$\frac{M_{im}}{D_{im}} = \left(\frac{PD_{im}}{PM_{im}}\right)\left(\frac{\delta_{im}}{1-\delta_{im}}\right)^{1/\left(1+\rho_{im}^c\right)} \quad (15)$$

Income block

$$YFCTR_f = \sum_i WF_f \cdot WFDIST_{i,f} \cdot FDSC_{i,f} \tag{16}$$

$$YH_{dprivt} = \sum_f fshare_{dprivt,f} YFCTR_f + \sum_{dinst} DTRANS_{dprivt,dinst} + \sum_{finst} FTRANS_{dprivt,finst} \tag{17}$$

$$TARIFF = \sum_{im} \left(tm_{im} M_{im} PWM_{im} EXR \right) \tag{18}$$

$$INDTAX = \sum_i \left(tx_i PX_i X_i \right) \tag{19}$$

$$DIRTAX = \sum_{dprivt} th_{dprivt} YH_{dprivt} \tag{20}$$

$$PRIVSAV = \sum_{dprivt} mps_{dprivt} YH_{dprivt} \left(1 - th_{dprivt} \right) \tag{21}$$

$$GR = TARIFF + INDTAX + DIRTAX + \sum_{dinst} DTRANS_{gov,dinst} + \sum_{finst} FTRANS_{gov,finst} + fshare_{gov,capital} YFCTR_{capital} \tag{22}$$

$$SAVING = PRIVSAV + GOVSAV - FSAV \cdot EXR \tag{23}$$

Expenditure block

$$PQ_i \cdot CD_i = \sum_{dprivt} cles_{i,dprivt} (1 - mps_{dprivt})(1 - th_{dprivt}) YH_{dprivt} \tag{24}$$

$$YH_{dprivt} = \sum_i cles_{i,dprivt} (1 - mps_{dprivt})(1 - th_{dprivt}) YH_{dprivt} + mps_{dprivt} YH_{dprivt} + th_{dprivt} YH_{dprivt} + \sum_{dinst} DTRANS_{dinst,dprivt} + \sum_{finst} FTRANS_{finst,dprivt} \tag{25}$$

$$GD_i = gles_i \cdot GDTOT \tag{26}$$

$$GR = \sum_i PQ_i GD_i + GOVSAV + \sum_{dinst} DTRANS_{dinst,gov} \tag{27}$$

$$DST_i = dstr_i \cdot X_i \tag{28}$$

$$FXDINV = INVEST - \sum_i DST_i \cdot PQ_i \tag{29}$$

$$PK_i \cdot DK_i = kshr_i \cdot FXDINV \tag{30}$$

$$ID_i = \sum_j b_{i,j} \cdot DK_j \tag{31}$$

System constraints

$$Q_i = INT_i + CD_i + GD_i + ID_i + DST_i \tag{32}$$

$$FS_f = \sum_i FDSC_{i,f} \tag{33}$$

$$\sum_{im} PWM_{im} M_{im} = \sum_{ie} PWE_{ie} E_{ie} + \sum_{finst} \sum_{dinst} FTRANS_{dinst,finst} - FSAV \tag{34}$$

$$SAVING = \sum_i ID_i \cdot PQ_i + WALRAS \tag{35}$$

$$GDPVA = \sum_i PV_i X_i + INDTAX + TARIFF \tag{36}$$

$$RGDP = \sum_i \left(CD_i + DST_i + ID_i + GD_i\right) + \sum_{ie} E_{ie} - \sum_{im} (1 - TMREAL_{im}) M_{im} \tag{37}$$

Financial Module

Household's behavior equations

$$HHPORTS = UOF\_S_{EQL,HH} + UOF\_S_{GB,HH} + UOF\_S_{BOTB,HH} + UOF\_S_{FIDFB,HH} + UOF\_S_{SOEB,HH} + UOF\_S_{CBOND,HH} \tag{38}$$

$$RRH1 = (RRN_{GB} \cdot UOF\_S_{GB,HH} + RRN_{BOTB} \cdot UOF\_S_{BOTB,HH} + RRN_{FIDFB} \cdot UOF\_S_{FIDFB,HH} + RRN_{SOEB} \cdot UOF\_S_{SOEB,HH} + RRN_{CBOND} \cdot UOF\_S_{CBOND,HH}) / (UOF\_S_{GB,HH} + UOF\_S_{BOTB,HH} + UOF\_S_{FIDFB,HH} + UOF\_S_{SOEB,HH} + UOF\_S_{CBOND,HH}) \tag{39}$$

$$RRH2 = (RRN_{BOTB} \cdot UOF\_S_{BOTB,HH} + RRN_{FIDFB} \cdot UOF\_S_{FIDFB,HH} + RRN_{SOEB} \cdot UOF\_S_{SOEB,HH} + RRN_{CBOND} \cdot UOF\_S_{CBOND,HH}) / (UOF\_S_{BOTB,HH} + UOF\_S_{FIDFB,HH} + UOF\_S_{SOEB,HH} + UOF\_S_{CBOND,HH}) \tag{40}$$

$$RRH3 = (RRN_{FIDFB} \cdot UOF\_S_{FIDFB,HH} + RRN_{SOEB} \cdot UOF\_S_{SOEB,HH} + RRN_{CBOND} \cdot UOF\_S_{CBOND,HH}) / (UOF\_S_{FIDFB,HH} + UOF\_S_{SOEB,HH} + UOF\_S_{CBOND,HH}) \quad (41)$$

$$RRH4 = (RRN_{SOEB} \cdot UOF\_S_{SOEB,HH} + RRN_{CBOND} \cdot UOF\_S_{CBOND,HH}) / (UOF\_S_{SOEB,HH} + UOF\_S_{CBOND,HH}) \quad (42)$$

$$GH1 = \frac{\tau_{h1} \cdot \left(\frac{1 + RRN_{EQL}}{1 + RRH1} \right)^{\sigma_{h1}}}{1 + \left(\tau_{h1} \cdot \left(\frac{1 + RRN_{EQL}}{1 + RRH1} \right)^{\sigma_{h1}} \right)} \quad (43)$$

$$GH2 = \frac{\tau_{h2} \cdot \left(\frac{1 + RRN_{GB}}{1 + RRH2} \right)^{\sigma_{h2}}}{1 + \left(\tau_{h2} \cdot \left(\frac{1 + RRN_{GB}}{1 + RRH2} \right)^{\sigma_{h2}} \right)} \quad (44)$$

$$GH3 = \frac{\tau_{h3} \cdot \left(\frac{1 + RRN_{BOTB}}{1 + RRH3} \right)^{\sigma_{h3}}}{1 + \left(\tau_{h3} \cdot \left(\frac{1 + RRN_{BOTB}}{1 + RRH3} \right)^{\sigma_{h3}} \right)} \quad (45)$$

$$GH4 = \frac{\tau_{h4} \cdot \left(\frac{1 + RRN_{FIDFB}}{1 + RRH4} \right)^{\sigma_{h4}}}{1 + \left(\tau_{h4} \cdot \left(\frac{1 + RRN_{FIDFB}}{1 + RRH4} \right)^{\sigma_{h4}} \right)} \quad (46)$$

$$GH5 = \frac{\tau_{h5} \cdot \left(\frac{1 + RRN_{SOEB}}{1 + RRN_{CBOND}} \right)^{\sigma_{h5}}}{1 + \left(\tau_{h5} \cdot \left(\frac{1 + RRN_{SOEB}}{1 + RRN_{CBOND}} \right)^{\sigma_{h5}} \right)} \quad (47)$$

$$UOF\_S_{EQL,HH} = GH1 \cdot HHPORTS \quad (48)$$

$$UOF\_S_{GB,HH} = GH2 \cdot (1 - GH1) \cdot HHPORTS \quad (49)$$

$$UOF\_S_{BOTB,HH} = GH3 \cdot (1 - GH2) \cdot (1 - GH1) \cdot HHPORTS \quad (50)$$

$$UOF\_S_{FIDFB,HH} = GH4 \cdot (1 - GH3) \cdot (1 - GH2) \cdot (1 - GH1) \cdot HHPORTS \quad (51)$$

$$UOF\_S_{SOEB,HH} = GH5 \cdot (1 - GH4) \cdot (1 - GH3) \cdot (1 - GH2) \cdot (1 - GH1) \cdot HHPORTS \quad (52)$$

$$UOF\_S_{CBOND,HH} = (1 - GH5) \cdot (1 - GH4) \cdot (1 - GH3) \cdot (1 - GH2) \cdot (1 - GH1) \cdot HHPORTS \quad (53)$$

$$SOF\_S_{LO,HH} = ph0 \cdot \left(SOF\_S_{DE,BANK}\right)^{ph1} \cdot \left(RRN_{LO}\right)^{ph2} \quad (54)$$

$$SOF\_S_{EQNL,HH} = sof\_slag_{EQNL,HH} + SOF\_F_{EQNL,HH} + SAV_{HH} + EXRADJ_{HH} + INTEXPADJ_{HH} \quad (55)$$

$$INTEXPADJ_{HH} = \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int}\right) \cdot uof\_s0_{asset\_int,HH} \right) - \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int}\right) \cdot sof\_s0_{asset\_int,HH} \right) \quad (56)$$

$$EXRADJ_{HH} = \left(EXR - exr0\right) \cdot uof\_sl\_d0_{HH} \quad (57)$$

$$UOF\_S_{FA,HH} = \left(uof\_sl\_d0_{HH} + UOF\_F\_D_{HH}\right) \cdot EXR \quad (58)$$

$$UOF\_F_{FA,HH} = UOF\_F\_D_{HH} \cdot EXR \quad (59)$$

$$UOF\_F\_D_{HH} = fahh0 \cdot (1 + \overline{RNF} - RRN("DE"))^{fahh1} \cdot RGDP^{fahh2} \cdot EXR \quad (60)$$

$$UOF\_F_{FIXED,HH} = fh0 \cdot (RRN_{LO})^{fh1} \quad (61)$$

$$UOF\_F_{CH,HH} = ch0_{HH} * sav_{HH} * RRN("DE"))^{cho} + INTEXPADJ_{HH} + CHADJ_{HH} \quad (62)$$

Enterprise's behavior equations

$$UOF\_S_{FIXED,ENTP} = pf0 \cdot \left(RRN_{LO}\right)^{pf1} \cdot \left(\overline{CAPUTILZT}\right)^{pf2} \quad (63)$$

$$UOF\_F_{DE,ENTP} = de0 \cdot \left(SAV_{ENTP}\right)^{de1} \quad (64)$$

$$SOF\_S_{LO,ENTP} = pp0 \cdot \left(SOF\_S_{DE,BANK}\right)^{pp1} \cdot \left(RRN_{LO}\right)^{pp2} \quad (65)$$

$$SOF\_S_{EQL,ENTP} = \sum_{inst} UOF\_S_{EQL,inst} \quad (66)$$

$$PEQ \cdot sof\_s0_{EQL,ENTP} = SOF\_S_{EQL,ENTP} \tag{67}$$

$$SOF\_S_{SOEB,ENTP} = \sum_{inst} UOF\_S_{SOEB,inst} \tag{68}$$

$$PSOEB \cdot sof\_s0_{SOEB,ENTP} = SOF\_S_{SOEB,ENTP} \tag{69}$$

$$SOF\_S_{CBOND,ENTP} = \sum_{inst} UOF\_S_{CBOND,inst} \tag{70}$$

$$PCBOND \cdot sof\_s0_{CBOND,ENTP} = SOF\_S_{CBOND,ENTP} \tag{71}$$

$$SOF\_S_{EQNL,ENTP} = sof\_slag_{EQNL,ENTP} + SOF\_F_{EQNL,ENTP} + SAV_{ENTP} + EXRADJ_{ENTP} + INTEXPADJ_{ENTP} \tag{72}$$

$$INTEXPADJ_{ENTP} = \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int} \right) \cdot uof\_s0_{asset\_int,ENTP} \right) - \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int} \right) \cdot sof\_s0_{asset\_int,ENTP} \right) \tag{73}$$

$$EXRADJ_{ENTP} = \left(EXR - exr0 \right) \cdot uof\_sl\_d0_{ENTP} \tag{74}$$

$$UOF\_S_{FA,ENTP} = \left(uof\_sl\_d0_{ENTP} + UOF\_F\_D_{ENTP} \right) \cdot EXR \tag{75}$$

$$UOF\_F_{FA,ENTP} = UOF\_F\_D_{ENTP} \cdot EXR \tag{76}$$

$$UOF\_F\_D_{ENTP} = faent0 \cdot (1 + \overline{RNF} - RRN("DE"))^{faent1} \cdot RGDP^{faent2} \cdot EXR \tag{77}$$

$$UOF\_F_{CH,ENTP} = ce0 \cdot (SAV_{ENTP})^{ce1} \cdot (RRN_{DE})^{ce2} + INTEXPADJ_{ENTP} \tag{78}$$

Banks' behavior equations

$$BANKPORTS = UOF\_S_{EQL,BANK} + UOF\_S_{GB,BANK} + UOF\_S_{BOTB,BANK} + UOF\_S_{FIDFB,BANK} + UOF\_S_{SOEB,BANK} + UOF\_S_{CBOND,BANK} \tag{79}$$

$$RRB1 = (RRN_{GB} \cdot UOF\_S_{GB,BANK} + RRN_{BOTB} \cdot UOF\_S_{BOTB,BANK} + RRN_{FIDFB} \cdot UOF\_S_{FIDFB,BANK} + RRN_{SOEB} \cdot UOF\_S_{SOEB,BANK} + RRN_{CBOND} \cdot UOF\_S_{CBOND,BANK}) / (UOF\_S_{GB,BANK} + UOF\_S_{BOTB,BANK} + UOF\_S_{FIDFB,BANK} + UOF\_S_{SOEB,BANK} + UOF\_S_{CBOND,BANK}) \tag{80}$$

$$RRB2 = (RRN_{BOTB} \cdot UOF\_S_{BOTB,BANK} + RRN_{FIDFB} \cdot UOF\_S_{FIDFB,BANK} + RRN_{SOEB} \cdot UOF\_S_{SOEB,BANK} + RRN_{CBOND} \cdot UOF\_S_{CBOND,BANK}) / (UOF\_S_{BOTB,BANK} + UOF\_S_{FIDFB,BANK} + UOF\_S_{SOEB,BANK} + UOF\_S_{CBOND,BANK}) \quad (81)$$

$$RRB3 = (RRN_{FIDFB} \cdot UOF\_S_{FIDFB,BANK} + RRN_{SOEB} \cdot UOF\_S_{SOEB,BANK} + RRN_{CBOND} \cdot UOF\_S_{CBOND,BANK}) / (UOF\_S_{FIDFB,BANK} + UOF\_S_{SOEB,BANK} + UOF\_S_{CBOND,BANK}) \quad (82)$$

$$RRB4 = (RRN_{SOEB} \cdot UOF\_S_{SOEB,BANK} + RRN_{CBOND} \cdot UOF\_S_{CBOND,BANK}) / (UOF\_S_{SOEB,BANK} + UOF\_S_{CBOND,BANK}) \quad (83)$$

$$GB1 = \frac{\tau_{b1} \cdot \left(\frac{1 + RRN_{EQL}}{1 + RRB1} \right)^{\sigma_{b1}}}{1 + \left(\tau_{b1} \cdot \left(\frac{1 + RRN_{EQL}}{1 + RRB1} \right)^{\sigma_{b1}} \right)} \quad (84)$$

$$GB2 = \frac{\tau_{b2} \cdot \left(\frac{1 + RRN_{GB}}{1 + RRB2} \right)^{\sigma_{b2}}}{1 + \left(\tau_{b2} \cdot \left(\frac{1 + RRN_{GB}}{1 + RRB2} \right)^{\sigma_{b2}} \right)} \quad (85)$$

$$GB3 = \frac{\tau_{b3} \cdot \left(\frac{1 + RRN_{BOTB}}{1 + RRB3} \right)^{\sigma_{b3}}}{1 + \left(\tau_{b3} \cdot \left(\frac{1 + RRN_{BOTB}}{1 + RRB3} \right)^{\sigma_{b3}} \right)} \quad (86)$$

$$GB4 = \frac{\tau_{b4} \cdot \left(\frac{1 + RRN_{FIDFB}}{1 + RRB4} \right)^{\sigma_{b4}}}{1 + \left(\tau_{b4} \cdot \left(\frac{1 + RRN_{FIDFB}}{1 + RRB4} \right)^{\sigma_{b4}} \right)} \quad (87)$$

$$GB5 = \frac{\tau_{b5} \cdot \left(\frac{1 + RRN_{SOEB}}{1 + RRN_{CBOND}} \right)^{\sigma_{b5}}}{1 + \left(\tau_{b5} \cdot \left(\frac{1 + RRN_{SOEB}}{1 + RRN_{CBOND}} \right)^{\sigma_{b5}} \right)} \quad (88)$$

$$UOF\_S_{EQL,BANK} = GB1 \cdot HHBANKS \quad (89)$$

$$UOF\_S_{GB,BANK} = GB2 \cdot (1 - GB1) \cdot HHBANKS \tag{90}$$

$$UOF\_S_{BOTB,BANK} = GB3 \cdot (1 - GB2) \cdot (1 - GB1) \cdot HHBANKS \tag{91}$$

$$UOF\_S_{FIDFB,BANK} = GB4 \cdot (1 - GB3) \cdot (1 - GB2) \cdot (1 - GB1) \cdot HHBANKS \tag{92}$$

$$UOF\_S_{SOEB,BANK} = GB5 \cdot (1 - GB4) \cdot (1 - GB3) \cdot (1 - GB2) \cdot (1 - GB1) \cdot HHBANKS \tag{93}$$

$$UOF\_S_{CBOND,BANK} = (1 - GB5) \cdot (1 - GB4) \cdot (1 - GB3) \cdot (1 - GB2) \cdot (1 - GB1) \cdot HHBANKS \tag{94}$$

$$SOF\_S_{EQNL,BANK} = sof\_slag_{EQNL,BANK} + SOF\_F_{EQNL,BANK} + SAV_{BANK} + EXRADJ_{BANK} + INTEXPADJ_{BANK} \tag{95}$$

$$INTEXPADJ_{BANK} = \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int} \right) \cdot uof\_s0_{asset\_int,BANK} \right) - \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int} \right) \cdot sof\_s0_{asset\_int,BANK} \right) \tag{96}$$

$$EXRADJ_{BANK} = \left(EXR - exr0 \right) \cdot uof\_sl\_d0_{BANK} \tag{97}$$

$$UOF\_S_{FA,BANK} = \left(uof\_dl\_do_{BANK} + UOF\_F\_D_{BANK} \right) \cdot EXR \tag{98}$$

$$UOF\_F_{FA,BANK} = UOF\_F\_D_{BANK} \cdot EXR \tag{99}$$

$$UOF\_F\_D_{BANK} = fabnk0 \cdot (1 + \overline{RNF} - RRN("DE"))^{fabnk1} \cdot RGDP^{fabnk2} \cdot EXR \tag{100}$$

Government's behavior equations

$$SOF\_S_{GB,GOV} = \sum_{inst} UOF\_S_{GB,inst} \tag{101}$$

$$PGB \cdot sof\_s0_{GB,GOV} = SOF\_S_{GB,GOV} \tag{102}$$

$$SOF\_S_{FIDFB,GOV} + SOF\_S_{FIDFB,BOT} = \sum_{inst} UOF\_S_{FIDFB,inst} \tag{103}$$

$$PFIDFB \cdot \left(sof\_s0_{FIDFB,GOV} + sof\_0_{FIDFB,BOT} \right) = SOF\_S_{FIDFB,GOV} + SOF\_S_{FIDFB,BOT} \tag{104}$$

$$SOF\_S_{EQNL,GOV} = sof\_slag_{EQNL,GOV} + SOF\_F_{EQNL,GOV} + SAV_{GOV} + EXRADJ_{GOV} + INTEXPADJ_{GOV} \quad (105)$$

$$INTEXPADJ_{GOV} = \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int} \right) \cdot uof\_s0_{asset\_int,GOV} \right) - \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int} \right) \cdot sof\_s0_{asset\_int,GOV} \right) \quad (106)$$

$$UOF\_F_{CH,GOV} = govch \cdot SAV_{GOV} + INTEXPADJ_{GOV} \quad (107)$$

Bank of Thailand (BOT)'s behavior equations

$$SOF\_S_{BOTB,BOT} = \sum_{inst} UOF\_S_{BOTB,inst} \quad (108)$$

$$PBOTB \cdot (sof\_s0_{BOTB,BOT}) = SOF\_S_{BOTB,BOT} \quad (109)$$

$$SOF\_S_{EQNL,BOT} = sof\_slag_{EQNL,BOT} + SOF\_F_{EQNL,BOT} + EXRADJ_{BOT} + INTEXPADJ_{BOT} \quad (110)$$

$$INTEXPADJ_{BOT} = \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int} \right) \cdot uof\_s0_{asset\_int,BOT} \right) - \left(\sum_{asset\_int} \left(RRN_{asset\_int} - rrn0_{asset\_int} \right) \cdot sof\_s0_{asset\_int,BOT} \right) \quad (111)$$

$$EXRADJ_{BOT} = \left(EXR - exr0 \right) \cdot uof\_sl\_d0_{BOT} \quad (112)$$

$$UOF\_S_{FA,BOT} = \left(uof\_sl\_d0_{BOT} + UOF\_F\_D_{BOT} \right) \cdot EXR \quad (113)$$

$$UOF\_F_{FA,BOT} = \left(UOF\_F\_D_{BOT} \right) \cdot EXR \quad (114)$$

$$UOF\_F\_D_{BOT} = fabot0 \cdot (1 + \overline{RNF} - RRN("DE"))^{fabot1} \cdot RGDP^{fabot2} \cdot EXR \quad (115)$$

$$SOF\_S_{DE,BOT} = UOF\_S_{DE,BANK} + botdeoth \quad (116)$$

$$BM = SOF\_S_{CH,BOT} + UOF\_S_{DE,BANK} \quad (117)$$

$$M2 = SOF\_S_{CH,BOT} + SOF\_S_{DE,BANK} \quad (118)$$

$$rratio = UOF\_S_{DE,BANK} / SOF\_S_{DE,BANK} \quad (119)$$

$$cratio = SOF\_S_{CH,BOT} / SOF\_S_{DE,BANK} \quad (120)$$

$$M2 = \left(\frac{1 + cratio}{cratio + rratio}\right) \cdot BM \quad (121)$$

$$SOF\_S_{CH,BOT} = botc0 \cdot \left(RRN_{LO}\right)^{botc1} \cdot \left(RGDP\right)^{botc2} \quad (122)$$

$$SOF\_F_{RP,BOT} - sof\_f_{RP,BOT} = \left(SOF\_F_{CH,BOT} - sof\_f_{ch,BOT}\right) \cdot (-1) \quad (123)$$

Rest of the world (ROW)'s behavior equations

$$UOF\_F_{LO,ROW} = rwlo0 \cdot \left(RRN_{LO} - \overline{RNF}\right)^{rwlo1} \cdot \left(\overline{EXPEXR}\right)^{rwlo2} \quad (124)$$

$$UOF\_F_{DE,ROW} = rwde0 \cdot \left(RRN_{DE} - \overline{RNF}\right)^{rwde1} \cdot \left(\overline{EXPEXR}\right)^{rwde2} \quad (125)$$

$$UOF\_F_{GB,ROW} = rwgb0 \cdot \left(rn_{GB} - \overline{RNF}\right)^{rwgb1} \cdot \left(\overline{EXPEXR}\right)^{rwgb2} \quad (126)$$

$$UOF\_F_{CBOND,ROW} = rwcbond0 \cdot \left(rn_{CBOND} - \overline{RNF}\right)^{rwcbond1} \cdot \left(\overline{EXPEXR}\right)^{rwcbond2} \quad (127)$$

$$UOF\_F_{EQL,ROW} = rweq10 \cdot \left(rn_{EQL} - \overline{RNF}\right)^{rweq11} \cdot \left(\overline{EXPEXR}\right)^{rweq12} \quad (128)$$

$$UOF\_S_{LO,ROW} = UOF\_F_{LO,ROW} + uof\_slag_{LO,ROW} \quad (129)$$

$$UOF\_S_{DE,ROW} = UOF\_F_{DE,ROW} + uof\_slag_{DE,ROW} \quad (130)$$

$$UOF\_S_{GB,ROW} = UOF\_F_{GB,ROW} + uof\_slag_{GB,ROW} \quad (131)$$

$$UOF\_S_{CBOND,ROW} = UOF\_F_{CBOND,ROW} + uof\_slag_{CBOND,ROW} \quad (132)$$

$$UOF\_S_{EQL,ROW} = UOF\_F_{EQL,ROW} + uof\_slag_{EQL,ROW} \quad (133)$$

System constraints

$$UOF\_S_{asset\_a,do\min st} = UOF\_F_{asset\_a,do\min st} + uof\_slag_{asset\_a,do\min st} \quad (134)$$

$$SOF\_S_{asset\_l,do\min st} = SOF\_F_{asset\_l,do\min st} + sof\_slag_{asset\_l,do\min st} \quad (135)$$

$$\sum_{inst} UOF\_F_{assetNF,inst} = \sum_{inst} SOF\_F_{assetNF,inst} \quad (136)$$

$$\sum_{asset} UOF\_F_{asset,inst} = \sum_{asset} SOF\_F_{asset,inst} + SAV_{inst} \quad (137)$$

$$INVEST = \sum_{inst} UOF\_F_{FIXED,inst} \quad (138)$$

$$RRN_{LO} - \overline{RNF} = \left(\frac{EXPEXR}{EXR} - 1 \right) \quad (139)$$

$$RRN_{LO} = RRN_{DE} + \overline{INTSPREAL} \quad (140)$$

$$RRN_{GB} = rn_{GB} - RRN_{DE} \quad (141)$$

$$RRN_{BOTB} = rn_{BOTB} - RRN_{DE} \quad (142)$$

$$RRN_{FIDFB} = rn_{FIDFB} - RRN_{DE} \quad (143)$$

$$RRN_{SOEB} = rn_{SOEB} - RRN_{DE} \quad (144)$$

$$RRN_{EQL} = rn_{EQL} - RRN_{DE} \quad (145)$$

$$SAV_{HH} = mps_{HH}; YH_{HH} \cdot (1 - th_{HH}) \quad (146)$$

$$SAV_{ENTP} = mps_{ENTP} \cdot YH_{ENTP} \cdot (1 - th_{ENTP}) \quad (147)$$

$$SAV_{GOV} = GOVSAV \quad (148)$$

$$SAV_{ROW} = EXR \cdot (-FSAV) \quad (149)$$

Poverty block

$$PDAVG = (\sum_i PD_i * D_i) / \sum_i D_i \quad (150)$$

$$POVLINE = PINDEX / PDAVG \cdot alphapov \cdot \sum_i PDi \quad (151)$$

$$INCDIST = YH_{HH1} / YH_{HH15} \quad (152)$$

$$RSRVRQRM = UOF\_F_{DE,BANK} / SOF\_F_{DE,BANK} \quad (153)$$

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