A MACROECONOMETRIC MODEL FOR THAILAND WITH WELFARE LINKAGES: ANALYSES OF SELECTED POLICIES IN RESPONSE TO ENERGY PRICE INCREASES

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A MACROECONOMETRIC MODEL FOR THAILAND WITH WELFARE LINKAGES: ANALYSES OF SELECTED POLICIES IN RESPONSE TO ENERGY PRICE INCREASES

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This dissertation uses the data from 1993 to 2004 to demonstrate the effects of the increase in petroleum price on the general economy of Thailand and their linkage with aspects of welfare. It also evaluates the effectiveness of the counterfactual policy responses. The evaluation is done using a macroeconometric model in which the data are first incorporated into a system of simultaneous equations. Then a policy or a combination of policies is simulated for each scenario. Charts of the results of the variables simulated in each scenario are analyzed. There are seven chapters in this dissertation. Chapter One begins with an introduction that discusses why an increase in the price of crude oil concerns not only an individual country but also the world as a whole, and then turns to the counterfactual policies proposed by this dissertation. The important scenarios of price surge in the past and the recent price situation are briefly discussed. Because the recent cases of price increase have different causes from those of the past, the shifts in the demand and the supply curves of both cost-push and demand-pull inflation as well as the dynamic movements of aggregate demand and supply are explained. This discussion is followed by an explanation of how the mechanism of an increase in the price of oil can lead to a change in welfare. Thailand's recent economic situation, including the years before, during, and after the era of the Asian financial crisis (1985-2006) is presented. The chapter also briefly discusses the data of the nation's gross domestic product, consumer price index (CPI),

and current account balance during the 1970s price surge. (This brief discussion reflects a suspicion that changes in these variables had been affected by changes in crude oil prices.) The chapter concludes with the discussions of Thailand's oil price structure and its oil fund program, an influential tool that the government has been using as an immediate policy response.

Chapter Two surveys the literature in two main categories: The first category is the macroeconometric models of various countries, and the second is the impact of changes in oil prices as determined by different modeling methods. Chapter Three explains the details of the macroeconometric framework that serves as the core model of the dissertation. This chapter also discusses the construction and the history of the core model, which is based on a supply and demand concept, as well as the advantages and disadvantages of the model.

Chapter Four presents the general economy block that is composed of the blocks for aggregate demand (C,I), trade (X, M), production (total output), and price (PGDP and CPI), all of which served as a core model. Chapter Five presents the energy, fiscal, and welfare blocks. Chapters Four and Five together explain the fundamental theories in building the overall structure and also present each dependent variable as a function of other variables. Finally, the relationships among the variables within a system or a block are demonstrated by a flowchart.

With a predefined set of explanatory variables for each dependent variable, each equation and ex-post simulation was calibrated using EVIEWS 6.0. The results of the coefficients, the fitted graphs, and the mean absolute percentage error (MAPE) are shown in Appendix C. The results of the baseline simulations, which are the attempts to match the model with actual data, can be found in Appendix D.

Chapter Six presents the results of the seven simulated scenarios. These scenarios include the impact of the world oil price increase (Scenario 1); the use of the oil fund as a counterfactual policy response when the world crude oil price increased by 50% (Scenario 2); the use of the oil fund when the world crude oil price increased by 200% (Scenario 3); the use of a tax reduction when the world crude oil price increased by 50% (Scenario 4); the impact of a reduction in the sales of automobiles (Scenario 5); the impact of the monetary policy response (Scenario 6); and the impact of the fiscal policy response in addition to the monetary policy response (Scenario 7).

The results show that the world crude oil price increase is followed by a decline in almost every variable, among which investment presents the greatest decline. When the price of the world crude oil increases by 50%, a 1.2 bath/liter subsidy from the oil fund or a 35% tax cut is needed to stabilize the economy. However, when the crude oil price increases by 200%, a 2.5 bath/liter subsidy from the oil fund is needed. A reduction in automobile sales shows only a few percent reduction in the usage of diesel as well as a very small reduction in the total number of automobiles. Finally, a rising interest rate in response to the rising price level indeed worsens the overall economy, and increasing government expenditures significantly helps only some variables such as unemployment. Chapter Seven concludes the dissertation.

BIOGRAPHICAL SKETCH

Warong Robert Sukchotrat was born in 1977 in Tallahassee, Florida. He went to Bangkok, Thailand, with his parents and lived there from the age of 2 until he was 16. He returned to the United States in 1994 to attend the Wyoming Seminary Preparatory School in Pennsylvania, where he graduated cum laude. In 1996, he was awarded a Royal Thai government scholarship. He continued his study in electrical and computer system engineering (telecommunications) at Rensselaer Polytechnic Institute, where in 2000 he graduated magna cum laude with a Bachelor of Science degree. In 2003, he earned a Master of Science degree in electrical and computer engineering (optoelectronics) at Cornell University. After a year as a Ph.D. student in electrical and computer engineering at Cornell University, he decided instead to pursue a doctoral degree in Regional Science there. His Master of Arts degree was awarded in 2008, and his Ph.D. was completed in January 2011.

To my beloved family

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CHAPTER 1

ECONOMY AND ENERGY

1.1 Introduction

Energy, like other commodities, is traded in world markets according to countries' resource scarcity or abundance. However, the major difference between energy and other commodities is its short-run price elasticity. Energy demand in the short run is very price inelastic because of its necessity and the rarity of immediate substitutes. The most important and widely used form of energy today is petroleum. Its world prices are controlled by decisions among a few oil exporting countries in which the price is not dependent merely on supply and demand as in competitive markets but also on profit maximization and politics.

Major changes in petroleum prices can greatly affect the world economy, especially among oil importing countries. The most worrisome economic condition, particularly among energy importers, is stagflation, the combination of inflation and recession in which there is an increase in the price level and a reduction in output at the same time. An increase in the price of petroleum causes the cost of goods and services (those of the production inputs depending on petroleum products) to rise, thus igniting pressure for increases in wages, salaries, and the prices of other goods and services. The result is an increase in inflation. To deal with inflation, governments use conservative monetary and fiscal policies. At the same time, the private sector reduces its investments in an effort to deal with the increased cost of production. The cumulative results are slower economic growth, higher unemployment, and higher interest rates, all of which will further dampen growth.

Most countries, especially developing nations, are oil importers. The recent increase in crude oil prices makes their import bills exceed their export income, which they need to generate to pay for imports. Their pursuit of economic development and its accompanying industrialization serves to increase their demand for oil. Without the extra oil supply or effective response policies, these countries may be forced to either slow their economic growth or to borrow abroad. Thus, change in energy prices can play a major role in a developing country's economy.

This dissertation aims to demonstrate the effects of petroleum price increases on the general economy of Thailand and their linkages to the welfare aspect as well as to evaluate the counterfactual policy responses. The evaluation uses a macroeconometric model based on data from 1993 to 2004. The model first incorporates the data into a system of simultaneous equations, generates the best fit for each equation, and simulates scenarios for a policy or a combination of policies. The two main policies are the use of the oil fund program and a tax cut that would directly affect the price that consumers pay. The changes in the price of diesel fuel will be used as a representative of all petroleum product prices because the price of diesel is considered to have the most overall economic impact. Its usage is more or less essential in every sector: agricultural, manufacturing, services, construction, utilities, and transportation. Thus, it has long been the main target of the energy price intervention via the use of the oil fund program by successive Thai governments. An analysis of the graphical data of changes between the baseline variables and the predicted variables permits the drawing of some conclusions about this intervention.

1.2 Recent World Crude Oil Price History

The world oil price increased significantly between 2002, when it was less than \$20/barrel, and September 2005, when it was as high as \$60/barrel. This increase was mostly because of the invasion of Iraq and growth in demand, especially in East Asia, factors that caused demand to outpace the rate of increases in supply. The price peak in September 2005 also was because of the impact in the United States of Hurricane Katrina and fear of Hurricane Rita. Because of the unusual increase in demand, on September 20, 2005, the Organization of the Oil Exporting Countries (OPEC) formally agreed to stop its role as a cartel and pushed the production capacities of its members to their limits in an effort that was both a public relations ploy and an attempt to bring oil prices down. Nevertheless, the prices of world crude oil remained substantially high. The price per barrel continued to rise, exceeding $80 in 2007 because of many factors, including a greater than expected shortfall in U.S. stockpiles and an attack on six pipelines in Mexico. In the face of continued high forward prices in the futures market, the price per barrel continued to rise, setting a record of $147.27 on July 11, 2008, after missile tests by Iran. However, within two weeks the price had dropped by more than $20 and continued to decline sharply to a low of $33.87 on December 21, 2008, because of the global financial crisis. Since then, the price has risen slowly to a close of $80 per barrel as of November 2009 (Figure 1.1) (Wikipedia 2010). This recent rate of increase in the price of oil is one of three highest in history since the 19th century. The other two were during the Yom Kippur and Iraq-Iran wars (Figure 1.2).

Figure 1.1: Recent World Crude Oil Prices, 1996-2010

Source: Wikipedia.org

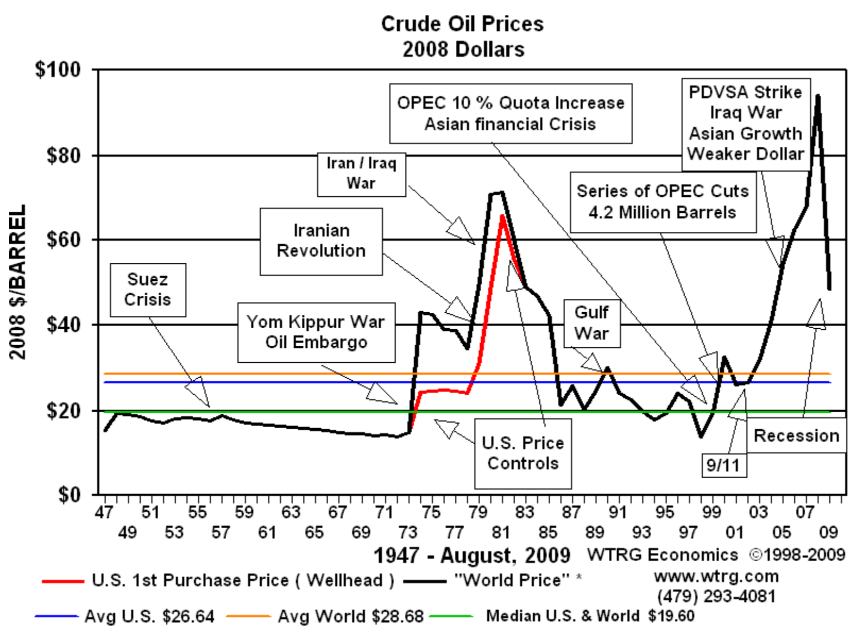


Figure 1.2: World Crude Oil Prices, 1947-2009 (US$/Barrel)

Source: http://www.wtrg.com/prices.htm

1.3 Energy Prices and Stagflation

Increases in the price of oil are, as a whole, the world's major economic concern because of the fear of stagflation. In order to deal with the problem, the causes of price increases must be known. Prices rose during the 1970s because of cost-push (supply-side) inflation. The Yom Kippur War and the Arab oil embargo that resulted in the leftward shift of the aggregate supply curve (Figure 1.3) for the rest of the world. This inflationary shock raised production costs and reduced output, thus causing stagflation. In contrast, the recent price increase is mostly because of demand-pull inflation. During 1990s, the economy in Asia's emerging markets, especially in China and India, began to grow exponentially. As the demand for their exports increased significantly, so did their domestic investment to expand their industries. The result was a heightened demand for energy. Figure 1.4 shows that for China and India, the demand in their factory production inputs, including energy, increases the price level and also the level of output. Few countries share the experiences of China and India, where oil price increases are the result of demand-pull; the rest of the world, excluding oil-exporting countries, experiences the problem as of one of cost-push, as illustrated in Figure 1.3.

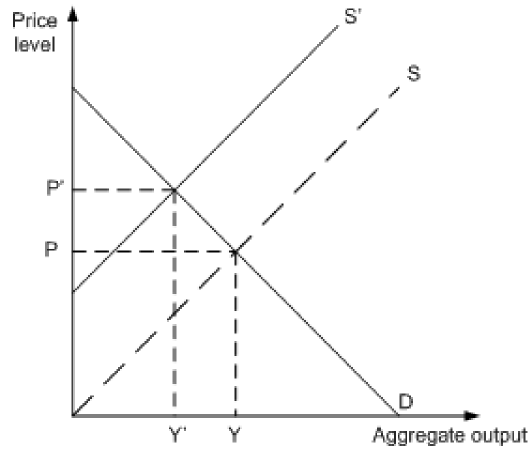


Figure 1.3: Cost-push inflation

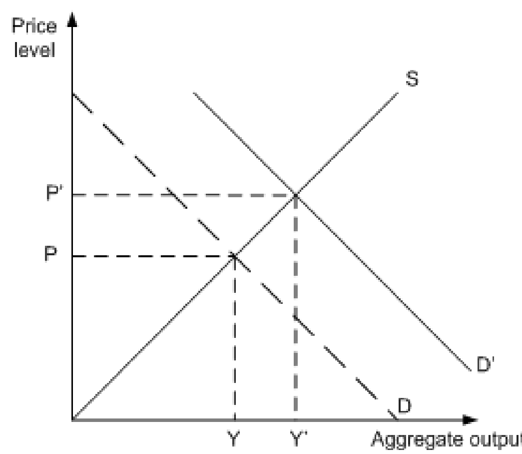


Figure 1.4: Demand-pull inflation

However, one might argue that the current economic situation is neither as bad as in the 1970s nor really as much of a slowdown. One reason the recent situation can be seen more favorably, compared with the 1970s, is because, first, there is a time lag between the higher prices and the subsequent decline in output (Azis 2008). Because one of the main tasks of any central bank (CB) is to monitor the economic situation and determine how to respond (mainly through interest rates), the CB would greatly benefit from the time lag. Second, the rest of the world has an option to invest in or export to emerging markets like China and India. By exercising these options, countries are able to compensate to some extent for their losses. However, the situation also can be more unfavorable in the long term than what happened in the 1970s because the recent increases in oil prices and their subsequent impacts tend to be more permanent than the earlier impacts. Nonetheless, in either situation, increases in oil prices definitely damage the world economy as a whole. Although, for the reasons given above, the adverse effects seem less than expected, this dissertation emphasizes the supply-push effects on Thailand and considers them the worst case scenario a country can face.

To incorporate an increase in the price of oil into the labor market and the aggregate supply-aggregate demand (AS-AD) model, another factor of production must be incorporated. An increase in one of the factors of production can be captured through an increase in the markup price. The effect is shown in Blanchard (2005). An increase in the markup price increases the natural rate of unemployment and decreases real wages. With a decrease in the natural level of employment, assuming a unit of output still requires the same amount of labor, the natural level of output also will decrease. Thus, an increase in the price of crude oil eventually will lead to a decrease in output.

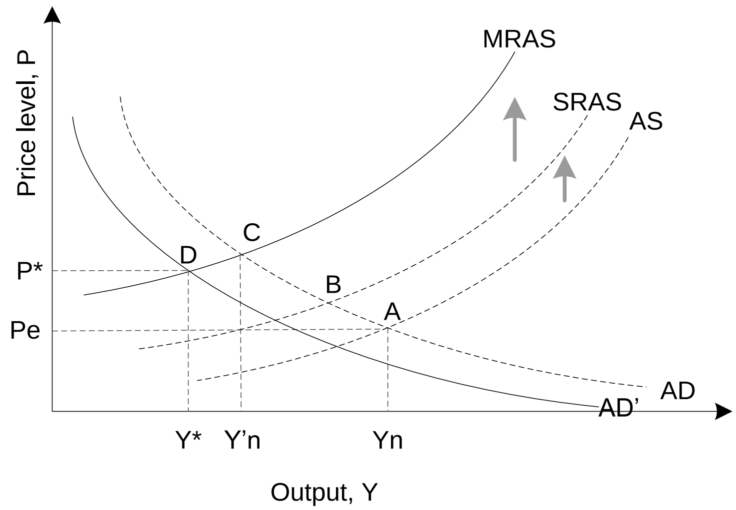


Figure 1.5: Effects of oil price increases

Source: Blanchard

According to the AS-AD model, in the short run an increase in the markup price leads to an upward shift in the AS curve (from the AS relationship), price levels increase and output decreases. An increase in oil prices will affect the income distribution between oil producers and oil consumers. Because Thailand is an oil consumer, this will affect its firms' investment plans as well as consumption demand. Thus, this shifting of AD to the left will further decrease output, putting downward pressure on prices; however, because oil is a necessity, it is hard in the short term for consumers to adjust their consumption of it.

In the medium run, as the natural level of output decreases further, the AS curve will continue to shift upward, resulting in further increases in prices and decreases in output. This is what happened during the 1970s oil crisis stagflation, the result of a combination of high inflation and negative growth.

1.4 Energy prices and welfare

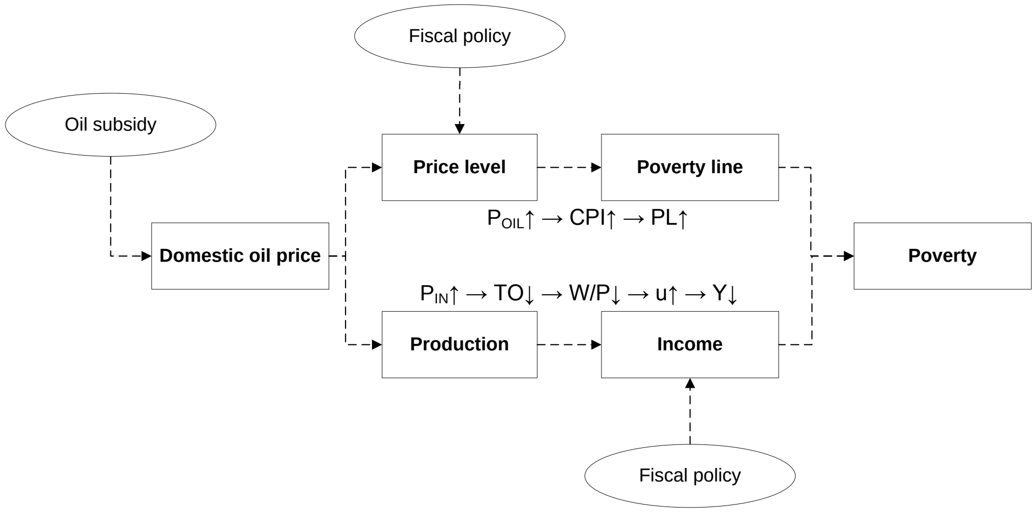


Figure 1.6: Impact of oil prices on poverty

Source: Macroeconomic and poverty impact of the oil price increase in Asia-Pacific; Iwan J. Azis

Figure 1.6 illustrates the mechanisms of how an oil price shock can eventually affect welfare. When oil prices increase, because the price of a factor of production increases, production will fall; this leads to a fall in real wages and a rise in the unemployment rate. Thus, through this channel, income will fall. Through another channel, when oil prices increase, price levels rise, which affects the poverty line because the poverty line is the minimum basket of goods required for basic needs multiplied by price. The increase in prices will make this basket of goods less affordable, so more people will fall below the poverty line. Changes in both income and the poverty line are indicators of poverty.

If a monetary policy is used, for example, an interest rate policy to directly change the price level which in turn effect production, policymaker must choose between an expansionary policy that will increase output but also increase price levels or a contractionary policy that will decrease inflation but also decrease output. The former also risks a wage-price spiral in which higher wages in response to higher consumer prices lead to higher unemployment. On the other hand, if fiscal policy is used to directly promote growth, it risks being inflationary and widening the budget deficit with the result of weakening economic fundamentals and causing instability. A direct subsidy is the most prominent way to avoid the complications of both policies. The advantage is that subsidies will not raise uncertainty about either future supplies or prices and consequently will not significantly affect consumption expenditures (Azis 2009).

1.5 Thailand's Economic Conditions

Thailand's recent economic history is categorized into three periods: boom (1985-1996), crisis (1997-1999), and post-crisis (2000-now). During its boom period, Thailand's average annual economic growth exceeded 7% and was among the highest rates in the world. Many factors contributed to such high growth, including low inflation, a stable exchange rate, low wages, and policy reform, but the most important factor was trade liberalization early in the boom years. However, in mid-1997, an economic crisis that originated in Thailand began to strike all Southeast Asian countries. The crisis came as a surprise. Many firms, especially trust funds and importers, went bankrupt because of the great increase in the U.S. dollar exchange rate. Later, it was determined that excessive borrowing by the private sector was one of the main causes of the crisis. Before 1997, the economy in the Southeast Asian countries seemed to be doing exceptionally well, and some of the macro-indicators agree, but still, the countries fell into crisis. In January 1998, the exchange rate reached its peak of more than double its value, and the economy contracted more than 10% that year. The economy began to recover in 1999, expanding by an average of more than 4% a year until early 2007, when it faltered after the military coup that occurred on September 19, 2006.

1.5.1 Boom Period (1985-1996)

Before 1985, Thailand's politics had long been only partially democratic with some governments formed under an appointment system and others were elected. None of these governments were stable and most of them were short-lived. Thus, Thailand's economy in that era was not very open to foreign investment, there was no financial liberalization, and trading was not fully liberated. However, when Gen. Chatchai Chunhawan took over the parliament (elected) in the late 1980s, his government made substantial changes in Thailand's economy policies. The main goals of the changes were trade and financial liberalization. One of the important policy changes of that government was the elimination of barriers that limited foreign investment. As a result, Thailand became one of the most attractive places for foreign investment in many forms (loans, foreign direct investment (FDI), and stock market). The factors that contributed to the subsequent high growth were the policy reforms, low wages, low inflation, and a stable exchange rate (a pegged exchange rate was used during this period, thus, increasing the confidence of foreign investors). The main sectors that contributed to Thailand's growth during these years were agriculture, tourism, and industry. However, the contribution from the agriculture consistently declined because the government aimed at diversification and promoted investment in small industries. During this period, Thailand ran trade deficits, importing more than it exported. Because the current and capital balance must be balanced, the trade deficit was offset by large capital inflows.

1.5.2 Crisis (1997-1999)

East Asia crisis erupted in 1997 and originated in Thailand. Unlike the Latin American crisis, it was subsequently determined that excessive private-sector debt was the main cause of the crisis. Some blamed the former government's elimination of capital barriers and encouragement of financial liberalization that resulted in excessive capital inflows. Nevertheless, trade and financial liberalization can be considered as "ideally" the final destination every country must reach, but there are some procedure that a country must take before arriving at it, for example, sterilization before liberalization. However, at that time, the procedures that must precede liberalization were not fully understood, and for this reason, government policy should not be blamed. At that time, there were substantial amounts of capital inflow in terms of short-term debt and portfolios, and many loans were used for real estate development (building for-sale housing projects). Consequently, when the economy weakened, large amounts of capital quickly flowed out, leaving loans that could not be repaid because the investment was not recoverable. The amount of non-performing loan (NPL) was tremendous. In early 1997, the country's international reserves were substantially exhausted by the effort to maintain the pegged exchange rate. The government, led at that time by Prime Minister Gen. Chavalit Yongjaiyut secretly sent a committee to China to ask for a $30 billion loan; however, the mission failed, and the loan obtained was only $2 billion. The government was left with no choice but to enter the International Monetary Fund (IMF) program. The total loan from the IMF was $4.8 billion and was to be repaid in three payments. It was just one of several loans the government obtained at that time.

1.5.3 Post-crisis (2000-2006)

When the government led by Pol. Lt. Taksin Shinawatara took over in 2000, economic policies were greatly reformed. Thailand's economy was gradually restored to normal. Dissatisfied with the IMF's contractionary policy, the government repaid its loan early, saving approximately $120 million in interest and at the same time further improving foreign investors' confidence that had already been bolstered by a cut in interest rates. One of the main contributors to economic improvement was the government's increase in its already strong promotion of exports. To promote exports, duties were kept low, except on essential commodities as rice (to prevent domestic shortages), although Thailand remains the largest exporter of rice in the world. This government's main policy was to encourage spending by shifting the proportions of debt from the private sector to the public sector. As a result, the government provides more support for health care, regional funding, and regional loans. Increases in government revenues to support these programs have come less from taxes than from the government's efforts to take over and eliminate a "black market financial system." Two examples of the elements of this "black market" system are "black market" loans and a lottery that exists despite a prohibition on gambling. There is even a movement to legalize gambling on the theory that the government can gain some of the revenue now being spent on illegal gambling. However, the increased in revenue of the government is not mainly from tax. Instead, the government tries to take the control and get rid of "black market financial system", such as black market loan and black market lottery. Even as of now there are some attempts to legalize the gambling (casino is illegal in the country) in order to shift the revenue to the government itself. The goal behind the government's embrace of welfare, subsidies, and spending is to promote growth via consumption. Some other monetary policies being employed are stricter rules on NPL and reforms associated with regulation of business and lending.

However, the drawbacks have been the government's larger debt and accusations that it has accrued too much political power.

After the Southeast Asian financial crisis, Thailand operated for years with a current account balance surplus that was the result of the exchange rate depreciation and heavy promotions of exports. However, since the beginning of 2005, most months have recorded a deficit in its current account. Many analysts blame oil imports as the major cause of these deficits. In early 2004, oil imports accounted for 17% of the total value of imports, but in mid-2005, oil accounted for almost 30% of the value of imports, a change attributable to a 74% increase in value of these oil imports. As a result, GDP growth started to decrease and inflation began to rise.

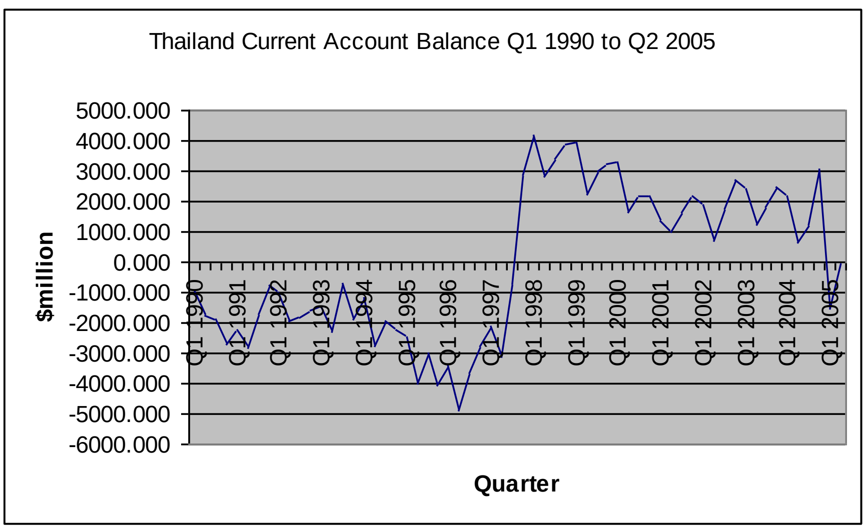


Figure 1.7: Thailand's Current Account Balance 1990-2005

Figure 1.8: Thailand's Percentage Change in Real GDP 1979-2005

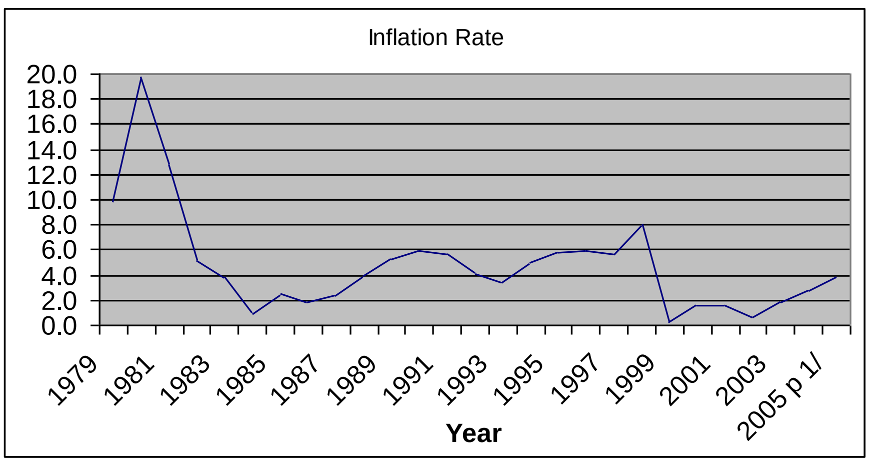


Figure 1.9: Thailand's Inflation Rate 1979-2005

1.6 Thailand's Economy during the 1970s Energy Price Surge

To see the effects on Thailand of the surge in energy prices in the 1970s, three macroeconomics indicators from 1969-1985 are plotted in Figures 1.10-1.12. First, during the second oil shock, the current account balance clearly underwent a sudden increase, which can imply a reduction in net exports because of energy bills. Second, a downward slope in the percentage change in GDP indicates economic contractions during both oil shock periods. Finally, the CPI clearly shows sudden increases in both periods, indicating abrupt deviations in the rate of inflation from its normal rate.

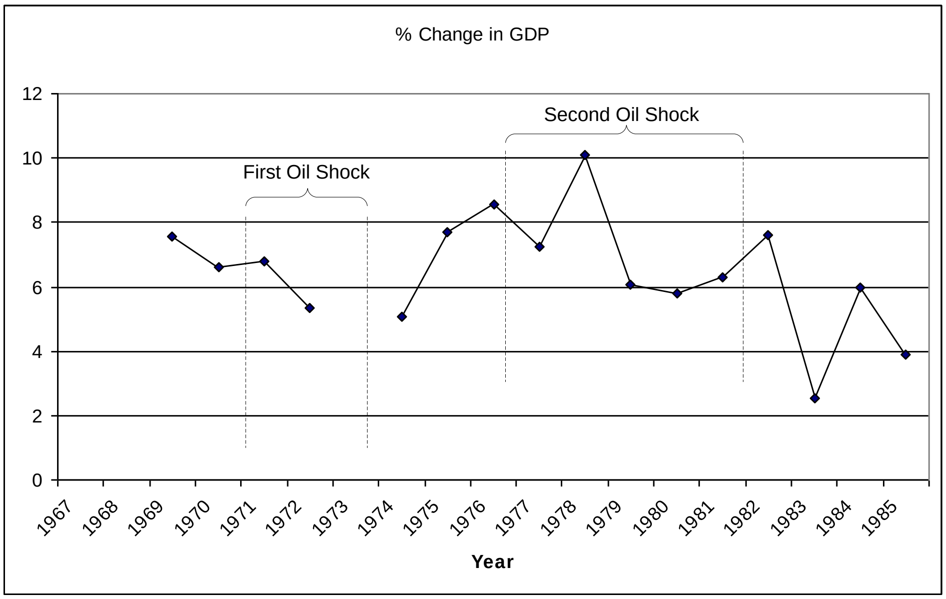


Figure 1.10: Percentage Change in GDP (1969-1985)

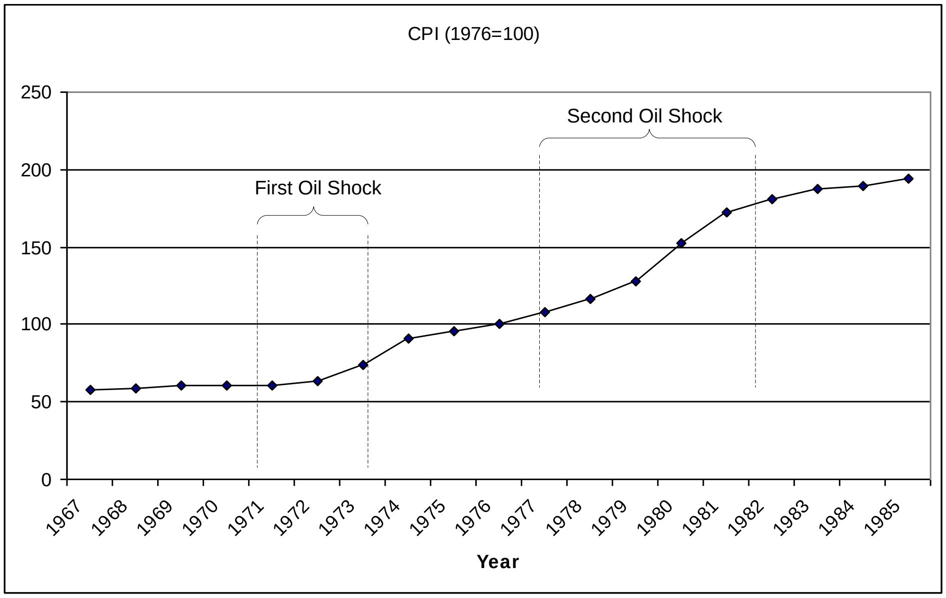


Figure 1.11: CPI (1969-1985)

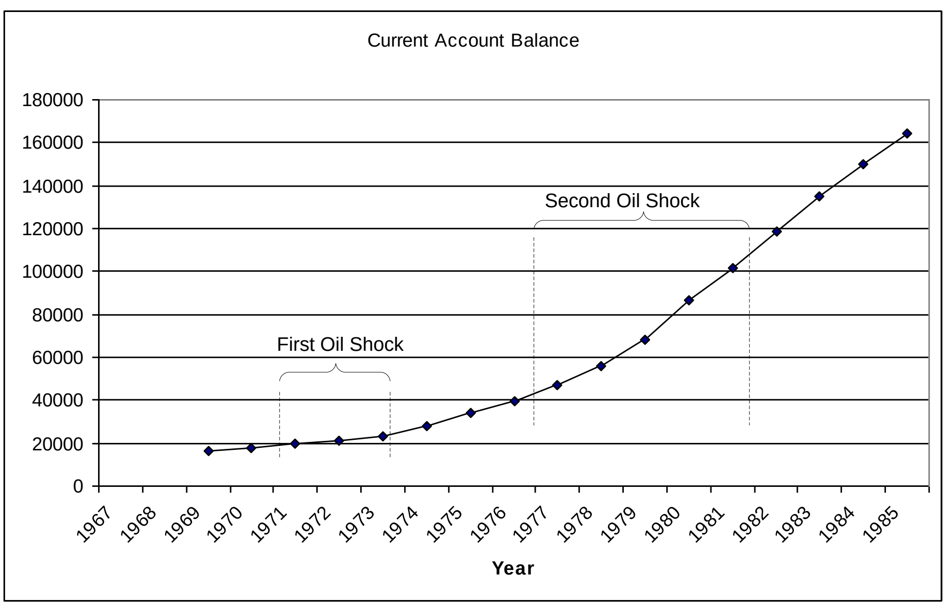


Figure 1.12: Current Account Balance (1969-1985)

1.7 Thailand's petroleum price structure

Thailand is an imported oil-oriented country. The country's production capacity is equal only to about 10% of total demand. In terms of percentages, the average domestic crude oil production vs. the imported supply is 9.67% to 90.32% respectively, or approximately 1:9.

1.7.1 Price Structure

Figure 1.13: Price Structure of Petroleum Products with an example of ULG 95, June 8, 2006 (Bath/Littre)

The wholesale price is the ex-refinery price plus tax, municipal tax, amount drawn for the oil fund (negative for subsidy) and conservation fund. The intermediate price is the wholesale price plus value added tax (VAT). The retail price is the intermediate price plus marketing margin and the VAT of the margin.

1.7.2 Consumer Price Distortion by the Oil Fund Program

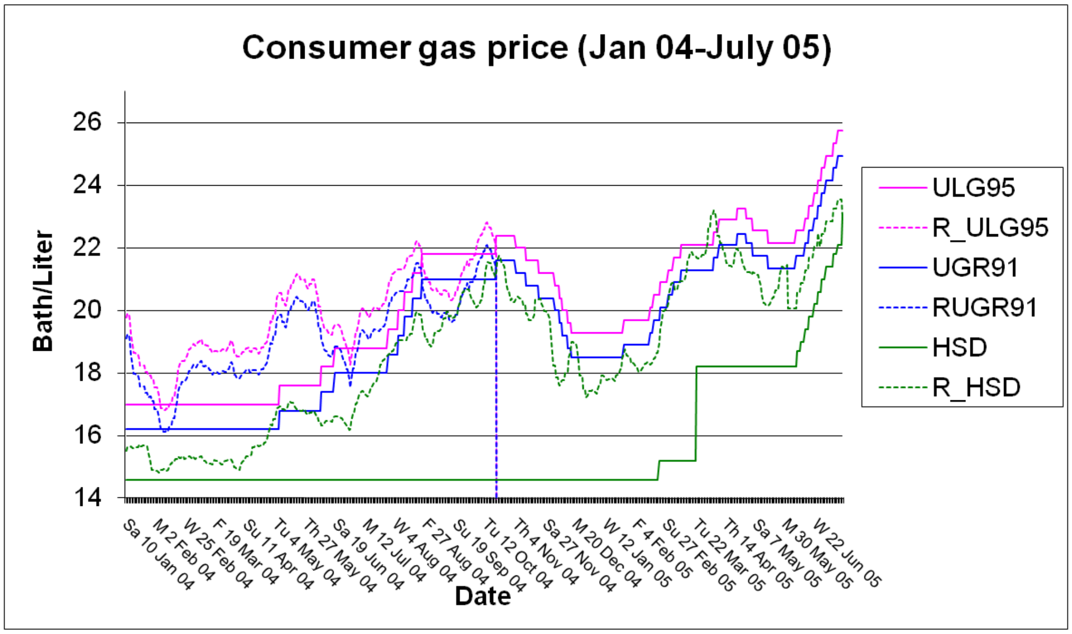


Figure 1.14: Retail price of gasoline, January 2004-July 2005 (Bath/Liter)

Source: Energy Policy and Planning Office (EPPO)

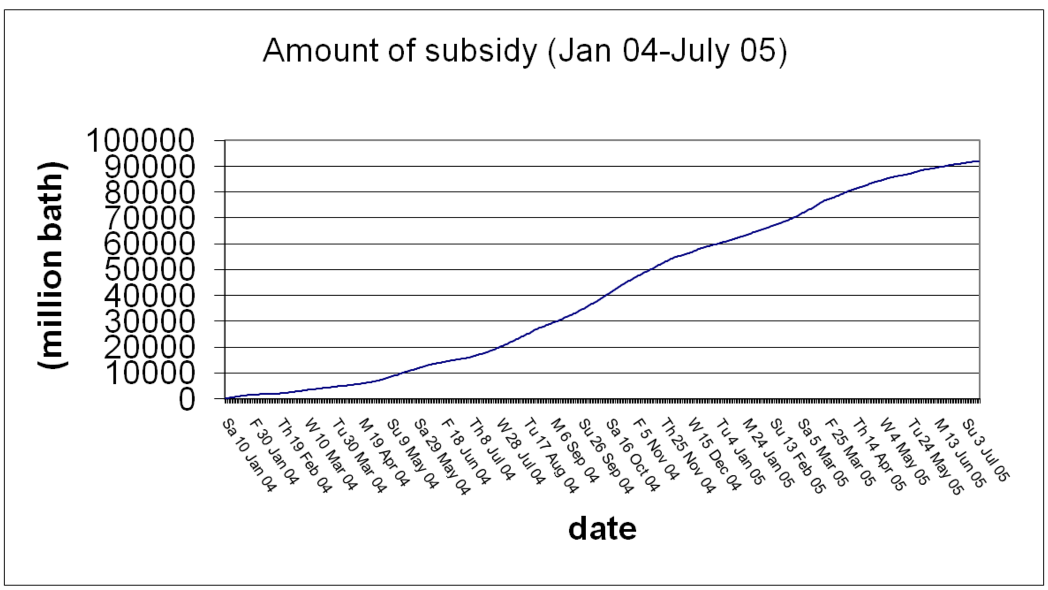


Figure 1.15: Amount of subsidy from the oil fund (January 2004-July 2005)

Source: EPPO

The government has operated an oil fund program as a way to deal with fluctuations in world oil prices for a long time. The oil fund accumulates a surplus when world price decrease. When world prices increase, the fund runs a deficit that is partly compensated for by its past surplus. Before 2004, the trend in world oil prices did not increase as significantly as recently and in those years, the oil fund's surplus often was enough to compensate for the deficit, or the relatively small deficit had little effect on government spending. However, because of the recent substantial increase in world oil prices, the oil fund started to run such a massive deficit that the government could no longer bear the cost despite its goal of keeping production costs low through a subsidy. On October 21, 2004, the government decided to float the ULG95 and UGR 91 benzene prices; both products are mostly used for private transportation. As for high speed diesel (HSD), which is mostly used by public transportation and industry, its price was adjusted a few times before being semi-floated with a fixed amount of subsidy and then fully floated on July 13, 2005 (Figure 1.14). Figure 1.15 shows the amount of subsidy from January 1, 2004, to July 13, 2005. The cumulative amount of subsidy for these 18 months was 92,071 million Bath (approximately $2.3 billion). At the end of period, the average subsidy for ULG95, UGR71, and HSD were calculated to be 0.16, -0.09 and 2.21 baht per liter, respectively.

CHAPTER 2
SURVEY OF LITERATURE

2.1 Introduction

Although the main goal of this dissertation is to demonstrate the effects of oil prices on the overall economy and on welfare, the core model itself was first developed and modified to be a well-defined building ground for a model of the Thai economy. Therefore, the key variables from the energy block were linked. Thus, the core is versatile in the sense that with some recalibration, one can replace the energy links with any other variables of interest. Because this dissertation has two major focuses, the development of a well-defined macroeconometric model for Thailand and the analysis of the effects of an oil price increase, the literature review will emphasize the development of the macroeconometric model and the study with any kind of model of the impact of oil price changes.

2.2 Macroeconometric models

Constantino et al (1990) illustrated the key features and the evolution of a macroeconomic model for a developing country. The model was composed of real sector production, expenditures, employment, wages, and prices. It also contained the financial, fiscal, and external sectors. The model prototype assumed that all markets clear via automatic price adjustments, which was unrealistic because full employment equilibrium is seldom reached in reality. To correct this shortcoming, the production sectors were therefore divided into "fix price," "flex price," and "flex price/ flex quantity" categories. The "fix price" category referred to the production sector in which the output level is adjusted, whereas the "flex price" category referred to the sector in which the price is adjusted. Finally, in the “flex price/ flex quantity” category, both the price and the output level were adjusted simultaneously.

Azis (1991) constructed a macroeconomic model to predict Indonesia’s economic growth and to study the effects of reducing the current account deficit by decelerating imports, which was a widely debated issue at that time. The model contained 125 variables, 94 of which were endogenous. Similar to the one by Constantino et al., the model captured the financial, fiscal, external, and real sectors (except for employment) as well as imperfections in the process of market clearing. The results revealed the reasonably high tracking ability of this model: The deviations of the estimated values from the actual outcomes were less than 10%. As for the policy analysis part, the model showed that the attempt to slow imports would be counterproductive because higher amounts of imports were still needed for various megaprojects.

Tinakorn and Sussangkarn (2000) from the Thailand Development Research Institute Foundation (TDRI) developed a macroeconometric model for Thailand with the goal of advising the Thai Bureau of Budget about the possible future of the overall economy so that a proper budget plan could be prepared. Based on yearly data from 1980 to 2000, the model focused on real sectors, emphasized an aggregate demand component, and predicted real GDP. The dependent variables include real sectors, production, prices, and government revenue. One of the findings is the difference in overall GDP that results when the government chooses between spending more on consumption or on investment.

Thailand’s Fiscal Policy Office (2003), which is under the Ministry of Finance, created a macroeconomic model for economic forecasts and policy analysis. Using 58 exogenous variables and three quarterly dummies to model 22 endogenous variables, the four major sectors of the economy were embedded in the model as in the Azis model (1991). This model's prediction of Thailand's economic growth from the fourth quarter of 2001 to the third quarter of 2003 was 92 percent accurate. Its predictions of private consumption, investment, and net exports were highly accurate, but those concerned with government spending had significant discrepancies.

2.3 Studies on the impact of an oil price change

Bernanke (1997) is one of the most prominent researchers specializing in the issue of counterfactual government policy involving oil prices. The main question is which contributes the most to a recession (in the case of the U.S.A.), an oil shock or a contractionary monetary policy? Using Vector Auto Regression (VAR) with two separate oil shock inputs, the model was run for three individual scenarios, a price shock with a policy response in which the federal fund rate (FFR) is changed, an oil price shock alone, and an oil price shock with consumers' expectation of a change in the FFR (without an actual change in the FFR). The results show that in the absence of a policy response, an oil price shock would lead not only to higher prices but also to higher output. However, output falls with the policy response. Thus, a large part of the real effect of oil price shocks comes from the resulting monetary policy response, not from the oil price shock itself.

Using his own modified VAR method called VARX, Abeysinghe (2001) measured the direct and indirect effects of oil prices on GDP growth in 12 countries with an emphasis on small, open economies, including Thailand's. The direct effect determines energy trade value, whereas the indirect effects indicate the overall trade ability with trade partners of that country. The results show that although oil exporters such as Malaysia and Indonesia are positively affected (directly) through the value of oil exports, they also incur indirect effects through the trade channel, resulting in slightly negative effects overall.

Barsky (2001) proposed that oil prices are not the cause of stagflation. By using a theoretical model, the author illustrated that, first, a policy response can produce stagflation in absence of an oil price shock. Second, neither theoretical nor robust empirical evidence supports a position that oil supply shocks are stagflationary. Third, a decrease in interest rates will increase demand for oil and hence, its price, but the higher investment in drilling and distribution in response to the higher prices will eventually cause prices to fall. Fourth, oil prices can be kept high when the economic environment is good (a decrease in interest rates, hence, a rise in output that strengthens the cartel). And finally, a substantial part of 1970s stagflation could have been avoided if the central bank had restrained the expansionary monetary policy.

Hunt (2002) used the IMF's multi-country model (MULTIMOD) to analyze the effects of an oil price shock. The author concluded that, first, an oil price shock affects headline inflation. There is a risk that headline inflation will be passed through to core inflation and that both headline inflation and core inflation will affect expectations about inflation. Second, if the central bank delays in responding to persistent oil price increases, the delay can have a high macroeconomic cost because of an erosion of monetary policy credibility. Last, all else being equal, monetary authorities should interpret data in a way that errs in favor of a more aggressive policy response.

Rodriguez (2005) examined the effects of oil price shocks on various industrialized OECD countries using VAR on output, exogenous oil prices, inflation, interest rates, real wages, and real effective exchange rates. He used both linear and co-linear methods. The results show that, first, an oil price increase had more impact on growth than an oil price decrease. Second, an oil price increase negatively affected the economic activities of all oil-importing countries in the sample except Japan. Last, in examining the oil exporting countries, he found that an oil price shock negatively affected the United Kingdom, but not Norway.

Carlstrom (2005) also followed the work of Bernanke (1997) in 2005 by asking what causes output to decline — an oil shock alone or the subsequent tightening of monetary policy. Asserting that empirical models cannot capture expectations very well, the author used a theoretical model based on assumptions that oil is used to produce output and that people expect the Federal Reserve to increase the FFR during an oil price shock but ignore asymmetries in the impact of oil prices (for example, a price increase has a larger effect than a decrease). The author's conclusions are similar to Bernanke's results. An oil price shock and an increase in the FFR reduce output. If the Federal Reserve surprises the public by not increasing the FFR, the decline in output will be mitigated substantially. However, if the public can accurately anticipate that the Federal Reserve will keep the FFR constant during the oil price shock, the magnitude of the decline in output will be as great as when the Federal Reserve increases the FFR.

Blanchard (2007) used VAR and a new Keynesian model to explain why the effect of the oil shock in the 2000s was milder than that of the oil shock in the 1970s. The structural VAR and rolling bivariate regressions showed that the negative effect of oil prices on GDP and employment weakened over time. The new Keynesian model also showed that the lack (by luck) of concurrent adverse shocks, a lessened role of oil in production, a more flexible labor market, and an improvement in the formation of monetary policy were all factors that weakened the impact of the surge in oil prices.

Hooker (1996) found that after 1973 in the United States, oil prices no longer Granger-cause the unemployment rate, the real GDP, the aggregate employment, and the industrial production. He also investigated possible explanations for such lack of Granger causality. First, was the lack of Granger causality the result of the exclusion of a structural break in 1973 when the OPEC raised the oil prices? The author's answer was that such an addition did not change the result. Second, was it because oil prices have been endogenous since 1973? The finding again was no: most variables do not Granger-cause oil prices in the periods either before or after 1973. Lastly, was it because the effects of oil price increase and decrease were unequal in magnitude? The author used a measure that captures such asymmetry, but it did not help with an explanation. However, using the historical decomposition of VAR, the author proposed that OPEC oil price shocks I and II (1970s) and III (1983) caused such Granger-causality to disappear.

Masih (1998) used a dynamic vector error correction model to measure the causal relationship between energy consumption and income in Thailand and Sri Lanka. The main result is that energy consumption Granger-causes income but not vice versa. The author also used variance decompositions and the impulse response function to measure how a movement of one variable is influenced by shocks in different variables (this was done to the forecast variance). The results are that energy consumption appears to be exogenous and influences income and price. In comparing the results in the two countries, the shocks to the economic system are either more sustained or more pronounced in Thailand than in Sri Lanka.

Asafu-Adjaye (2000) followed Masih's (1998) work and used a cointegration and error correction model to study the causal relationships between energy consumption and income in India, Indonesia, the Philippines, and Thailand. The results were that in India and Indonesia, energy consumption Granger-causes income. In Thailand and the Philippines, energy, income, and price are mutually causal. In the latter case, high economic growth leads to higher demand for energy and vice versa (contrary to the findings of Masih (1998)). Thus, energy consumption and income are not neutral with respect to each other.

By exploring the determinants of Asian demand, the availability of Asian oil and gas supply, and the need for imports, Aoyama (1997) predicted in 1997 that by 2010, the exposure of Asian countries to oil market disruptions would worsen and the import intensity with the Middle East would increase because of the more intense Asian oil imbalance in which oil consumption increases but oil production does not.

Adams (2000) used yearly data from 1978 to 1993 for an econometric model in which the baseline is from the LINK model. The authors predicted that until 2010, Thailand, which is energy deficient but with a growing economy, will bear a heavy energy import cost that will grow with GDP and industrial production. Fortunately, the cost of more energy imports is growing slower than the pace of export growth. Improvements in efficiency will help mitigate the tendency for energy imports to increase with growth and also will reduce the effect of higher energy taxes.

Hamilton (2000) used OLS and nonlinear regression models to illustrate that the relationship between changes in oil prices and GDP growth is nonlinear (oil price increases are more important than decreases). The author also regressed the growth in oil prices by using exogenous disruptions in petroleum supplies as instruments. The results are very similar to the nonlinear specifications. This suggests that oil shocks are important causes of economic downturns through disruptions of spending by consumers and firms.

Basher (2006) explored the impact of oil price risks on stock markets by using a conditional multifactor model on the data of 21 emerging stock markets. The result shows that for daily and monthly data, there is a positive relationship between oil price increases and market return in up markets and a negative relationship in down markets.

Buranakunaporn (2007) employed the dynamic translog modeling approach to model the energy demand of Thailand's manufacturing sector 1979-1999. The results, based on annual data, were that the substitutability between energy-capital and energy-labor was weak, hence policies that alter capital formation or wages have only a small effect on energy usage. However, the substitutability between LPG-diesel, and fuel oil-electricity is strong, thus the government can promote usage of one type of energy over another by making the price of the undesirable energy less attractive (example, semi-floating the price of LPG to encourage the use of diesel).

Aguiar-Conraria (2007) suggested that standard models fail to replicate the magnitude of the 1974-75 recession and the strong recovery in 1976-78, both swings based on fluctuations in the price of oil, because of a missing multiplier acceleration mechanism. Using a general equilibrium model, a modification of the one introduced by Wen (1998), the authors were able to capture the effect by using a multiplier effect drawn from capacity utilization and an accelerator effect that results from externalities or an increasing return to scale.

Using a Computable General Equilibrium (CGE) approach based on a 1998 Social Accounting Matrix (SAM), Manopiniwes (2005) evaluated the impact of three policies on the real and financial sectors and environment in Thailand. The policies examined were high interest rates, bank recapitalization, and the oil subsidy. The criteria used in the examination were impact on overall macroeconomic performance, income distribution and poverty, and water quality. The scenario on the oil subsidy policy assumed no reduction in subsidy in 2005 (In reality, Thailand reduced the amount of oil subsidy from 60,000 million to 10,000 million baht). This 25.97% reduction in the price of oil contributed to a slightly higher real GDP, higher real investment, and higher real consumption while nominal GDP, the poverty level, and price levels were lowered by a few percent.

Rafiq (2009) used quarterly data from 1993Q1 to 2006Q4 to examine the effect of oil price volatility on Thailand's key macroeconomic indicators. A VAR model was used to perform a Granger causality test on oil price volatility, GDP growth, investment, rate of unemployment, inflation, interest rate, trade balance, and budget deficit. A structural break was included to allow for the Asian financial crisis (1997-1998). The results were that first, throughout the period 1993 to 2006, oil price volatility had a significant impact on key macroeconomic indicators, particularly investment and unemployment rates. Second, after 1997, oil price volatility affects budget deficits the most. This is possibly because of the floating exchange rate that adds more pressure to the oil fund. The author also concluded that oil subsidization would play an important role in mitigating the adverse effects of oil price volatility.

Azis (2009) focuses in Chapter 5 on the macroeconomic and poverty impact of oil price increases in Asia and the Pacific. The author categorizes policy responses as falling into three main types: fuel subsidies that directly affect the domestic oil price and interest rate and fiscal policies that affect price levels and household income, respectively. Rather than focusing on macro indicators as an end result, the author emphasized welfare in which oil prices affect the total output and the general price level. The total output affects household income, whereas the price level affects poverty. Both household income and the poverty level determine the incidence of poverty. Using data from China, India, Korea, Thailand, and Indonesia, the author used a Social Accounting Matrix (SAM) and Structural Path Analysis (SPA) to determine the effect of an oil price increase on income distribution and relied on a VAR model to determine the effects of an oil price shock and policy responses to it. The results from SAM showed that the increase in prices of different types of oil affects different households differently. An increase in the price of oil used in oil-intensive industries mostly affected high-income households, while low-income households were affected by increases in the prices of kerosene and gasoline, which are the types of oil that households consume directly. The results from the VAR model showed that an increase in the price of kerosene affects poor households more than an increase in the price of non-kerosene. Hence, reductions in the kerosene subsidy are lower than for other types of fuel. However, increases in the prices of other types of fuels tend to be inflationary, leading to a tightening of monetary policy.

Despite the efforts undertaken to understand the direct and indirect (by the counterfactual policies itself) effects of oil price increases on economies, few studies have been made, even in small developing countries, on the effect of a direct price subsidy. This might be because such a policy is very costly and consumers would not change their consumption behavior. Thus, such a policy proposed for a big developed country like the United States (with a larger services sector compared to manufacturing than in Thailand) would not seem feasible. However, for Thailand, which is smaller and still in a transitional phase from agriculture to manufacturing, oil is more essential for development. Thus, a direct price subsidy would be a more promising policy as a way to deal with an increase in the price of oil.

Based on a review of the literature, many studies have been made of the effects of oil price shocks on developed countries and some as well on developing countries. However, most of them focus on effects but not on counterfactual policy responses and on some major macroeconomic indicators, but not on welfare. This dissertation aims to fill in the gap by showing the details of the effects of oil price shocks (more variable by sector), including key welfare variables, and develop some policy responses for Thailand.

CHAPTER 3
MACROECONOMETRICS FRAMEWORK

3.1 Introduction

A macroeconometrics model has been one of the most popular tools in policy making. The attractive properties of such a model are that it is a consistent and systematic framework capable of averaging past behaviors from input data and then forecasting the future based on an assumption of no extreme behavioral departures from the past. The model can forecast the macroeconomic big picture and evaluate the impacts of different policies and external factors on the economy. To effectively predict the outcome of the policies, a core model is first built by incorporating a relevant set of past data and fitting the data into a system of equations. Other assumed inputs are then incorporated into the model. These are the predicted data trends of the model itself, the evaluators' assumptions, and results from other models. The evaluator generates policy recommendations from the model, uses his or her judgment, and finally makes a decision.

The model developed for this dissertation emphasizes demand, supply, and price based on both classical and Keynesian concepts. The output level is determined predominantly from supply constraints implied in the classical approach. However, the components of aggregate demand are also incorporated into a production equation both directly and indirectly through price levels, hence the Keynesian approach. In the price equations, representative variables from both the demand and supply sides are presented, thus, emphasizing the roles of both in the determination of price.

3.2 Core structure: Demand and supply revisited

According to basic supply-demand theory, the demand, supply, and price of any commodity can generally be written in three equations,

$Q^D = f(Y, P)$

$Q^S = f(K, L, P)$

$Q^D = Q^S$

where Q^D is quantity demand, Q^S is quantity supply, P is commodity price, Y is income, K is capital, and L is labor. An equilibrium price in a market is found by equating Q^D and Q^S.

The theory is then applied to the structure of the model. However, because the demand and supply of the model are aggregated, to determine the AD and AS separately and then assume that the market automatically cleared through adjusted price is not realistic. One of the reasons this may be unrealistic is that less than full employment equilibrium may exist because of a change in the prices of a factor of production, which in this case is petroleum. Thus, endogenous equations of price also are constructed. The general equation structure can be depicted as follows:

1. Aggregated demand side (C+I+G+X-M)

    C = f(income, etc.)

    I = f(value added, interest rate, exchange rate, etc.)

    X = f(number of tourists, etc.)

    M = f(domestic demand, etc.)

while G is exogenous. The aggregate demand is the sum of C, I, G, X and –M.

2. Aggregated supply side

    Total output = f(K, L, other factors that affect supply in each sector)

3. Price

GDP deflator = f(factors that affect demand, factors that affect supply)

The core variables are divided into six sectors of agriculture, manufacturing, transportation, utilities, construction and services. Thus, each sector incorporates a variable that represents demand, supply, and price, thus emphasizing the feedback interaction between demand and supply through prices within a sector. Representative variables are consumption and investment for demand, total output and value added for supply and price levels.

Because the quantity demanded must be equal to the quantity supplied, we need a macro closure. However, a simple identity that forces them to be equal will limit the changes in every equation in the system; thus, it cannot be used. Therefore, the aggregate demand and the aggregate supply are first allowed to adjust independently in the simulation. Afterward, an adjustment by feedback through the price level is used to merge them back again. This mechanism will be discussed in detail in the next chapter.

3.3 Data Preparation

3.3.1 Frequency conversion, seasonal adjustment, and exponential smoothing

Frequency adjustment or interpolation is the process of manipulating a time series variable to a higher frequency than the one actually available. In this case, the yearly data are manipulated into quarterly data. The target data undergo an automatic interpolation in the Eviews by using a quadratic match sum for stock variables and a quadratic match average for flow variables. The data points generated are filled by fitting a local quadratic polynomial. The quadratic polynomial is formed by taking sets of three adjacent points from the source series and fitting a quadratic so that either the average or the sum of the high frequency points match the low frequency data actually observed (Quantitative Micro Software 2007).

Quarterly time series data are likely to contain a seasonal effect. Thus, a seasonal adjustment (Census X12) is used for some variables that are prone to seasonal effects. However, because not all raw data are available in quarterly form, to be able to solve a system of equations simultaneously, the yearly data must first undergo frequency adjustment processes.

Exponential smoothing is a procedure for continually revising a forecast in the light of more recent experience. Exponential smoothing assigns exponentially decreasing weight as the observation get older. In other words, recent observations are given relatively more weight in forecasting than older observations (Kalekar 2004).

The result after these three processes is quarterly data that has no seasonal effects with some dampened structural breaks.

3.3.2 Unit root and Augmented Dickey-Fuller unit root test

Because of the nature of time series, a high R^2 cannot be the only reliable indicator. To avoid the potential problem of spurious regression (Granger, Clive, and Newbold 1974) in which the variables seems to be correlated (high R^2 and significant t-statistics) but actually lack any economic meaning, the Augmented Dickey-Fuller (ADF) unit root test (Dickey and Fuller 1979) is used to test all the quarterly data to determine whether they are stationary processes. However, it can be expected that most macro time series variables are Integration of order 1 or I(1). Although an individual series is nonstationary, a linear combination of two or more of such a series may be stationary. If such a linear combination exists, the series are said to be cointegrated (Engle and Granger 1987). Hence, for each fitted equation, it is not necessary at the outset to use the variables' first difference for each nonstationary series. These cointegrating equations can be interpreted as long-run equilibrium relationships among the variables (acceptable if the relationship can be explained by an economic reason) because in long run, $E(\varepsilon)=0$. To ensure there are no spurious regressions, an estimation error from a regression was inspected if it became white noise because it implies I(0); otherwise, a cointegration test is used.

Following a standard procedure unit root test (Enders 1995) for each variable, its Autocorrelation Function (ACF) correlogram is first inspected, then an ADF test for the unit root at its level with an intercept (Case 2) is performed. The lag length is automatically chosen by SIC (Schwartz Information Criterion). For an economic variable, the presence of an intercept and absence of a trend is most appropriate because a constant term will be necessary, and an additional trend term is generally superfluous (Vogelvang 2005). Rejection of the null hypothesis allows a conclusion that the process is stationary. Based on the first test, if the statistic with the constant term is close to zero and significant, an additional test is performed with an option in the absence of an intercept and a trend (Case 1). If the null hypothesis is not rejected, and the result shows that the statistic is not zero and significant, the unit root test on the variable's level is repeated with the presence of a trend and an intercept (Case 3). If the null hypothesis is still not rejected, a third unit root test of the variable's first difference is performed. If the null hypothesis is rejected, it can be concluded that the process is stationary and the variable is an integration of the first order, I(1). However, if the third test still fails to reject the null hypothesis, the unit test is repeated a final time to test the variable's second difference. If the null hypothesis is rejected, it can be concluded that the process is stationary, and the variable is an integration of the second order, I(2). If the test fails to reject the null hypothesis, it can be concluded that the variable is not stationary. The results of the test are shown in Appendix B.2

3.4 Ex-post simulation

The ex-post simulation period is from 1993:1 to 2004:2. This estimation step is the most important procedure in a macroeconometrics model because the forecasting results depend both on how well each individual equation fits and on how baselines behave after the whole system is run simultaneously.

Dependent variables are selected according to the variables of interest so that their changes in response to other variables may be observed. Explanatory variables are first selected from the theory, and then one can add other variables of interest with a suspicion that a change in explanatory variables will lead more or less to changes in the dependent variables. After selection of variables, different lag lengths and different functional forms (on both sides) also must be evaluated. The explanatory variables may be eliminated after the estimation if they have the wrong sign expected for the coefficients. Explanatory variables bearing the expected sign also may be eliminated if the estimates have t-statistics less than about two in absolute value (not statistically significant), although in practice this rule varies (Ray C. Fair 1984). However, a parameter might be insignificant because of multicollinearity, a situation in which one variable makes another insignificant. When this occurs, a more significant variable can be removed instead. In this dissertation, the coefficients are accepted at a 90% confidence interval (a p-value of less than 0.1) However, in a few cases, p-values of approximately 0.2 with the expected sign are accepted if the variable has considerable theoretical economic meaning and, thus, is part of a fundamental building block. Finally, the ability to forecast is observed using Theil's inequality coefficient and the proportions of inequality as defined in Pindyck (1998). Along with the variable selection criteria discussed above, the techniques that are mainly used are as follows:

3.4.1 Two-Stage Least Squares

A Two-Stage Least Squares (2SLS) estimator was chosen as the method of estimation because the model is structural (in a model with endogenous explanatory variables, OLS will be inconsistent because of possible correlation between endogenous variables and estimation errors from other equations). Of various possible limited-information estimators, the 2SLS estimator generally performs best in terms of both bias and mean squared error. It also is usually more stable than the others; specifically, it is not greatly affected by specification errors (Intriligator 1996). Thus, 2SLS solves endogeneity problems, degree of freedom problems (because it estimates each equation in a system individually) and overidentified equations (because it provides only one estimate per parameter). In practical use, instrument variables must be variables that are uncorrelated with the error term; this includes exogenous variables, lag of explanatory variables, lag of endogenous variables, and constants. In addition, R^2 in Stage 1 must be high, and the number of instrumental variables must be at least equal to the number of coefficients in the equation.

3.4.2 Log transformation

Log transformations are used for all of the quantity variables, rate variables and price levels. Besides scaling down the size of coefficients, transformation can remove nonlinearity, limit changes in variances of the variables, and allow coefficients to be interpreted as elasticities (Vogelvang 2005). When log transformation is being used on both endogenous and explanatory variables, each coefficient then exhibits a constant elasticity, which captures the percentage change of an endogenous variable given 1 percent change in an explanatory variable. Thus, for example, with ln(GDP), the coefficient became the GDP growth rate and with ln(CPI), the coefficient became the inflation rate. It also is important to note that according to Taylor's approximation, when r is small, $\ln(1+r) \approx r$, log transformation of any rate variables can be omitted.

3.4.3 Lags

Lags are used for both endogenous variables and explanatory variables, but with different implications. Explanatory lag variables are used when the coefficient becomes more significant, suggesting that there is a time lag for the explanatory variable to take effect on the endogenous variable. However, an endogenous lag variable (as an explanatory) is used when some autocorrelation still found, indicating that there is still some information of the endogenous from period t-1 that helps explain period t.

3.4.4 Dummy variables

There are three forms of intercept dummy variables: impulse, ridge, and step. A dummy is used when there is an event that estimation cannot capture and the economy cannot adjust back to normal. An impulse dummy (a quarter) represents a shock to the economy. A ridge dummy represents a continuous series of events that change a normal economic condition over time. For example, the effect of a crisis can last longer than a quarter because some new problem might occur or new information might be unveiled while the economy is still trying to adjust back to normal. Last, a step dummy represents an event that forever changes the economy. However, a dummy variable is added only to change an intercept term or slope but not the estimation structure itself. Another method of dealing with this change is to separate an explanatory variable into two periods (0's in each separated series for opposite time periods).

3.4.5 Autocorrelation and Autoregressive (AR) process

An AR process is used at the end of estimation in a persistent autocorrelation. It represents information that cannot be explained and captured by all of the explanatory variables from the previous period that determines the present period.

All equations are then incorporated into a system and solved simultaneously using the Gauss-Seidel iteration method with the static and deterministic (without random error) option.

Static and dynamic simulations serve different purposes. Static simulation uses the actual lagged endogenous variable in every period; thus, it is suitable for policy simulations. However, in dynamic simulation, the actual lagged endogenous variables are only used in the first period of simulation. Afterward, all the simulated values are from the solution within the system itself (in contrast to static simulation). Thus, dynamic simulation is suitable for forecasting endogenous variables many periods beyond the available actual data.

CHAPTER 4

GENERAL ECONOMIC BLOCK

4.1 Introduction

The model consist of a total of seven blocks, Aggregate Demand (C,I), Trade (X, M), Production (total output, VA(GDP)), Price (PGDP by 6 sectors, CPI), Fiscal, Energy, and Welfare. The first four blocks are considered the core general economic blocks and will be discussed in this chapter. A flowchart of the blocks is shown in Appendix G.

For each equation, the possible explanatory variables are first considered according to theory; however, the decision whether to include each one of them also depends on whether that variable actually helps explain the dependent variable and whether its coefficient is significant.

4.2 Consumption variables (Aggregate Demand block)

Consumption durable is consumption of goods and is composed of transport equipment, electrical machinery, machinery and equipment, furniture, rubber products, and glass and plastic products. Consumption of durable goods can be considered as longer term household spending in which the household would decide between buying the goods or keeping the money in the bank.

Consumption nondurable is consumption of goods and services and is composed of food products, beverages, energy, and services. Consumption of nondurable goods can be considered as necessary goods that would be more inelastic to a change in price. The factor distinguishing these from durable goods would be wealth.

Disposable income is included as part of the basic theory in which consumption is a function of disposable income. The fraction of change in income that is consumed is the marginal propensity to consume or the slope of the consumption function. The expected sign is positive because an increase in income leads to an increase in consumption. Disposable income is personal income less taxes, approximately represented by GDP*(1-personal tax rate).

Wealth: An individual's real wealth. According to the permanent income hypothesis, the key determinant of consumption is an individual's real wealth, not the current real disposable income. Permanent income is determined by both nonhuman wealth — stocks, bonds, property, and checking and saving accounts — and human wealth, which is expected after-tax labor income and depends on an individual's education and experience.

Changes in real wealth result in shifts in consumption, thus changing the overall level of consumption. The expected sign is positive because an increase in wealth leads to an increase in consumption. Wealth is the value of M2 + Securities (cash, checking accounts, saving accounts, and securities).

4.3 Investment variables (Aggregate Demand block)

GDP: Growth in GDP is likely to result in overall growth of investment. However, the sign of the coefficient for each sector can tell in which direction the industry is heading. For a developing country, the economy is likely headed toward manufacturing. The expected sign is positive.

Net FDI: Thailand can be considered as one of the major exporters of both agricultural products, i.e., rice, and manufacturing products, mostly apparel, because of the nation's lower wages in comparison to the rest of the world. Some production is from orders by Thailand-owned manufacturers, but others are from foreign companies. Thus, net foreign investment also determines the amount of private investment. The expected sign is positive, because Net FDI is part of private investment.

Exports: Because Thailand is a net manufacturing exporter, the growth in exports will affect private investment. The expected sign is positive.

Real minimum loan rate: The real minimum loan rate can affect decisions to borrow for investment. A higher rate will discourage investment by borrowers. Thus, the expected sign is negative.

Money supply: Money supply and loan rates are inversely proportional. More money supply and resultant lower loan rates will encourage investment. The expected sign is positive.

4.4 Import variables (Trade block)

Domestic demand: Domestic demand can be calculated from GDP – export + import. The expected sign is positive; increases in domestic demand lead to increases in imports.

Total output: The expected sign is positive; an increase in total output leads to increases in imports.

Investment: Substantial amount of goods are imported as capital goods or as factors of production. The expected sign is positive; increased investment can lead to an increase in imports.

Real exchange rate: The exchange rate determines the relative price of foreign and domestic goods. The expected sign is negative; depreciation in the Thai baht will lead to decreases in imports.

Export of goods: The larger the volume of final goods exports, the more imports of intermediate goods are needed from aboard. The expected sign is positive.

4.5 Export variables (Trade block)

Foreign income: Represented by the GDP of the top 10 trading partner countries. The expected sign is positive; higher growth in countries that are trade partners will lead to increases in export.

Total output: The expected sign is positive; higher total output will lead to increases in exports.

Real exchange rate: The expected sign is positive; depreciation in the Thai baht will lead to increases in exports.

Amount of domestic tourism: Majority of Thailand's service exports are from tourism. The expected sign is positive.

4.6 Production variables

There are three possible methods in dealing with the functional form of the production block, each based on a different assumption. This dissertation implements Method 3: Production is a linear transformation of demand, and there are intermediate inputs. All three methods are discussed below.

Method 1: Production is a not linear transformation of demand.

The assumption expressed in Method 1 implies that changes in production (total output) are not linearly proportional to changes in demand (value added (VA)). When the price of one of the factors of production increases, firm choose to cut their labor costs (reduce wages) instead of reducing production proportional to the increasing input price. Thus, production (total output) can stay the same or can be somewhat reduced, but the VA greatly decreases. In this case, the ratio of the output and the VA are not constant. However, the data on production in Thailand can only be found from the input-output table, which is available every five years.

Method 2: Production is a linear transformation of demand, and there are no intermediate inputs.

A general form of the production function can be written as

Production output = f(Capital, Labor, some other factors varying accross different sectors)

From the Leontief Input-Output model (Leontief 1966),

$$X = (I-\Lambda)^{-1}D$$

Where X is the production matrix

I is the identity matrix

Λ is the input-output matrix

D is the demand matrix

Demand (GDP) can be generated by $D = (I-\Lambda)X$, and because the demand is simply a linear transformation of production output, the form of the demand by sectors can be written as,

$$D_i = a + bX_i$$

Because X is a function of capital and labor from above,

$$D_i = a + bf(K_i, L_i)$$

In the regression form of $Y = c_0 + c_1X_1 + c_2X_2$, the coefficients c_0, c_1, c_2 will take into account the value of a and b; thus, GDP from the supply side can take the general form of

$GDP_i = c_0 + c_1K_i + c_2L_i + c_3$(some other factors varying across different sectors)

where i stands for different sectors (6 sectors)

Method 3: Production is a linear transformation of demand, and there are intermediate inputs.

To incorporate intermediate input and to solve the problem of too little data on production (total output), production is first assumed to be a linear transformation of the demand (VA). Second, the ratio of the total output to the VA in each sector in Thailand's 2004 SAM is used as an approximation converter to convert the VA to production (TO). Then, the ratio of the value of the input of a particular sector to total input is used as a constant to generate each intermediate input from that sector. The series of VA are converted to TO from,

$$TO_i = z_i VA_i$$

Where z_i is the approximate ratio of TO to VA in different sectors (6 sectors) From SAM 2004, z_i is as follows:

1. Agriculture: 1.58
2. Manufacturing: 4.13
3. Construction: 2.13
4. Utilities: 2.86
5. Transportation: 3.88
6. Services: 2.04

In the above list of ratios, the manufacturing sector has the highest ratio, which means it takes most of the intermediate input as a proportion of its total output. The agriculture sector takes the least intermediate input as a proportion of its total output.

The intermediate inputs from sectors other than oil and transportation also are calculated as,

$$IN_i = \Sigma s_{ij} TO_j$$

Where s_i is the approximate ratio of the IN from the j sector to the i sector to the TO j sector

From SAM 2004, the s_{ij} are as follows:

Z (TO/VA)	1.612	4.215	2.141	3.383	4.067	2.067
Sag (IN/TO)	0.094	0.461	0	0	0	0.083
Sma	0.013	0.235	0.014	0.021	0.014	0.044
Sco	0.005	0.324	0.159	0	0.154	0.039
Sut	0	0.338	0.002	0.017	0.012	0.016
Str	0.013	0.166	0.016	0.016	0.496	0.033
Sse	0.012	0.013	0.001	0.001	0.247	0.068

According to the above list, an s_i value of less than 1 means the VA is greater than IN for that sector, and it does not need much IN (compared with VA) to generate TO (Agriculture).

The intermediate inputs from the transportation sector are also calculated as

$IN_{tr\_i} = t_i TO_{tr}$

Where t_i is the approximate ratio of the IN from the transportation sector to the i sector to TO in the transportation sector

From SAM 2004, the s_i are as follows:

1. Agriculture: 0.08
2. Manufacturing: 0.27
3. Construction: 0.01
4. Utilities: 0.29
5. Transportation: 2.02
6. Services: 0.14

Then the general production equation for each sector can be written as,

$TO_i = c_0 + c_1K_i + c_2L_i + b_1IN_{Oil} + b_2IN_{Non\text{-}Oil} + b_3IN_{Tran}$

Where, TO_i is the total output from the i sector.

K_i is the capital for the i sector.

L_i is the labor for the i sector.

b_i is the ratio of the intermediate input.

Capital: According to the Cobb-Douglas production function, an increase in capital will increase production. The expected sign is positive.

Labor: According to the Cobb-Douglas production function, an increase in labor will increase production. The expected sign is positive.

4.7 Price variables

Price deflator for each sector: The price deflator can be calculated from the ratio of nominal GDP to real GDP. The changes in price levels for each sector are implied by the changes in both demand and supply from that sector.

Representative demand variables: These are variables, such as income, that affect the demand side. The expected sign is positive; an increase in demand will lead to an increase in price levels.

Representative supply variables: These are variables that affect supply side prices such as the price of a factor of production. The expected sign is positive; increases in cost can lead to increases in price levels. The variables that affect quantity on the supply side tend to lower the price levels. The expected sign is negative; the increase in quantity of supply will lead to decreases in price levels.

Prices of world crude oil: Because this dissertation focuses on the issue of rising oil prices, the effects of increases are captured through price levels.

4.8 Macro closure mechanism

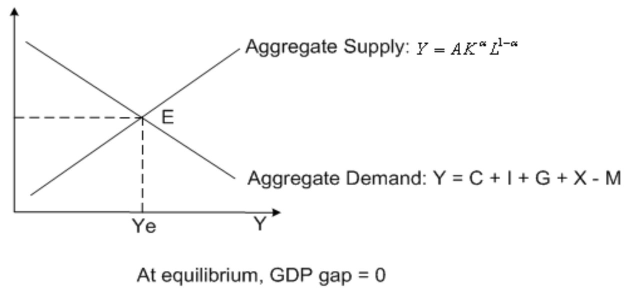


Figure 4.1: Demand-supply at equilibrium

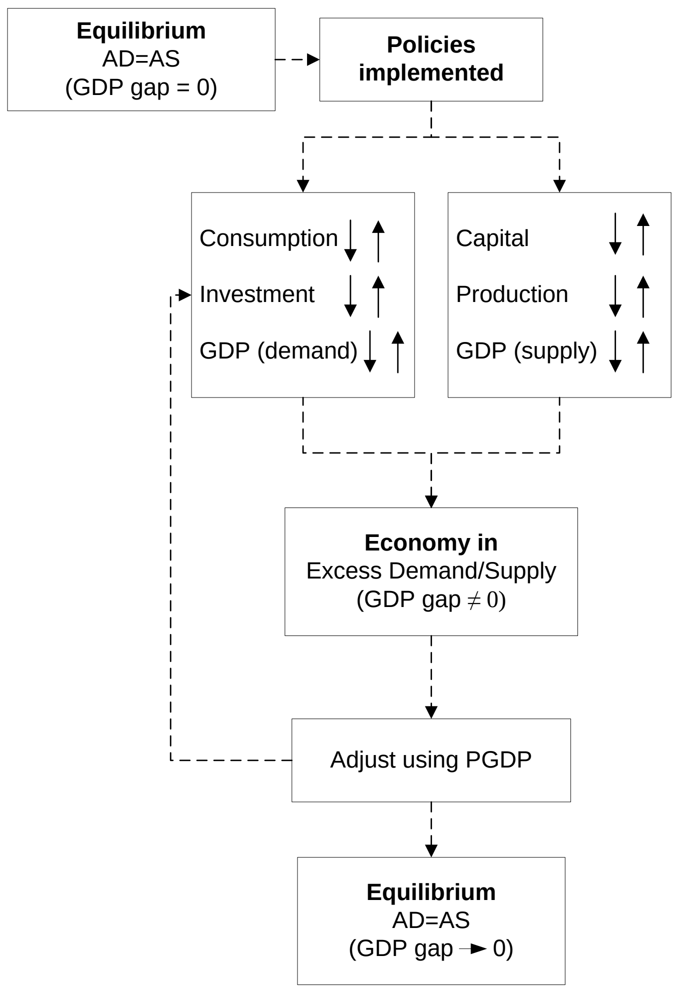


Figure 4.2: Macro closure

The purpose of the macro-closure mechanism is to equate the GDP from the demand and supply sides or to bring them closer together. In the mean time, a closure variable can be defined as a variable that is allowed to change so that it can explain why GDP demand and GDP supply are not equal. In this dissertation, the changes in inventory and statistical discrepancies were chosen to serve this function of explaining this inequality.

Before a simulation by the model, the economy is first assumed to be in equilibrium, and the gap between supply and demand is zero. When there is a shock in the system, the variables from the demand and supply side will change. As a consequence, the sum of the components from the demand side will not be equal to the sum of the components from the supply side. Under such circumstances, the economy is said to be in excess demand or supply. Thus, a mechanism is needed to restore the equilibrium.

The mechanism developed for this model makes the appropriate adjustment through feedback that uses price levels. When there is a GDP gap (a difference between supply and demand side GDP), the gap is captured by an identity of a weighted average of the price levels.

$$\text{PGDPAVE} = \frac{\begin{array}{l}(\text{PGDPAG*GDPAG+PGDPMA*GDPMA+PGDPCO*GDPCO+PGDPUT*GDPUT}\\ \text{+PGDPTR*GDPTR+PGDPSE*GDPSE+PGDPAVE1*GDP\_GAP})\end{array}}{(\text{GDPAG+GDPMA+GDPCO+GDPUT+GDPTR+GDPSE+GDP\_GAP})}$$

EQ. 4.1: Weighted average of price levels

Thus, if there is excess demand (GDPD>GDPS), the price level would increase. If there is excess supply (GDPS>GDPD), the price level would decrease. This change in price levels serves as feedback to some variables in the system and merges GDPD and GDPS.

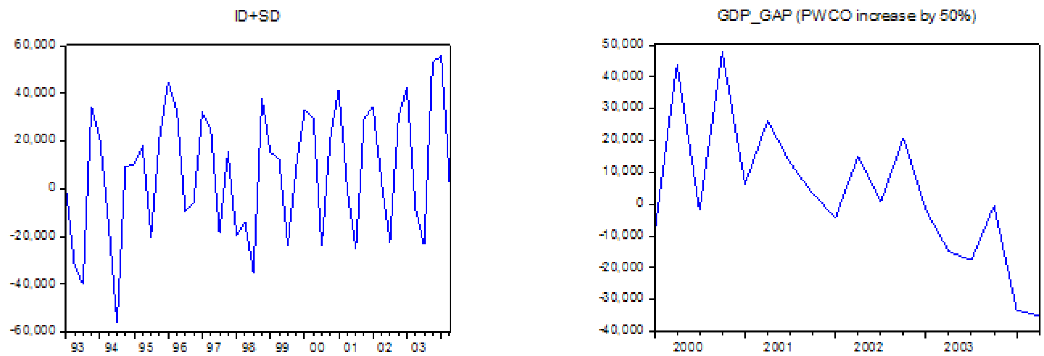


Figure 4.3: Actual changes in inventory plus statistical discrepancies compared with a simulated GDP gap.

Figure 4.3 shows the comparable magnitude of a generated GDP gap compared with the actual data of a change in inventory + statistical discrepancies. It can be concluded that this type of closure is a very realistic one.

CHAPTER 5

ENERGY, FISCAL, AND WELFARE BLOCKS

5.1 Energy block

5.1.1 Oil fund mechanism

The composition of the retail price of diesel is as follows (from Figure 1.13),

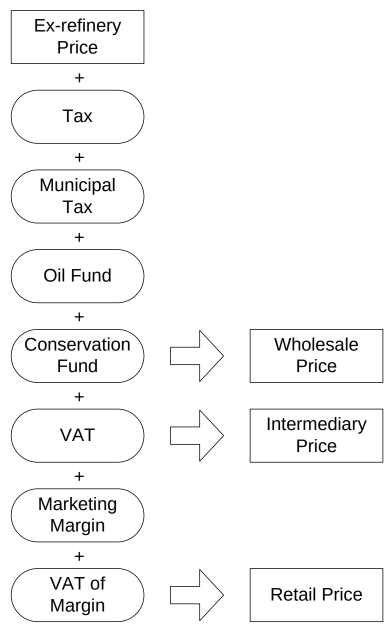


Figure 5.1: Oil price structure

From Figure 5.1, Retail Price = Ex-Refinery price + Tax + M. Tax + Oil fund + Conservation Fund + VATs + Marketing Margin.

When there are no crises (Figure 5.2), the government normally collects excise taxes from oil producers and import taxes from oil importers. However, when the world crude oil price increases (Figure 5.3), domestic prices will become higher than normal unless the government intervenes. In such cases, the government then will decide to use the oil fund to subsidize oil for some amount. The fund goes directly to oil producers, who pass it through to consumers in the form of lower retail prices.

Even after the world crude oil price retreats, the government will continue maintaining the high domestic prices for a certain period, keeping retail prices at a higher point than actually justified by crude prices as a way to rebuild the oil fund (Figure 5.4). However, a problem arises if a prolonged crisis depletes the oil fund and the government has to resort to generating the subsidy from elsewhere (Figure 5.5). In the past in such a situation, the government chose to issue oil bonds that do not show as expenditure but as debt.

The oil fund is not the government's only tool of intervention. It also can choose to intervene on behalf of the lower oil prices by reducing the tax it imposes. The degree of intervention (amount of subsidy or tax cut) will determine the degree of overall improvement in the economy.

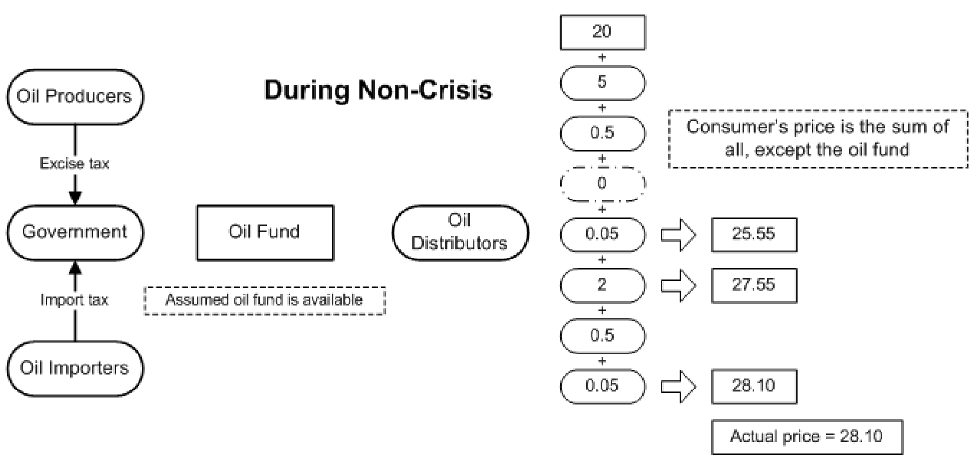


Figure 5.2: Noncrisis

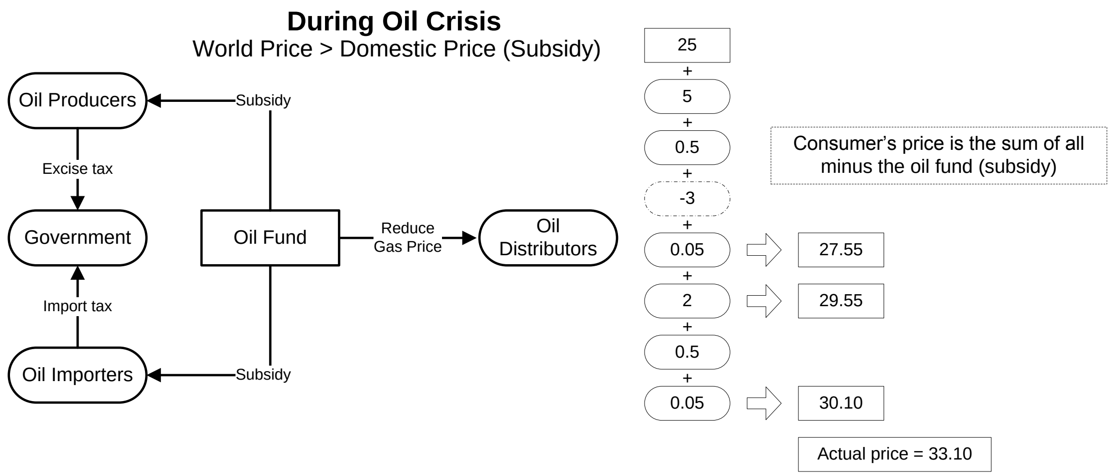


Figure 5.3: During oil crisis

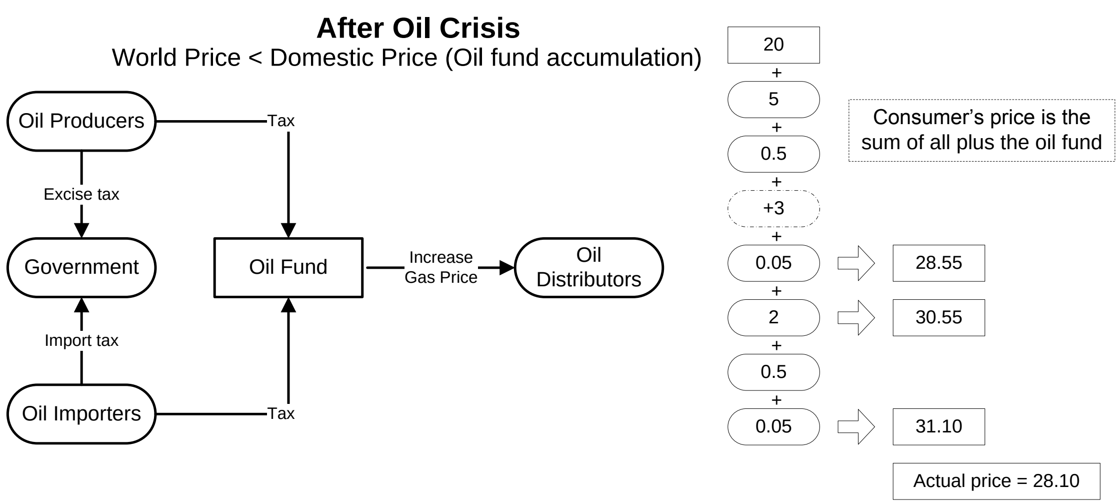


Figure 5.4: After oil crisis

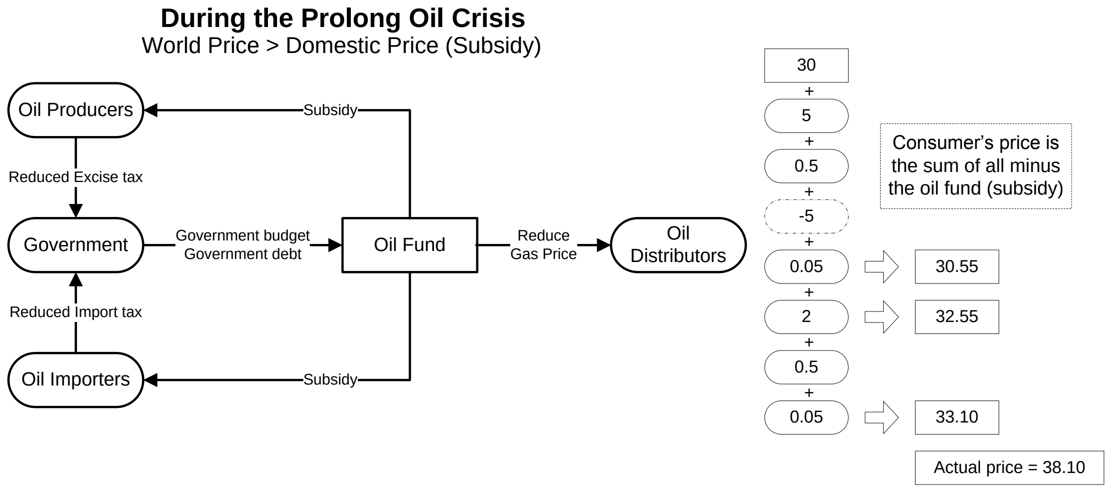


Figure 5.5: Prolonged oil crisis

5.1.2 Energy variables

The flow chart of the energy block can be found in Appendix G

The ex-refinery price is the price of petroleum products after the crude oil has been refined. The price reflects the cost of world crude oil prices, import taxes and duties, and cost of refining. However, in Thailand the ex-refinery price does not reflect the total cost because the price is pegged to the Singapore ex-refinery price. The ex-refinery price is a function of world crude oil prices, and the expected sign is positive.

The retail price of diesel is an identity of all prices as explained in Figure 5.1. The price of diesel is linked to consumption, investment, and the price block.

Demand for diesel is the actual total usage of diesel in the country. It is a function of the price of diesel, the number of personal automobiles, the number of commercial automobiles, and total output. The expected coefficient sign for the price of diesel and the number of personal automobiles is negative, but the rest are all positive.

The number of automobiles is the total number of each type in the country. Automobiles are categorized into two major types, personal and commercial. The majority of personal cars represent the upper class's choice of automobiles but some are also used in services (hotels' limousines). Personal cars tend to use gasoline more than diesel; thus, if the proportion of personal to commercial automobiles increases, the demand for diesel would decrease, and the expected sign for the demand for diesel fuel is negative. The majority of the commercial automobiles are used in agriculture, manufacturing, transportation, and services. The commercial type also represents the automotive choices of the working class. The majority of the commercial category of automobiles use diesel, thus, the sign for the price of diesel must be positive.

Total output: Because diesel is considered one of the factors of production and in this model oil is an intermediate input, the sign for the demand must be positive.

Automobile tax is the total amount of tax revenue. It is a function of the sale of automobiles. The expected sign for the sale of automobiles is positive. The increase in tax revenue can either be from increasing the tax rate or sales or both; however, in Thailand the automobile tax rate has been kept approximately constant for many years.

5.1.3 Substitution of personal and commercial types

In this dissertation, the sale of automobiles is the total unit of such sales. The expected sign for the number of automobile of the commercial type is a function of output and the retail price of diesel, and the expected signs are positive and negative. However, the sale of personal types of automobile is derived from CES (Constant Elasticity of Substitution) and thus shows the substitution effect between the two. The goal is to maximize demand (total number of automobiles), where C and T are the total number of personal and commercial types of automobile, respectively.

Maximization is subject to the total budget where UCC_C and UCC_T are the user costs of both types and can be represented by the price of gasoline and diesel.

According to the CES form, subject to a total budget

$$Max_{C,T} \quad D^T = \left[a \cdot C^{-\delta} + b \cdot T^{-\delta}\right]^{-\frac{1}{\delta}}$$

s.t. $UCC_C \cdot C + UCC_T \cdot T = TB$

$$Max_{C,T} \quad \left[a \cdot C^{-\delta} + b \cdot T^{-\delta}\right]^{-\frac{1}{\delta}} + \lambda[TB - UCC_C \cdot C - UCC_T \cdot T]$$

denote $\lambda = \frac{1}{PGDP}$, 1 unit increase if price decreases

F.O.C. C $\rightarrow \frac{1}{\delta}\left[a \cdot C^{-\delta} + b \cdot T^{-\delta}\right]^{-\frac{1}{\delta}-1} \cdot \delta \cdot a \cdot C^{-\delta-1} = \lambda \cdot UCC_C = \frac{UCC_C}{PGDP}$

$$\rightarrow \left[(D^T)^{-\delta}\right]^{-\frac{1}{\delta}-1} a \cdot C^{-(1+\delta)} = \frac{UCC_C}{PGDP}$$

$$\rightarrow (D^T)^{(1+\delta)} a \cdot C^{-(1+\delta)} = \frac{UCC_C}{PGDP}$$

$$\rightarrow \left[\frac{D^T}{C}\right]^{(1+\delta)} = \frac{UCC_C}{PGDP}$$

$$\rightarrow a \frac{(D^T)^{(1+\delta)}}{\mathrm{C}^{(1+\delta)}} = \frac{UCC_C}{PGDP}$$

Denote $\sigma = \frac{1}{1+\delta}$, elasticity of substitution

$$\rightarrow \left[\mathrm{C}^{(1+\delta)}\right]^{\sigma} = \left[a \cdot \frac{PGDP}{UCC_C} \cdot (D^T)^{(1+\delta)}\right]^{\sigma}$$

$$\rightarrow \mathrm{C} = \left[a \cdot \frac{PGDP}{UCC_C}\right]^{\sigma} \cdot D^T$$

Repeat the process for T, and divide the two equations,

$$\frac{C}{T} = \left(\frac{a}{b} \cdot \frac{UCC_T}{UCC_C}\right)^{\sigma}$$

$$C = \left(\frac{a}{b}\right)^{\sigma} \cdot \left(\frac{UCC_T}{UCC_C}\right)^{\sigma} \cdot T$$

Take the log on both sides for a final functional form,

$$\log(C) = \sigma(\log(a) - \log(b)) + \sigma(\log(UCC_T) - \log(UCC_C)) + \log(T)$$

The first term of the equation is captured by a constant. UCC_T and UCC_C are represented by PDH and PGP, respectively.

5.2 Fiscal block

The flowchart of the fiscal block can be found in Appendix G. The purpose of the fiscal block is to capture the change in government revenue. The composition of the revenue is as follows ((r) denotes regression):

ICTAX = PICTAX(r)+BICTAX(r)

DTAX = ICTAX+ODTAX(r)

IDTAX=PTAX(r)+ATAX(r)+OIDTAX(r)

GREV=DTAX+IDTAX+CUTAX(r)+OREV(r)

5.2.1 Fiscal variables

Personal income tax, Business income tax, Other direct tax, and Other indirect tax: These variables are a function of both output and price; their changes are positively correlated with output, and thus the expected coefficient sign for output is positive. When price levels increase, revenue can increase because most tax rates are a fixed percentage. However, revenue also can decrease because of a reduction in income. Thus, the coefficient sign for price levels is uncertain.

Petroleum tax revenue: This revenue depends on usage of the petroleum product and the number of automobiles of both types. The expected coefficient sign is positive.

Automobile tax revenue: Revenue from automobile tax depends solely on the sale of automobiles (the tax rate for most types of automobiles has been kept constant for a very long time). The expected coefficient sign is positive.

Custom tax revenue: Customs revenue depends on price levels and volume of imports and exports. The expected coefficient signs for imports and exports are positive.

5.3 Welfare block

The flowchart for the welfare block can be found in Appendix G as a block linked to the core economy block.

Unemployment rate: According to Okun's law, the unemployment rate decreases when output exceeds potential output, and according to the Phillips' relation, an unemployment rate has a negative relationship with an inflation rate. Thus, an unemployment rate is a function of the rates of output and inflation, and the expected signs are negative for both. However, employments is endogenized in this model, and the unemployment rate is influenced by the sum of each sector's employment,

$$Unemployment\ rate = 1 - \frac{\sum Employment_i}{Labor\ force}$$

Household monthly income is a function of output, the CPI, and wealth. The expected sign for the CPI is negative, but the rest are expected to be positive.

Poverty line is the minimum basket of goods for basic needs times price. It is a function of household monthly income and the CPI. A decrease in household monthly income coupled with an increase in price levels will make more people fall below the poverty line; thus, the signs are negative and positive, respectively.

Poverty severity: Based on the Foster Greer Thorbecke (FGT) class of poverty measurement where α=2, poverty is the poverty line or income when income is lower than the poverty line. Thus, the severity of poverty is a function of population, the poverty line, and individual monthly income. However, because only data for household monthly income can be found, individual income is determined by dividing household monthly income by 3.6 (the average number of persons per household). Because the FGT class of poverty measurement takes the form of,

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{N}(\frac{z-y_i}{z})^\alpha$$

Take the log on both sides,

$$\ln(P_\alpha) = -\ln(N) + \alpha\ln\sum_{i=1}^{N}(z-y_i) - \alpha\ln(z)$$

CHAPTER 6

MODEL SCENARIOS

The main scenarios evaluated are the following:

S1. The increase of world crude oil prices by 50%, 100%, 150%, and 200**%.**

S2. The use of the oil fund when world crude oil prices increased by 50%.

S3. The use of the oil fund when world crude oil prices increased by 200%.

S4. The use of a tax cut when world crude prices increased by 50%.

S5. Reductions in automobile sales.

S6. Policy mix: the use of the oil fund and monetary policy.

S7. Policy mix: the use of the oil fund, monetary and fiscal policies

According to the results generated, changes in the variables for every scenario were compared to the baseline. In the baseline, the exogenous variables were not modified in the ex-post simulation period (1995:1-2004:4); any policies that already had been implemented in the real situation were left unaltered. The main results that are discussed in this chapter are the average percentage changes of the variables over the course of five years (the duration of an oil shock is assumed to be five years). The results for the simulated baseline, average percentage change, average absolute change, and a graph of the changes can be found in appendices D, E, and F.

6.1 Scenario 1: An increase in world crude oil prices

6.1.1 Modeling Method

To capture the effects of an increase in petroleum prices, Scenario 1 aims to focus on the changes in every variable in response to assumed changes in the world crude oil prices by 50%, 100%, 150%, and 200%, all starting from 2000 Q1, generated by the following method,

$$P_t = P_t^{actual} + 0.50xP_{t-1}^{actual}$$

The series generated depends on the magnitude of the previous actual data and its trend. By this method, the value of the assumed prices will still reflect the trend of the actual data and would not diverge indefinitely.

Figure 6.1: World crude oil prices (1996-2009)

In Figure 6.1, an attempt has been made to make assumptions about the increases in world crude oil prices match the actual increases that occurred. Because prices started to rise continuously in 2002, an average value of 0% change has been assumed from 1999 to 2004. Thus, the increases of 50%, 100%, 150%, and 200% can be matched to the years of 2005, 2006, 2006Q2, and 2008, respectively.

6.1.2 Scenario 1 Results

For consumption (Figure E.1.1), among six sectors, those most affected are manufacturing, services, and transportation; agriculture and utilities are the least affected. The reasons are that although manufacturing products are mostly durable goods and services (and transportation) are mostly nondurables, they are mostly not necessity goods, and thus, their price-demand elasticity is high. However, most agricultural products and utilities are necessity and non-durables; thus, their elasticity is low. The results indeed reflect the different price elasticities of demand among sectors.

Among three sectors (Figure E.1.2), investment in manufacturing is the most affected, and construction and services are moderately affected. One possible explanation is that investments in services and construction tend to be of longer terms than investments in manufacturing; therefore, the adjustments take longer. Another explanation is that the production base of the manufacturing sector can be moved to other countries where the cost of production is lower, but investments in the construction and services sectors cannot be relocated easily.

According to Figure E.1.3, total output in construction is affected the most, and total output in agriculture is affected the least. The result of the total decline in construction output can result from lower overall investments because construction can stem from an investment in any sector. The result of the total output in agriculture is as expected, because producers can switch to growing energy-producing crops (sugarcane, cassava, etc., for gasohol) to take advantage of high oil prices.

According to Figure E.1.4, the price levels of manufacturing goods yield the highest increase compared with other sectors because of the low elasticity of substitution in the type of oil available for use as intermediate input. However, the price levels of services declined slightly after a decrease in consumption of services (for example, hotels usually give more and higher discounts when demand is low). Agricultural price levels also increased substantially because Thailand processes some of its agriculture products into alcohol for gasohol, which is more widely used in Thailand than in the United States. Thus, besides the usual mechanism from the core model, the price levels in agriculture have “an extra kick” because some products can be sold for higher prices as ingredients in gasohol than if they were directly consumed.

The external block is shown in Figure E.1.5. As expected, the import value of energy increases considerably. The decrease in the export of services implies a very slight decrease in tourism. The decrease in imports of final products directly reflects the decrease in demand. The decrease in imports of intermediate goods reflects a decline in both consumption and investment (some intermediate goods are processed domestically as part of final export products).

Figure E.1.7 shows that household monthly income is lower than the baseline, while there has been a significant reduction in wealth. Wealth declines significantly for two reasons. First, inflation reduces the value of asset holdings. Second, the reduction in aggregate demand leads to a reduction in investment and, therefore, a reduction in wealth. The lower aggregate demand resulting from the oil price hike caused a decline in employment (and an increase in unemployment) and hence, household income. The poverty line has risen because of higher inflation, which along with the reduction in household income, will worsen the severity of poverty.

From Figure E.1.8, given that Thailand has been using an inflation target of less than approximately 2%, the price level rises moderately. The reduction in the supply side GDP is lower than the demand side. Private investment is the most affected among all the indicators. This is partly consistent with Rafig's (2009) findings that the unemployment rate and investment are especially adversely affected by oil price volatility. Unemployment, however, is relatively unaffected and remained low even during the Asian financial crisis because approximately 45% of the country's employment is in the agriculture sector. Reverse migration from urban areas to rural parts of the country also has contributed to mitigation of the rate of increase in unemployment.

According to Figure E.1.9, although all other types of tax revenue decreased, revenue from other direct taxes which mainly in the form of value added tax (VAT) increased. Higher prices for commodities resulted in higher taxes collected via VAT. Nevertheless, overall tax revenue decreased.

6.2 Scenarios 2 and 3: The use of the oil fund program

6.2.1 Modeling method

These two scenarios have the goals of determining the effectiveness of the oil fund policy under conditions of both moderate and substantial oil price increases. Scenario 2 assumes world crude oil prices increase by 50% with a counterfactual policy of increasing the amount of subsidy by 1, 2, 3, and 4 baht per liter. Scenario 3 assumes an increase of 200% in the world crude oil prices and a counterfactual policy of increasing the amount of subsidy by 2, 3, 4, and 5 baht per liter.

The benefits of this direct subsidy that in effect immediately lowers the actual price paid by consumers are that it will keep constant the prices consumers pay as well as production costs and the rate of inflation. The costs are that the subsidy can greatly increase the government's expenditures and that consumers will not change their petroleum consumption behavior. However, the Thai government does not pay the subsidy out of current expenditures but instead from the oil fund, which is partly accumulated from levies on consumers during normal economic times. The government also funds the oil fund through bonds, which do require interest payments. Thus, in these scenarios, government spending is assumed to be unchanged and remains exogenous because the debt is not counted as expenditure. Figure 6.2 shows the effects of the subsidy, which eventually leads to improvement in welfare.

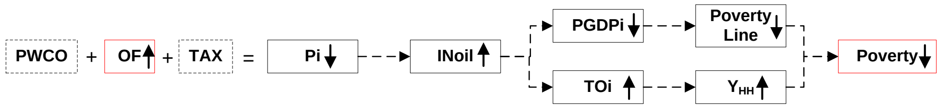


Figure 6.2: Effects of an oil subsidy

6.2.2 Scenarios 2 and 3 Results

Both scenarios show that the subsidy, indeed, leads to improvement in every variable, including welfare. When world crude oil prices increased moderately (50% under Scenario 2), the result showed that the economy can be stabilized using a subsidy of approximately 1.2 bath per liter. Under Scenario 3, a substantial oil price increase of 200%, the result shows that the economy can be stabilized using a subsidy of approximately 2.5 bath per liter.

6.3 Scenario 4: Tax cut

6.3.1 Modeling method

The goal of this scenario was to determine the effectiveness of a tax cut policy when a moderate oil price increase is assumed. Scenario 4 assumed a price increase of 50% with a counterfactual policy to decrease taxes by 25%, 50%, 75%, and 100%. Because a tax cut also directly lowers the consumer's price, the benefits and costs are similar to the use of oil fund; however, instead of increases in government spending or debt, government revenue decreases.

6.3.2 Scenario 4 Results

As in the case of the oil fund, this scenario shows that a tax cut also improved every variable. When world crude oil prices increase moderately (50%), the result shows that the economy can be stabilized if the government reduces the oil tax rate by approximately 35%.

6.4 Scenario 5: Reduction in automobile sales

6.4.1 Modeling method

The goal of this scenario was to determine the economic impact of reducing, by whatever means, the number of sales of commercial automobiles that mostly use diesel. The model was modified so that such sales are now exogenous. The assumed reductions are 10%, 20%, 30%, and 40%.

6.4.2 Scenario 5 Results

The results show that reduced automobile sales will lead to a moderate reduction in demand for diesel (Figure E.5.4). The number of commercial and personal types of automobiles also decreased somewhat, and the price of diesel decreased very slightly. Although for this scenario, the price of diesel was endogenized so that its change also would depend on demand, the coefficient was significant; nonetheless, the magnitude remains small compared with the world crude oil price coefficient. In addition, the result also shows a decrease in the sale of personal types of automobiles. Although derivation for an equation on the sale of personal types of automobiles (Section 5.1.3) has already captured the elasticity of substitution between both types, the effects of the last term (+log(SACC)) still dominate the user's cost term (log(UCC_T). Thus, based on CES derivation, the sales of neither type can be evaluated independently.

Almost all other variables also worsen with very small magnitude of change. This can reflect the proportion of the use of automobiles in each sector as a factor of production. Consumption in the agriculture and utilities sectors was virtually unaffected because they are nondurable and necessities. As expected, transportation and services are the sectors most affected (Figure E.5.1).

6.5 Scenarios 6 and 7: Mixed policies

The goals of this scenario are to determine the effectiveness of monetary and fiscal policy responses in addition to a price subsidy.

6.5.1 Modeling method

Using Scenario 2 as a comparison, the interest rate was endogenized in Scenario 6; then government spending was raised by 5% in Scenario 7. The improvement in the variables in this situation would be determined from the welfare indicators.

6.5.2 Scenarios 6 and 7 Results

According to figures E.1.7, E.6.1, and E.7.1, using only a subsidy would improve all the indicators. When an interest rate is endogenized, it results in changes in price levels and aggregate demand, thus worsening the overall economy and every welfare variable. However, when the government tries to boost the economy by increasing its spending, it only helps return household monthly income to the same level as in the absence of the interest rate. Increased government spending also yields a little improvement in the poverty line, poverty severity, and in wealth. However, this spending brings major improvement in the unemployment rate. Thus, it can be concluded that an independent monetary response based on price level alone is not the best policy response in dealing with changes in oil prices.

CHAPTER 7

CONCLUSION AND FURTHER REMARKS

7.1 Model results conclusion

The purpose of this dissertation is to demonstrate the effects of the increase in petroleum price on Thailand's general economy, with linkages to aspects of the nation's welfare system and the evaluation of effective counterfactual policy responses. Five policies were analyzed; the oil fund as a mean of subsidy; a cut in taxes on petroleum; a reduction in automobile sales; changes in interest rates; and the increase in government spending. These policies were evaluated by comparing with the baseline the results of simulating each scenario. The results also were analyzed based on overall macroeconomic performance, especially on the welfare variables.

The task of developing a macroeconometric model began with the collection of raw data yearly, quarterly, monthly, weekly, and of irregular frequencies before processing and combining all data into a single database. Then, based on aggregate-demand and aggregate-supply concepts, the data for the core model were categorized into six sectors. The core block was composed of the private demand (C,I), production (total output), and price blocks (GDP deflator). The rest of the data were then categorized into peripheral blocks, including, external, fiscal, energy, and welfare blocks. The equation system was then calibrated by determining the best fit for each equation while observing its baseline result (See Appendix G for step-by-step procedures).

The evaluation of policies was accomplished by comparing the economic situation that resulted from a simulation of an increase in oil prices with and without the effects from any counterfactual policy (Scenarios 2, 3, 4, 6, and 7).

The results of the simulated impact of the increase in oil price (Scenario 1) show a decrease in almost every variable in response to the oil shock. The degree of the decline in consumption of different types of goods clearly reflects the elasticity of demand for each type of good. The decline in agricultural product consumption is relatively small compared to other sectors; this is because food in one form or another is a necessity, but some types of manufactured products and services are not. When the world crude oil prices increased by 200%, consumption of agricultural products declined only by 0.93%, but consumption in manufacturing and services declined by 2.69% and 2.83%, respectively. Among the key macro variables, the decline in investment was the largest (approximately 10% for all sectors) because it is the first variable that would respond to an economic slowdown. The total output in construction, which can be a form of investment, exhibited the largest decline with the magnitude of 4%, compared to the 1%-2% decline in all other sectors. The overall price level increased as expected but remained within the acceptable range set by the Bank of Thailand (±2%). A 2.97% reduction in the imports of final goods reflected decreasing domestic demand, and a 19% increase in the import bill for energy clearly reflected the increase in the prices of energy.

In terms of welfare, employment decreased across all sectors that are involved with production, especially construction and utilities, which exhibited a decline in employment by 2.05% and 1.68%, respectively. Such decline led to only a 0.3% decline in household income, whereas wealth showed a much more significant decline of 4.73%. The decline in wealth, along with higher price levels, raised the poverty line and the severity of poverty by 0.34% and 0.43%, respectively.

7.2 Direct price intervention policies

The results from the simulations with the oil fund (Scenarios 2, 3) and tax reductions (Scenario 4) showed that when the world crude oil price increased by 50% and 200%, the subsidies of 1.2 bath per liter and 2.5 bath per liter are needed to stabilize the economy. When the world crude oil price increased by 50%, a 35% tax cut is needed stabilize the economy. However, to implement policies to counter these adverse effects, a policymaker must make a decision on the amount of subsidy from the oil fund program or the size of the tax reduction. There is no specific limit on the size of the oil fund because its size depends on the government's ability to generate it (directly from consumer, oil bonds, and other means),

According to Figure 7.1, the government had adequate leeway in 2005 to use a tax reduction to counter the increased price of oil. On the other hand, for the more recent price increase, there was insufficient leeway unless the subsidy from the oil fund was increased (a 100% tax cut would approximately equal to a 2 bath per liter subsidy). Thus, the use of tax reduction policy has its limit.

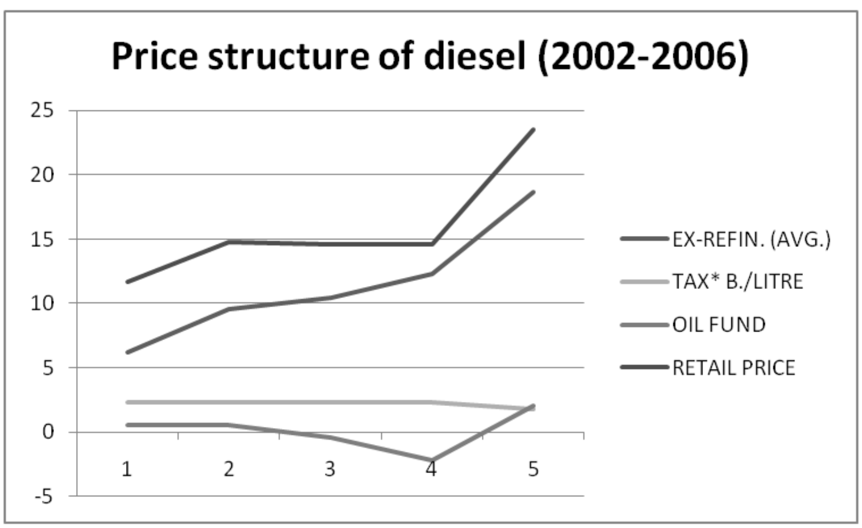


Figure 7.1: Price structure of diesel

When the use of the oil fund results in increasing government debt (or when the oil tax reduction reduces the government revenue), a policymaker must consider a potential tradeoff in which the losses incurred in trying to bring the economy back on track might be offset by the increase in the government revenue from other types of taxes. Figure 7.2 shows the reduction in the government revenue when world crude oil price increased by 50%, 100%, 150%, and 200%. In deciding whether the subsidy outlays are worthwhile (solely from the perspective of the government's budget), the simulated amount of the loss in government revenue can be compared to the amount of the actual oil fund subsidy in 2005.

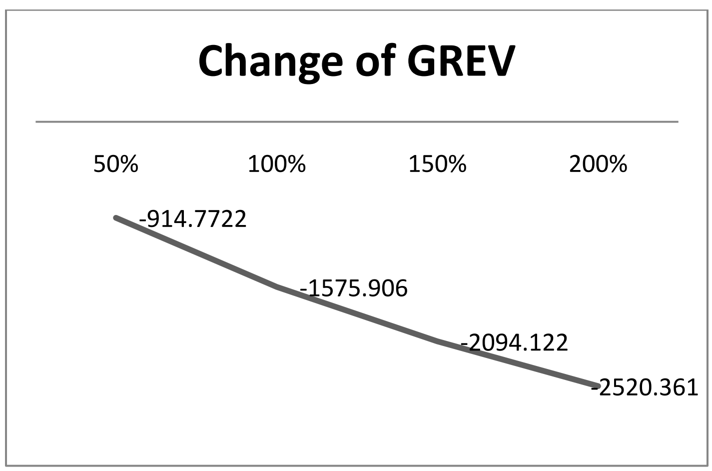


Figure 7.2: Change in government budget

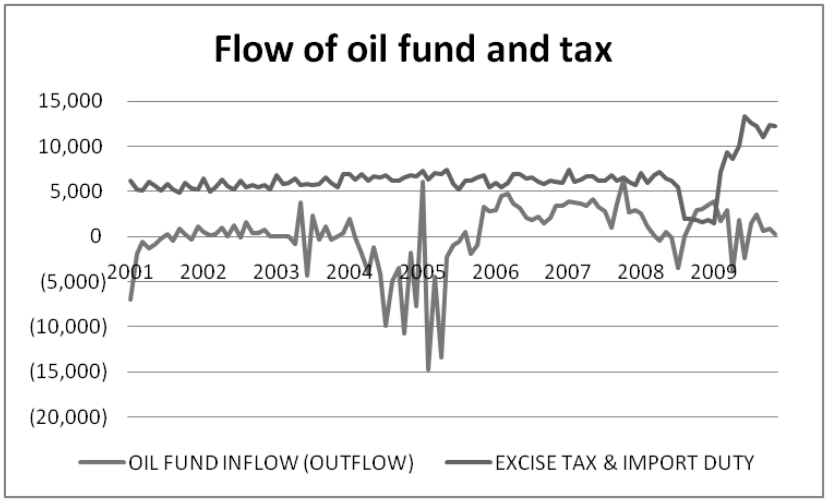


Figure 7.3: Flow of oil fund and tax

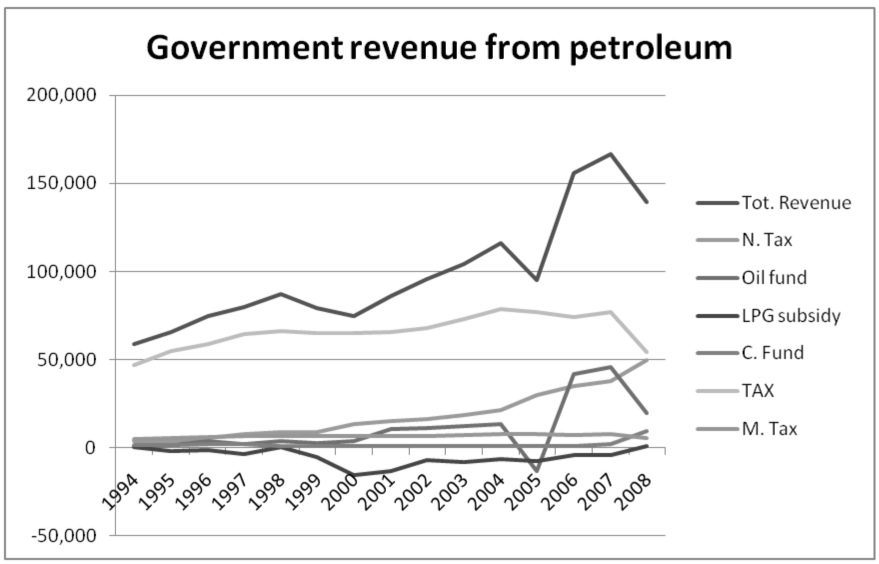


Figure 7.4: Revenue from petroleum

In 2005 when the ex-refinery price of diesel rose approximately by 30% (from 10 baht to 13 baht), the government intervened to lower the price by 3 baht via spending 12,000 million baht in subsidy. The simulated result shows that the amount of subsidy considerably exceeds the loss in government revenue, but this is not the only aspect to be considered. The more important concern is that whether the subsidy would improve the overall economic condition and the welfare of the people. Moreover, the majority of cash in the oil fund is not a direct subsidy from the government. Instead, it is the savings collected over the years from oil consumers (Figure 7.3). The chart also implies that a reduction in the oil tax ranks second to the use of the oil fund as a policy choice for the government to deal with an oil shock. Figure 7.4 shows that the amount of tax revenue from petroleum is considerably more than the amount of the oil fund. These figures show that policymakers have options available to reduce domestic oil prices. Thus, the economic impact of the increase in oil price largely depends on how policymakers use the options available to them. If the welfare of consumers is the first priority, it can be concluded that if the oil price increase appears to be temporary, the government must subsidize, at least partially, at all costs by optimizing the use of both the oil fund and a tax cut. A subsidy is also necessary, at least in the short run, even if the price increase is permanent, until alternative solutions are available.

7.3 Reduction of automobile sales policy

The cutback in the sales of automobiles yields only a few percent reduction in the usage of diesel. The reduction in the total number of automobiles following the cutback is also small. However, capturing the effects of policies to reduce the number of automobiles, such as an increase in the automobile tax rate or directly reducing the number of sales (i.e., by quota), is extremely difficult. The effect of the reduction in the sales on the number of automobiles would be small because Thailand does not strictly impose a law to terminate automobile usage either by the age or performance of a vehicle. As a result, the life span of an automobile could be very long. In addition, reducing sales does not necessarily translate into the lower usage of diesel because the number of automobiles is only a record and does not reveal how consumers use them. Thus, even if the automobiles are less affordable, consumers may decide to buy cheaper car or even a motorcycle and drive more often if they still can afford gas.

In dealing with the automobile industry, it is best to focus more on social policies by the means such as promoting the social value of environmental issues. As for a fiscal policy response, the government could promote better public transportation. Unfortunately, the model is unable to capture these policies.

7.4 Discussion of monetary and fiscal policies

The result of using an interest rate policy to counter rising inflation confirms the findings of Bernanke (1997) and more recent researchers. A rising interest rate worsens the overall economy as well as welfare indicators. Because the results show that inflation can be kept within an acceptable range, the central bank must not adjust the interest rate in response to price levels alone; such an adjustment has the tendency to further worsen the overall economy. An increase in government spending (after an increase in the interest rate) lowers the unemployment rate significantly to a level even below what was in place before the increase in the interest rate. However, an increase in government spending only increases wealth by an insignificant amount. Thus, this is evidence indicating that different policy tools cannot be considered and implemented independently.

7.5 Further Remarks

Sometimes, the decision to subsidize domestic petroleum prices to improve the overall economy is more for political reasons than for economic ones.

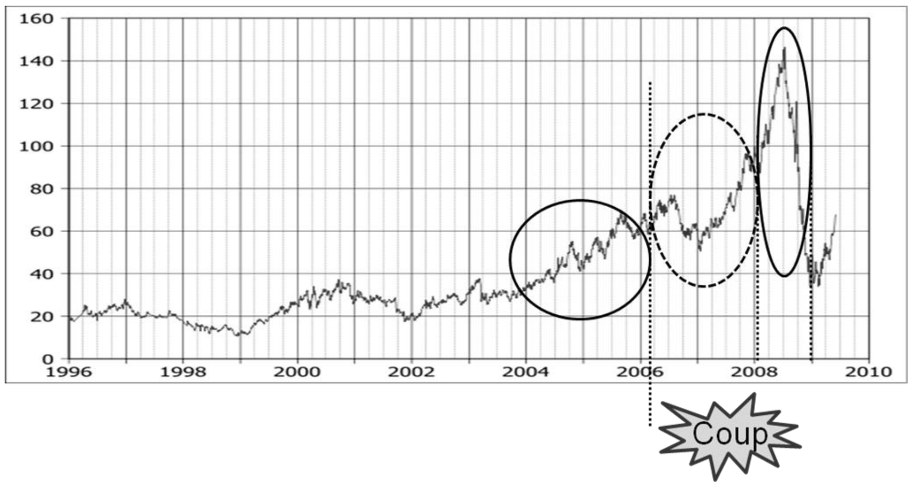


Figure 7.5: World crude oil prices (1996-2009)

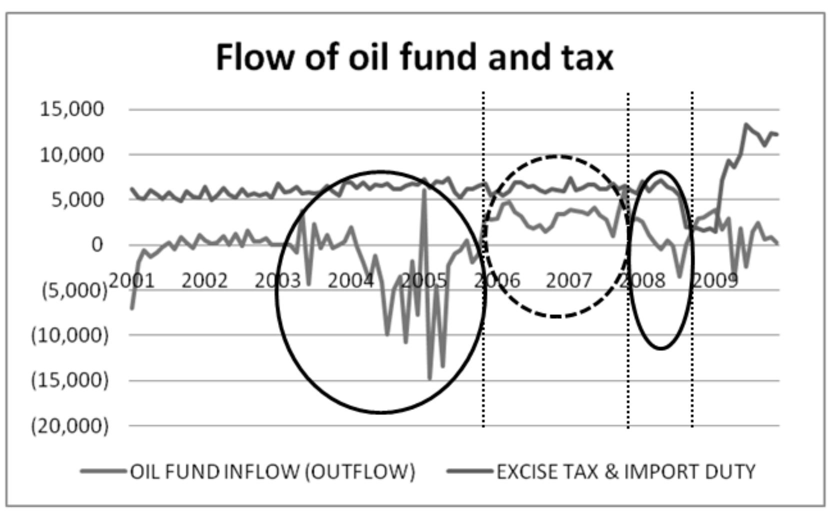


Figure 7.6: Flow of oil fund and tax

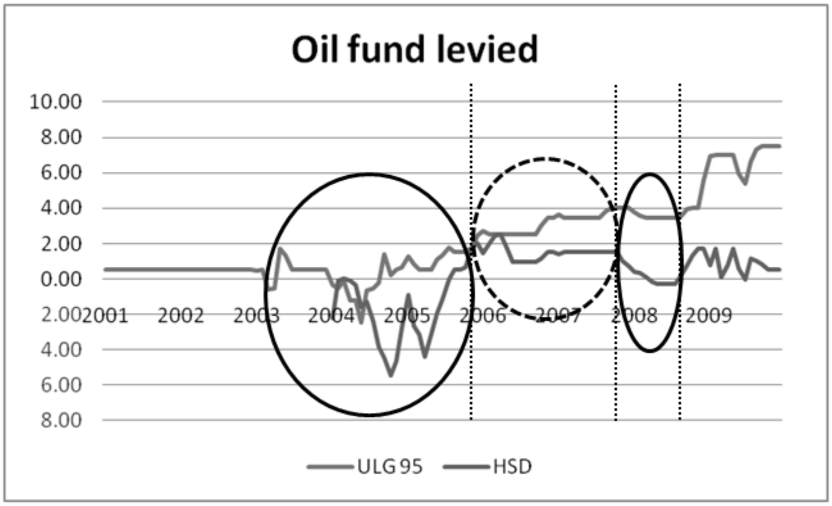


Figure 7.7: Oil fund levied

In Figure 7.5-7.7, the solid circle shows the period when Thailand had an elected government, and the dotted circle shows the period when a military government was in power. It is clear that different types of government differ in the types of oil fund policies they prefer to implement.

7.6 Possibilities for future research

This dissertation demonstrates how to construct and use a macroeconometric model to analyze the impacts of the increase in oil price on various macroeconomic variables, with an emphasis on welfare. Some assumptions about the mechanisms of the Thai economy have been made. Possible improvements to the model would involve both its structure and the issues it embraces.

First, the model can be considered as a partial equilibrium model. Many variables such as the GDP of Thailand's top ten trade partners are considered as exogenous. However, in reality, changes in the price of oil would affect the world as a whole, changing the GDP of other counties and, thus, having additional effects on

Thailand's trade bloc. Therefore, improvements could be made by endogenizing those variables or linking the model to another model (for example, LINK).

Second, because the model was first customized to capture the effects of oil prices, the inclusion of the shock to the automobile variable can only be analyzed within the block. Hence, the type of shock that can be created in the model is limited.

Finally, diesel is used as a representative variable for all types of petroleum products. This is because of the complications in the calibration process and the fact that not every type of oil can be linked to every variable. Thus, the model has limited flexibility to use and determine the effects created by changes in the prices of various types of oil.

The model is a simplification of an entire economy. Future research can expand the model with more equations and sectors. The results obtained here through the model make qualitative sense; however, any absolute quantitative value should be judged in conjunction with other models before committing to definite policies. In any case, this dissertation provides a useful macroeconometric model that links various blocks into the core model.

APPENDIX A

LIST OF VARIABLES

A.1 List of Endogenous Variables

ATAX	=	Automobile tax revenue	M. baht, current price (SA)
BICTAX	=	Business income tax revenue	M. baht, current price (SA)
CAG	=	Private consumption, Agriculture	M. baht, 1988 price (SA)
CMA	=	Private consumption, Manufacturing	M. baht, 1988 price (SA)
CPI	=	Headline consumer price index	1998=100
CPR	=	Total private consumption	M. baht, 1988 price (SA)
CSE	=	Private consumption, Services	M. baht, 1988 price (SA)
CTR	=	Private consumption, Transportation	M. baht, 1988 price (SA)
CUT	=	Private consumption, Utilities	M. baht, 1988 price (SA)
CUTAX	=	Custom tax revenue	M. baht, current price (SA)
DD	=	Domestic demand	M. baht, 1988 price (SA)
DTAX	=	Direct tax revenue	M. baht, current price (SA)
DTDI	=	Demand of diesel	Barrels/day
EMP_AG	=	Employment, Agriculture	Thousand
EMP_ALL	=	Employment, All sector	Thousand
EMP_CON	=	Employment, Construction	Thousand
EMP_MA	=	Employment, Manufacturing	Thousand
EMP_SER	=	Employment, Services	Thousand
EMP_TRA	=	Employment, Transportation	Thousand
EMP_UTI	=	Employment, Utilities	Thousand
GDP_GAP	=	Change in inventories+statistical discrepancies	M. baht, 1988 price (SA)
GDPAG	=	Gross Domestic Products, Agriculture	M. baht, 1988 price (SA)
GDPCO	=	Gross Domestic Products, Construction	M. baht, 1988 price (SA)
GDPD	=	Gross Domestic Products, Demand side	M. baht, 1988 price (SA)
GDPMA	=	Gross Domestic Products, Manufacturting	M. baht, 1988 price (SA)
GDPS	=	Gross Domestic Products, Supply side	M. baht, 1988 price (SA)
GDPSE	=	Gross Domestic Products, Services	M. baht, 1988 price (SA)
GDPTR	=	Gross Domestic Products, Transportation	M. baht, 1988 price (SA)
GDPUT	=	Gross Domestic Products, Utilities	M. baht, 1988 price (SA)
GREV	=	Total government revenue	M. baht, current price (SA)
HHMI	=	Household monthly income	baht
ICO	=	Investment, Construction	M. baht, 1988 price (SA)
ICTAX	=	Income tax revenue	M. baht, current price (SA)
IDTAX	=	Indirect tax revenue	M. baht, current price (SA)
IMA	=	Investment, Manufacturing	M. baht, 1988 price (SA)
INF_RATE	=	Inflation rate	%
IPR	=	Total private investment	M. baht, 1988 price (SA)
ISE	=	Investment, Services	M. baht, 1988 price (SA)
MEN	=	Import value of energy	M. baht, 1988 price (SA)
MFG	=	Import of final goods	M. baht, 1988 price (SA)
MGR	=	Total import of goods	M. baht, 1988 price (SA)
MGS	=	Import of goods and services	M. baht, 1988 price (SA)
MIG	=	Import of intermediate goods	M. baht, 1988 price (SA)

MSR	=	Import of services	M. baht, 1988 price (SA)
NPC	=	Number of personal automobiles	Unit
NTC	=	Number of trucks	Unit
ODTAX	=	Other direct tax revenue	M. baht, current price (SA)
OIDTAX	=	Other indirect tax revenue	M. baht, current price (SA)
OREV	=	Other government revenue	M. baht, current price (SA)
PDH	=	Retail price of high speed diesel	Baht per liter
PE_HD	=	Ex-refinery price of high speed diesel	Baht per liter
PGDPAG	=	GDP deflator, Agriculture	1988=1
PGDPAVE	=	GDP deflator, Average (initial)	1988=1
PGDPAVE1	=	GDP deflator, Average	1988=1
PGDPCO	=	GDP deflator, Construction	1988=1
PGDPMA	=	GDP deflator, Manufacturing	1988=1
PGDPSE	=	GDP deflator, Services	1988=1
PGDPTR	=	GDP deflator, Transportation	1988=1
PGDPUT	=	GDP deflator, Utilities	1988=1
PICTAX	=	Personal income tax revenue	M. baht, current price (SA)
POVL	=	Poverty line	baht/person
POVS	=	Severity of poverty	-
PTAX	=	Petroleum tax revenue	M. baht, current price (SA)
SACC	=	Sale of commercial type automobiles	Unit
SACP	=	Sale of personal type automobiles	Unit
TOAG	=	Total output, Agriculture	M. baht, 1988 price (SA)
TOALL	=	Total output, All	M. baht, 1988 price (SA)
TOCO	=	Total output, Construction	M. baht, 1988 price (SA)
TOMA	=	Total output, Manufacturing	M. baht, 1988 price (SA)
TOSE	=	Total output, Services	M. baht, 1988 price (SA)
TOTR	=	Total output, Transportation	M. baht, 1988 price (SA)
TOUT	=	Total output, Utilities	M. baht, 1988 price (SA)
UNEMPR	=	Unemployment rate	%
WEALTH	=	M2+Securities	M. baht, 1988 price (SA)
XGR	=	Export of goods	M. baht, 1988 price (SA)
XGS	=	Export of goods and services	M. baht, 1988 price (SA)
XSR	=	Export of services	M. baht, 1988 price (SA)
YI	=	Individual monthly income	Baht

A.2 List of Exogenous Variables

CG	=	Public consumption	M. baht, 1988 price (SA)
CGR	=	Public consumption	M. baht, current price (SA)
D00Q1	=	Dummy variable, at 2000q1 = 1, otherwise = 0	
D012	=	Dummy variable, beginning 2001q2 = 1, otherwise = 0	
D01Q2	=	Dummy variable, at 2001q2 = 1, otherwise = 0	
D03Q2	=	Dummy variable, at 2003q2 = 1, otherwise = 0	
D964	=	Dummy variable, beginning 1996q4 = 1, otherwise = 0	
D96Q2	=	Dummy variable, at 1996q2 = 1, otherwise = 0	
D96Q4	=	Dummy variable, at 1996q4 = 1, otherwise = 0	
D971	=	Dummy variable, beginning 1997q1 = 1, otherwise = 0	
D972	=	Dummy variable, beginning 1997q2 = 1, otherwise = 0	

D97Q1	=	Dummy variable, at 1997q1 = 1, otherwise = 0	
D98Q1	=	Dummy variable, at 1998q1 = 1, otherwise = 0	
D98Q2	=	Dummy variable, at 1998q1 = 1, otherwise = 0	
EMP_COM	=	Employment, Commerce	Thousand
EMP_OTH	=	Employment, Other	Thousand
EXR	=	Nominal exchange rate	baht/$
GDPW	=	Total GDP of top 10 trade partners	Billion U.S.
INAG	=	Intermediate input, Agriculture	M. baht, 1988 price (SA)
INCO	=	Intermediate input, Construction	M. baht, 1988 price (SA)
INMA	=	Intermediate input, Manufacturing	M. baht, 1988 price (SA)
INSE	=	Intermediate input, Services	M. baht, 1988 price (SA)
INTR	=	Intermediate input, Transportation	M. baht, 1988 price (SA)
INUT	=	Intermediate input, Utilities	M. baht, 1988 price (SA)
KAG	=	Net capital stock, Agriculture	M. baht, 1988 price
KCO	=	Net capital stock, Construction	M. baht, 1988 price
KMA	=	Net capital stock, Manufacturing	M. baht, 1988 price
KSE	=	Net capital stock, Services	M. baht, 1988 price
KTR	=	Net capital stock, Transportation	M. baht, 1988 price
KUT	=	Net capital stock, Utilities	M. baht, 1988 price
LF	=	Labor force	Thousand
MM_HD	=	Marketing margin, high speed diesel	Baht per liter
MTAX_HD	=	Municipal tax, high speed diesel	Baht per liter
OF_HD	=	Oil fund subsidy, high speed diesel	Baht per liter
PE_HD	=	Ex-refinery price, high speed diesel	Baht per liter
PGP	=	Retail price of premium gasoline	Baht per liter
POP	=	Population	Thousand
PWCO	=	World crude oil prices	$
RD3M	=	Three-month deposit rate	%
RER	=	Real exchange rate	baht/$
RH	=	Personal income tax rate	%
T	=	Time trend	
TAX_HD	=	Tax, high speed diesel	Baht per liter
TOUR	=	Number of tourists	Thousand
VAT_HD	=	Value added tax, high speed diesel	Baht per liter

APPENDIX B

AUGMENTED DICKEY-FULLER UNIT ROOT TEST

	Integration of order	Case 1 No. intercepts & trends	Case 2 Intercepts	Case 3 Intercepts & trends	Significance level	No. lagged
ATAX	1		-3.631146		1% level	0
BICTAX	1		-8.358781		1% level	1
CAG	0			-4.242438	1% level	0
CG	0			-3.759723	1% level	0
CGR	0			-5.785413	1% level	0
CMA	1		-4.572317		1% level	0
CPI	1		-3.709997		1% level	0
CPR	1		-4.708436		1% level	0
CSE	1		-8.499389		1% level	0
CTR	1		-7.318656		1% level	0
CUT	1		-9.122721		1% level	0
CUTAX	1		-4.252096		1% level	0
DD	1		-5.763398		1% level	0
DTAX	1			-6.930049	1% level	1
DTDI	1		-6.262988		1% level	0
EMP_AG	0		-4.792018		1% level	0
EMP_CON	1		-7.55597		1% level	0
EMP_MA	0			-3.299025	10% level	0
EMP_SER	1		-7.647986		1% level	0
EMP_TRA	0		-2.609511		10% level	0
EMP_UTI	1		-8.655686		1% level	0
EXR	1		-5.103572		1% level	0
GDPAG	0			-3.911729	5% level	0
GDPCO	1		-7.64069		1% level	0
GDPD	1		-4.03039		1% level	0
GDPMA	1		-3.511466		5% level	0
GDPS	1		-4.03039		1% level	0
GDPSE	1		-3.903236		1% level	1
GDPTR	1		-5.553302		1% level	1
GDPUT	1		-8.017351		1% level	0
GDPW	0			-3.576956	5% level	0
GREV	1		-8.182374		1% level	0
HHMI	1	-1.916713			10% level	0
ICO	1		-7.181472		1% level	0
ICTAX	1		-7.452086		1% level	1
IDTAX	1		-5.540817		1% level	0
IMA	1		-6.008549		1% level	0
INAG	1		-5.608587		1% level	0
INCO	1		-5.35044		1% level	0
INMA	1		-3.812602		1% level	0
INSE	1		-3.796437		1% level	0
INTR	1		-4.250057		1% level	0

INUT	1		-3.528		5% level	0
IPR	1	-1.826552			10% level	2
ISE	1		-7.223508		1% level	0
KAG	2		-4.031641		1% level	7
KCO	0		-2.70313		10% level	1
KMA	2		-7.961563		1% level	0
KSE	0		-2.804875		10% level	1
KTR	2		-8.119402		1% level	0
KUT	2		-7.714252		1% level	0
MEN	1		-3.740826		1% level	0
MFG	1		-4.227383		1% level	0
MGR	1		-4.990738		1% level	0
MIG	1		-5.302613		1% level	0
MSR	0			-4.317057	1% level	0
NFDI	1		-12.24513		1% level	0
NPC	1			-4.161408	5% level	7
NTC	1		-2.697467		10% level	0
ODTAX	1		-5.248376		1% level	0
OIDTAX	1		-7.421191		1% level	0
OREV	0		-5.96964		1% level	0
PDH	1		-5.679505		1% level	0
PGDPAG	1		-6.348941		1% level	0
PGDPAVE	1		-4.324661		1% level	0
PGDPCO	1		-6.572787		1% level	0
PGDPMA	1		-4.203559		1% level	0
PGDPSE	1		-3.408037		5% level	2
PGDPTR	1		-6.632571		1% level	1
PGDPUT	0			-3.214596	10% level	0
PGP	1		-7.0004		1% level	0
PICTAX	1		-4.786838		1% level	0
POP	1		-4.858226		1% level	0
POVL	2		-8.264046		1% level	0
POVS	1	-2.408396			5% level	0
PTAX	1		-13.10594		1% level	0
PWCO	1		-5.672488		1% level	0
RD3M	1		-4.324299		1% level	0
RER	1		-5.261201		1% level	0
SACC	1		-2.712433		10% level	0
SACP	1		-3.103917		5% level	0
TOAG	0			-3.911729	5% level	0
TOCO	1		-7.64069		1% level	0
TOMA	1		-3.511466		5% level	0
TOSE	1		-3.903236		1% level	1
TOTR	1		-5.553302		1% level	1
TOUR	2		-7.893498		1% level	4
TOUT	1		-8.017351		1% level	0
WEALTH	1		-6.233022		1% level	0
XGR	1		-6.037858		1% level	0
XSR	0			-4.607104	1% level	0

APPENDIX C

EX-POST SIMULATION

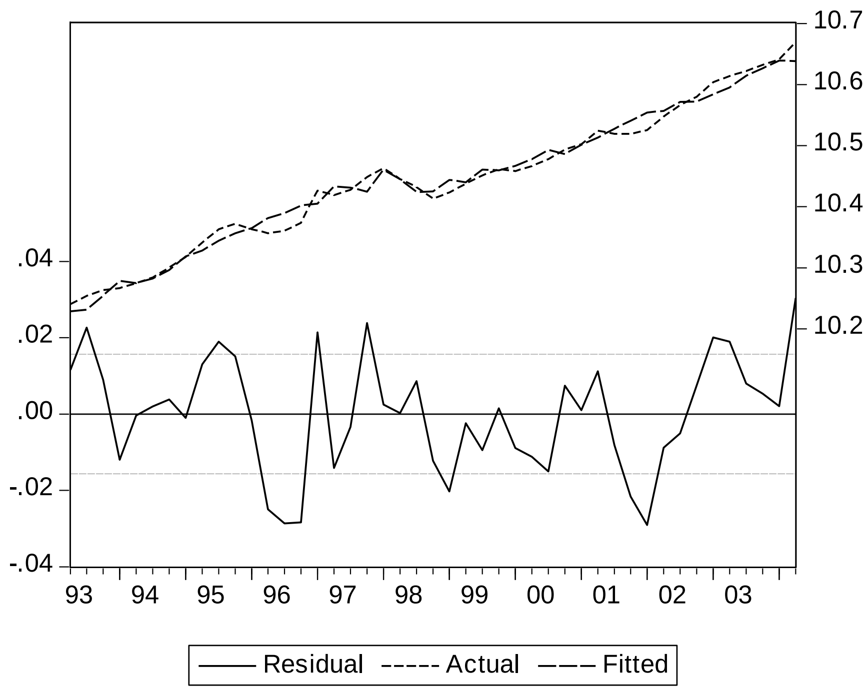
C.1. List of Equations

EQ. E1. Private Consumption, Agriculture

$$Log(CAG) = \underset{(15.4183)}{7.1310} + \underset{(6.8353)}{0.2402}\ Log(GDPD(\text{-}1)*(1\text{-}RH)) - \underset{(-1.4088)}{0.0426}\ Log(PDH)$$

$$+\underset{(14.8735)}{0.0078}\ T + \underset{(2.7344)}{0.0370}\ D98Q1{+}D98Q2$$

$R^2 = 0.9828$ SER = 0.0157 DW = 1.1412



Root Mean Squared Error	575.3041
Mean Absolute Error	444.5222
Mean Abs. Percent Error	1.233219
Theil Inequality Coefficient	0.008088
Bias Proportion	0.002404
Variance Proportion	0.141139
Covariance Proportion	0.856457

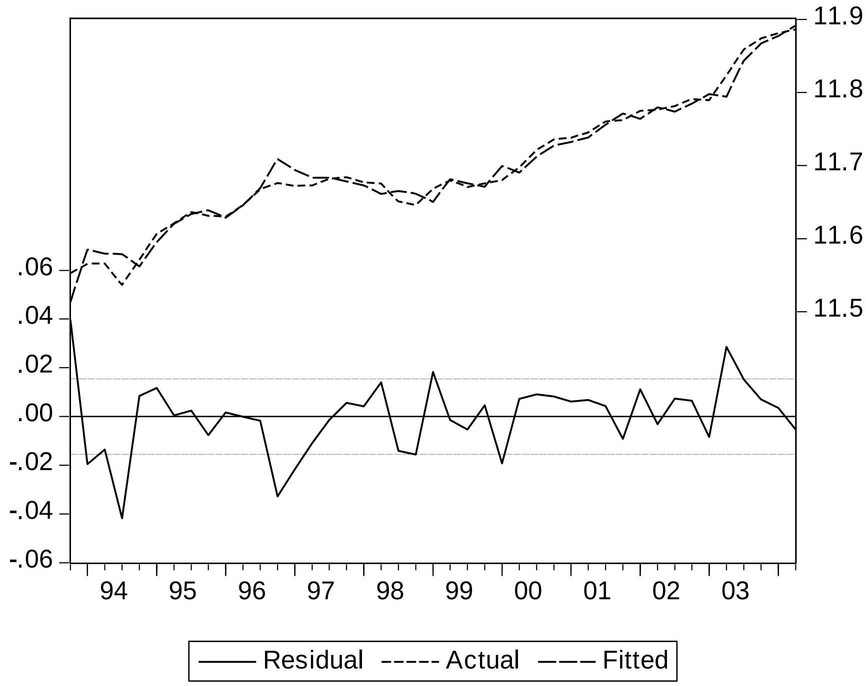
EQ. E2. Total Output, Agriculture

$$Log(TOAG) = \underset{(5.5700)}{5.0418} + \underset{(4.0047)}{0.2403\, Log(KAG(-1)/EMP\_AG(-1))}$$

$$+ \underset{(5.1054)}{0.4621\, Log(INAG(-2))} + \underset{(1.4246)}{0.0988\, Log(DTDI)}$$

AR(1) 0.7851 (t=10.6862)

$R^2 = 0.9725$ SER = 0.0155 DW = 1.6700



Root Mean Squared Error	1832.345
Mean Absolute Error	1343.197
Mean Abs. Percent Error	1.101047
Theil Inequality Coefficient	0.007461
Bias Proportion	0.007969
Variance Proportion	0.029514
Covariance Proportion	0.962517

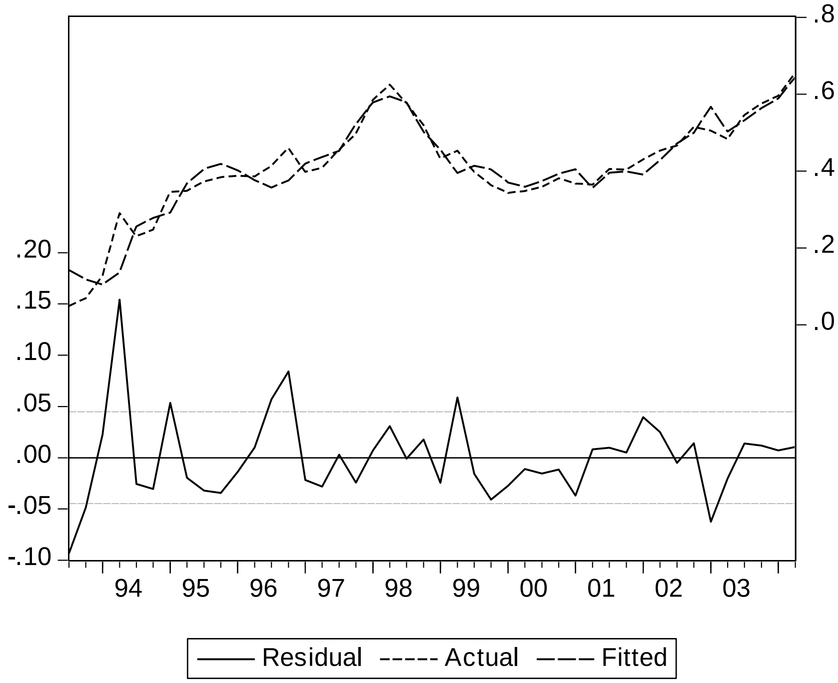
EQ. E3. GDP Deflator, Agriculture

$$\text{Log}\,(PGDPAG) = \underset{(-3.3811)}{-12.3039} \underset{(2.7732)}{+1.9681}\, Log(CAG) \underset{(-1.2870)}{-0.6979}\, Log(TOAG(\text{-}1))$$

$$\underset{(1.4010)}{+0.1294}\, Log(PDH) \underset{(8.6775)}{+0.8073}\, Log(PGDPAG(\text{-}1)) \underset{(-3.9386)}{-0.0127}\ \text{T}$$

$$\underset{(-1.7135)}{-0.0757}\, D97Q1 + D01Q2 + D03Q2$$

$R^2 = 0.9013$ SER = 0.0448 DW = 1.6439



Root Mean Squared Error	0.059431
Mean Absolute Error	0.044366
Mean Abs. Percent Error	2.871651
Theil Inequality Coefficient	0.018932
Bias Proportion	0.000648
Variance Proportion	0.082119
Covariance Proportion	0.917234

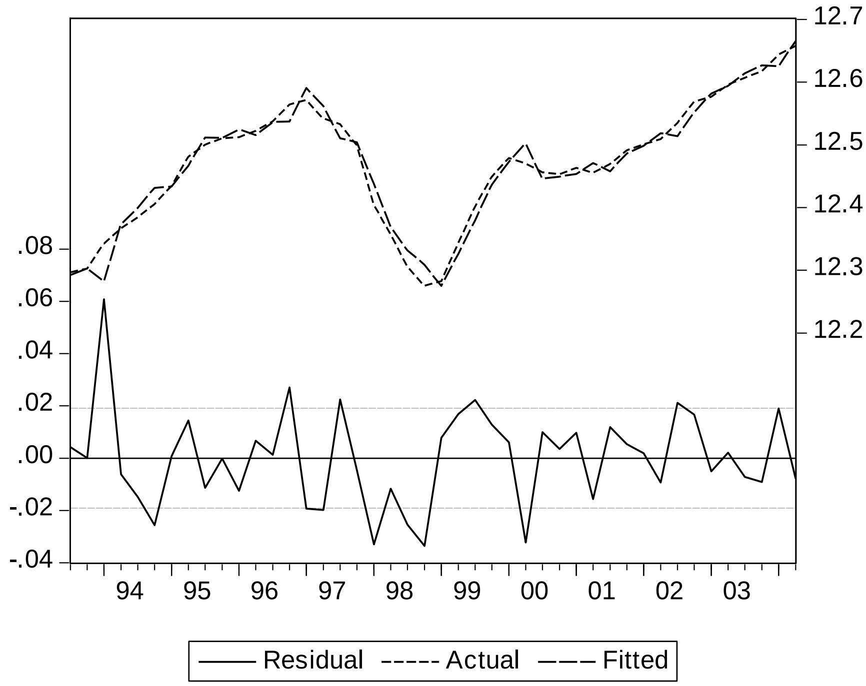
EQ. E4. Private Consumption, Manufacturing

$$Log(CMA) = 0.6147\ Log(CMA(-1)) + 0.3140\ Log(GDPD * (1 - RH))$$
$$\qquad\qquad (5.6064) \qquad\qquad\qquad (3.1934)$$

$$+0.0804\ Log(WEALTH) - 0.0549\ Log(PDH)$$
$$(2.5521) \qquad\qquad (-1.4522)$$

AR(1) 0.6091 (t=5.2353)

$R^2 = 0.9665$ SER = 0.0191 DW = 1.9776



Root Mean Squared Error	4531.002
Mean Absolute Error	3650.040
Mean Abs. Percent Error	1.411050
Theil Inequality Coefficient	0.008469
Bias Proportion	0.001009
Variance Proportion	0.003066
Covariance Proportion	0.995925

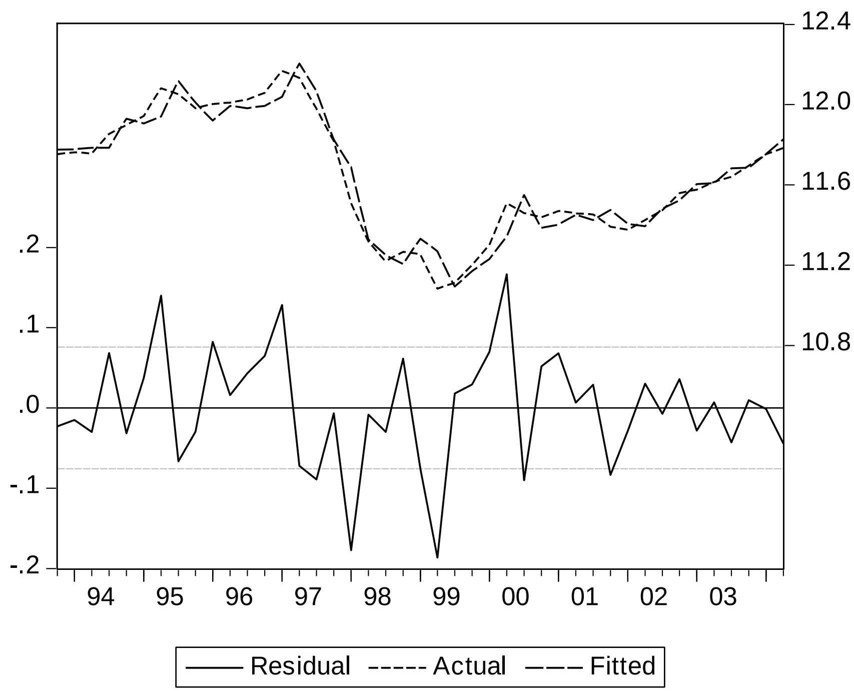
EQ. E5. Private Investment, Manufacturing

$$Log(IMA) = 0.2421\ Log(GDPD(-1)) + 08557\ Log(IMA(-1))$$
$$(2.0164) \qquad (7.8762)$$

$$-0.1511\ Log(RD3M(-2)) - 0.5756\ Log(PDH)$$
$$(-2.5165) \qquad (-2.3935)$$

AR(1) 0.4770 (t=2.4952)

R^2 = 0.9442 SER = 0.0758 DW = 1.9487



Root Mean Squared Error	8771.492
Mean Absolute Error	6515.824
Mean Abs. Percent Error	5.407027
Theil Inequality Coefficient	0.035171
Bias Proportion	0.000221
Variance Proportion	0.009686
Covariance Proportion	0.990093

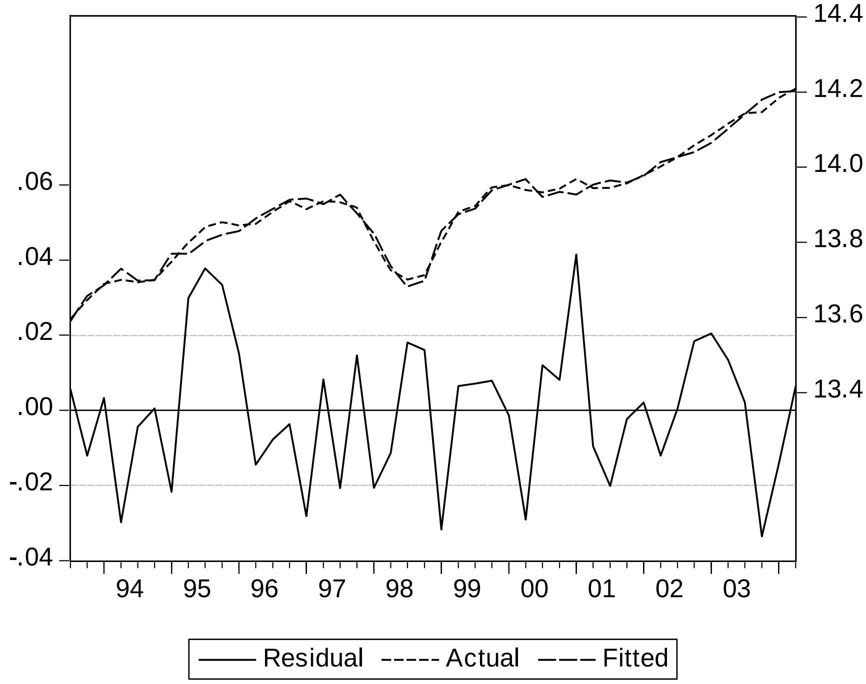
EQ. E6. Total Output, Manufacturing

$$Log(TOMA) = 0.5970\ Log(KMA(-1)/EMP\_MA(-1)) + 0.2023\ Log(DTDI)$$
$$\qquad (3.0987) \qquad\qquad (2.0651)$$

$$+0.7182\ Log(INMA(-1)) - 0.1687\ Log(RD3M) - 0.0090\ T$$
$$(6.4636) \qquad (-4.4836) \qquad (-3.5664)$$

AR(1) 0.5363 (t=3.8468)

$R^2 = 0.9841$ SER = 0.0199 DW = 1.7542



Root Mean Squared Error	20672.43
Mean Absolute Error	16675.16
Mean Abs. Percent Error	1.503301
Theil Inequality Coefficient	0.009093
Bias Proportion	0.001357
Variance Proportion	0.000532
Covariance Proportion	0.998111

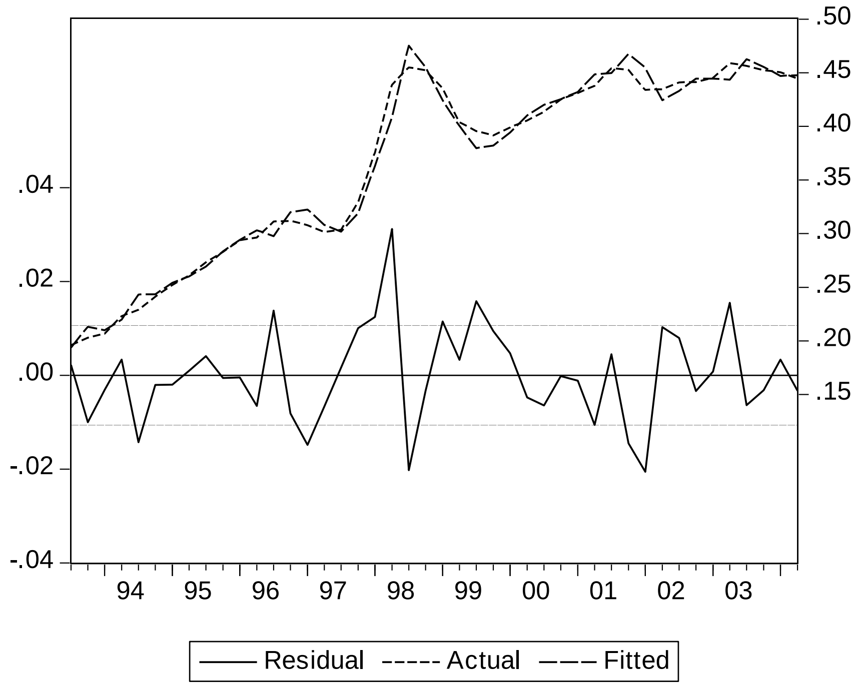
EQ. E7. GDP Deflator, Manufacturing

$$Log(PGDPMA) = 0.6642\ Log(PGDPMA(-1)) + 0.1586\ Log(CMA(-1))$$
$$\qquad\qquad (11.7823) \qquad\qquad\qquad (2.8131)$$

$$-0.1985\ Log(TOMA) + 0.0824\ Log(PDH)$$
$$(-3.6637) \qquad\qquad (3.7674)$$

AR(1) 0.5118 (t=3.1754)

$R^2 = 0.9867$ SER = 0.0106 DW = 1.9211



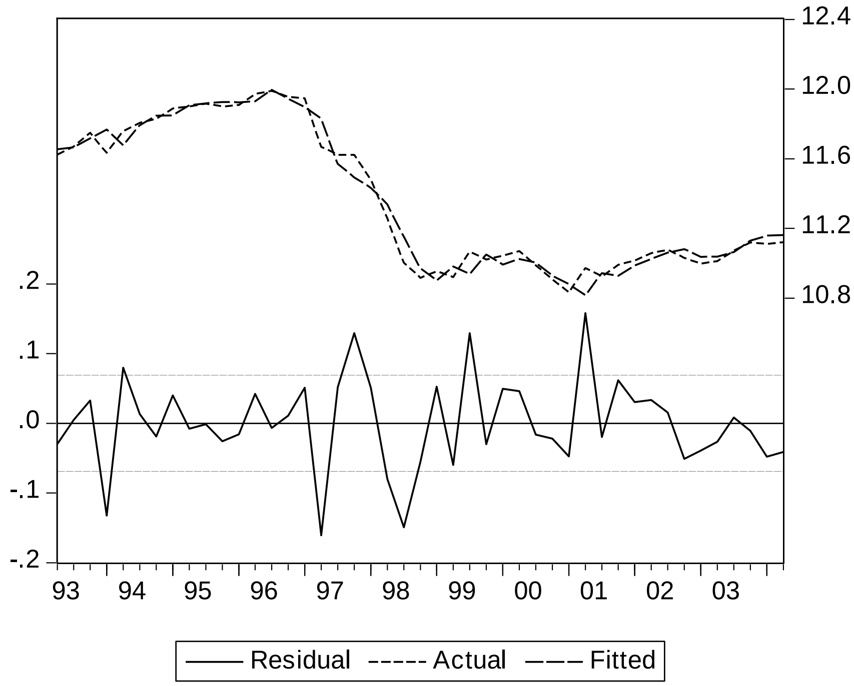
Root Mean Squared Error	0.015618
Mean Absolute Error	0.011758
Mean Abs. Percent Error	0.789572
Theil Inequality Coefficient	0.005327
Bias Proportion	0.006436
Variance Proportion	0.004545
Covariance Proportion	0.989019

EQ. E8. Private Investment, Construction

$$Log(ICO) = \underset{(-0.9607)}{-2.3772} \; \underset{(10.4848)}{+0.8388\, Log(ICO(-1))} \; \underset{(1.5677)}{+0.3747\, Log(GDPD)}$$

$$\underset{(-1.4882)}{-0.0613\, Log(RD3M(-1))} \; \underset{(-1.714)}{-0.2866\, Log(PDH)} \; \underset{(-2.7541)}{-0.0515\, D964 + D971 + D972}$$

R^2 = 0.9744   SER = 0.0689   DW = 2.2290



Root Mean Squared Error	5969.159
Mean Absolute Error	4214.887
Mean Abs. Percent Error	4.895954
Theil Inequality Coefficient	0.030297
Bias Proportion	0.000001
Variance Proportion	0.000317
Covariance Proportion	0.999682

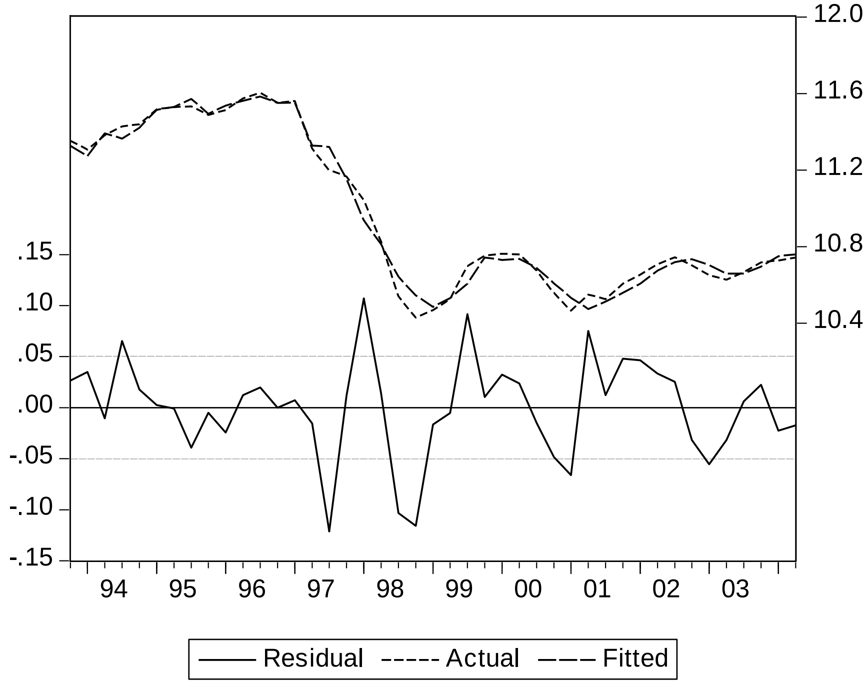
EQ. E9. Total Output, Construction

$$Log(TOCO) = -13.7584 \; +0.2143\, Log(KCO(-2)/EMP\_CON(-2))$$
$$(-4.0095) \qquad\qquad (1.5726)$$

$$+1.6857\, Log(INCO(-1)) +0.4008\, Log(DTDI)$$
$$(6.2914) \qquad\qquad (1.4961)$$

AR(1) 0.9827 (t= 45.9975)

R^2 = 0.9862 SER = 0.0503 DW = 1.4517



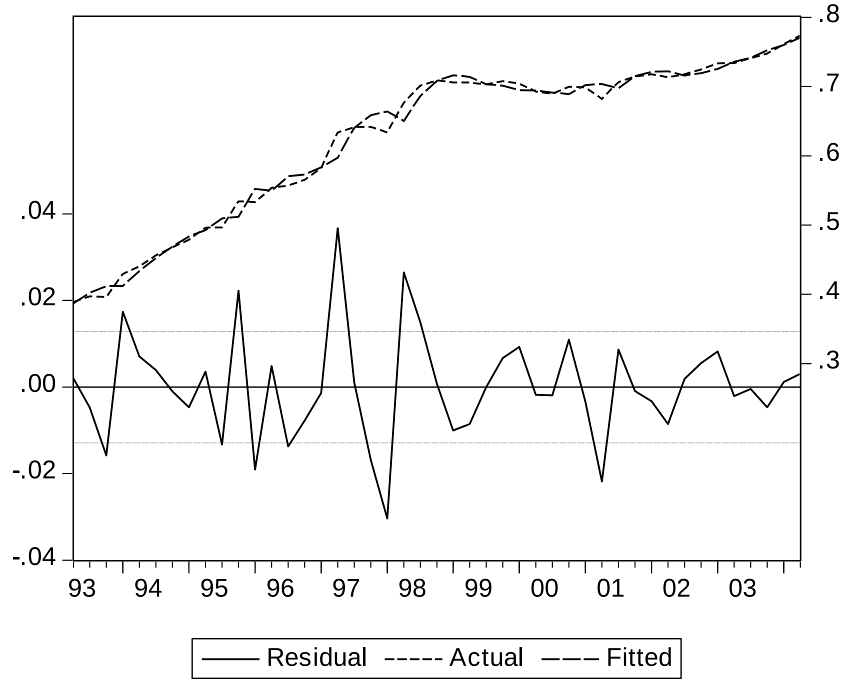
Root Mean Squared Error	2628.122
Mean Absolute Error	1875.981
Mean Abs. Percent Error	3.457706
Theil Inequality Coefficient	0.019627
Bias Proportion	0.000656
Variance Proportion	0.000061
Covariance Proportion	0.999283

EQ. E10. GDP Deflator, Construction

$$Log(PGDPCO) = -0.2595 \underset{(-2.0015)}{} +0.9694 \, Log(PGDPCO(-1)) \underset{(25.4765)}{}$$

$$+0.1488 \, Log(ICO(-1)) \underset{(2.2390)}{} -0.1338 \, Log(TOCO(-1)) \underset{(-2.0971)}{} +0.0278 \, Log(PDH) \underset{(1.4008)}{}$$

$R^2 = 0.9886$ SER = 0.0129 DW = 2.2365



Root Mean Squared Error	0.022619
Mean Absolute Error	0.016167
Mean Abs. Percent Error	0.859113
Theil Inequality Coefficient	0.005851
Bias Proportion	0.000097
Variance Proportion	0.006247
Covariance Proportion	0.993656

EQ. E11. Private Consumption, Utilities

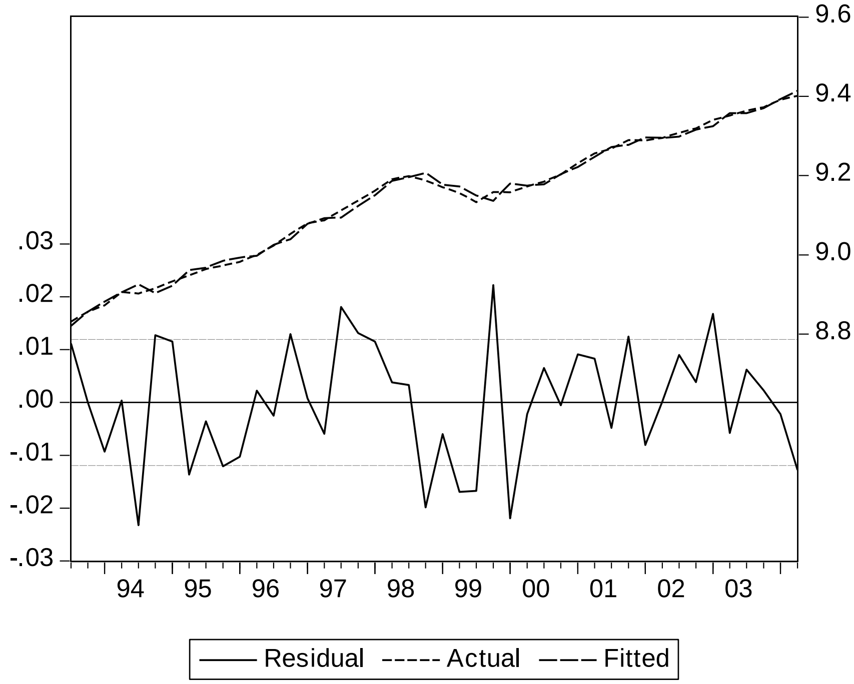
$$Log(CUT) = -35.6689 + 0.0877\, Log(GDPD * (1 - RH))$$
$$(-8.6249) \qquad (1.9769)$$

$$-0.0395\, Log(PDH)/Log(PGDPAVE) + 3.9756\, Log(POP)$$
$$(-3.3481) \qquad (10.4041)$$

AR(1) 1.2574 (t=8.3788)

AR(2) -0.4426 (t=-3.1797)

R^2 = 0.9952 SER = 0.0119 DW = 2.0710



Root Mean Squared Error	110.3680
Mean Absolute Error	88.46553
Mean Abs. Percent Error	0.927576
Theil Inequality Coefficient	0.005636
Bias Proportion	0.002640
Variance Proportion	0.034574
Covariance Proportion	0.962786

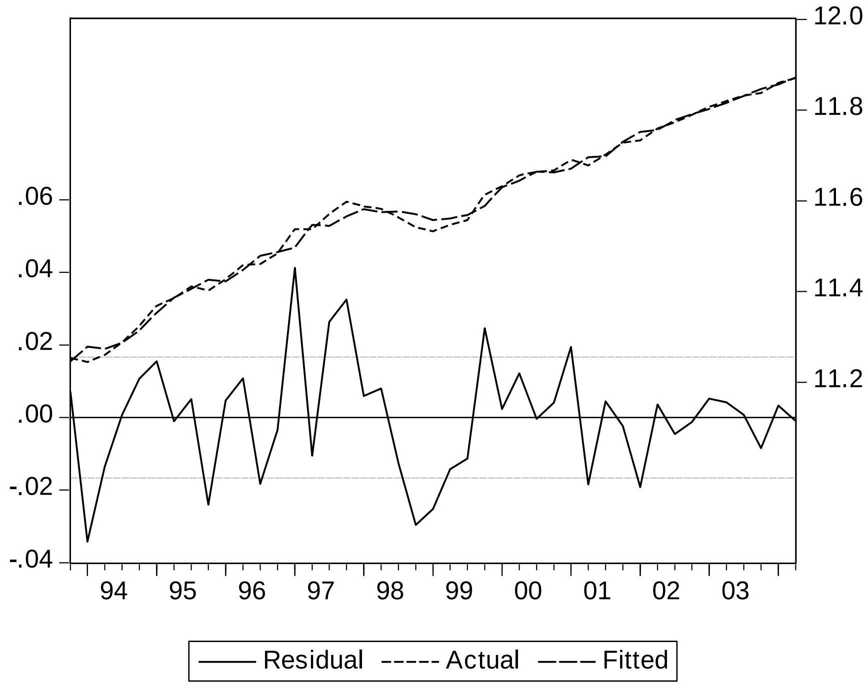
EQ. E12. Total Output, Utilities

$$Log(TOUT) = \underset{(10.4842)}{9.4760} \;\; + \underset{(1.2965)}{0.0397}\, Log(KUT(-2)/EMP\_UTI(-2))$$

$$+ \underset{(1.7064)}{0.1237}\, Log(DTDI) + \underset{(6.7638)}{0.0112}\, T$$

AR(1) 0.7909 (t=7.7007)

R^2 = 0.9919 SER = 0.0167 DW = 1.7674



Root Mean Squared Error	1593.363
Mean Absolute Error	1217.271
Mean Abs. Percent Error	1.160699
Theil Inequality Coefficient	0.007054
Bias Proportion	0.000275
Variance Proportion	0.005292
Covariance Proportion	0.994433

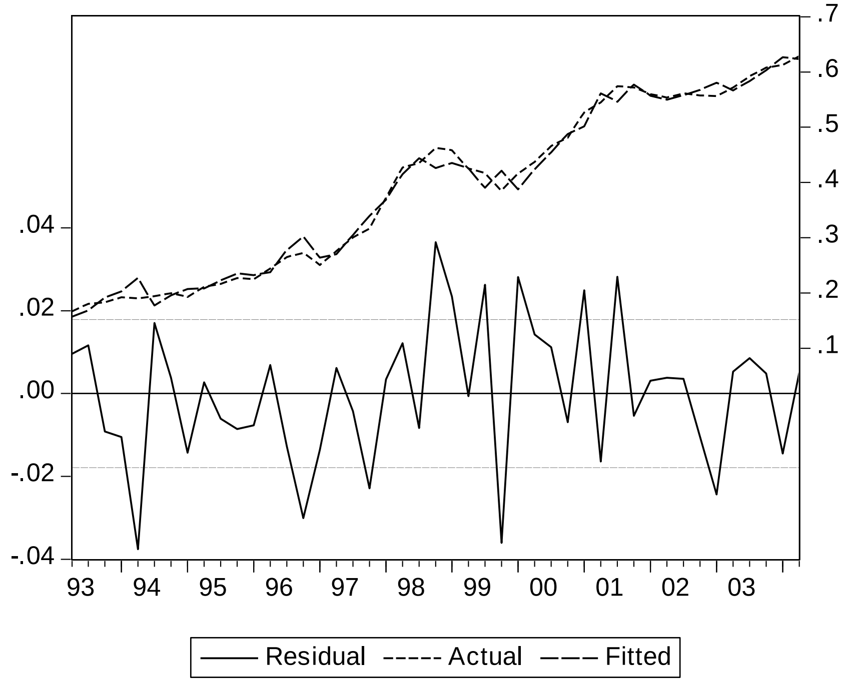
EQ. E13. GDP Deflator, Utilities

$$Log(PGDPUT) = -6.7778 \; +1.3570\, Log(CUT) - 0.4720\, Log(TOUT)$$
$$(-4.0685) \qquad (6.7672) \qquad (-2.2875)$$

$$+0.1068\, Log(PDH) - 0.0300\, D971$$
$$(1.3250) \qquad (-1.2158)$$

AR(1) 0.7992 (t= 8.1975)

R^2 = 0.9882 SER = 0.0179 DW = 2.2595



Root Mean Squared Error	0.025316
Mean Absolute Error	0.020221
Mean Abs. Percent Error	1.334752
Theil Inequality Coefficient	0.008170
Bias Proportion	0.000717
Variance Proportion	0.036140
Covariance Proportion	0.963143

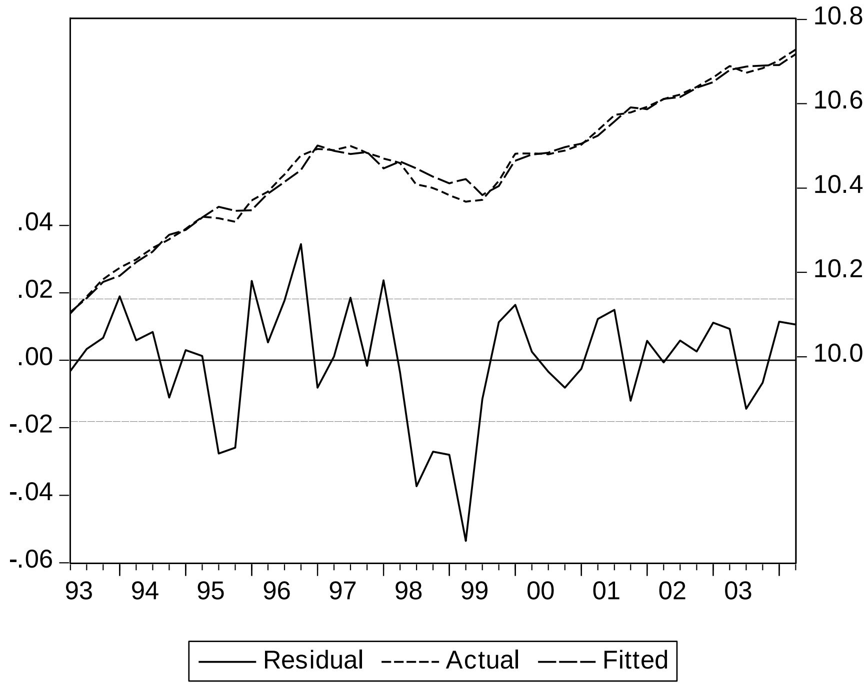
EQ. E14. Private Consumption, Transportation

$$Log(CTR) = \underset{(0.9285)}{1.2025} + \underset{(2.6079)}{0.2307}\, Log(GDPD * (1 - RH)) + \underset{(1.6481)}{0.1292}\, Log(DTDI)$$

$$\underset{(5.5569)}{0.5968}\, Log(TOUR) + \underset{(1.7548)}{0.0277}\ D00Q1$$

AR(1) 0.8559 (t=10.5951)

$R^2 = 0.9880$ SER = 0.0182 DW = 1.2338



Root Mean Squared Error	724.9858
Mean Absolute Error	512.9722
Mean Abs. Percent Error	1.431910
Theil Inequality Coefficient	0.009908
Bias Proportion	0.005438
Variance Proportion	0.003481
Covariance Proportion	0.991081

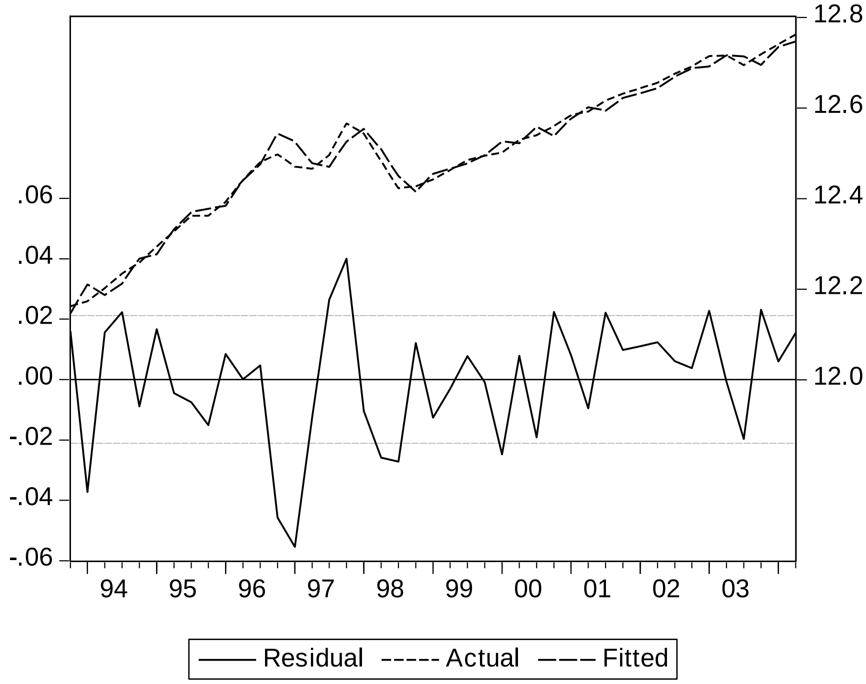
EQ. E15. Total Output, Transportation

$$Log(TOTR) = \underset{(-2.2378)}{-3.7379} \; \underset{(4.4983)}{+0.7022}\, Log(KTR/EMP\_TRA) \underset{(4.8184)}{+0.7595}\, Log(INTR(-2))$$

$$\underset{(2.0270)}{+0.1968}\, Log(DTDI)$$

AR(1) 0.7780 (t=7.6814)

R^2 = 0.9840 SER = 0.0211 DW = 1.7172



Root Mean Squared Error	5638.573
Mean Absolute Error	4518.488
Mean Abs. Percent Error	1.637056
Theil Inequality Coefficient	0.010043
Bias Proportion	0.000026
Variance Proportion	0.030397
Covariance Proportion	0.969577

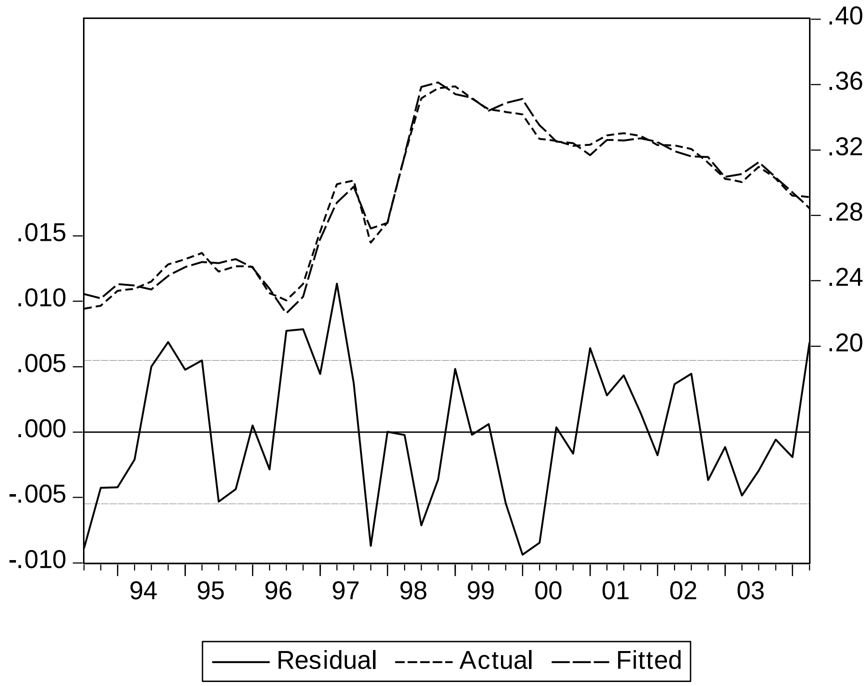
EQ. E16. GDP Deflator, Transportation

$$Log(PGDPTR) = \underset{(9.2721)}{6.1677} + \underset{(2.9887)}{0.2343}\, Log(PGDPTR(-1)) + \underset{(1.2489)}{0.0670}\, Log(CTR)$$

$$\underset{(-11.8312)}{-0.5236}\, Log(TOTR) + \underset{(1.1585)}{0.0305}\, Log(PDH(-1))$$

AR(1) 0.9587 (t=107.2617)

$R^2 = 0.9853$ SER = 0.0055 DW = 1.1302



Root Mean Squared Error	0.007499
Mean Absolute Error	0.006018
Mean Abs. Percent Error	0.448546
Theil Inequality Coefficient	0.002785
Bias Proportion	0.019705
Variance Proportion	0.050931
Covariance Proportion	0.929364

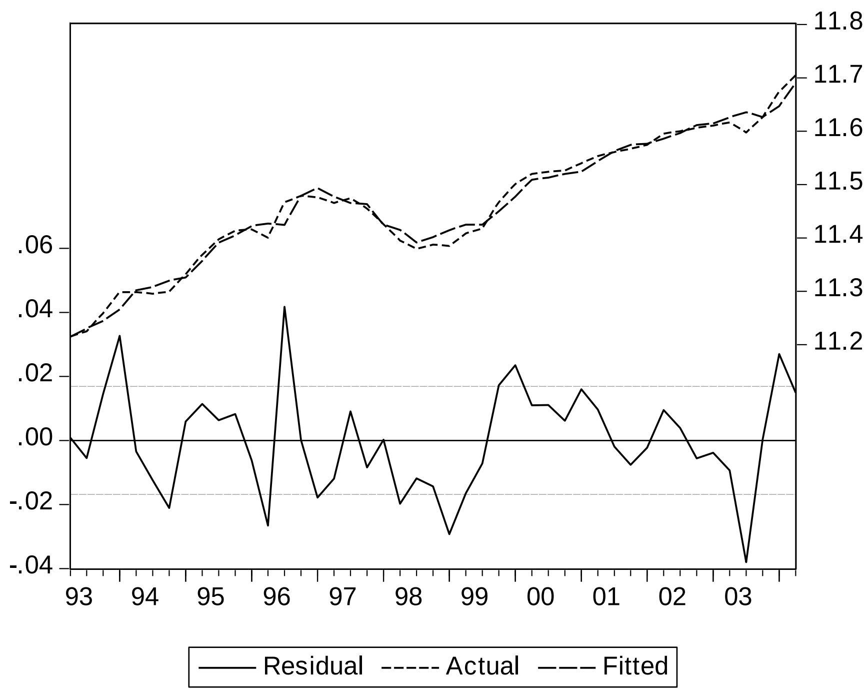
EQ. E17. Private Consumption, Services

$$Log(CSE) = \underset{(6.0039)}{6.7109} + \underset{(1.3856)}{0.1240}\, Log(GDPD * (1 - RH)) + \underset{(3.2536)}{0.2337}\, Log(DTDI)$$

$$+ \underset{(7.2216)}{0.0070}\, Log(T)$$

AR(1) 0.7701 (t=7.2216)

R^2 = 0.9824 SER = 0.0169 DW = 1.4705



Root Mean Squared Error	1580.371
Mean Absolute Error	1257.961
Mean Abs. Percent Error	1.290865
Theil Inequality Coefficient	0.007975
Bias Proportion	0.000174
Variance Proportion	0.006312
Covariance Proportion	0.993513

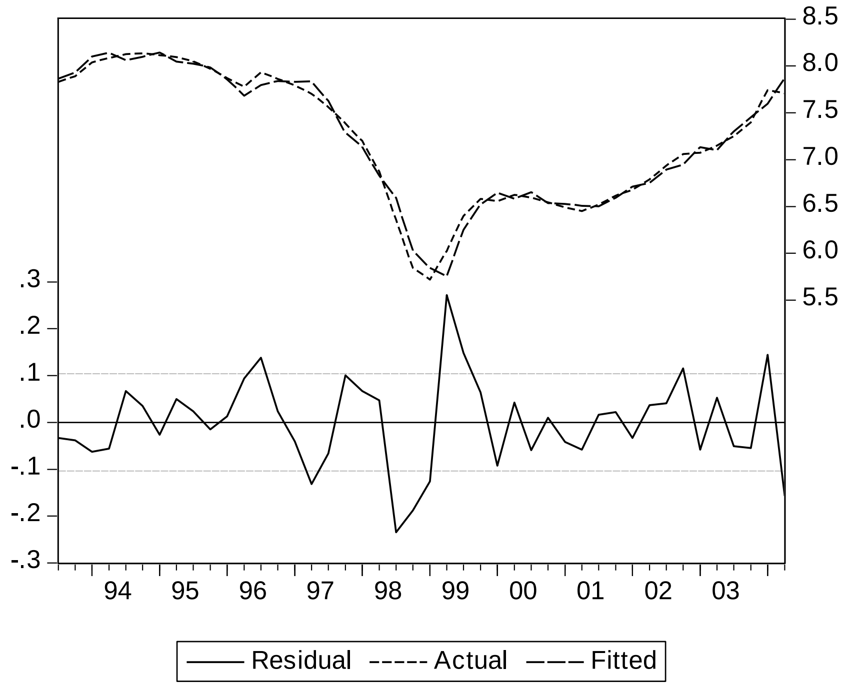
EQ. E18. Private Investment, Services

$$Log(ISE) = -16.2638 \; +0.7885\, Log(ISE(-1)) + 1.5003\, Log(GDPD(-1))$$
$$(-2.6878) \qquad (10.6762) \qquad (3.1145)$$

$$-0.4641\, Log(RD3M) - 0.4252\, Log(PDH) - 0.0317\, T - 0.1461\, D96Q1 - D96Q4$$
$$(-4.8764) \qquad (-1.2851) \qquad (-3.1295) \qquad (-1.7710)$$

AR(1) 0.4581 (t=2.5383)

$R^2 = 0.9818$ SER = 0.1040 DW = 1.6101



Root Mean Squared Error	144.7945
Mean Absolute Error	111.1832
Mean Abs. Percent Error	7.556632
Theil Inequality Coefficient	0.037013
Bias Proportion	0.008754
Variance Proportion	0.003923
Covariance Proportion	0.987323

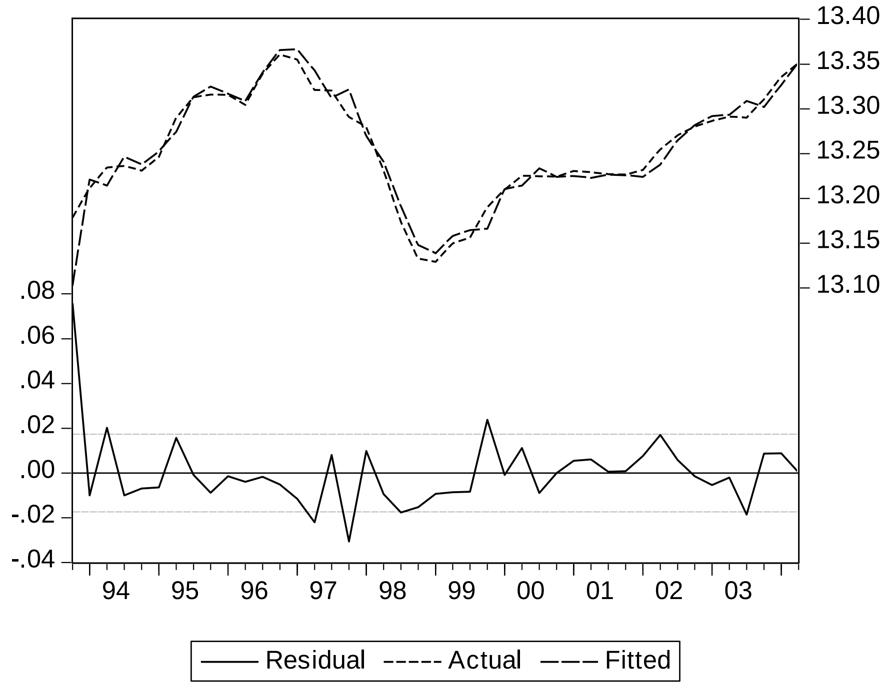
EQ. E19. Total Output, Services

$$Log(TOSE) = \underset{(1.6311)}{3.2098} + \underset{(1.5866)}{0.2203}\, Log(KSE/EMP\_SER(-1))$$

$$+\underset{(4.0607)}{0.6364}\, Log(INSE(-2)) + \underset{(1.3994)}{0.1187}\, Log(DTDI) \underset{(-1.8286)}{-0.0190}\, D96Q2 + D01Q2$$

AR(1) 0.9306 (t=12.8937)

R^2 = 0.929 SER = 0.0174 DW = 1.6603



Root Mean Squared Error	6435.959
Mean Absolute Error	5079.813
Mean Abs. Percent Error	0.887320
Theil Inequality Coefficient	0.005564
Bias Proportion	0.015041
Variance Proportion	0.000000
Covariance Proportion	0.984958

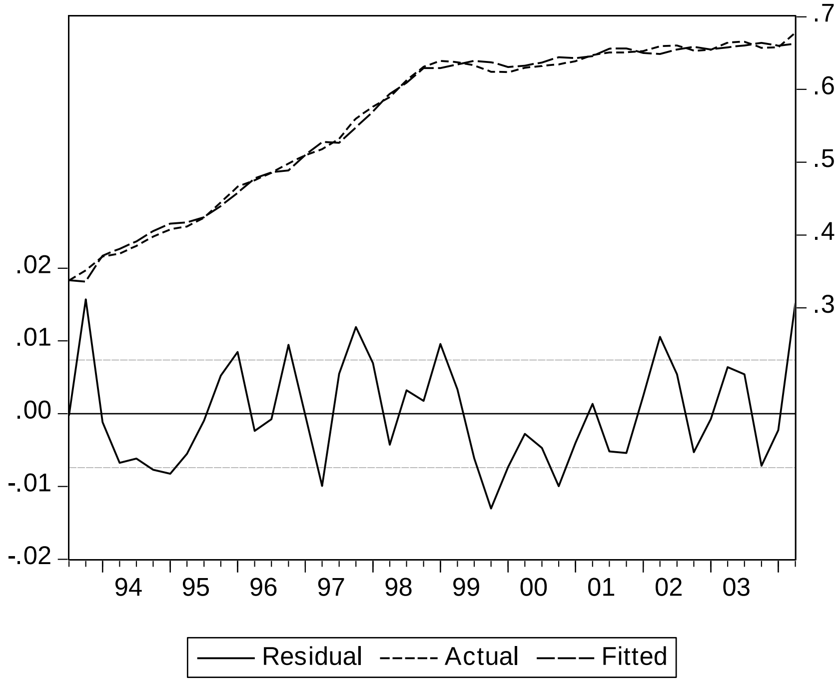
EQ. E20. GDP Deflator, Services

$$Log(PGDPSE) = \underset{(3.8355)}{3.1729} + \underset{(1.8731)}{0.2284}\,Log(CSE) - \underset{(-3.3388)}{0.4010}Log(TOSE)$$

$$+\underset{(1.7714)}{0.0686}\,Log(PDH(-1))$$

AR(1) 0.9148 (t=35.5822)

$R^2 = 0.9958$ SER = 0.0074 DW = 1.3146



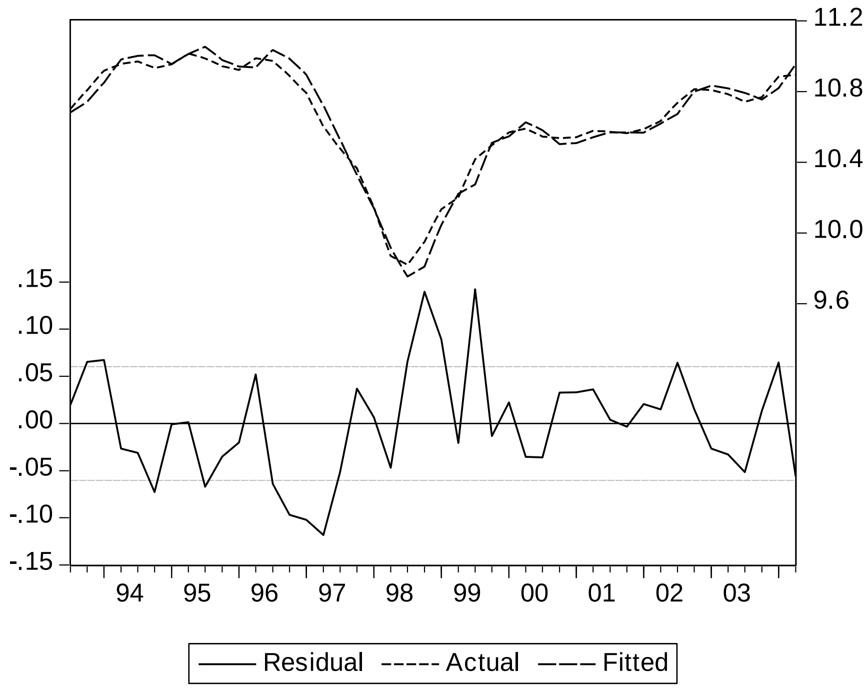
Root Mean Squared Error	0.013739
Mean Absolute Error	0.011048
Mean Abs. Percent Error	0.610865
Theil Inequality Coefficient	0.003828
Bias Proportion	0.003760
Variance Proportion	0.046832
Covariance Proportion	0.949408

EQ. E21. Import of final goods

$$Log(MFG) = 0.3340\ Log(MFG(-1)) + 0.7381\ Log(DD) - 0.7474\ Log(EXR)$$
$$\qquad (2.2717) \qquad\qquad (4.8671) \qquad\qquad (-3.4133)$$

AR(1) 0.9650 (t=17.0322)

$R^2 = 0.9649$ SER = 0.0603 DW = 1.2586



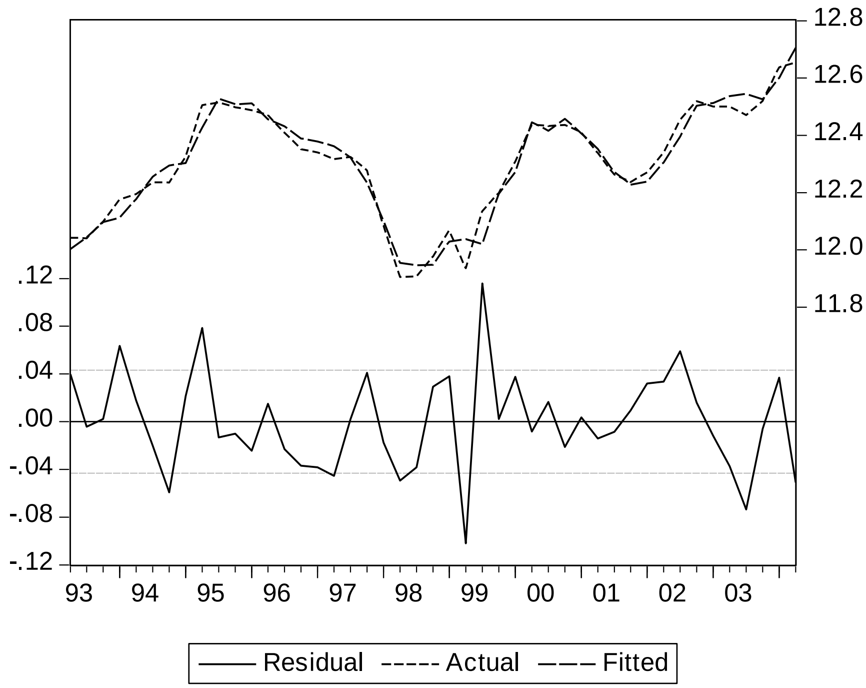
Root Mean Squared Error	2718.194
Mean Absolute Error	2065.280
Mean Abs. Percent Error	4.761591
Theil Inequality Coefficient	0.029641
Bias Proportion	0.005386
Variance Proportion	0.104977
Covariance Proportion	0.889636

EQ. E22. Import of intermediate goods

$$Log(MIG) = -2.9726 \quad +0.2535\, Log(IMA) + 1.2378\, Log(XGR) - 0.9344\, Log(RER)$$
$$(-2.0289) \qquad (2.4649) \qquad (7.6382) \qquad (-3.8144)$$

AR(1) 0.7075 (t=7.0513)

R^2 = 0.9548 SER = 0.0431 DW = 2.0403



Root Mean Squared Error	10191.96
Mean Absolute Error	8008.402
Mean Abs. Percent Error	3.491063
Theil Inequality Coefficient	0.021521
Bias Proportion	0.019135
Variance Proportion	0.087311
Covariance Proportion	0.893554

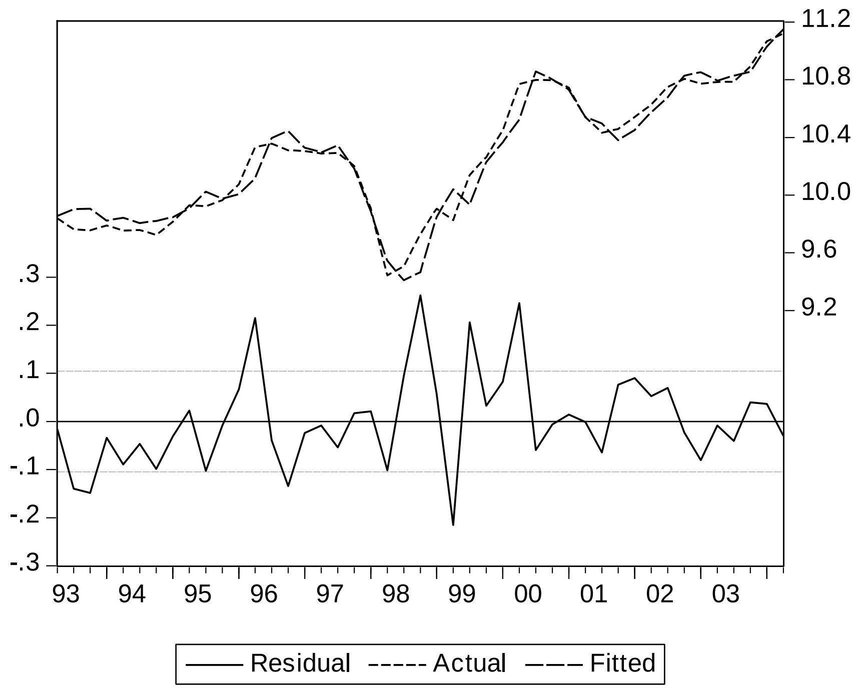
EQ. E23. Import of energy

$$Log(MEN) = 1.1582\ Log(TOALL) + 0.8900\ Log(PDH) - 1.9415\ Log(RER)$$
$$(3.8407) \qquad (2.0282) \qquad (-4.3915)$$

$$-0.1981\ D012$$
$$(-1.4159)$$

AR(1) 0.9886 (t=32.9643)

R^2 = 0.9502 SER = 0.1049 DW = 1.7607



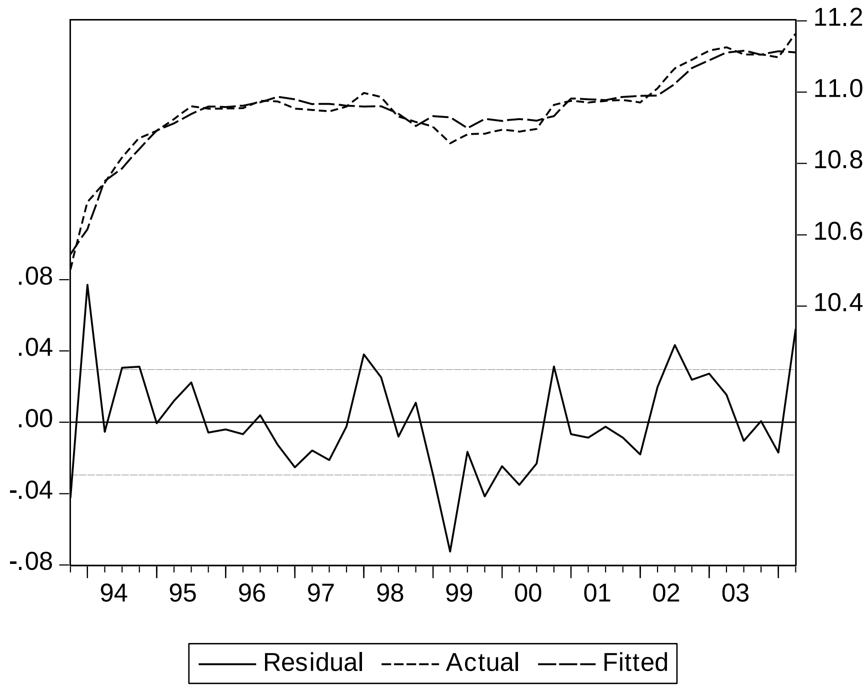
Root Mean Squared Error	2798.450
Mean Absolute Error	2082.540
Mean Abs. Percent Error	6.863804
Theil Inequality Coefficient	0.037253
Bias Proportion	0.004222
Variance Proportion	0.009211
Covariance Proportion	0.986568

EQ. E24. Import of services

$$Log(MSR) = \underset{(1.9392)}{7.0782} + \underset{(1.3098)}{0.3020}\, Log(TOALL) - \underset{(-1.2273)}{0.1792}\, Log(RER(-2)) + \underset{(1.3924)}{0.0051}T$$

AR(1) 0.7082 (t=12.3383)

$R^2 = 0.9435$ SER = 0.0295 DW = 1.4924



Root Mean Squared Error	1826.714
Mean Absolute Error	1354.710
Mean Abs. Percent Error	2.286482
Theil Inequality Coefficient	0.015527
Bias Proportion	0.022463
Variance Proportion	0.139268
Covariance Proportion	0.838270

EQ. E25. Export of goods

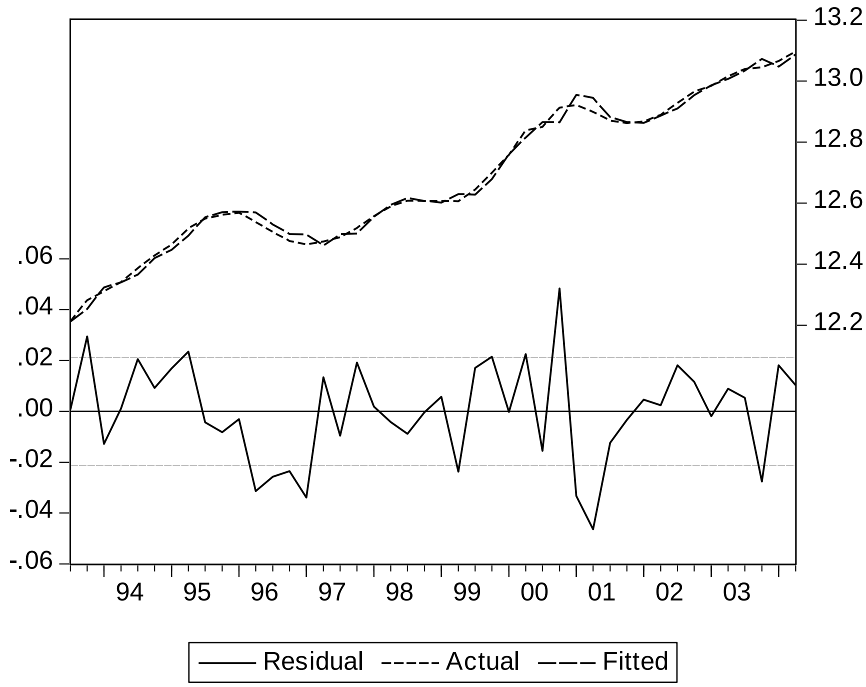
$$Log(XGR) = -7.1564 \underset{(-0.9718)}{} +0.6182\, Log(XGR(-1)) \underset{(1.7554)}{} +1.0230\, Log(GDPW(-1)) \underset{(1.3549)}{}$$

$$+0.1742\, Log(GDPD) \underset{(1.4070)}{} +0.2930\, Log(TOMA(-1)) \underset{(1.472)}{} +0.3477\, Log(RER(-1)) \underset{(1.8891)}{}$$

$$-0.0104\, T \underset{(-0.9562)}{}$$

AR(1) 0.7736 (t=2.3154)

R^2 = 0.9935 SER = 0.0212 DW = 1.8680



Root Mean Squared Error	6701.959
Mean Absolute Error	5004.435
Mean Abs. Percent Error	1.460738
Theil Inequality Coefficient	0.009497
Bias Proportion	0.001292
Variance Proportion	0.000369
Covariance Proportion	0.998339

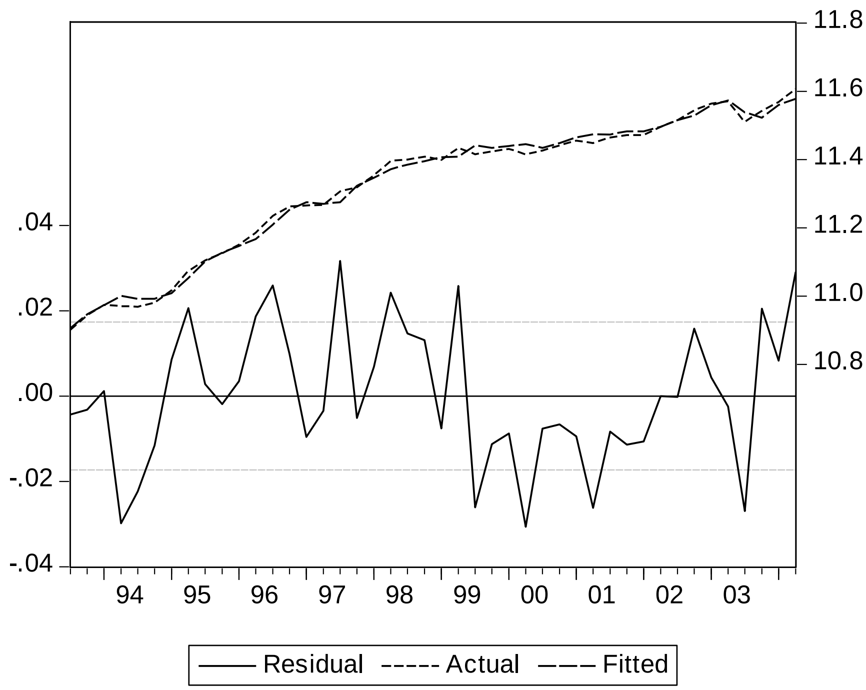
EQ. E26. Export of services

$$Log(XSR) = \; -4.5130 \;\; +0.2216 \, Log(TOSE) + 1.6724 \, Log(TOUR)$$
$$(-0.6559) \qquad (1.4171) \qquad (1.7549)$$

$$+0.1631 \, Log(RER) - 0.0138 \, T$$
$$(2.0458) \qquad (-1.1371)$$

AR(1) 0.9426 (t=15.7337)

R^2 = 0.9936 SER = 0.0173 DW = 1.4202



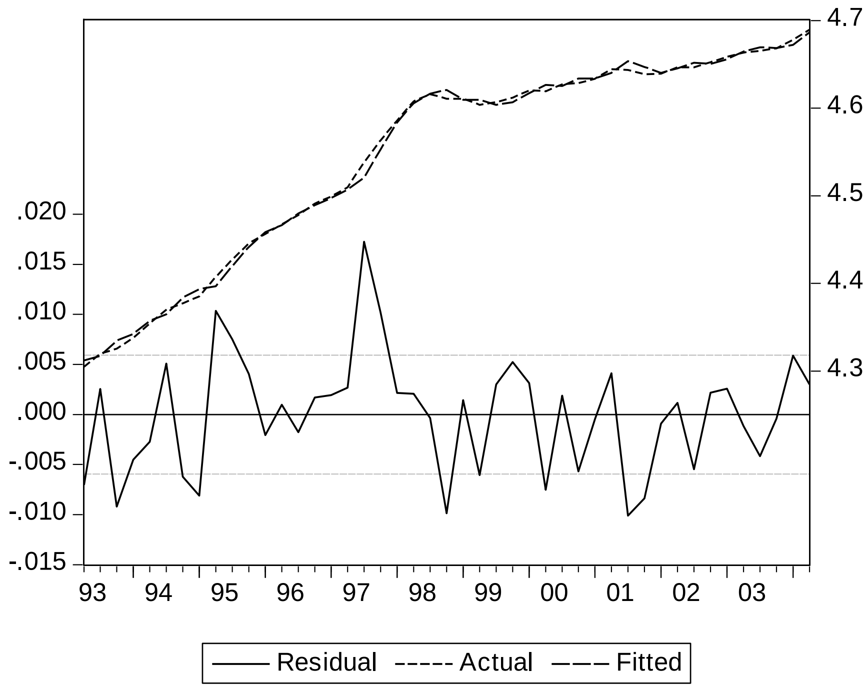
Root Mean Squared Error	2691.914
Mean Absolute Error	1546.859
Mean Abs. Percent Error	1.671881
Theil Inequality Coefficient	0.015199
Bias Proportion	0.004335
Variance Proportion	0.030873
Covariance Proportion	0.964792

EQ. E27. Consumer price index

$$Log(CPI) = \quad 4.5487 \quad +0.4227\, Log(PGDPAVE)$$
$$(43.4176) \qquad\qquad (4.4289)$$

AR(1) 0.9721 (t=86.0193)

R^2 = 0.9976 SER = 0.0059 DW = 1.5760



Root Mean Squared Error	0.547264
Mean Absolute Error	0.434606
Mean Abs. Percent Error	0.452419
Theil Inequality Coefficient	0.002809
Bias Proportion	0.002274
Variance Proportion	0.011631
Covariance Proportion	0.986096

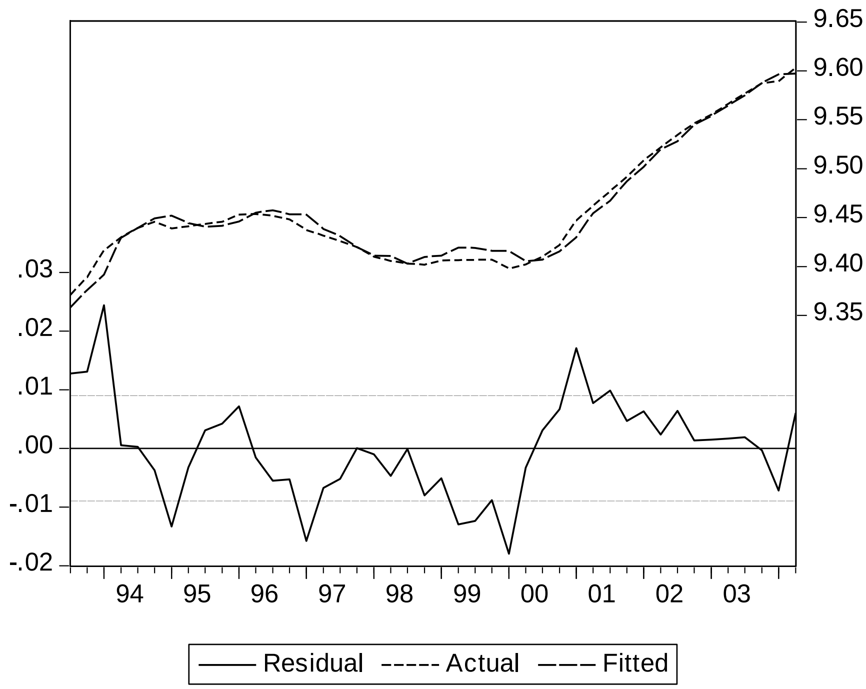
EQ. E28. Household monthly income

$$Log(HHMI) = 0.0490\ Log(GDPD) - 0.3716\ \text{Log}\ (CPI(-1)) + 0.0246\ Log(WEALTH)$$
$$\qquad (1.1978) \qquad\qquad (-1.6898) \qquad\qquad (1.5137)$$

$$+0.0312\ T$$
$$(1.3178)$$

AR(1) 0.9975 (t=340.6739)

$R^2 = 0.9809$ SER = 0.0090 DW = 0.7374



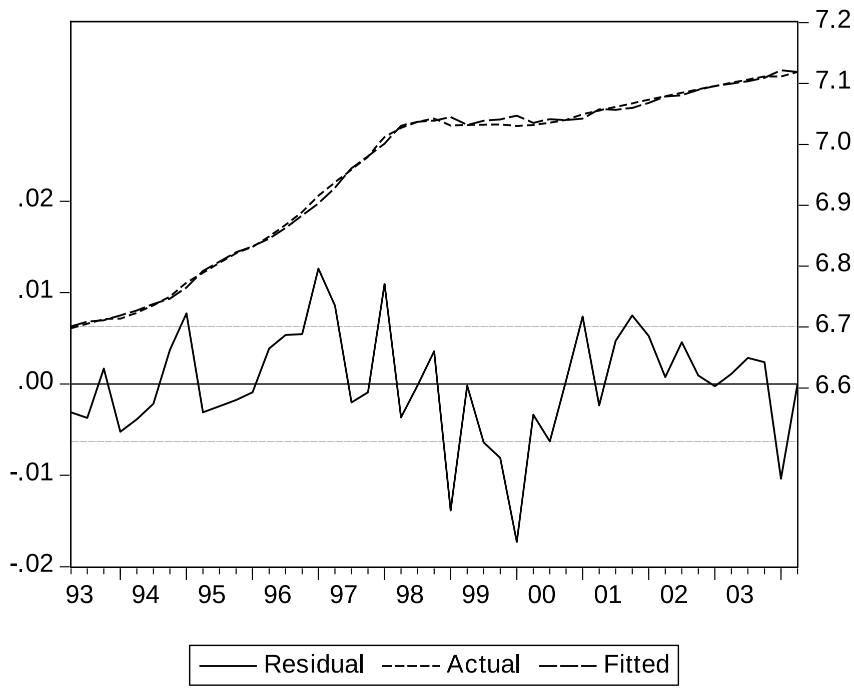
Root Mean Squared Error	107.2475
Mean Absolute Error	82.66974
Mean Abs. Percent Error	0.641328
Theil Inequality Coefficient	0.004122
Bias Proportion	0.000297
Variance Proportion	0.120135
Covariance Proportion	0.879568

EQ. E29. Poverty line

$$Log(POVL) = \underset{(4.2976)}{7.3763} \; \underset{(3.5302)}{+0.5982}\, Log(CPI) \; \underset{(-2.2567)}{-0.3442}\, Log(HHMI) \; \underset{(2.6801)}{+0.0053}\, T$$

AR(1) 0.9286 (t=11.0045)

R^2 = 0.9981 SER = 0.0063 DW = 1.4112



Root Mean Squared Error	7.064279
Mean Absolute Error	5.281076
Mean Abs. Percent Error	0.483517
Theil Inequality Coefficient	0.003233
Bias Proportion	0.007040
Variance Proportion	0.000640
Covariance Proportion	0.992320

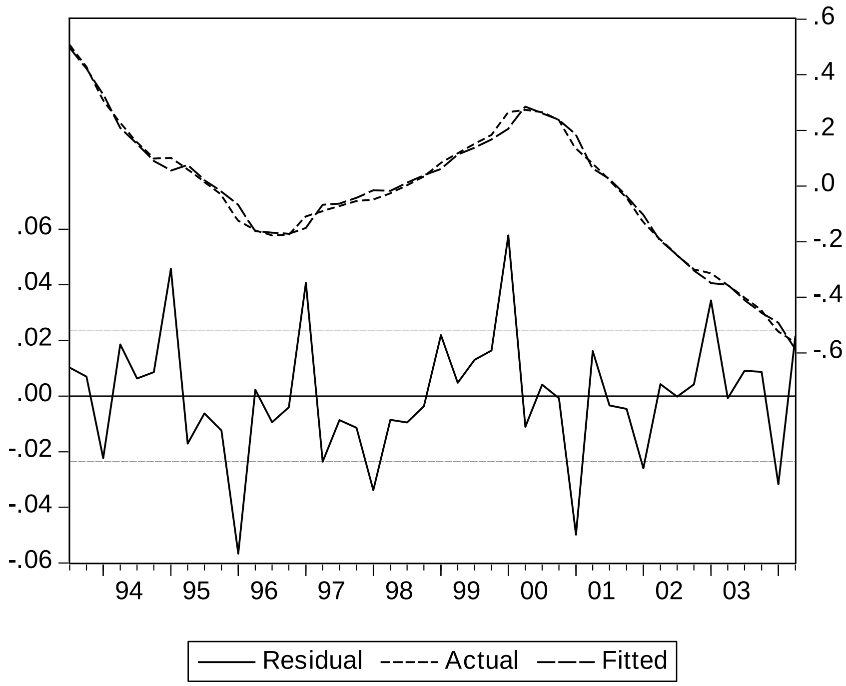
EQ. E30. Poverty severity

$$Log(POVS) = \underset{(3.1484)}{0.2369\ Log(POP)} + \underset{(11.9255)}{0.7519\ Log(POVS(-1))} + \underset{(5.4624)}{0.0003\ POVL - YI}$$

$$\underset{(-2.5051)}{-0.2567\ Log(POVL)}$$

AR(1) 0.5046 (t=3.0426)

R^2 = 0.9915 SER = 0.0235 DW = 2.0654



Root Mean Squared Error	0.023159
Mean Absolute Error	0.016617
Mean Abs. Percent Error	1.742870
Theil Inequality Coefficient	0.011751
Bias Proportion	0.000876
Variance Proportion	0.000324
Covariance Proportion	0.998801

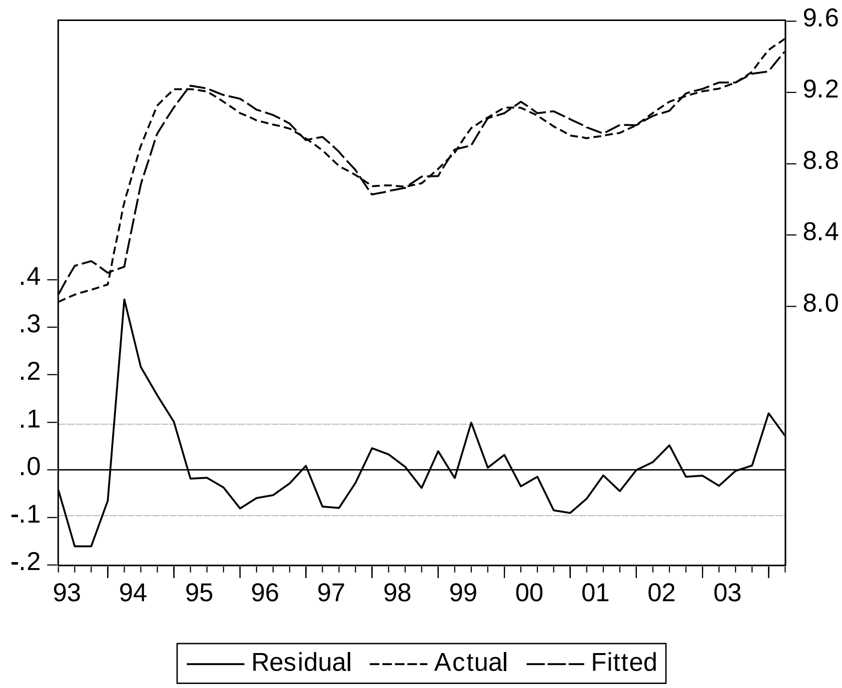
EQ. E31. Wealth

$$Log(WEALTH) = \ 0.4200 \ -2.4464\, Log(PGDPAVE)$$
$$(0.0584) \qquad\qquad (-1.5000)$$

$$+\ 0.7014\, Log(GDPD * (1 - RH)) + 0.0215\, T - 0.1716\, D971$$
$$(1.3573) \qquad\qquad (1.7156) \qquad (-1.5352)$$

AR(1) 0.8625 (t=15.6399)

R^2 = 0.9282 SER = 0.0961 DW = 0.9350



Root Mean Squared Error	613.7815
Mean Absolute Error	450.4801
Mean Abs. Percent Error	5.471573
Theil Inequality Coefficient	0.034985
Bias Proportion	0.002761
Variance Proportion	0.003804
Covariance Proportion	0.993435

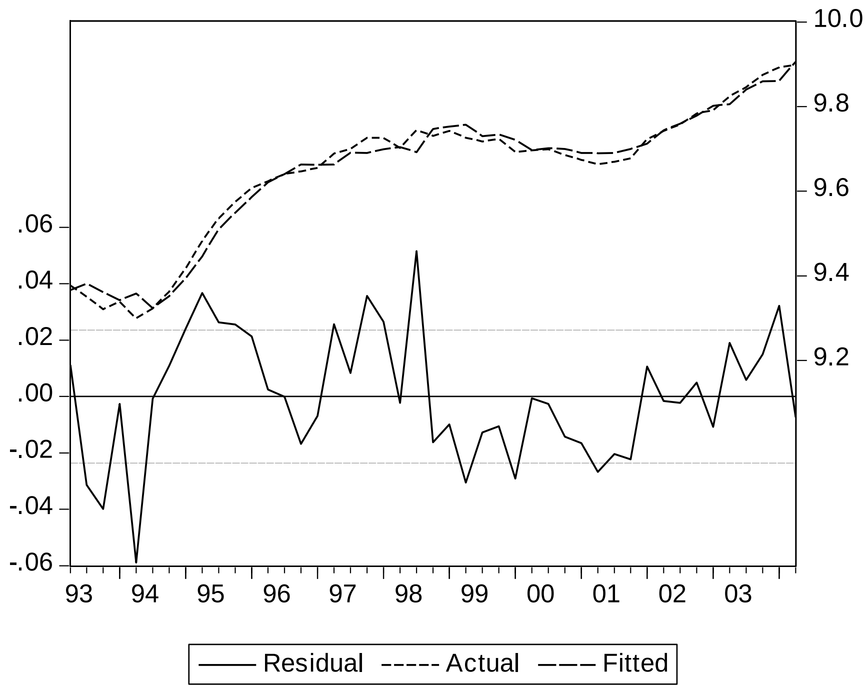
EQ. E32. Petroleum tax revenue

$$Log(PTAX) = \underset{(0.4315)}{1.5590} + \underset{(2.4354)}{0.2474}\, Log(DTDI) + \underset{(1.4373)}{0.3085}\, Log(NTC + NPC)$$

$$+ \underset{(1.6436)}{0.0070}\, T$$

AR(1) 0.9135 (t=13.2428)

R^2 = 0.9808 SER = 0.0236 DW = 1.2783



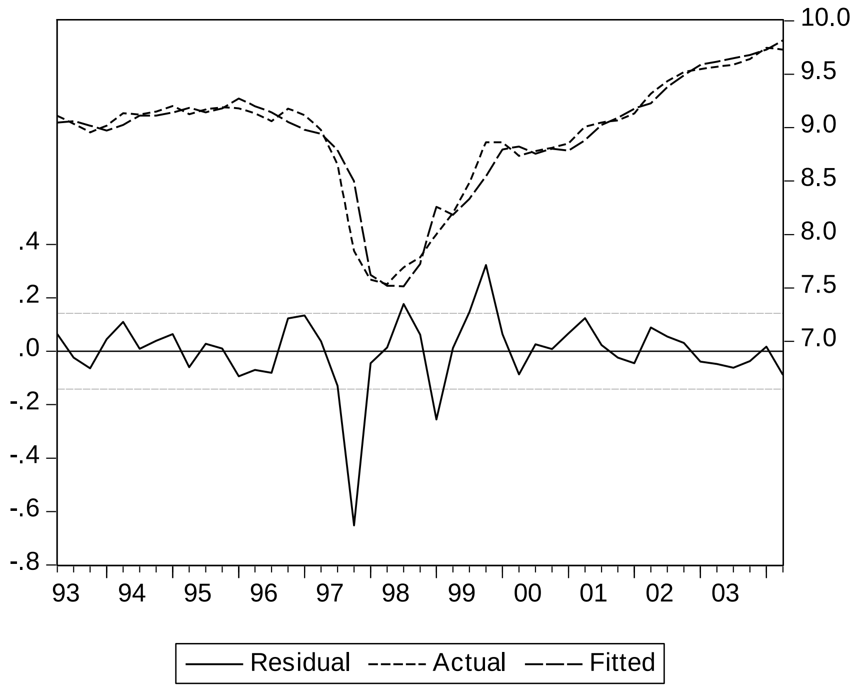
Root Mean Squared Error	345.9362
Mean Absolute Error	277.0833
Mean Abs. Percent Error	1.729544
Theil Inequality Coefficient	0.010611
Bias Proportion	0.003919
Variance Proportion	0.001417
Covariance Proportion	0.994663

EQ. E33. Automobile tax revenue

$$Log(ATAX) = -3.7632 + 1.0684\, Log(SACC + SACP) + 0.0184\, T$$
$$(-2.3192) \qquad (7.5641) \qquad (3.7657)$$

AR(1) 0.6667 (t=4.9033)

R^2 = 0.9414 SER = 0.1417 DW = 1.4825



Root Mean Squared Error	937.7565
Mean Absolute Error	697.1741
Mean Abs. Percent Error	9.546313
Theil Inequality Coefficient	0.047164
Bias Proportion	0.012158
Variance Proportion	0.115003
Covariance Proportion	0.872839

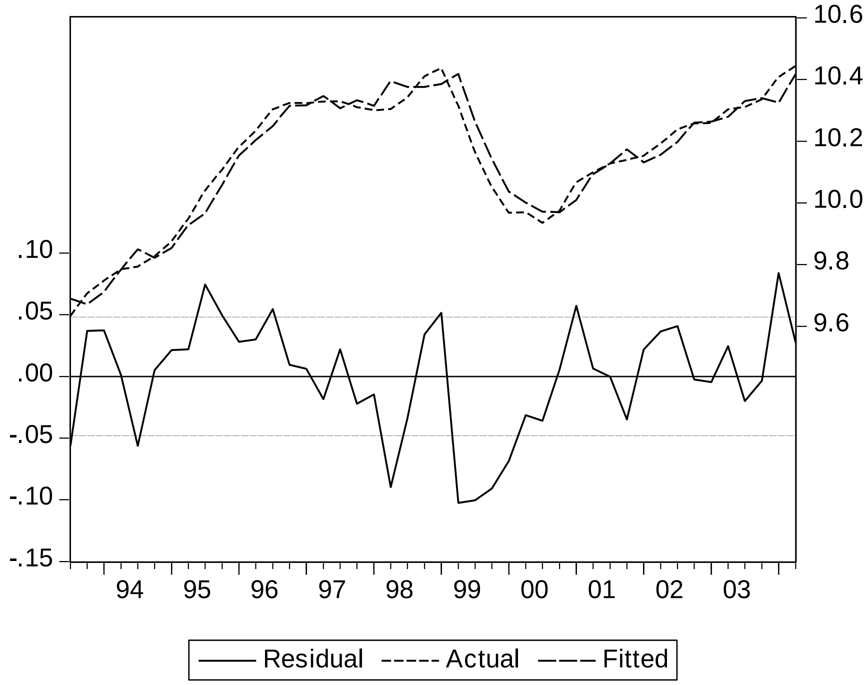
EQ. E34. Personal income tax revenue

$$Log(PICTAX) = \underset{(0.9733)}{3.2562} + \underset{(1.7783)}{0.4112}\,Log(GDPD) + \underset{(3.1674)}{2.6411}\,Log(PGDPAVE(-1))$$

$$\underset{(-1.2469)}{-0.0544}\,D97Q1$$

AR(1) 0.9636 (t=24.8177)

$R^2 = 0.9548$ SER = 0.0480 DW = 1.0547



Root Mean Squared Error	1241.369
Mean Absolute Error	952.1161
Mean Abs. Percent Error	3.534517
Theil Inequality Coefficient	0.022743
Bias Proportion	0.000134
Variance Proportion	0.000921
Covariance Proportion	0.998945

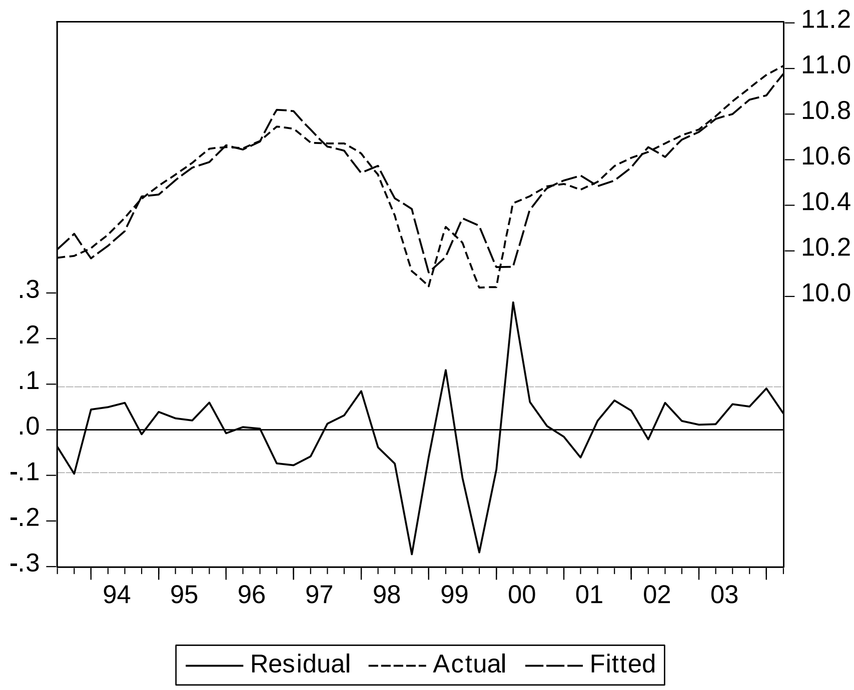
EQ. E35. Business income tax revenue

$$Log(BICTAX) = 0.8768\, Log(GDPD) - 2.3881\, Log(PGDPAVE(-1))$$
$$(10.7060) \qquad\qquad (-1.4897)$$

$$+0.1675\, D964$$
$$(1.2688)$$

AR(1) 0.9312 (t=15.9659)

R^2 = 0.8661 SER = 0.0940 DW = 1.4712



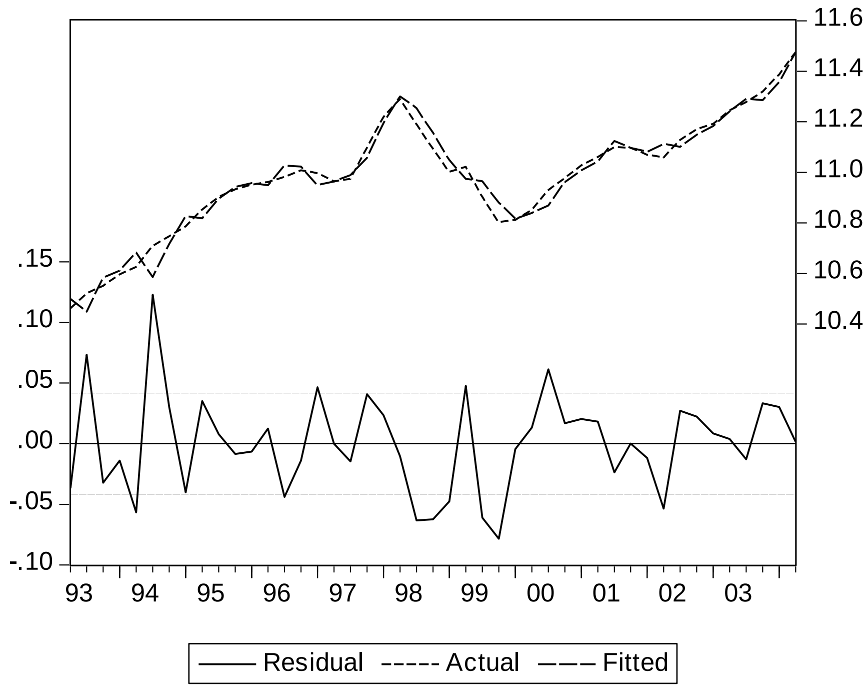
Root Mean Squared Error	3141.085
Mean Absolute Error	2318.341
Mean Abs. Percent Error	6.368031
Theil Inequality Coefficient	0.038082
Bias Proportion	0.027403
Variance Proportion	0.129662
Covariance Proportion	0.842935

EQ. E36. Other direct tax revenue

$$Log(ODTAX) = -10.4291 + 1.2550\,Log(TOALL) + 5.4160\,Log(PGDPAVE)$$
$$(-1.6509) \qquad (3.1705) \qquad (5.5598)$$

AR(1) 0.9497 (t=69.5109)

R^2 = 0.9686 SER = 0.0418 DW = 1.9750



Root Mean Squared Error	2285.108
Mean Absolute Error	1807.186
Mean Abs. Percent Error	2.971873
Theil Inequality Coefficient	0.017423
Bias Proportion	0.000936
Variance Proportion	0.007350
Covariance Proportion	0.991713

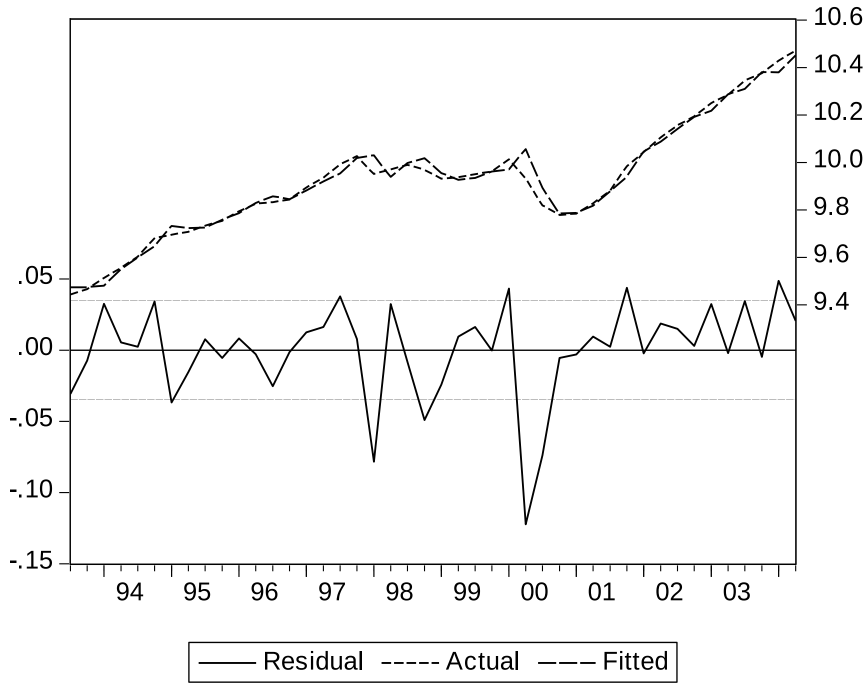
EQ. E37. Other indirect tax revenue

$$Log(OIDTAX) = 0.2324\ Log(GDPD) + 0.6297\ Log(PGDPAVE(-1))$$
$$\qquad\qquad\qquad (2.1768) \qquad\qquad\qquad (1.3617)$$

$$+0.6566\ Log(OIDTAX(-1))$$
$$(4.1005)$$

AR(1) 0.8041 (t=4.8411)

R^2 = 0.9812 SER = 0.0347 DW = 1.8201



Root Mean Squared Error	881.9603
Mean Absolute Error	578.1066
Mean Abs. Percent Error	2.494717
Theil Inequality Coefficient	0.019458
Bias Proportion	0.000513
Variance Proportion	0.013489
Covariance Proportion	0.985998

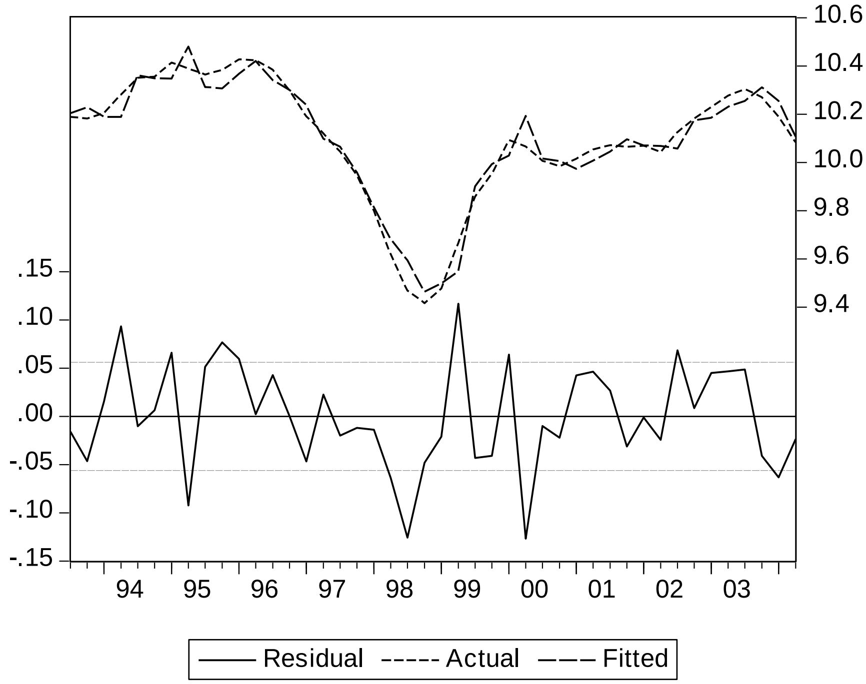
EQ. E38. Custom tax revenue

$$Log(CUTAX) = -2.2086\, Log(PGDPAVE) + 0.8201\, Log(MGS + XGS)$$
$$(-4.3341) \qquad\qquad (45.5971)$$

AR(1) 1.3994 (t=10.2491)

AR(2) -0.5873 (t=-4.3576)

R^2 = 0.9566 SER = 0.0561 DW = 1.9004



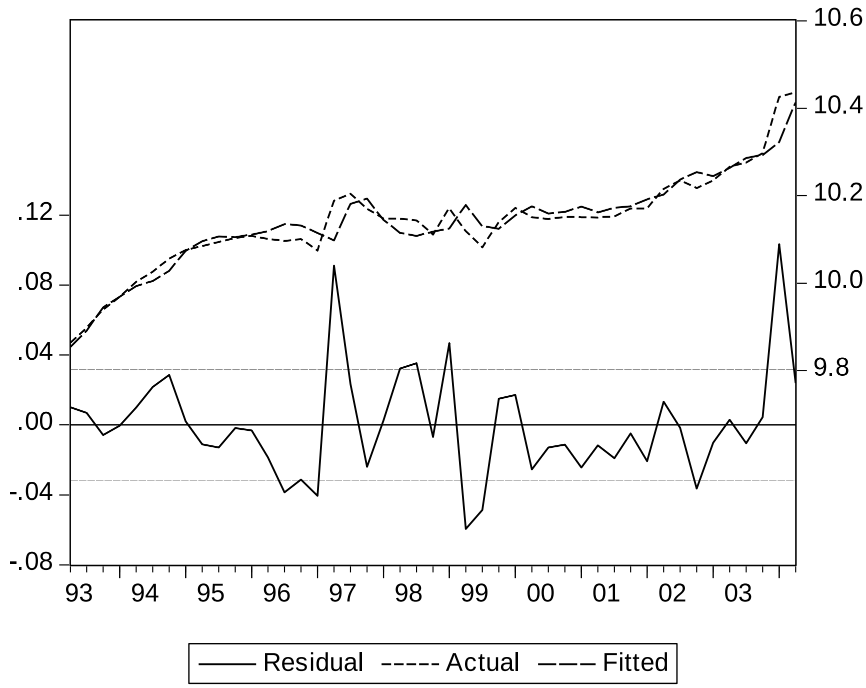
Root Mean Squared Error	1433.917
Mean Absolute Error	1110.937
Mean Abs. Percent Error	4.516168
Theil Inequality Coefficient	0.028002
Bias Proportion	0.019165
Variance Proportion	0.040139
Covariance Proportion	0.940696

EQ. E39. Other government revenue

$$Log(OREV) = 0.6833\ Log(TOALL) + 0.3647\ Log(PGDPAVE)$$
$$\qquad\qquad\qquad (127.6542) \qquad\qquad\qquad (2.2404)$$

AR(1) 0.6631 (t=5.2464)

R^2 = 0.9218 SER = 0.0317 DW = 1.6807



Root Mean Squared Error	1467.878
Mean Absolute Error	822.7822
Mean Abs. Percent Error	3.043319
Theil Inequality Coefficient	0.028047
Bias Proportion	0.001092
Variance Proportion	0.011584
Covariance Proportion	0.987324

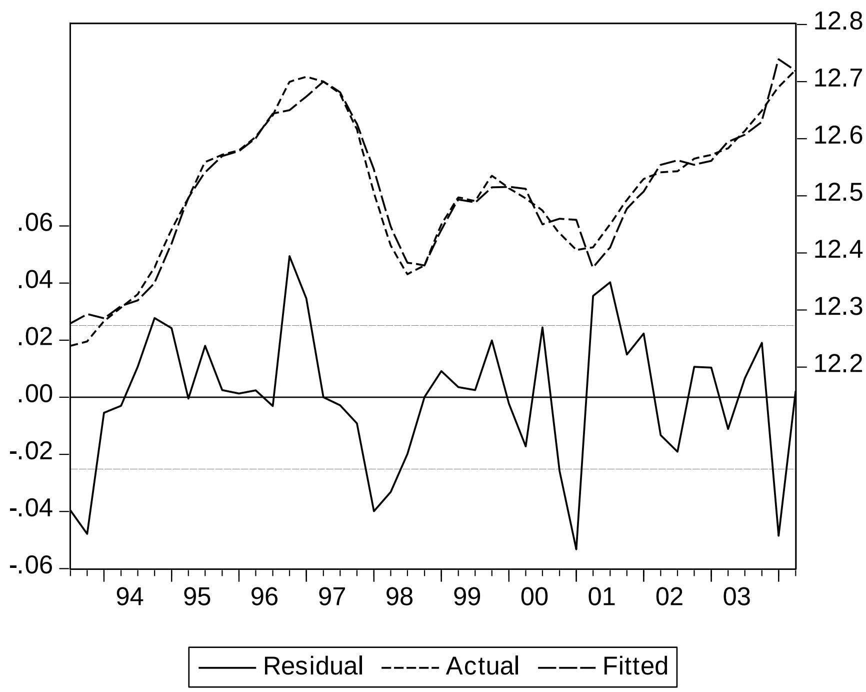
EQ. E40. Demand for high speed diesel

$$Log(DTDI) = -0.3935 \text{ Log } (PDH) + 1.1947 \ Log(TOALL)$$
$$(-3.3556) \qquad (7.1827)$$

$$+0.4243 \ Log(NTC(-1)) - 0.6156 \ Log(NPC)$$
$$(1.3772) \qquad (-2.6466)$$

AR(1) 0.9464 (t=31.1359)

R^2 = 0.9643   SER = 0.0252   DW = 1.3929



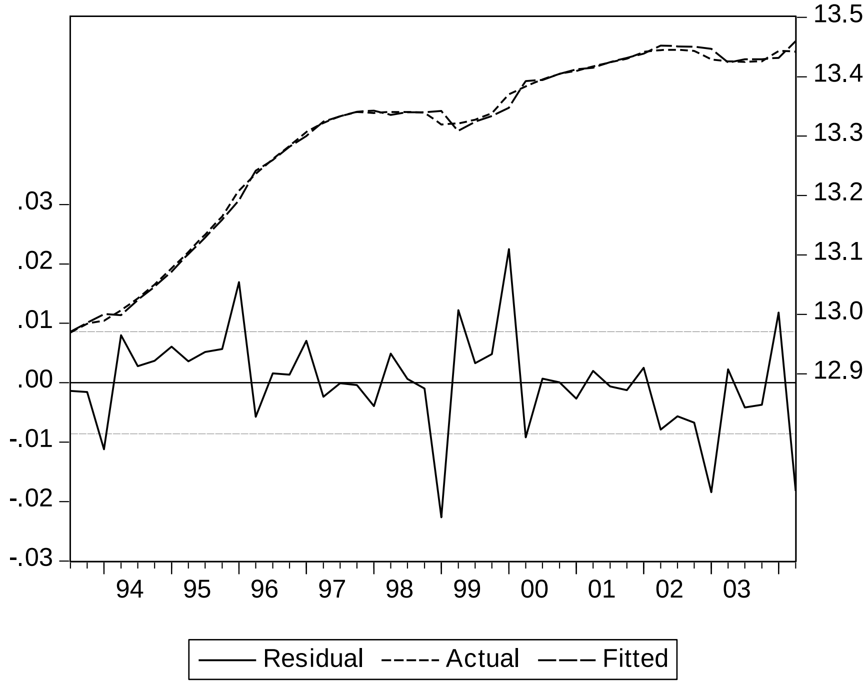
Root Mean Squared Error	7798.603
Mean Absolute Error	5361.210
Mean Abs. Percent Error	1.868104
Theil Inequality Coefficient	0.013892
Bias Proportion	0.038419
Variance Proportion	0.067966
Covariance Proportion	0.893615

EQ. E41. Number of trucks

$$Log(NTC) = 0.9911\ Log(NTC(-1)) - 0.0116\ Log(SACC)$$
$$(190.8194) \qquad\qquad (1.8632)$$

AR(1) 0.6506 (t=5.2153)

$R^2 = 0.9969$ SER = 0.0086 DW = 2.1503



Root Mean Squared Error	5432.673
Mean Absolute Error	3888.253
Mean Abs. Percent Error	0.632227
Theil Inequality Coefficient	0.004396
Bias Proportion	0.007591
Variance Proportion	0.100256
Covariance Proportion	0.892152

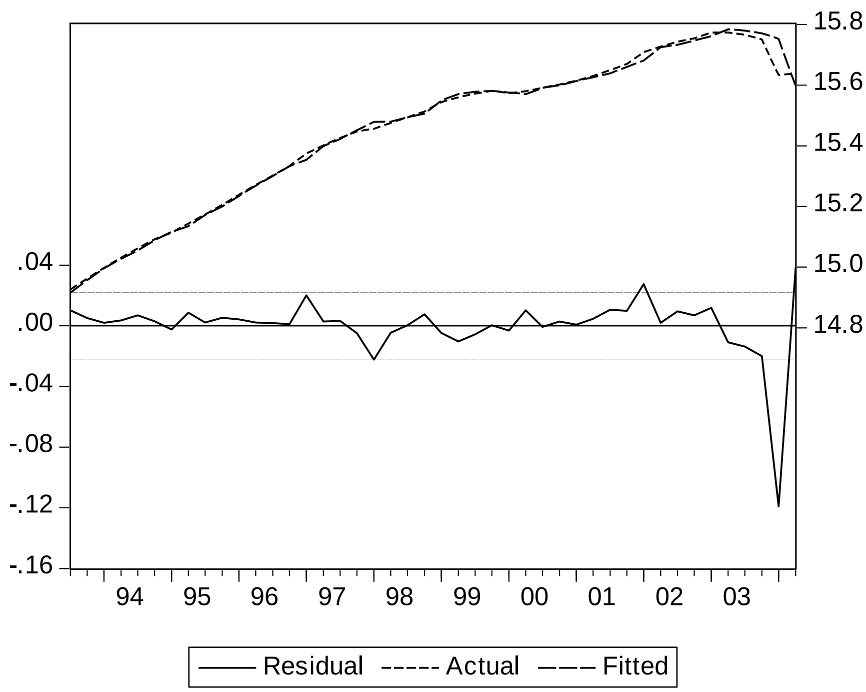
EQ. E42. Number of personal automobiles

$$Log(NPC) = 0.9930\ Log(NPC(-1)) + 0.0522\ Log(SACP)$$
$$(141.6621) \qquad (2.0375)$$

$$-0.0462\ Log(ATAX(-1))$$
$$(-2.0420)$$

AR(1) 0.3324 (t=2.271)

$R^2 = 0.9929$ SER = 0.0219 DW = 2.0009



Root Mean Squared Error	142191.6
Mean Absolute Error	68791.30
Mean Abs. Percent Error	1.146379
Theil Inequality Coefficient	0.012781
Bias Proportion	0.001148
Variance Proportion	0.003209
Covariance Proportion	0.995643

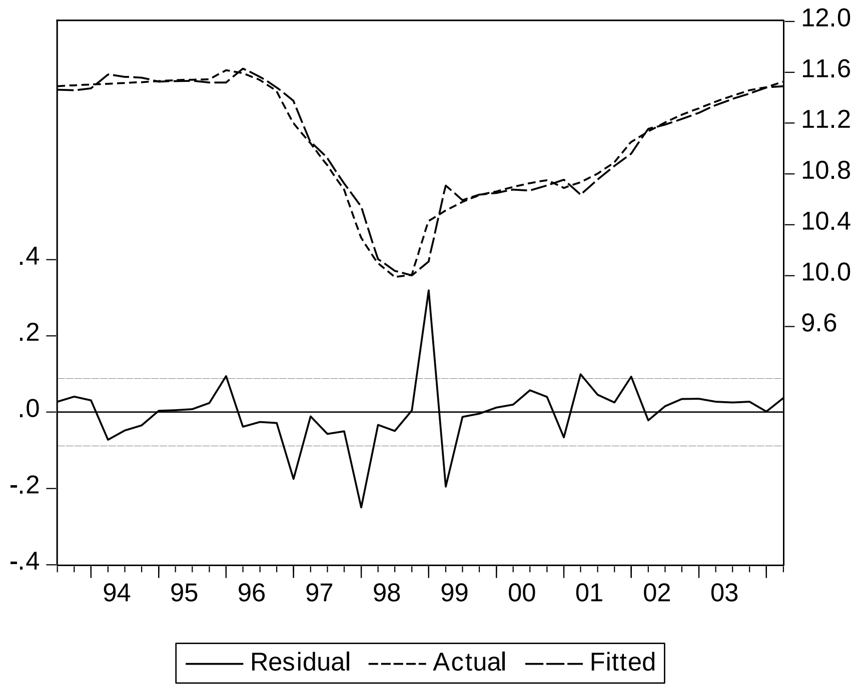
EQ. E43. Sale of commercial-type automobiles

$$Log(SACC) = 0.5950\ Log(SACC(-1)) + 0.2261\ Log(TOALL)$$
$$\qquad\qquad\qquad (3.0806) \qquad\qquad\qquad (1.3941)$$

$$+0.2374\ Log(WEALTH) - 0.4166\ Log(PDH)$$
$$\qquad (1.3984) \qquad\qquad\qquad (-1.3138)$$

AR(1) 0.8876 (t=8.6062)

R^2 = 0.9692   SER = 0.0884   DW = 2.0981



Root Mean Squared Error	4411.397
Mean Absolute Error	3242.627
Mean Abs. Percent Error	5.388277
Theil Inequality Coefficient	0.028740
Bias Proportion	0.000649
Variance Proportion	0.003181
Covariance Proportion	0.996169

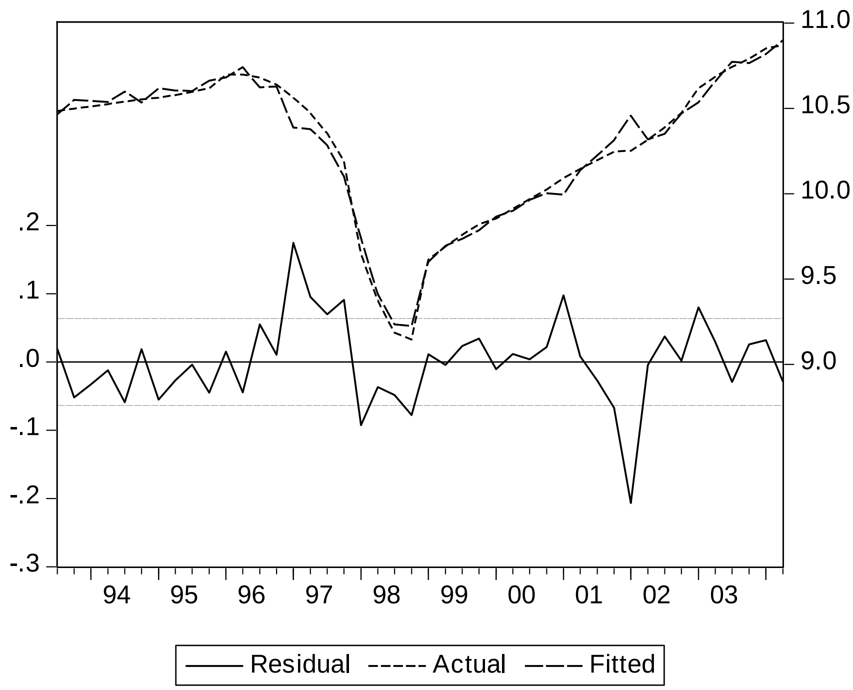
EQ. E44. Sale of personal-type automobiles

$$Log(SACP) = -1.5924 + 0.5407\, Log(PDH(-1)) - Log(PGP(-1))$$
$$(-1.4824) \qquad\qquad (1.6629)$$

$$+1.0908\, Log(SACC)$$
$$(10.8743)$$

AR(1) 0.9158 (t=16.3654)

R^2 = 0.9809 SER = 0.0637 DW = 1.3814



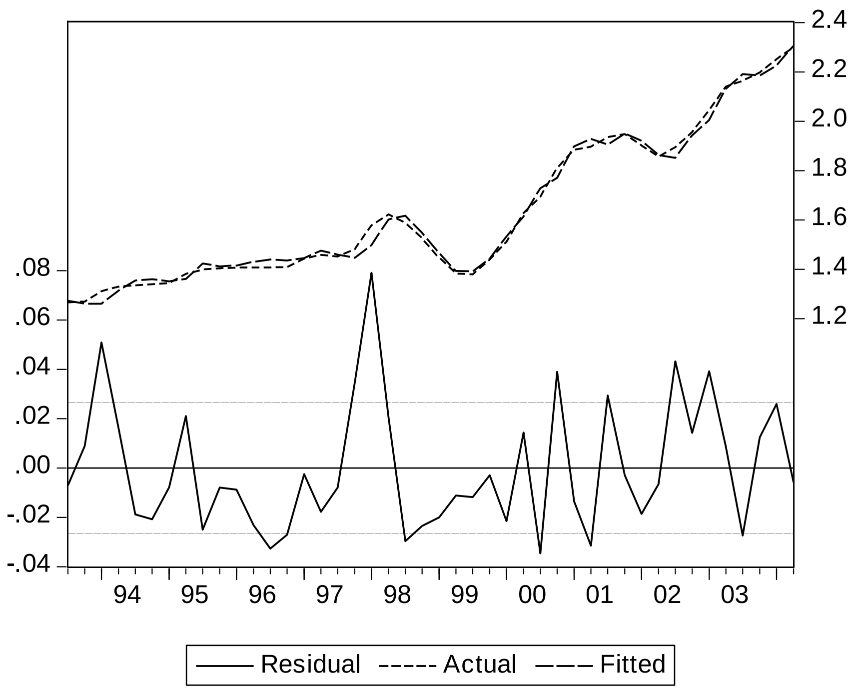
Root Mean Squared Error	1944.281
Mean Absolute Error	1373.842
Mean Abs. Percent Error	4.351244
Theil Inequality Coefficient	0.027985
Bias Proportion	0.000260
Variance Proportion	0.001453
Covariance Proportion	0.998287

EQ. E45. Ex-refinery price of high speed diesel

$$Log(PE\_HD) = 0.3485\ Log(PWCO) + 0.5330\ Log(PE\_HD(-1))$$
$$\qquad\qquad\qquad (5.8516) \qquad\qquad\qquad (6.5484)$$

AR(1) 0.9745 (t= 47.6027)

R^2 = 0.9927 SER = 0.0265 DW = 1.5836



Root Mean Squared Error	0.184604
Mean Absolute Error	0.135964
Mean Abs. Percent Error	2.287164
Theil Inequality Coefficient	0.015200
Bias Proportion	0.011397
Variance Proportion	0.055945
Covariance Proportion	0.932658

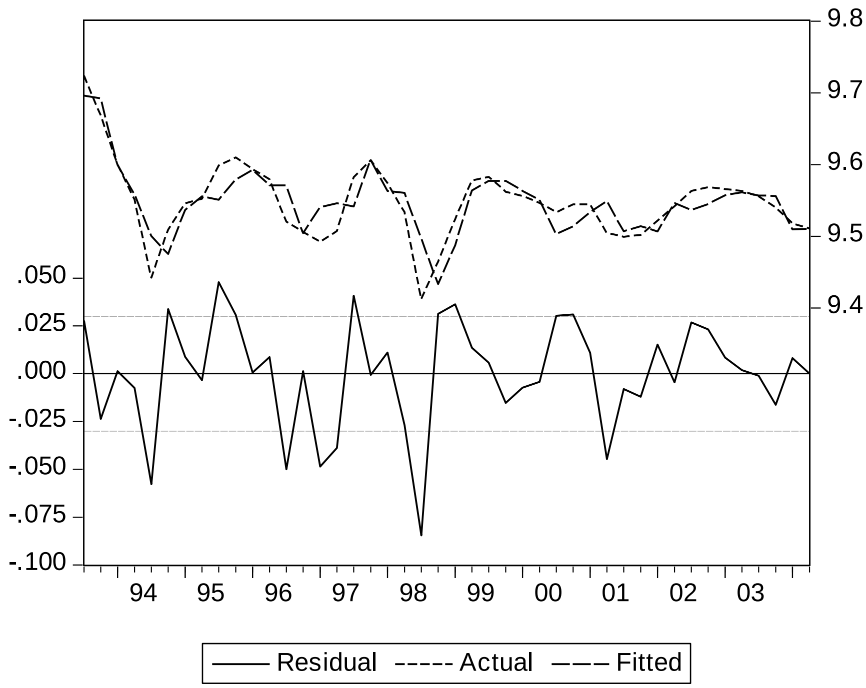
EQ. E46. Employment in agriculture

$$Log(EMP\_AG) = \underset{(1.7407)}{5.1634} + \underset{(2.3599)}{0.5605}\, Log(EMP\_AG(-1)) \underset{(-3.0616)}{-0.8515}\, Log(EMP\_MA)$$

$$+\underset{(2.9382)}{0.4588}\, Log(GDPD) + \underset{(1.7849)}{0.0454}\, D972$$

AR(1) 0.4359 (t= 1.6170)

$R^2 = 0.7203$ SER = 0.0300 DW = 1.8813



Root Mean Squared Error	370.6127
Mean Absolute Error	270.2195
Mean Abs. Percent Error	1.981994
Theil Inequality Coefficient	0.013313
Bias Proportion	0.000183
Variance Proportion	0.064036
Covariance Proportion	0.935781

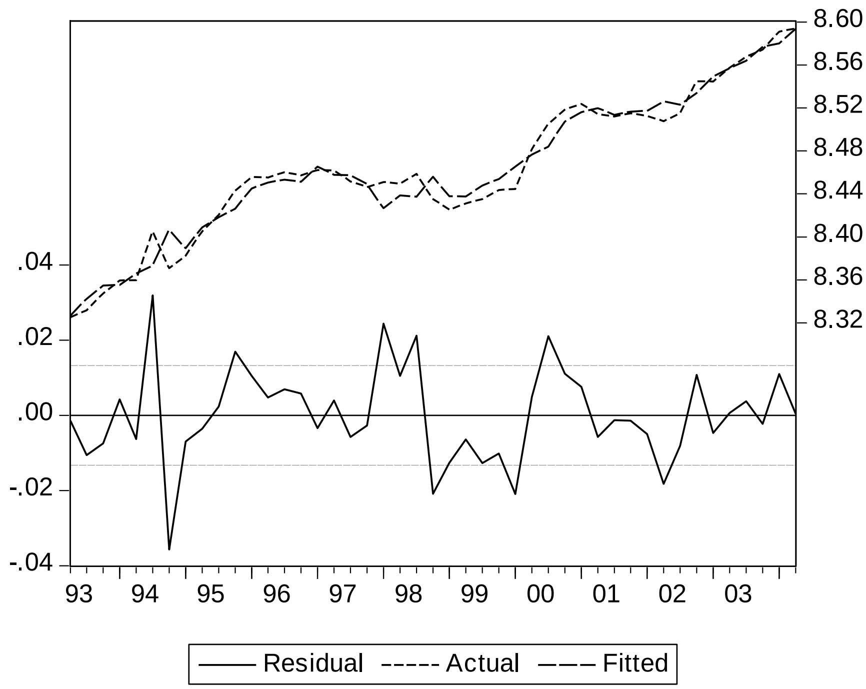
EQ. E47. Employment manufacturing in manufacturing

$$Log(EMP\_MA) = \underset{(7.9142)}{5.8281} + \underset{(1.8879)}{0.0520}\, Log(MIG) + \underset{(2.1377)}{0.1410}\, Log(GDPD)$$

$$+ \underset{(8.1946)}{0.0037}\, T$$

AR(1) 0.5612 (t= 3.5704)

R^2 = 0.9654 SER = 0.0133 DW = 1.8975



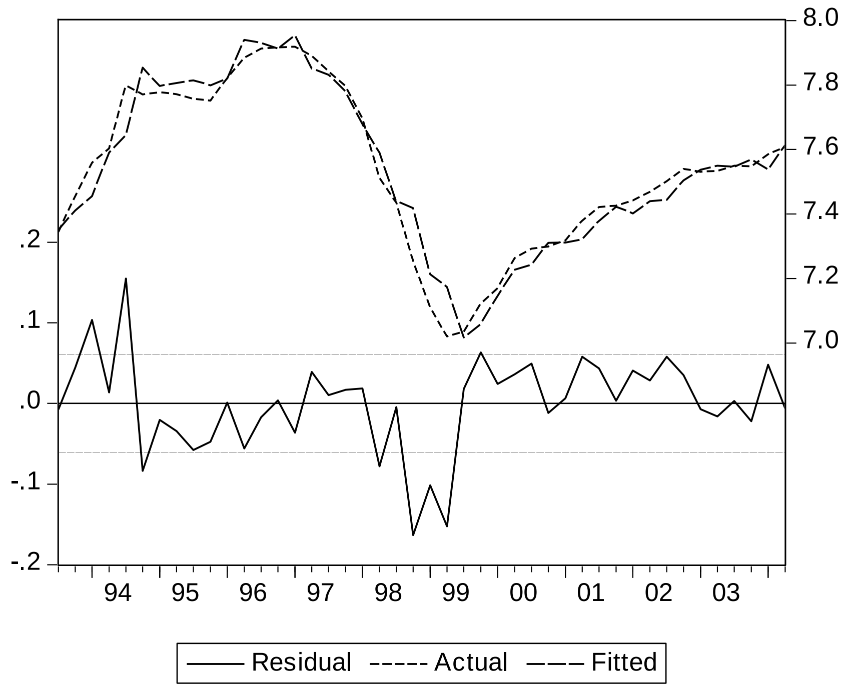
Root Mean Squared Error	60.11513
Mean Absolute Error	47.08906
Mean Abs. Percent Error	0.990313
Theil Inequality Coefficient	0.006223
Bias Proportion	0.002960
Variance Proportion	0.008293
Covariance Proportion	0.988747

EQ. E48. Employment construction

$$Log(EMP\_CON) = -23.9875 + 2.0774\,Log(KCO(-1)) + 0.5718\,Log(GDPD)$$
$$(-3.1042) \qquad (3.1059) \qquad (1.4087)$$

AR(1) 0.9479 (t= 40.0596)

$R^2 = 0.9455$ SER = 0.0610 DW = 1.4330



Root Mean Squared Error	106.1280
Mean Absolute Error	77.63614
Mean Abs. Percent Error	4.205368
Theil Inequality Coefficient	0.026337
Bias Proportion	0.000414
Variance Proportion	0.012653
Covariance Proportion	0.986933

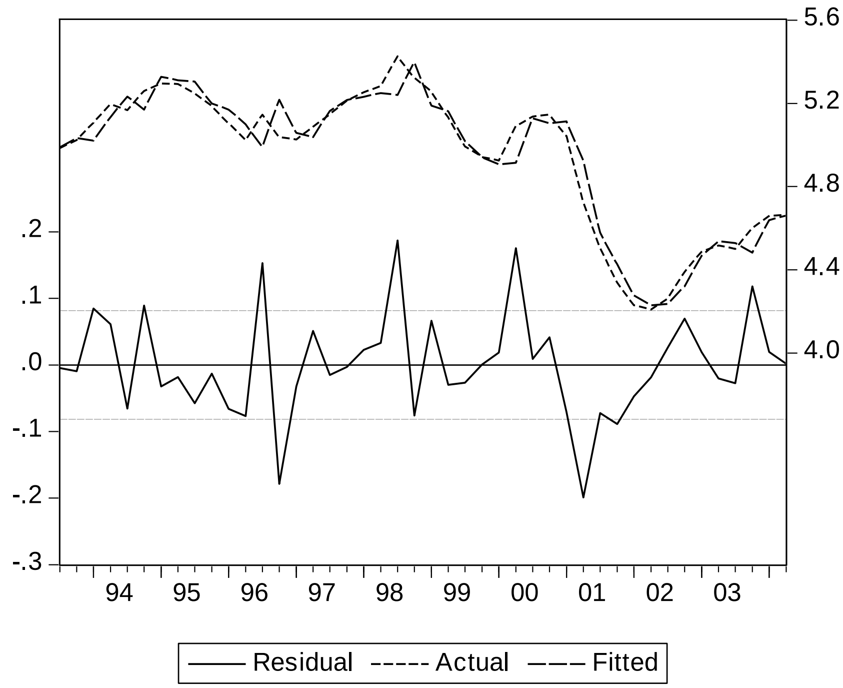
EQ. E49. Employment Utilities

$$Log(EMP\_UTI) = -13.4460 + 0.7463\, Log(EMP\_UTI(-1))$$
$$(-1.2565) \qquad (3.5734)$$

$$+1.3200\, Log(TOUT) - 0.0237\, T$$
$$(1.3415) \qquad (-1.5433)$$

AR(1) 0.6095 (t=2.2409)

$R^2 = 0.9478$ SER = 0.0817 DW = 2.0396



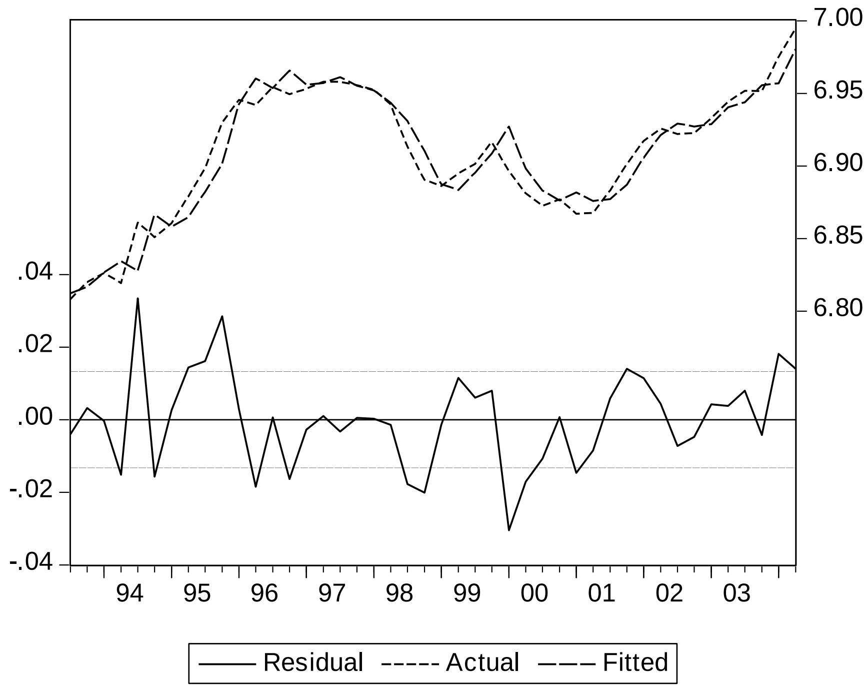
Root Mean Squared Error	12.41588
Mean Absolute Error	9.022688
Mean Abs. Percent Error	6.117677
Theil Inequality Coefficient	0.040874
Bias Proportion	0.000846
Variance Proportion	0.003154
Covariance Proportion	0.996000

EQ. E50. Employment transportation

$$Log(EMP\_TRA) = 0.3924\ Log(KTR(-1)) + 0.1705\ Log(CTR)$$
$$(4.4685) \qquad\qquad (1.5966)$$

AR(1) 0.9497 (t= 35.4682)

$R^2 = 0.9170$ SER = 0.0133 DW = 1.6418



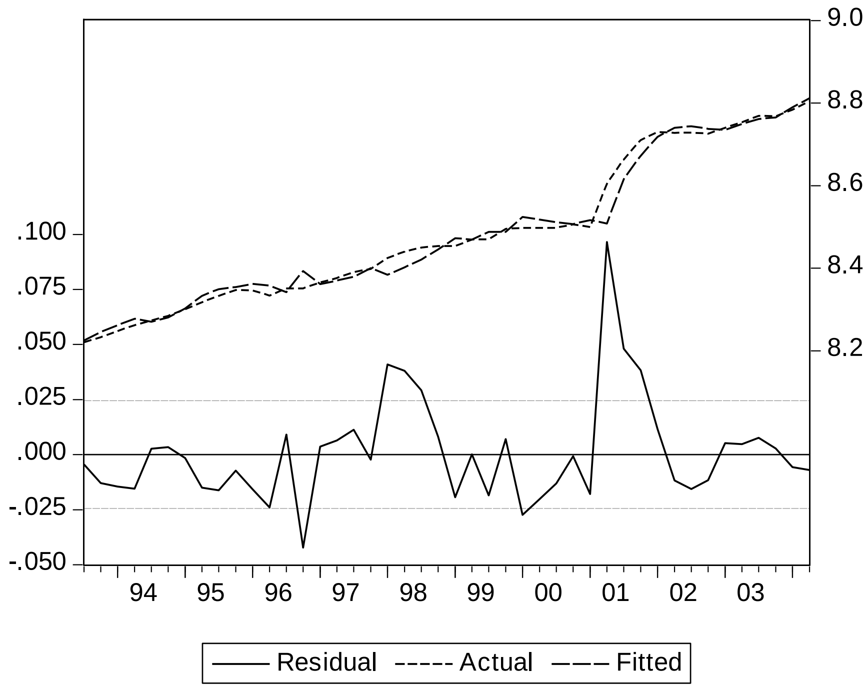
Root Mean Squared Error	13.16062
Mean Absolute Error	10.26866
Mean Abs. Percent Error	1.022149
Theil Inequality Coefficient	0.006510
Bias Proportion	0.000000
Variance Proportion	0.000262
Covariance Proportion	0.999738

EQ. E51. Employment services

$$Log(EMP\_SER) = 0.2485\ Log(TOALL) + 0.4449\ Log(CSE(-1))$$
$$(1.4574) \qquad\qquad (2.0212)$$

AR(1) 0.9789 (t= 30.3579)

R^2 = 0.9823 SER = 0.0244 DW = 1.2398



Root Mean Squared Error	120.9704
Mean Absolute Error	82.96076
Mean Abs. Percent Error	1.636368
Theil Inequality Coefficient	0.011746
Bias Proportion	0.002832
Variance Proportion	0.004867
Covariance Proportion	0.992301

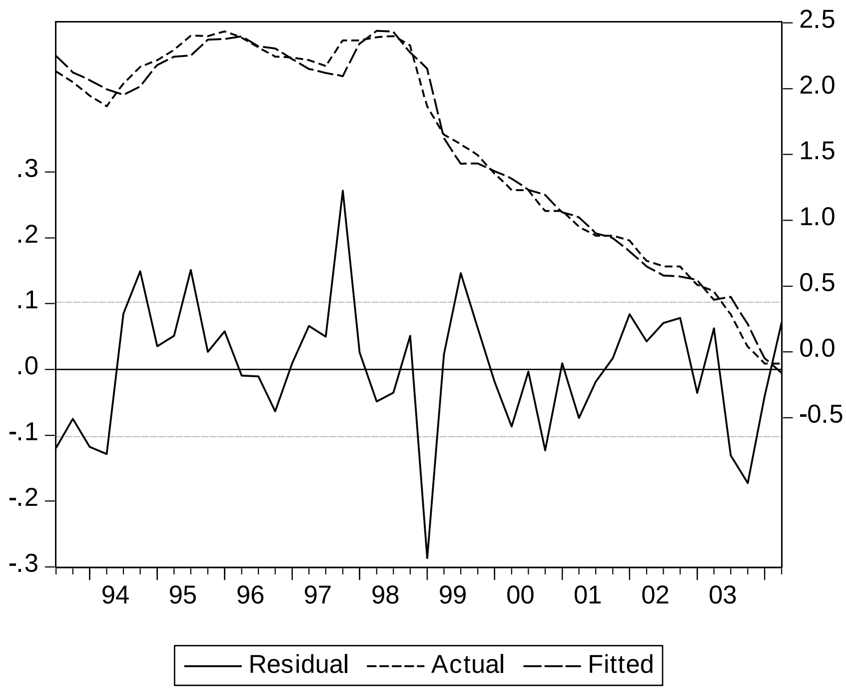
EQ. E52. Interest rate

$$Log(RD3M) = 6.5405\ Log(PGDPAVE(-1)) + 0.4734\ Log(PWCO(-1)) - 0.1144\ T$$
$$\qquad\qquad(5.4274)\qquad\qquad\qquad(2.3802)\qquad\qquad(-8.7851)$$

AR(1) 0.8744 (t=12.7817)

$R^2 = 0.9848$ SER = 0.1023 DW = 1.4926

Remarks: For scenario 6 only.



Root Mean Squared Error	0.680807
Mean Absolute Error	0.423065
Mean Abs. Percent Error	7.248200
Theil Inequality Coefficient	0.049515
Bias Proportion	0.020268
Variance Proportion	0.031745
Covariance Proportion	0.947986

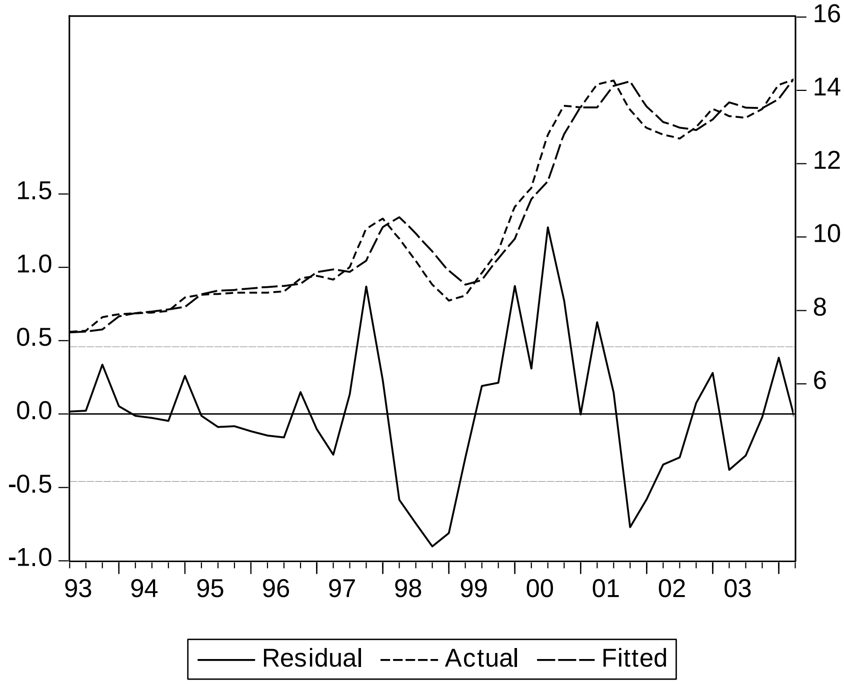
EQ. E53. Price of high speed diesel

$$Log(PDH) = 0.4434\ Log(DTDI) + 0.1905\ T$$
$$(3.0901) \qquad (3.7897)$$

AR(1) 0.8879 (t= 12.9070)

R^2 = 0.9651 SER = 0.4584 DW = 0.9095

Remarks: For scenario 5 only where PDH is endogenized.



Root Mean Squared Error	0.531501
Mean Absolute Error	0.414619
Mean Abs. Percent Error	3.219956
Theil Inequality Coefficient	0.020176
Bias Proportion	0.044574
Variance Proportion	0.172010
Covariance Proportion	0.783416

C.2. List of Identities

1. Demand Identity

1. CPR = CAG+CUT+CMA+CSE+CTR
2. IPR = IMA+ICO+ISE
3. MGR=MFG+MIG+MEN
4. MGS = MGR + MSR
5. XGS = XGR + XSR
6. DD = CPR+IPR+CGR
7. GDPD = CPR+IPR+CGR+XGS-MGS+GDP_FACTOR
8. GDP_GAP = GDPD-GDPS

2. Supply Identity

9. GDPAG= TOAG/ZAG
10. GDPMA= TOMA/ZMA
11. GDPCO= TOCO/ZCO
12. GDPUT= TOUT/ZUT
13. GDPTR= TOUT/ZTR
14. GDPSE= TOSE/ZSE
15. TOALL = TOAG+TOMA+TOCO+TOUT+TOTR+TOSE
16. GDPS =(TOAG/ZAG)+(TOMA/ZMA)+(TOCO/ZCO)+(TOUT/ZUT) +(TOTR/ZTR)+(TOSE/ZSE)

3. Price Identity

17.PGDPAVE1=(PGDPAG*GDPAG+PGDPMA*GDPMA+PGDPCO*GDPCO+PGDPUT*GDPUT+PGDPTR*GDPTR+PGDPSE*GDPSE)/(GDPAG+GDPMA+GDPCO+GDPUT+GDPTR+GDPSE)

18.PGDPAVE=(PGDPAG*GDPAG+PGDPMA*GDPMA+PGDPCO*GDPCO+PGDPUT*GDPUT+PGDPTR*GDPTR+PGDPSE*GDPSE+PGDPAVE1*GDP_GAP)/(GDPAG+GDPMA+GDPCO+GDPUT+GDPTR+GDPSE+GDP_GAP)

19. INF_RATE=(PGDPAVE-PGDPAVE(-1))/PGDPAVE(-1)

4. Fiscal Identity

20. ICTAX = PICTAX + BICTAX
21. DTAX = ICTAX+ODTAX
22. IDTAX = PTAX + ATAX + OIDTAX
23. GREV = DTAX + IDTAX + CUTAX + OREV
24. GREV_FIN = GREV+GREV_FACTOR
25. BUDGET = GREV_FIN-CG

5. Energy Identity

26. PDH=PE_HD+TAX_HD+MTAX_HD+OF_HD+VAT_HD+MM_HD +PDH_FAC

6. Welfare Identity

27. YI=HHMI/3.6

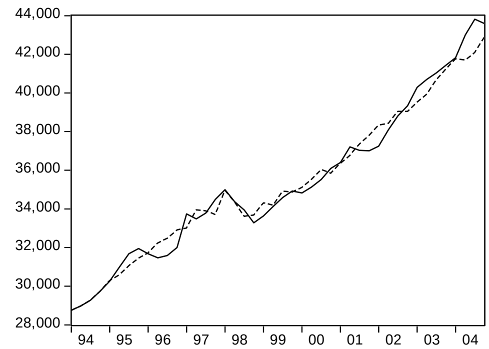
28. EMP_ALL = EMP_AG+EMP_MA+EMP_UTI+EMP_CON+EMP_TRA +EMP_SER+EMP_COM+EMP_OTH

29. UNEMPR = (1-(EMP_ALL/LF))*100

APPENDIX D

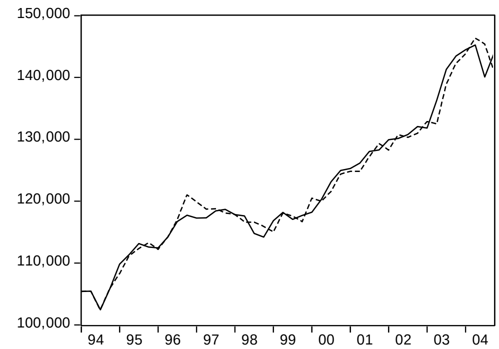
DETERMINISTIC DYNAMIC BASELINE SIMULATION

Consumption in agriculture



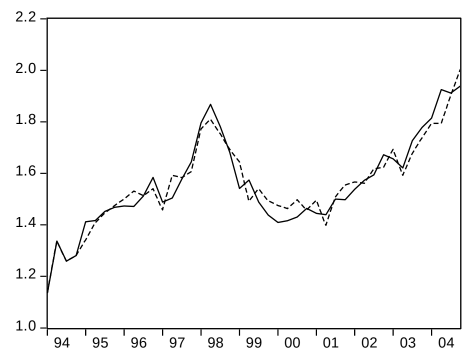
CAG ---- CAG (baseline_sametrend)

Total output in agriculture



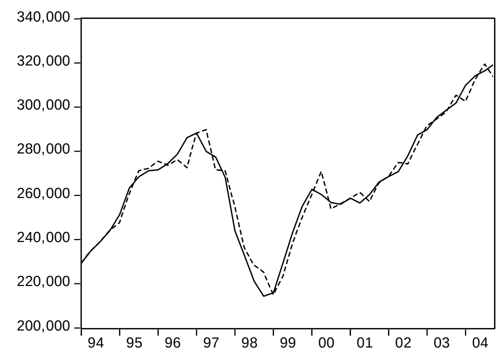
TOAG ---- TOAG (baseline_sametrend)

Price in agriculture



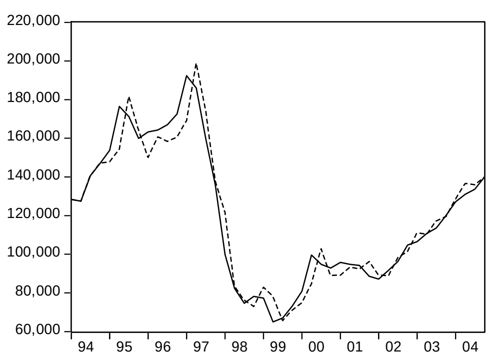
PGDPAG
---- PGDPAG (baseline_sametrend)

Consumption in manufacturing



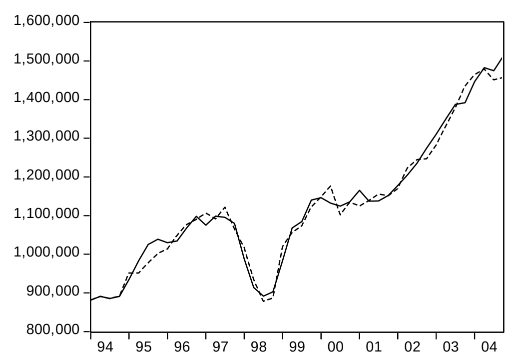
CMA ---- CMA (baseline_sametrend)

Investment in manufacturing



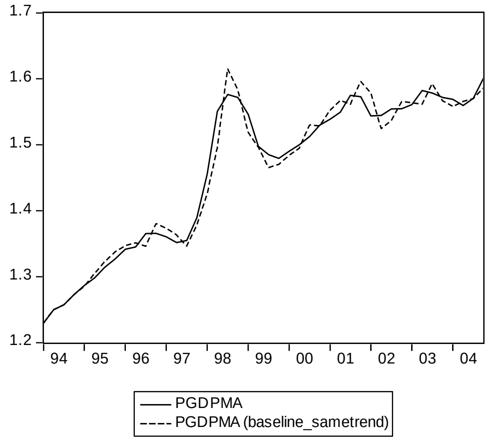
IMA ---- IMA (baseline_sametrend)

Total output in manufacturing

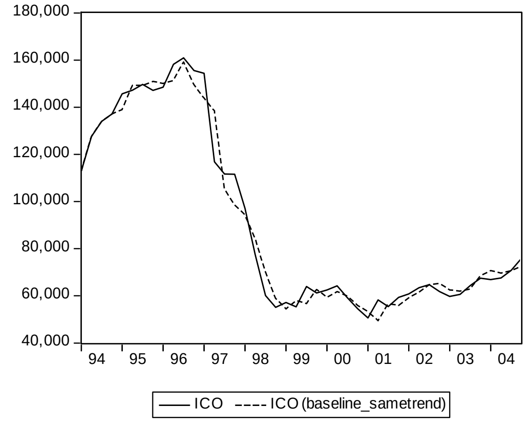


TOMA ---- TOMA (baseline_sametrend)

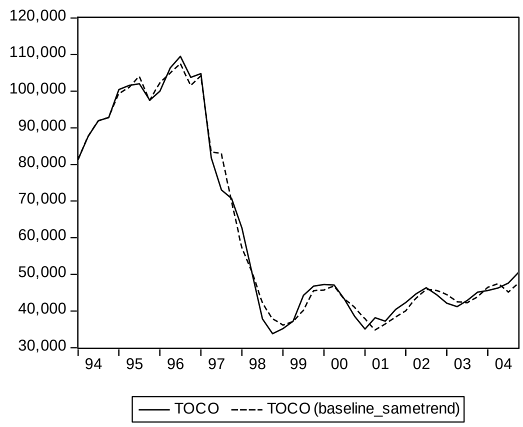
Price in manufacturing



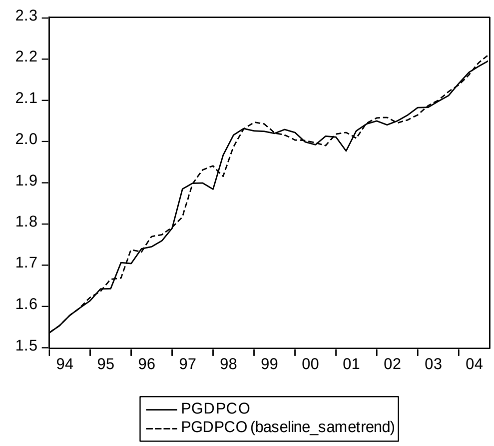
Investment in construction



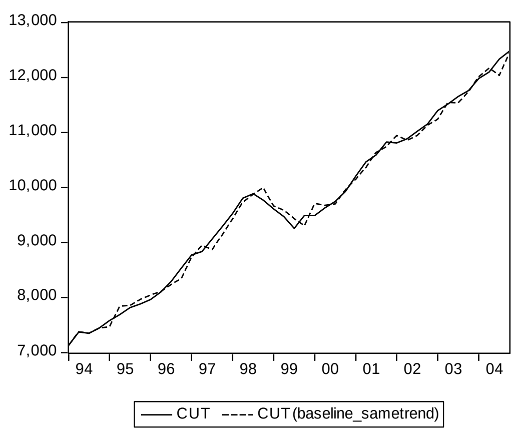
Total output in construction



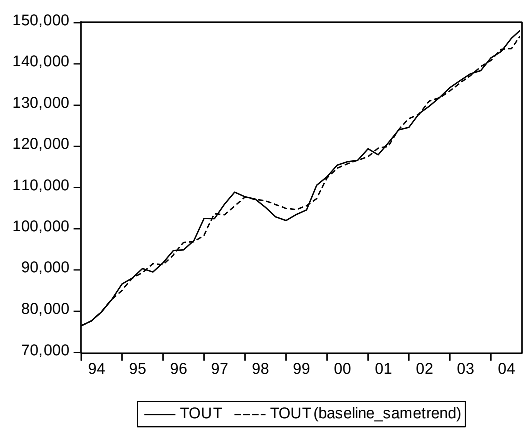
Price in construction



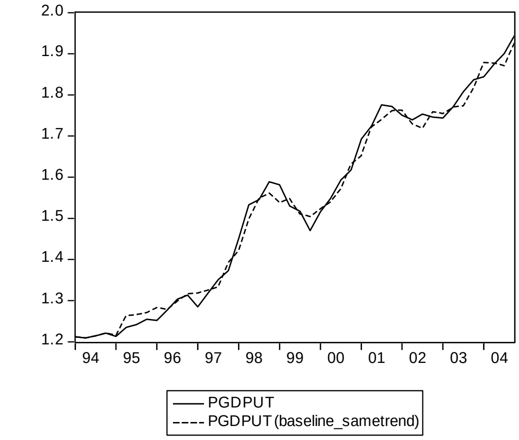
Consumption in utility



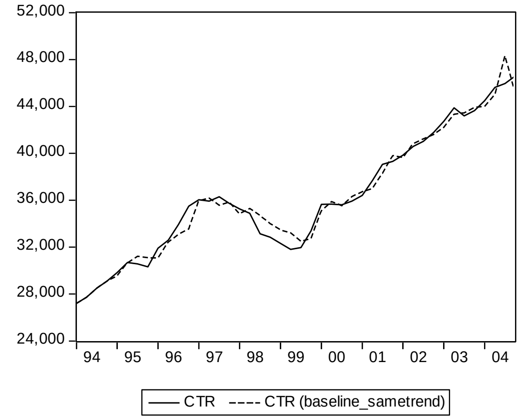
Total output in utility



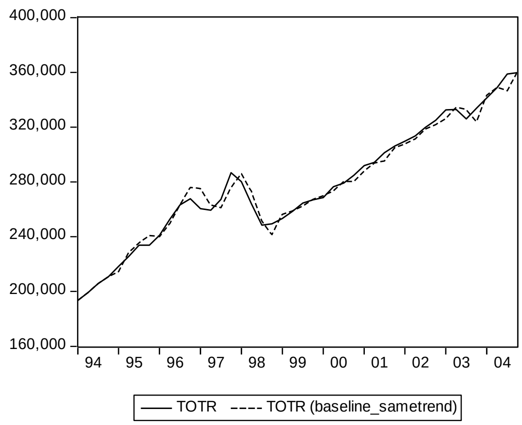
Price in utility



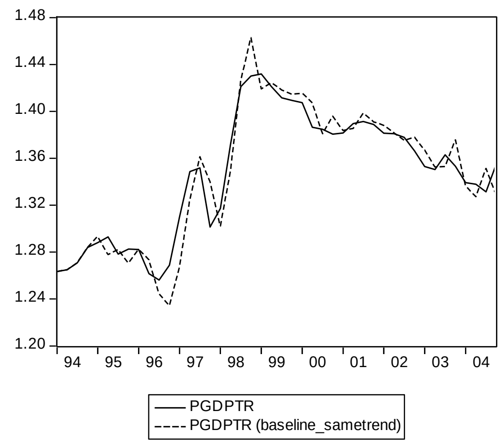
Consumption in transportation



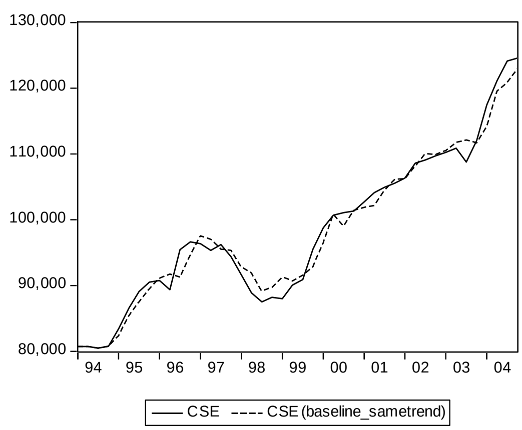
Total output in transportation



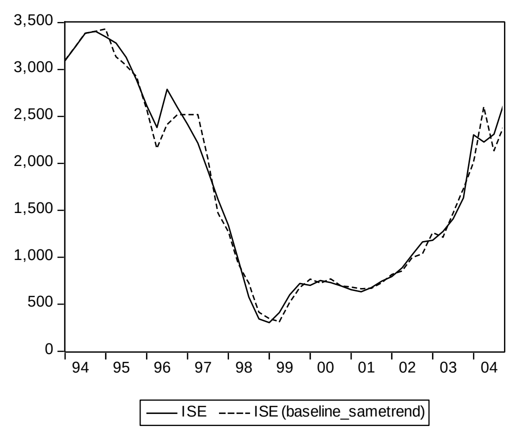
Price in transportation



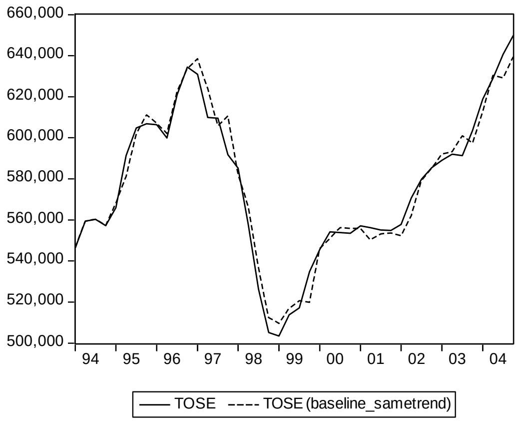
Consumption in service



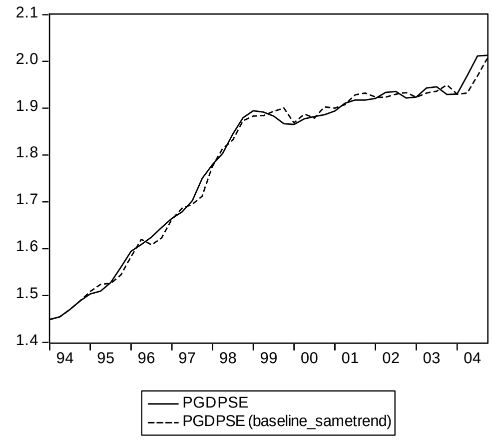
Investment in service



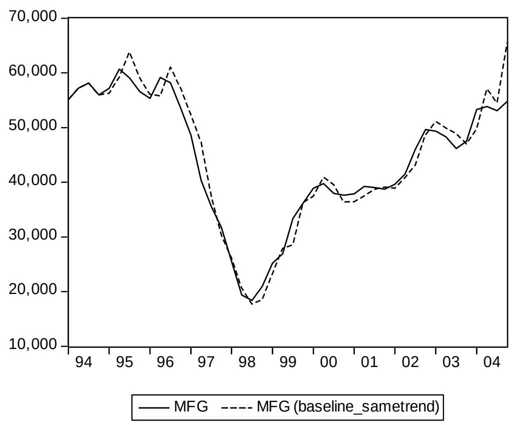
Total output in service



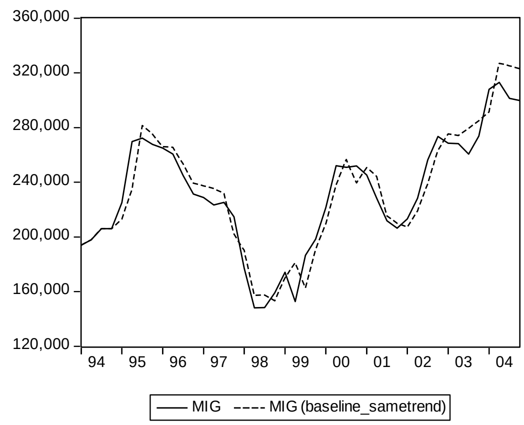
Price in service



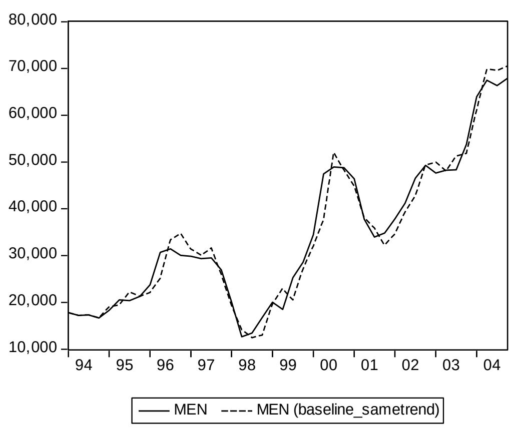
Import of final goods



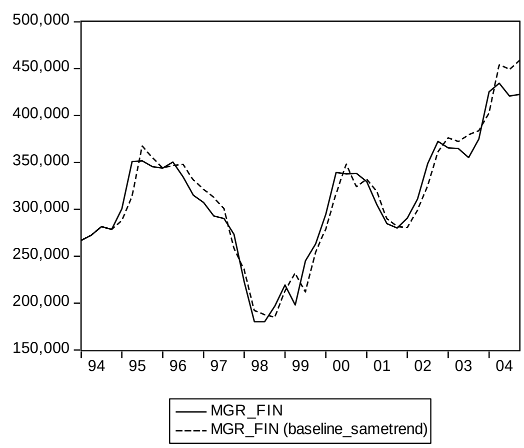
Import of intermediate goods



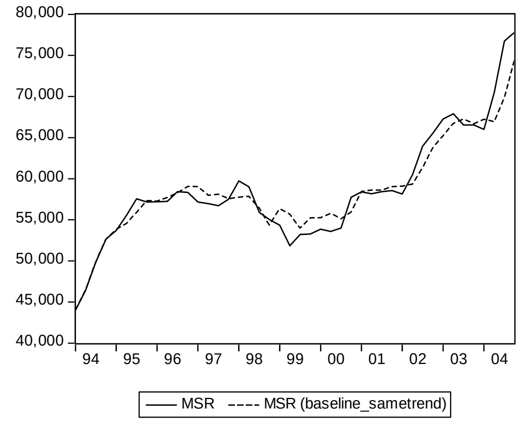
Import value of energy



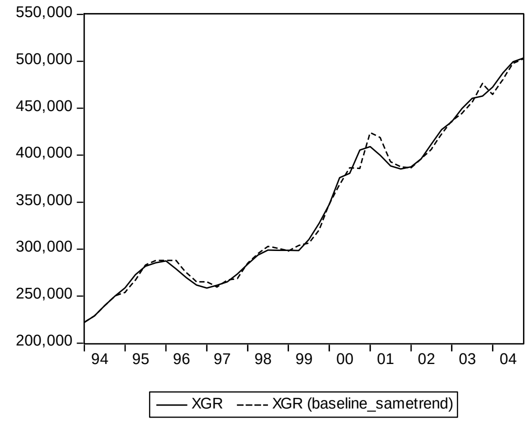
Import of goods (actual and base)



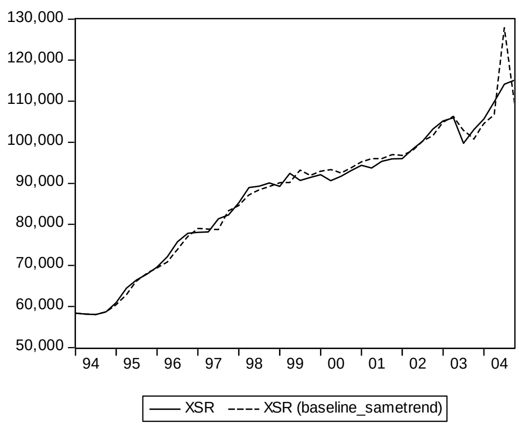
Import of services (actual and base)



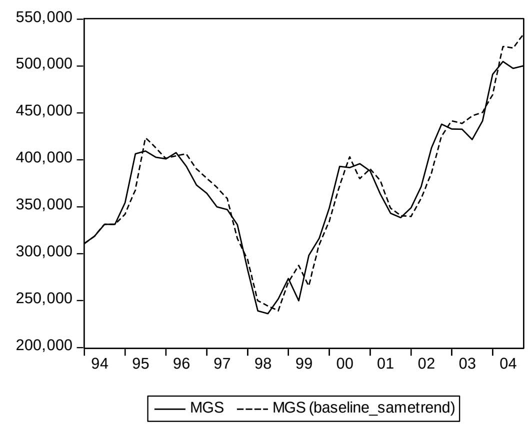
Export of goods (actual and base)



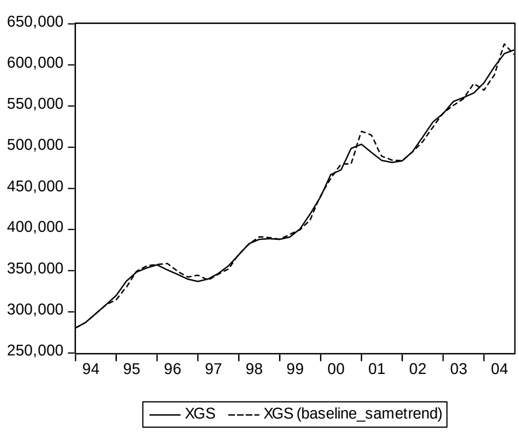
Export of services (actual and base)



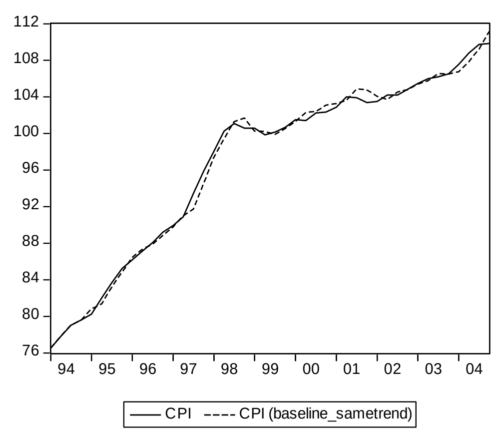
Import of goods and services (actual and base)



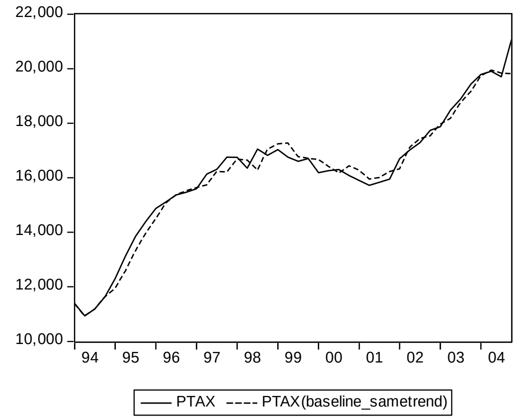
Export of goods and services (actual and base)



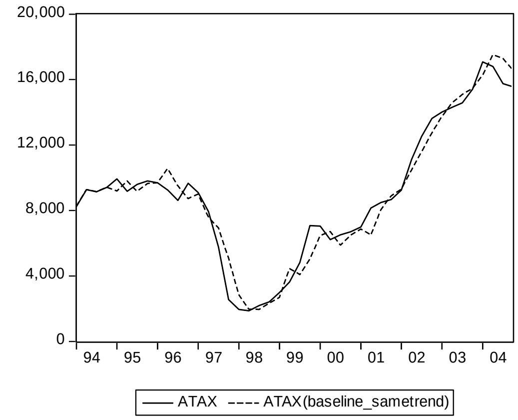
CPI



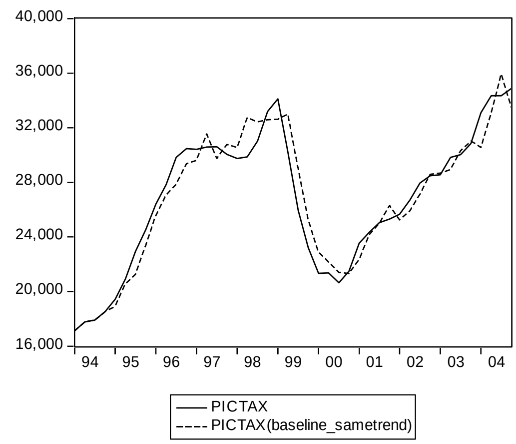
Petroleum tax (Reg)



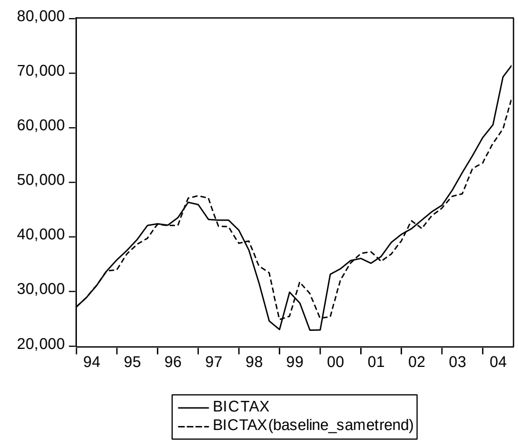
Automobile tax (Reg)



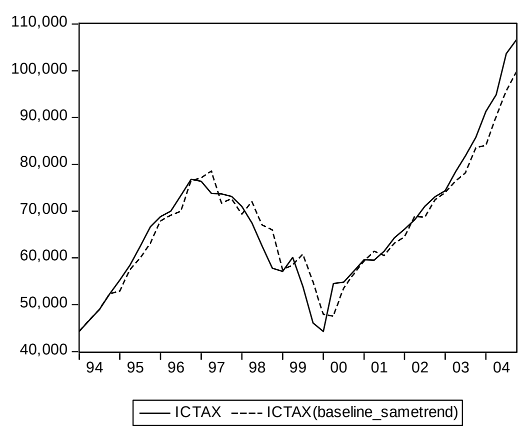
Personal ncome tax (Reg)



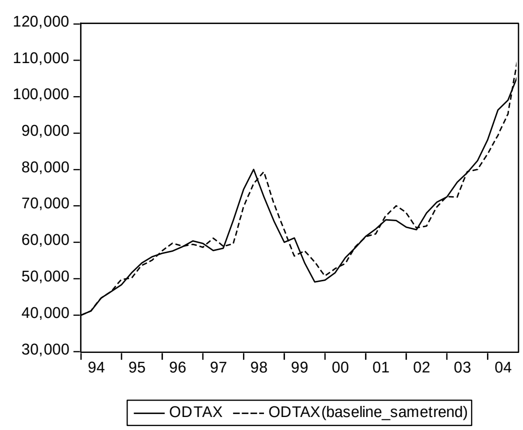
Business income tax (Reg)



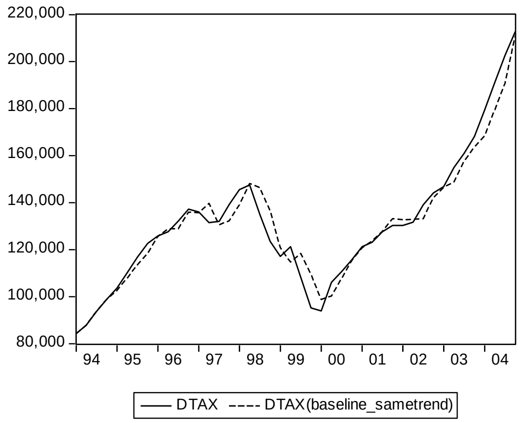
Income tax (PICTAX+BICTAX)



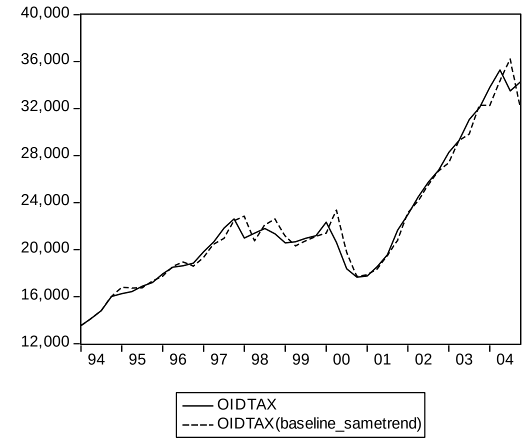
Other direct tax (Reg)



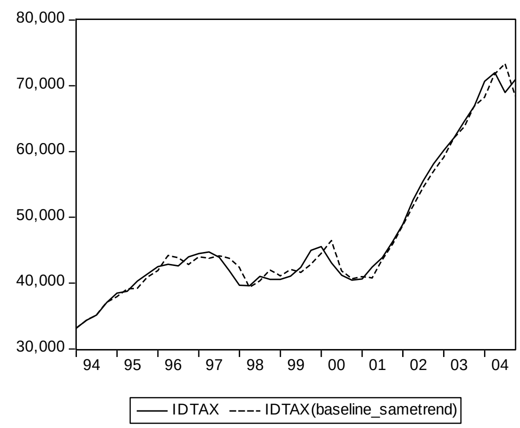
Direct tax (ICTAX+ODTAX)



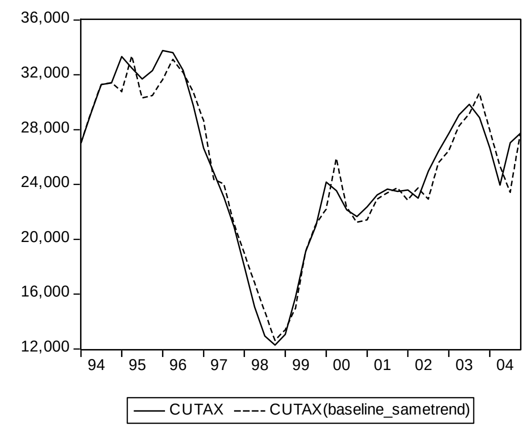
Other indirect tax (Reg)



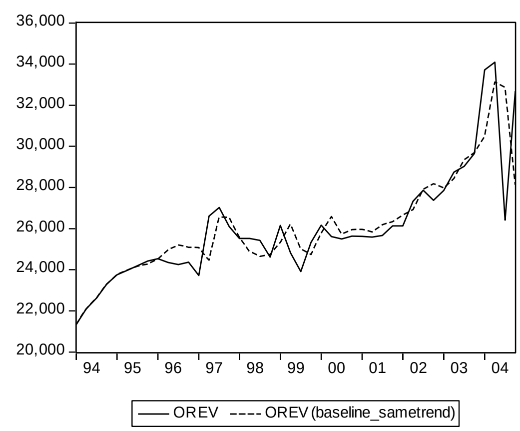
Indirect tax (PTAX+ATAX+OIDTAX)



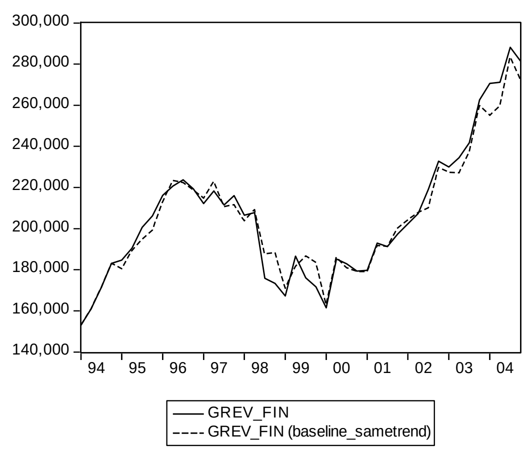
Custom tax (Reg)

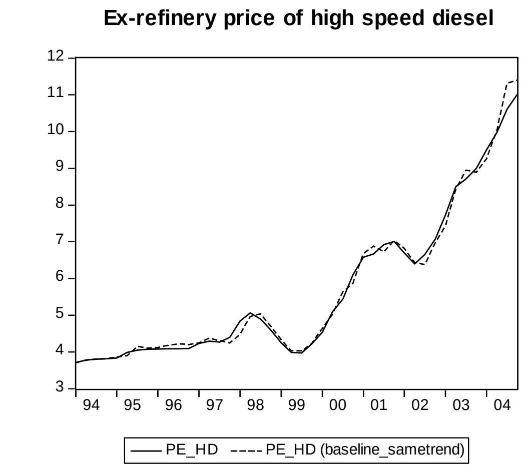


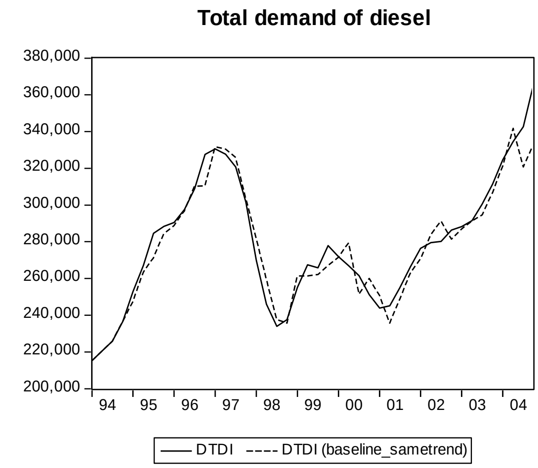
Other government revenue (Reg)

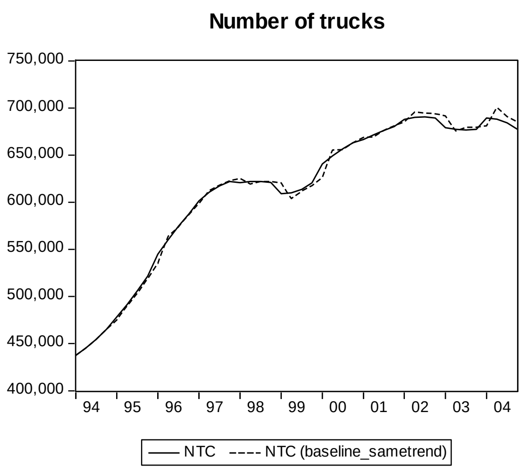


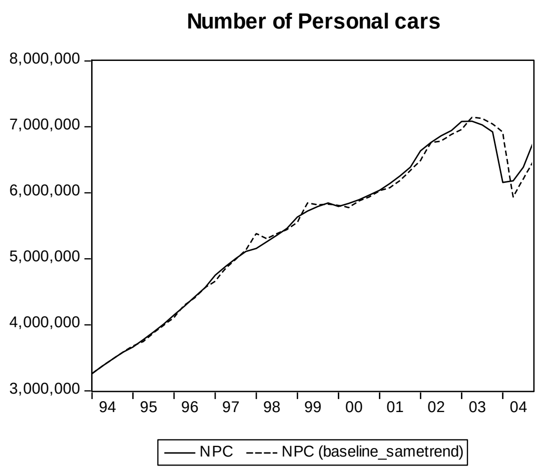
Total government revenue (DTAX+IDTAX+CUTAX+OREV)

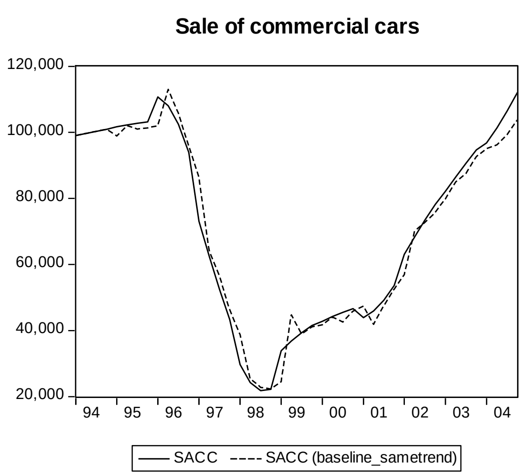


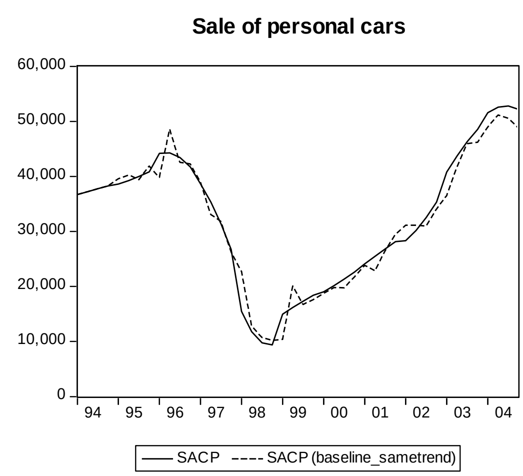

Ex-refinery price of high speed diesel
12
11
10
9
8
7
6
5
4
3
94 95 96 97 98 99 00 01 02 03 04
PE_HD
PE_HD (baseline_sametrend)


Total demand of diesel
380,000
360,000
340,000
320,000
300,000
280,000
260,000
240,000
220,000
200,000
94 95 96 97 98 99 00 01 02 03 04
DTDI
DTDI (baseline_sametrend)

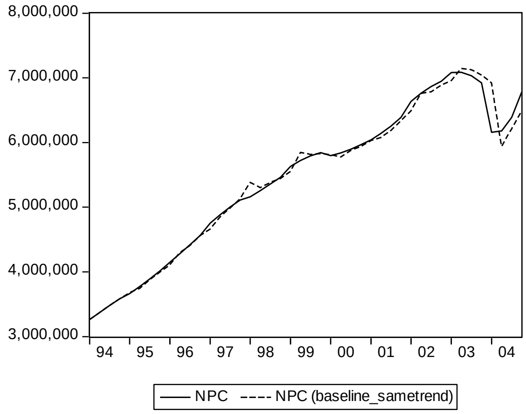

Number of trucks
750,000
700,000
650,000
600,000
550,000
500,000
450,000
400,000
94 95 96 97 98 99 00 01 02 03 04
NTC
NTC (baseline_sametrend)


Number of Personal cars
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
94 95 96 97 98 99 00 01 02 03 04
NPC
NPC (baseline_sametrend)

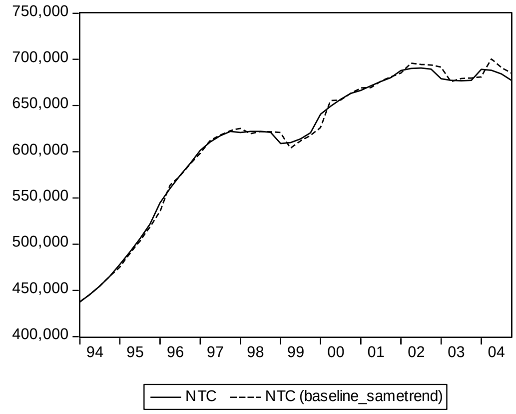

Sale of commercial cars
120,000
100,000
80,000
60,000
40,000
20,000
94 95 96 97 98 99 00 01 02 03 04
SACC
SACC (baseline_sametrend)


Sale of personal cars
60,000
50,000
40,000
30,000
20,000
10,000
0
94 95 96 97 98 99 00 01 02 03 04
SACP
SACP (baseline_sametrend)

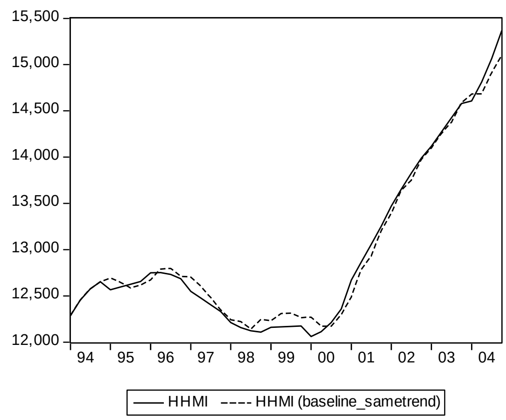
Number of personal cars



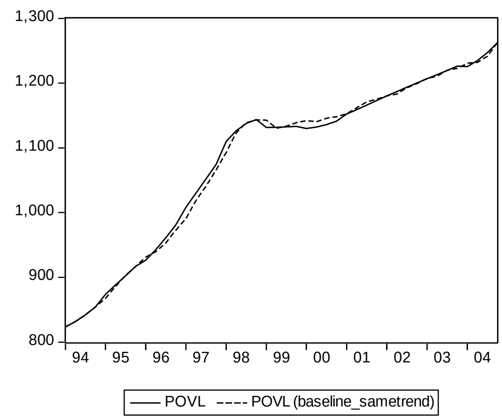
Number of trucks



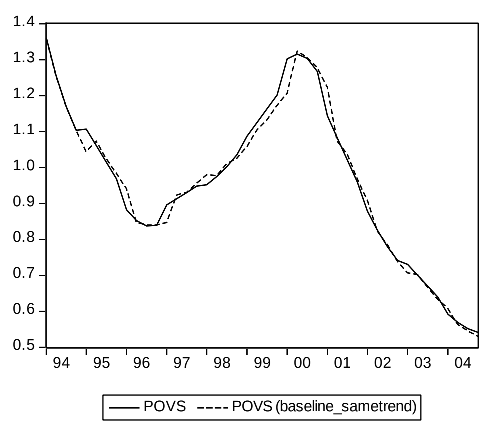
Household monthly income



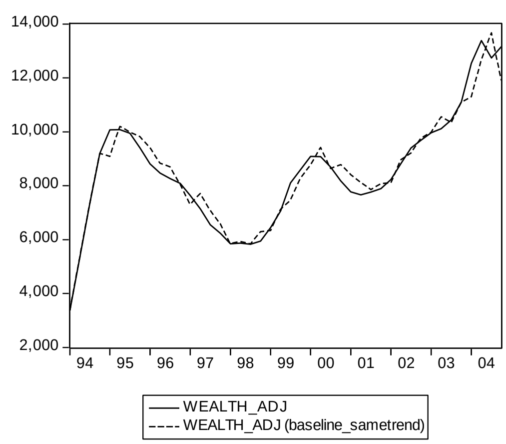
Poverty line



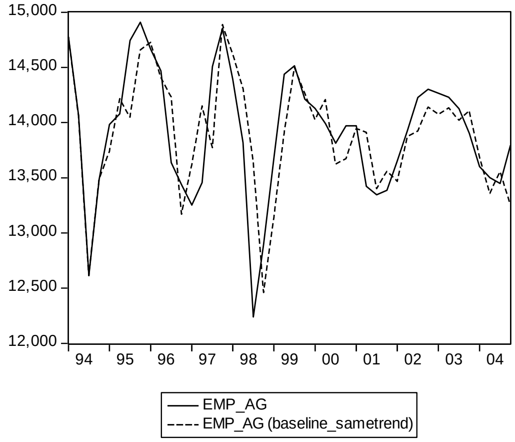
Poverty severity



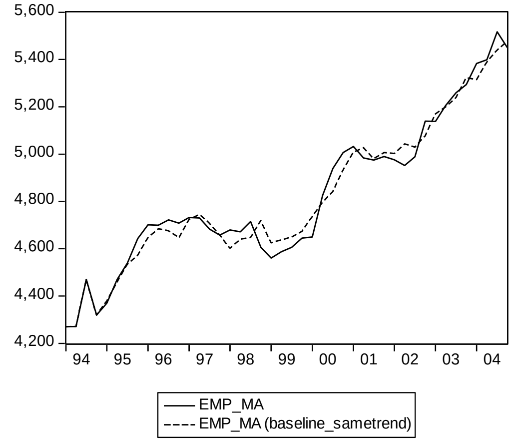
Wealth



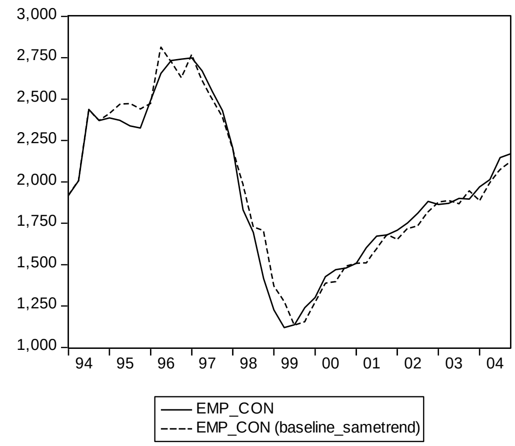
Employment rate agriculture



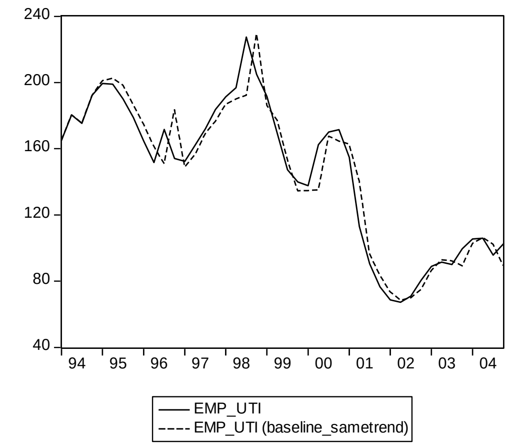
Employment rate manufacturing



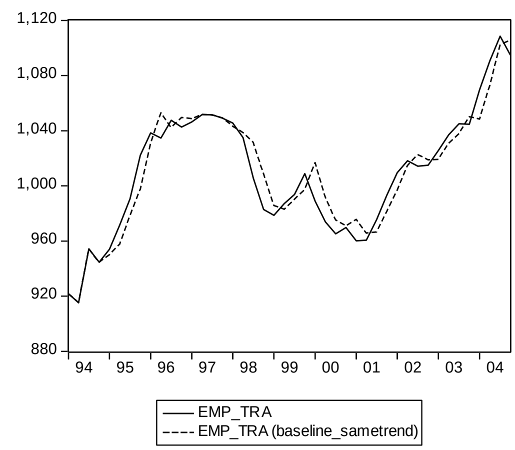
Employment rate construction



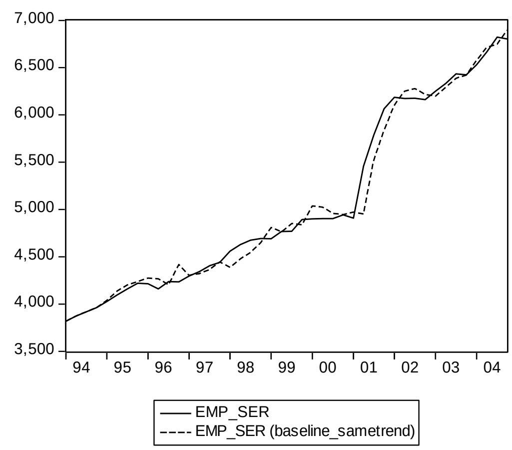
Employment rate utility



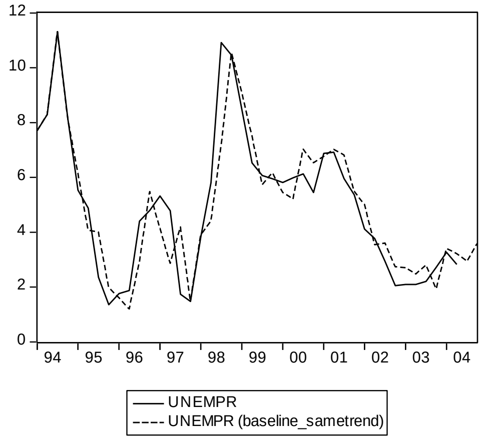
Employment rate transportation



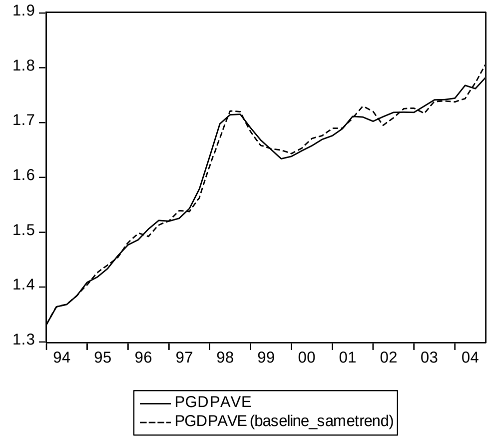
Employment rate service



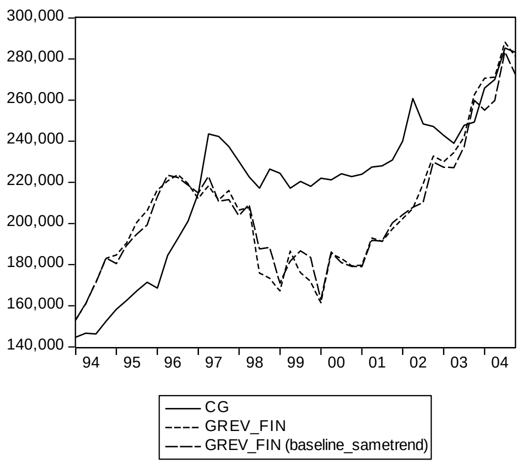
Unemployment rate (r)



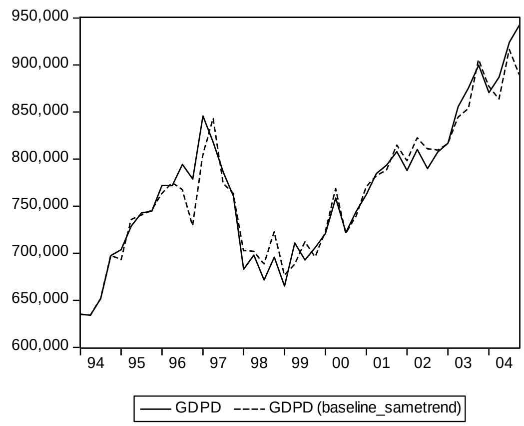
PGDP average



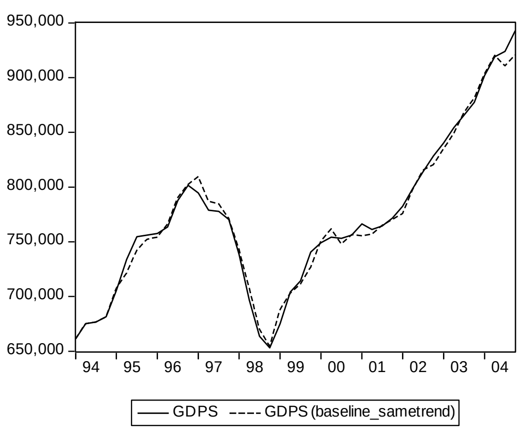
Budget deficit



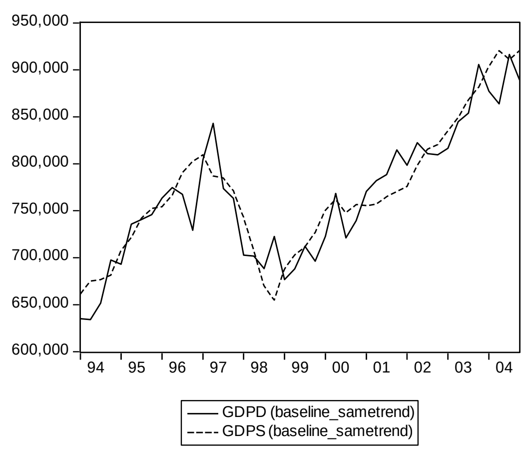
GDPD actual and GDPD baseline (adjusted factor)



GDPS actual and GDPS baseline



GDPD & GDPS baseline



APPENDIX E

SCENARIO RESULTS

E.1 Scenario 1

Scenario 1: World crude oil price increased by 50%, 100%, 150% and 200%

		Average percentage change				Average absolute change			
EQ		50%	100%	150%	200%	50%	100%	150%	200%
1	CAG	-0.32429	-0.566998	-0.762225	-0.926111	-125.5306	-219.4128	-294.89	-358.2256
2	TOAG	-0.356918	-0.62394	-0.838627	-1.018794	-470.3444	-821.95	-1104.489	-1341.5
3	PGDPAG	0.348688	0.611245	0.823413	1.002208	0.005581	0.009781	0.013173	0.01603
4	CMA	-0.942179	-1.646947	-2.213972	-2.690318	-2643.939	-4620.406	-6209.872	-7544.694
5	IMA	-4.294253	-7.393147	-9.816737	-11.80509	-4444.76	-7644.922	-10143.46	-12190.56
6	TOMA	-0.729187	-1.272862	-1.708882	-2.07402	-9200.778	-16053.61	-21545.22	-26141.28
7	PGDPMA	0.777198	1.364655	1.840749	2.242904	0.012088	0.021222	0.028624	0.034876
8	ICO	-2.619088	-4.542099	-6.066559	-7.331402	-1615.596	-2800.952	-3740.125	-4519.018
9	TOCO	-1.439326	-2.505588	-3.356473	-4.066155	-614.1028	-1069.091	-1432.178	-1735.005
10	PGDPCO	0.212438	0.372206	0.501193	0.609804	0.00438	0.007674	0.010332	0.01257
11	CUT	-0.550461	-0.958942	-1.285462	-1.558266	-60.30133	-105.0029	-140.7101	-170.5275
12	TOUT	-0.446532	-0.780328	-1.048534	-1.273525	-574.4667	-1003.478	-1347.95	-1636.767
13	PGDPUT	0.277138	0.489366	0.662899	0.810424	0.004827	0.008521	0.01154	0.014105
14	CTR	-0.752893	-1.31633	-1.769749	-2.150686	-305.5794	-534.0394	-717.7661	-872.0461
15	TOTR	-0.619359	-1.081344	-1.451931	-1.762319	-1934.4	-3375.828	-4531.256	-5498.461
16	PGDPTR	0.275132	0.481839	0.648542	0.788771	0.003782	0.006623	0.008915	0.010843
17	CSE	-0.995238	-1.736678	-2.331045	-2.828728	-1074.931	-1875.199	-2516.42	-3053.141
18	ISE	-3.191194	-5.517901	-7.352026	-8.866545	-37.17972	-64.13163	-85.28593	-102.6942
19	TOSE	-0.428576	-0.74899	-1.006491	-1.222502	-2473.922	-4322.772	-5808.161	-7053.922
20	PGDPSE	-0.056221	-0.098674	-0.133091	-0.162179	-0.00108	-0.001896	-0.002557	-0.003115
21	MFG	-1.059425	-1.839478	-2.459328	-2.974681	-470.6711	-816.7878	-1091.555	-1319.824
22	MIG	-1.373158	-2.393176	-3.209116	-3.891112	-3506.35	-6109.339	-8190.411	-9929.061
23	MEN	6.262703	11.2273	15.40153	19.03538	2911.791	5220.693	7162.169	8852.313
24	MSR	-0.188198	-0.329128	-0.442524	-0.537743	-116.3861	-203.4694	-273.4972	-332.2728
25	XGR	-0.217504	-0.382117	-0.515867	-0.629193	-921.8611	-1619.139	-2185.467	-2665.183
26	XSR	-0.092925	-0.162612	-0.218733	-0.26592	-92.49278	-161.8244	-217.6411	-264.5594
27	CPI	0.138981	0.243583	0.328052	0.399199	0.145717	0.255367	0.3439	0.418461
28	HHMI	-0.102513	-0.180035	-0.242988	-0.296276	-13.96389	-24.51667	-33.08222	-40.33056
29	POVL	0.118453	0.207765	0.280041	0.34103	1.409889	2.472611	3.332444	4.057889
30	POVS	0.149575	0.262757	0.354689	0.432551	0.001272	0.002238	0.003024	0.00369
31	WEALTH	-1.666076	-2.90497	-3.897175	-4.727555	-161.0817	-280.7626	-376.5485	-456.6691
32	PTAX	-0.950617	-1.658007	-2.224459	-2.698252	-166.6478	-290.5667	-389.7417	-472.6578
33	ATAX	-4.00709	-6.907899	-9.182256	-11.05208	-453.2158	-779.4774	-1034.238	-1243.019
34	PICTAX	-0.512737	-0.899739	-1.213506	-1.478886	-139.2889	-244.2878	-329.3461	-401.245
35	BICTAX	-1.089904	-1.908105	-2.568682	-3.125451	-467.315	-817.3556	-1099.551	-1337.151
36	ODTAX	1.001931	1.763055	2.382193	2.906699	702.4922	1235.247	1668.104	2034.471
37	OIDTAX	-0.290076	-0.509475	-0.687637	-0.838532	-74.705	-131.1333	-176.9156	-215.6672
38	CUTAX	-0.916131	-1.585993	-2.114874	-2.551968	-230.7744	-399.2922	-532.2122	-641.9772
39	OREV	-0.305938	-0.534615	-0.718367	-0.87249	-85.30722	-149.0283	-200.205	-243.1128
40	DTDI	-3.551056	-6.131046	-8.159327	-9.830458	-10037.48	-17322.39	-23044.93	-27756.82
41	NTC	-0.043189	-0.075621	-0.101772	-0.123769	-293.0111	-512.9722	-690.3056	-839.4444
42	NPC	-0.211681	-0.370374	-0.498187	-0.605606	-13779.44	-24101.39	-32410.33	-39390.72
43	SACC	-3.648143	-6.298205	-8.381453	-10.09786	-2495.652	-4300.266	-5714.186	-6876.112

44	SACP	-3.972468	-6.849378	-9.105695	-10.96114	-1350.307	-2322.741	-3082.344	-3705.056
45	PE_HD	14.73319	26.58019	36.65084	45.49659	1.051914	1.897271	2.615634	3.246483
46	EMP_AG	-0.361525	-0.635144	-0.857506	-1.045968	-49.98778	-87.82389	-118.5733	-144.6356
47	EMP_MA	-0.247925	-0.435075	-0.586769	-0.715024	-12.64433	-22.18583	-29.91789	-36.45417
48	EMP_CON	-0.712161	-1.248689	-1.683043	-2.049982	-12.278	-21.51617	-28.98883	-35.29794
49	EMP_UTI	-0.589006	-1.028733	-1.381721	-1.677563	-0.614902	-1.075668	-1.446416	-1.757667
50	EMP_TRA	-0.128742	-0.225658	-0.303978	-0.370024	-1.304856	-2.28695	-3.080478	-3.749567
51	EMP_SER	-0.154874	-0.270886	-0.364251	-0.442668	-9.161778	-16.01478	-21.52467	-26.149
ID									
1	CPR	-0.879157	-1.536069	-2.064068	-2.507215	-4210.267	-7354.044	-9879.661	-11998.62
2	IPR	-3.66147	-6.315692	-8.398974	-10.1133	-6097.528	-10510	-13968.86	-16812.25
3	MGR	-0.315116	-0.506639	-0.632278	-0.717653	-1065.211	-1705.417	-2119.772	-2396.561
4	MGS	-0.295063	-0.478328	-0.601643	-0.68813	-1181.606	-1908.894	-2393.267	-2728.833
5	XGS	-0.193723	-0.340219	-0.45915	-0.559848	-1014.333	-1780.956	-2403.106	-2929.733
6	GDPD	-1.242026	-2.173092	-2.923958	-3.556241	-10140.52	-17736.09	-23858.35	-29011.76
7	TOALL	-0.62186	-1.085706	-1.457817	-1.769507	-15268.06	-26646.78	-35769.39	-43406.94
8	GDPS	-0.578428	-1.009984	-1.356247	-1.646339	-4719.994	-8238.817	-11060.59	-13423.58
9	PGDPAVE	0.329157	0.57729	0.77795	0.947127	0.005634	0.00988	0.013313	0.016207
10	ICTAX	-0.864093	-1.513475	-2.038211	-2.480812	-606.6044	-1061.644	-1428.896	-1738.395
11	DTAX	0.072706	0.131494	0.181102	0.224116	95.88722	173.5989	239.2111	296.0883
12	IDTAX	-1.261226	-2.183568	-2.912719	-3.516423	-694.57	-1201.179	-1600.899	-1931.346
13	GREV	-0.365742	-0.630685	-0.83869	-1.00998	-914.7722	-1575.906	-2094.122	-2520.361
14	PDH	7.938777	14.32036	19.74409	24.50754	1.051914	1.897271	2.615634	3.246483
15	UNEMPR	0.250868	0.440281	0.593874	0.72379				

Table E.1: Scenario 1 results

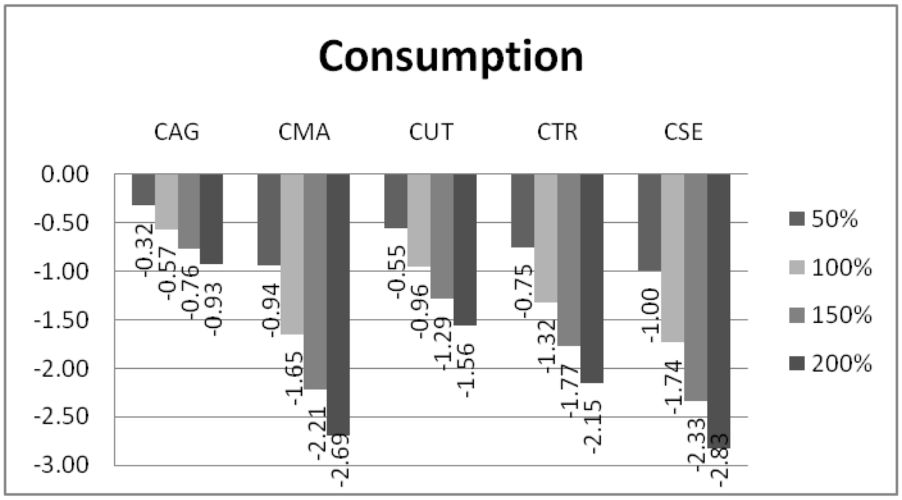


Figure E.1.1: Percentage change in consumption (Scenario 1)

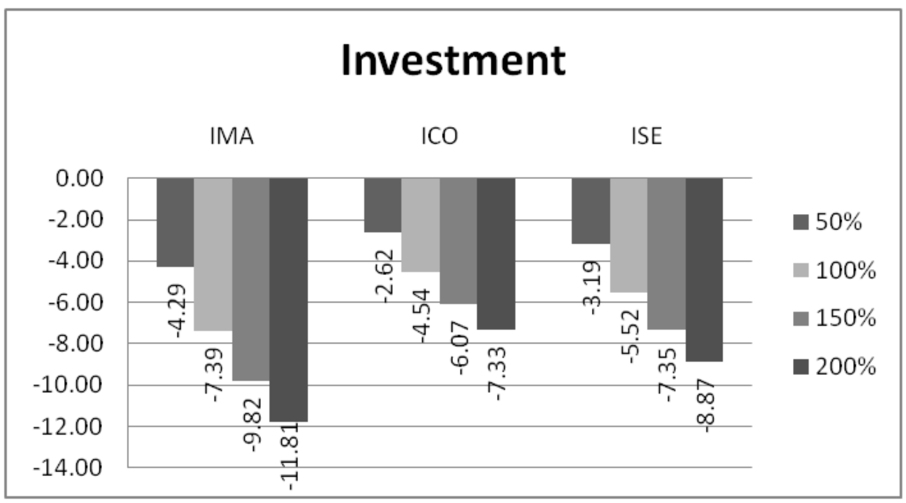


Figure E.1.2: Percentage change in investment (Scenario 1)

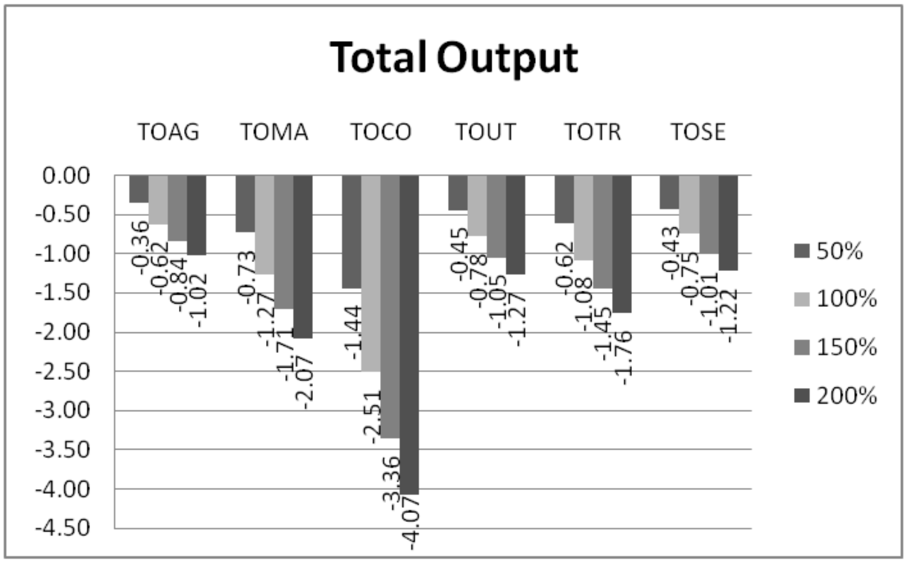


Figure E.1.3: Percentage change of total output (Scenario 1)

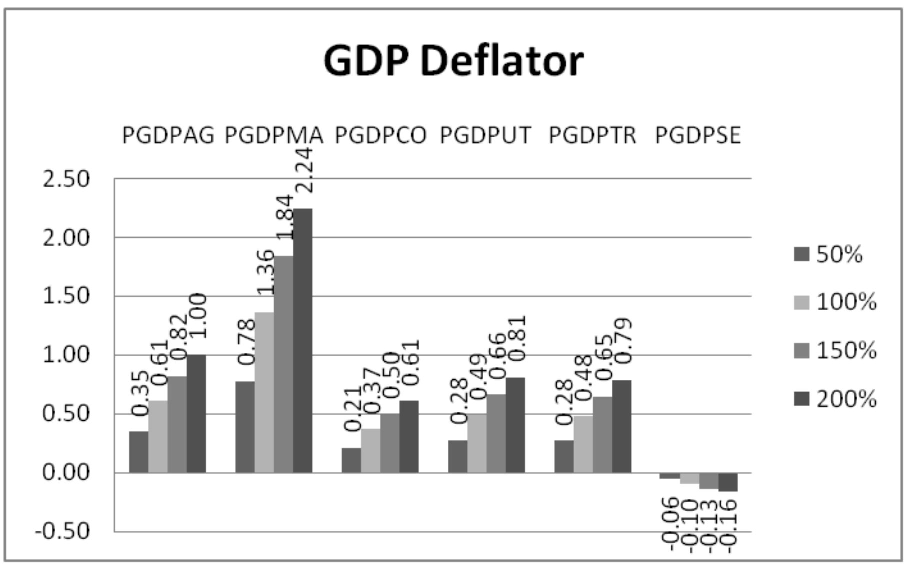


Figure E.1.4: Percentage change of GDP deflator (Scenario 1)

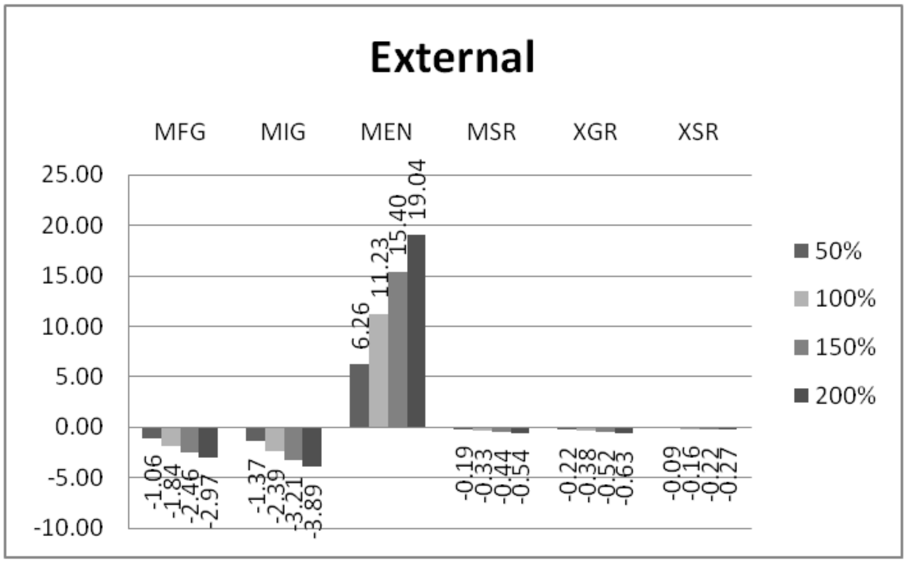


Figure E.1.5: Percentage change of imports and exports (Scenario 1)

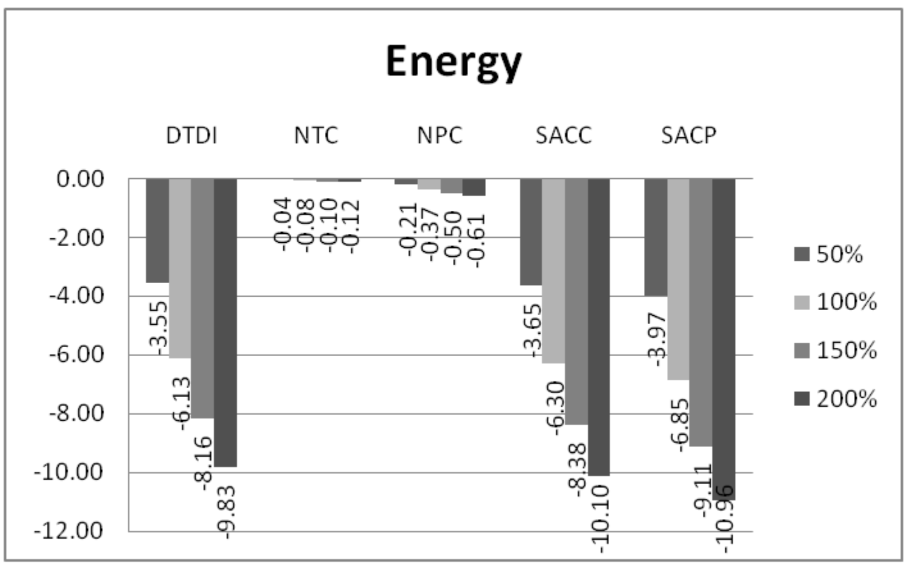


Figure E.1.6: Percentage change of energy variables (Scenario 1)

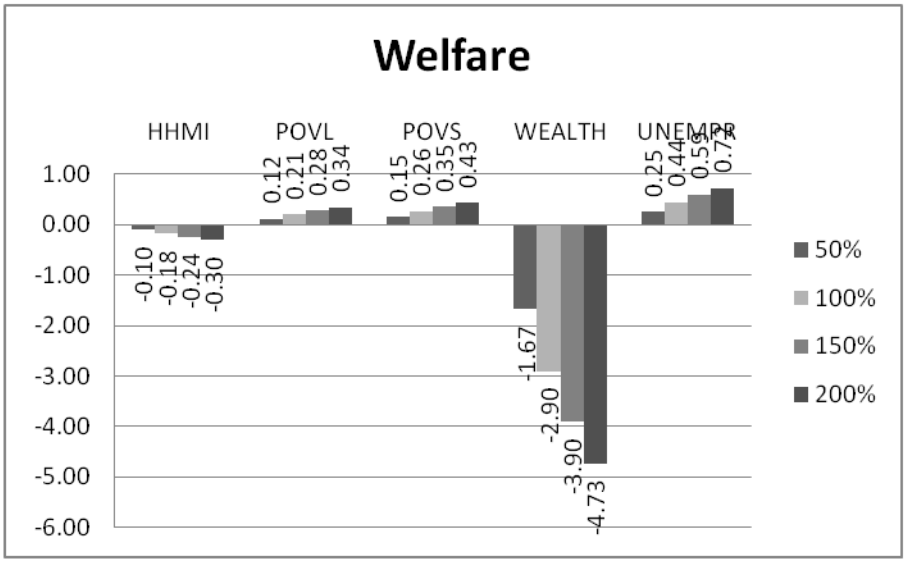


Figure E.1.7: Percentage change of welfare variables (Scenario 1)

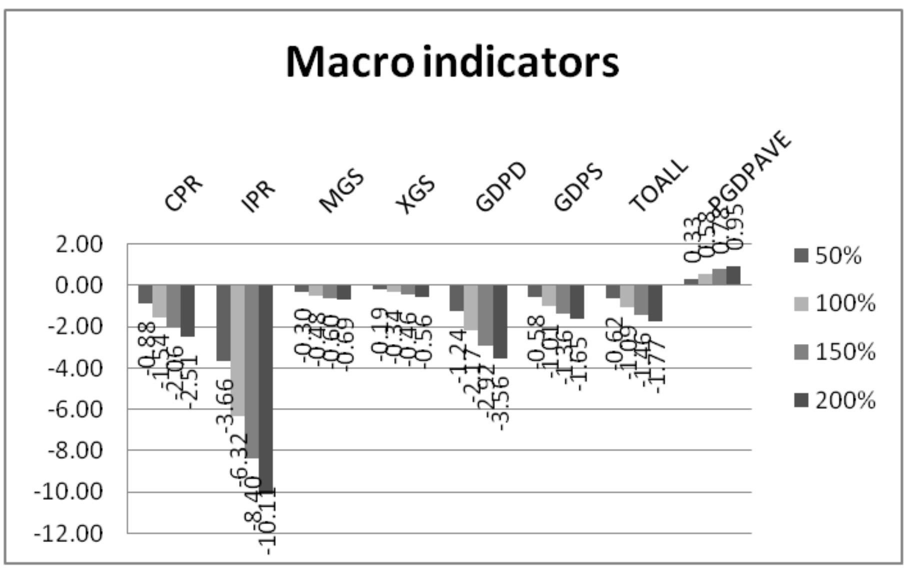


Figure E.1.8: Percentage change of selected macro variables (Scenario 1)

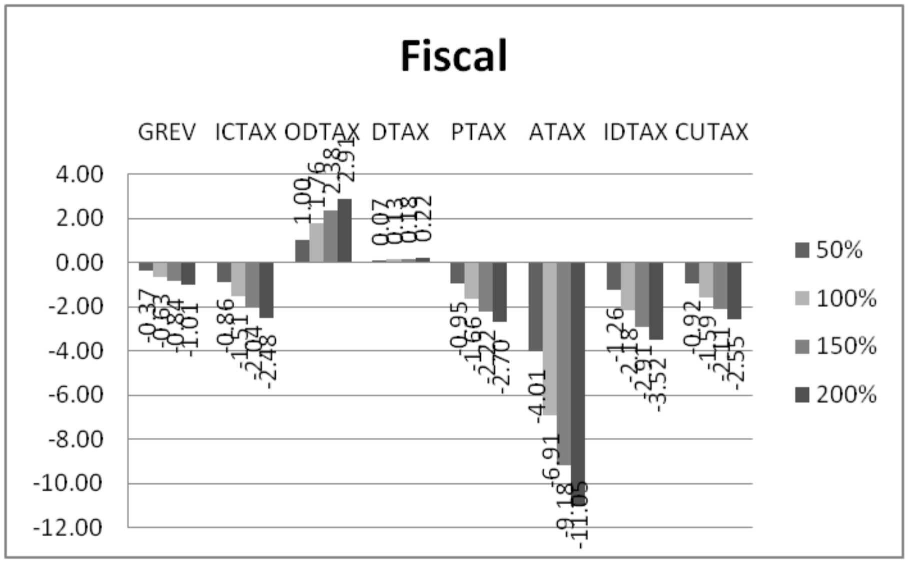


Figure E.1.9: Percentage change of fiscal variables (Scenario 1)

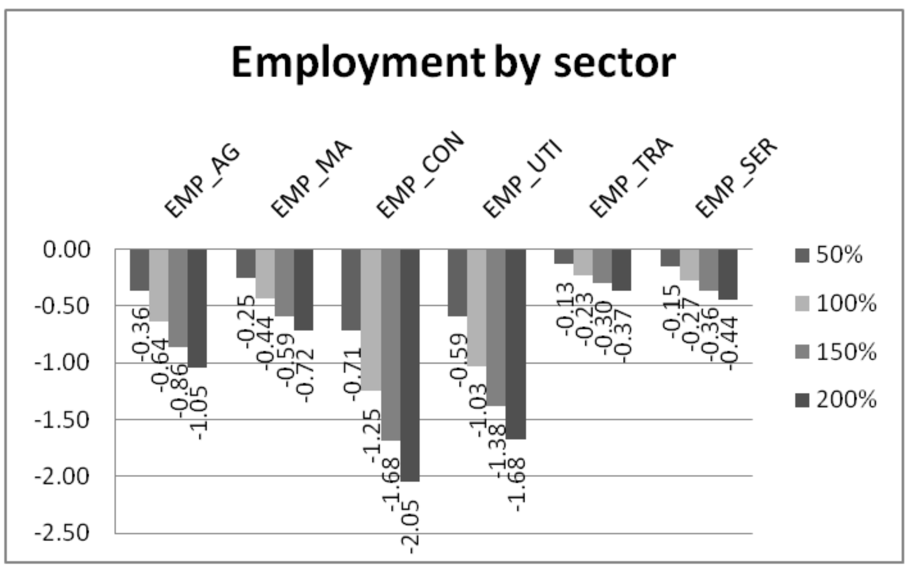


Figure E.1.10: Percentage change of employment by sector (Scenario 1)

E.2 Scenario 2

Scenario 2: World crude oil price increased by 50%, Counter by increasing oil subsidy 1, 2, 3, 4 baht per litre

		Average percentage change				Average absolute change			
EQ		50%	100%	150%	200%	50%	100%	150%	200%
1	CAG	-0.012098	0.326184	0.695263	1.10124	-6.107222	123.2628	264.3667	419.5178
2	TOAG	-0.013337	0.359177	0.765804	1.213349	-23.30556	461.2389	989.9722	1571.667
3	PGDPAG	0.013022	-0.348231	-0.739468	-1.166333	0.000279	-0.005426	-0.011603	-0.01834
4	CMA	-0.040637	0.937851	2.008724	3.192475	-145.3056	2565.911	5532.256	8810.139
5	IMA	-0.158335	4.511607	9.839938	15.99595	-296.5078	4381.748	9711.876	15859.08
6	TOMA	-0.02719	0.736751	1.574135	2.499954	-499.8889	8965.778	19337.56	30799.5
7	PGDPMA	0.029079	-0.772646	-1.636885	-2.575097	0.000495	-0.011926	-0.025315	-0.039847
8	ICO	-0.102292	2.685204	5.801101	9.322738	-78.21611	1624.437	3527.581	5678.41
9	TOCO	-0.05357	1.465469	3.143735	5.015385	-22.31667	626.605	1343.836	2144.106
10	PGDPCO	0.007935	-0.212467	-0.451507	-0.712764	0.000185	-0.004337	-0.00924	-0.014599
11	CUT	-0.017992	0.565533	1.210571	1.931001	-2.902278	59.97017	129.4307	206.9557
12	TOUT	-0.01666	0.449814	0.959508	1.521112	-30.19444	560.2111	1205.05	1915.2
13	PGDPUT	0.013781	-0.262907	-0.553924	-0.860258	0.000295	-0.004467	-0.009475	-0.014748
14	CTR	-0.03129	0.751388	1.607132	2.551756	-17.62444	294.5756	635.755	1012.146
15	TOTR	-0.022711	0.62619	1.336889	2.121814	-101.0389	1892.111	4074.061	6482.517
16	PGDPTR	0.009858	-0.276238	-0.586692	-0.925991	0.000124	-0.003821	-0.008102	-0.012782
17	CSE	-0.038816	1.003306	2.147687	3.416034	-53.61556	1058.892	2280.139	3633.102
18	ISE	-0.118063	3.311773	7.175987	11.57894	-4.244944	32.43264	73.64869	120.4646
19	TOSE	-0.015995	0.431622	0.920638	1.459337	-111.0222	2452.117	5251.772	8335.133
20	PGDPSE	-0.002492	0.055242	0.117781	0.186153	-5.02E-05	0.001056	0.002255	0.003565
21	MFG	-0.047699	1.068861	2.312501	3.712982	-31.29556	453.3628	992.8567	1599.943
22	MIG	-0.054087	1.388007	2.977491	4.746632	-202.3389	3407.678	7383.889	11805.82
23	MEN	0.237036	-5.883616	-12.10903	-18.451	189.7461	-2574.764	-5386.055	-8249.324
24	MSR	-0.007086	0.189048	0.402889	0.637931	-6.033889	113.4333	243.6367	386.6822
25	XGR	-0.010551	0.211423	0.451613	0.714288	-61.15556	861.4278	1858.95	2948.822
26	XSR	-0.003468	0.093259	0.198537	0.314036	-4.232778	91.18167	195.0078	308.8828
27	CPI	0.006008	-0.137103	-0.292015	-0.460914	0.006806	-0.142683	-0.304483	-0.480872
28	HHMI	-0.004865	0.099877	0.213178	0.336941	-0.847778	13.21667	28.42444	45.02833
29	POVL	0.005262	-0.116373	-0.247931	-0.391382	0.070111	-1.369444	-2.926222	-4.623444
30	POVS	0.009054	-0.1414	-0.303781	-0.48069	0.0000051	-0.001354	-0.002822	-0.004425
31	WEALTH	-0.076408	1.659379	3.571404	5.699795	-10.46744	153.9277	334.9342	536.3181
32	PTAX	-0.03551	0.96256	2.059224	3.274948	-8.247778	164.4756	354.2122	564.4828
33	ATAX	-0.152605	4.183675	9.112188	14.78294	-47.05861	408.9772	926.0786	1519.333
34	PICTAX	-0.024869	0.499979	1.069697	1.694905	-10.38667	128.1972	278.5111	443.3061
35	BICTAX	-0.052823	1.069329	2.295064	3.649321	-43.12333	415.1661	914.8278	1465.598
36	ODTAX	0.047622	-0.968106	-2.054513	-3.223299	55.95889	-631.7206	-1366.663	-2156.572
37	OIDTAX	-0.014063	0.282199	0.603023	0.954183	-6.156667	67.36667	146.9178	233.9028
38	CUTAX	-0.037723	0.937664	2.029272	3.262536	-13.08778	228.5789	498.9694	804.3489
39	OREV	-0.01086	0.309456	0.659639	1.045703	-4.064444	84.10556	180.4689	286.6694
40	DTDI	-0.131354	3.700439	8.036141	12.99972	-495.0056	10195.84	22290.59	36134.07
41	NTC	-0.001651	0.043206	0.09197	0.145409	-12.47222	290.4333	619.6722	980.3944
42	NPC	-0.008098	0.212119	0.451968	0.715333	-677.0556	13492.72	28921.44	45857.17
43	SACC	-0.138262	3.795278	8.247524	13.34701	-231.755	2301.454	5163.312	8433.579
44	SACP	-0.150412	4.147624	9.030515	14.64607	-138.685	1220.896	2761.473	4527.555
45	PE_HD	14.73319	14.73319	14.73319	14.73319	1.051914	1.051914	1.051914	1.051914
46	EMP_AG	-0.018093	0.350354	0.749241	1.185934	-2.446111	48.56222	103.7894	164.2578
47	EMP_MA	-0.011378	0.242966	0.518735	0.820754	-0.677	12.18767	26.13194	41.39817
48	EMP_CON	-0.034528	0.695917	1.490525	2.364555	-0.901889	11.35161	24.66917	39.30083
49	EMP_UTI	-0.021973	0.594224	1.268609	2.012938	-8.28E-05	0.668397	1.400468	2.209114

50	EMP_TRA	-0.005348	0.127648	0.272067	0.430311	-0.059761	1.282161	2.739261	4.335739
51	EMP_SER	-0.005829	0.155519	0.331373	0.524583	-0.526333	8.818278	18.99839	30.17689
ID									
1	CPR	-0.036548	0.87895	1.881744	2.990895	-225.5667	4102.628	8841.972	14081.89
2	IPR	-0.145493	3.803065	8.282656	13.42675	-378.9667	6038.628	13313.11	21657.94
3	MGR	-0.006433	0.394226	0.906491	1.556529	-43.86667	1286.289	2990.706	5156.433
4	MGS	-0.006576	0.362016	0.827739	1.413249	-49.89444	1399.717	3234.344	5543.117
5	XGS	-0.009383	0.18849	0.4027	0.637021	-65.40556	952.6167	2053.95	3257.706
6	GDPD	-0.060185	1.220562	2.621842	4.17284	-619.9944	9694.15	20974.68	33454.42
7	TOALL	-0.02338	0.627587	1.340741	2.128723	-787.7778	14958	32202.22	51248
8	GDPS	-0.021737	0.583632	1.246653	1.979041	-236.9889	4636.761	9973.022	15865.38
9	PGDPAVE	0.014219	-0.324044	-0.689465	-1.08699	0.000264	-0.005502	-0.011731	-0.018507
10	ICTAX	-0.044874	0.840179	1.805302	2.869638	-53.50833	543.3639	1193.341	1908.906
11	DTAX	-0.000498	-0.071955	-0.139258	-0.198822	2.452778	-88.35778	-173.3161	-247.65
12	IDTAX	-0.071344	1.249117	2.728522	4.404989	-61.46556	640.8172	1427.206	2317.714
13	GREV	-0.01924	0.370133	0.812567	1.321875	-76.17778	865.1333	1933.322	3161.061
14	PDH	0.301819	-7.33514	-14.9721	-22.60905	0.051914	-0.948086	-1.948086	-2.948086
15	UNEMPR	0.012309	-0.244161	-0.52231	-0.82717				

Table E.2: Scenario 2 results

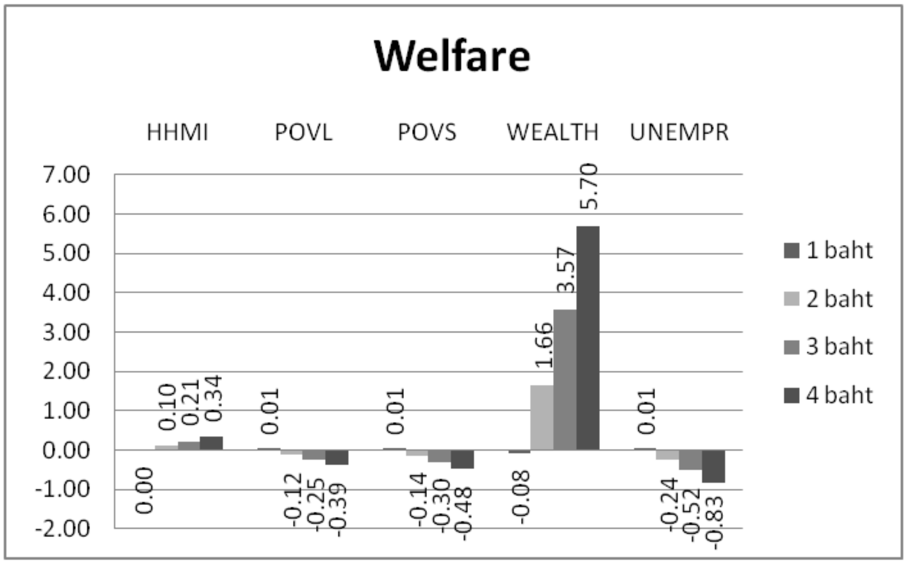


Figure E.2.1: Percentage change of welfare variables (Scenario 2)

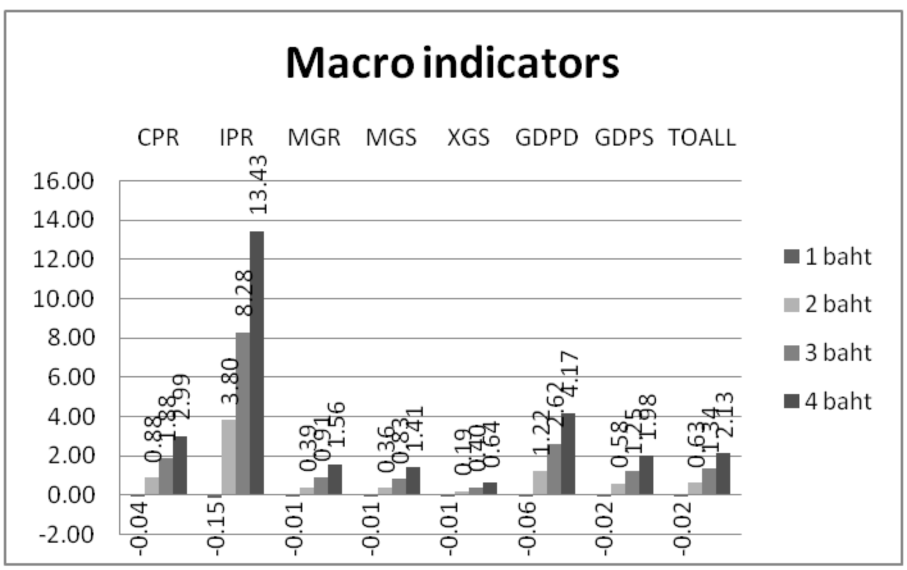


Figure E.2.2: Percentage change of selected macro variables (Scenario 2)

E.3 Scenario 3

Scenario 3: World crude oil price increased by 200%, Counter by increasing oil subsidy 2,3,4,5 baht per litre

		Average percentage change				Average absolute change			
EQ		50%	100%	150%	200%	50%	100%	150%	200%
1	CAG	-0.370491	-0.060889	0.274595	0.640666	-145.9761	-27.76722	100.2694	239.9078
2	TOAG	-0.407755	-0.067029	0.302375	0.705678	-547.6278	-105.1944	374.2556	897.4167
3	PGDPAG	0.398951	0.065876	-0.292583	-0.680823	0.006514	0.001263	-0.004387	-0.010503
4	CMA	-1.086786	-0.193318	0.776294	1.837503	-3106.633	-635.0944	2045.933	4978.75
5	IMA	-4.86328	-0.774785	3.843279	9.116218	-5264.864	-1194.898	3393.639	8621.031
6	TOMA	-0.832353	-0.13643	0.620918	1.451232	-10785.61	-2184.778	7170.167	17419.89
7	PGDPMA	0.890084	0.14742	-0.648389	-1.506325	0.013921	0.002419	-0.009904	-0.023186
8	ICO	-2.987978	-0.497278	2.261596	5.346624	-1869.962	-351.2161	1330.764	3211.22
9	TOCO	-1.640399	-0.267465	1.237625	2.900944	-699.2122	-112.6867	530.5656	1241.807
10	PGDPCO	0.242992	0.040085	-0.178582	-0.41578	0.005048	0.000888	-0.003594	-0.008456
11	CUT	-0.623404	-0.095111	0.483948	1.124319	-69.94894	-13.16378	49.0305	117.7472
12	TOUT	-0.51004	-0.08377	0.378776	0.884276	-671.95	-133.6444	450.1333	1087.683
13	PGDPUT	0.324157	0.063162	-0.210925	-0.499012	0.005747	0.001261	-0.00345	-0.008402
14	CTR	-0.866338	-0.151005	0.624811	1.473122	-360.5083	-75.83389	232.7	569.7861
15	TOTR	-0.706319	-0.114784	0.528582	1.233359	-2260.15	-447.5167	1522.7	3679.339
16	PGDPTR	0.31381	0.050635	-0.23323	-0.541283	0.004292	0.000661	-0.003255	-0.007506
17	CSE	-1.139095	-0.191193	0.841648	1.976027	-1251.345	-241.0911	859.1667	2066.902
18	ISE	-3.622916	-0.582482	2.811654	6.637642	-47.24239	-15.22694	20.38684	60.36428
19	TOSE	-0.489534	-0.08042	0.363446	0.848438	-2860.061	-519.9611	2018.239	4790.739
20	PGDPSE	-0.06514	-0.011837	0.045436	0.107465	-0.001256	-0.000234	0.000863	0.002051
21	MFG	-1.220806	-0.220537	0.883295	2.112943	-560.6383	-128.125	348.7444	879.4044
22	MIG	-1.571619	-0.264745	1.164016	2.739127	-4132.456	-870.0278	2693.483	6617.856
23	MEN	7.257662	1.243018	-4.865989	-11.07913	3535.341	820.86	-1935.549	-4738.147
24	MSR	-0.215159	-0.035541	0.158967	0.371069	-136.0644	-26.88222	91.28944	220.07
25	XGR	-0.253891	-0.048585	0.171563	0.409747	-1106.533	-254.8889	657.4167	1643.283
26	XSR	-0.106221	-0.017488	0.078456	0.18288	-107.16	-19.73556	74.76389	177.5767
27	CPI	0.160463	0.028626	-0.113238	-0.266775	0.169161	0.031511	-0.116589	-0.27685
28	HHMI	-0.11942	-0.022559	0.081325	0.193673	-16.605	-3.619444	10.3	25.34333
29	POVL	0.137142	0.024899	-0.095705	-0.226143	1.645944	0.318444	-1.107667	-2.649722
30	POVS	0.177865	0.038704	-0.110236	-0.270909	0.001382	0.000117	-0.001239	-0.002706
31	WEALTH	-1.926885	-0.353531	1.364179	3.256328	-191.9677	-43.38722	118.7186	297.1498
32	PTAX	-1.08475	-0.177739	0.811535	1.898761	-193.8233	-37.15111	133.6667	321.315
33	ATAX	-4.549548	-0.739443	3.548078	8.424183	-566.4152	-171.5691	271.2346	772.7499
34	PICTAX	-0.598058	-0.114266	0.406049	0.970769	-169.1033	-41.76833	95.02667	243.295
35	BICTAX	-1.269348	-0.24177	0.869798	2.083855	-581.4328	-164.2656	285.8783	776.0244
36	ODTAX	1.167356	0.220701	-0.786727	-1.864151	859.7944	221.2611	-457.5661	-1182.672
37	OIDTAX	-0.33853	-0.064748	0.229042	0.547153	-91.86944	-24.18889	48.34556	126.7667
38	CUTAX	-1.047059	-0.178864	0.785288	1.864675	-270.0667	-55.62278	182.4167	448.7661
39	OREV	-0.348441	-0.05574	0.262003	0.609426	-99.04278	-18.61333	68.66278	164.0461
40	DTDI	-4.028274	-0.645953	3.144983	7.437014	-11601.94	-2188.278	8359.344	20296.87
41	NTC	-0.049462	-0.008254	0.036239	0.084614	-337.8444	-59.75	240.4556	566.7611
42	NPC	-0.242313	-0.040403	0.178	0.415897	-16042.39	-3072.111	10951.78	26219.78
43	SACC	-4.144101	-0.673393	3.217192	7.623309	-3074.691	-865.8967	1603.293	4390.358
44	SACP	-4.509219	-0.730809	3.519355	8.350857	-1684.215	-505.825	814.9028	2309.73
45	PE_HD	45.49659	45.49659	45.49659	45.49659	3.246483	3.246483	3.246483	3.246483
46	EMP_AG	-0.423047	-0.082397	0.28292	0.67837	-58.39944	-11.23556	39.34833	94.11111
47	EMP_MA	-0.287962	-0.053315	0.198929	0.472398	-14.86317	-3.005444	9.736667	23.54467
48	EMP_CON	-0.830236	-0.158445	0.565471	1.352914	-14.87267	-3.639889	8.449	21.57806
49	EMP_UTI	-0.672551	-0.110359	0.500598	1.169347	-0.662657	-0.049333	0.617922	1.349261

50	EMP_TRA	-0.148362	-0.02596	0.105957	0.249216	-1.513922	-0.279556	1.050633	2.495033
51	EMP_SER	-0.177074	-0.029255	0.130762	0.305189	-10.79928	-2.263056	6.971389	17.02928
ID									
1	CPR	-1.011263	-0.176123	0.731185	1.725103	-4934.422	-992.9556	3287.1	7973.111
2	IPR	-4.169079	-0.694879	3.207471	7.636906	-7182.061	-1561.311	4744.789	11892.62
3	MGR	-0.333748	-0.03359	0.357695	0.859845	-1157.728	-177.2444	1106.706	2759.139
4	MGS	-0.314891	-0.033942	0.326367	0.783129	-1293.794	-204.1444	1197.989	2979.2
5	XGS	-0.226042	-0.043186	0.153027	0.36542	-1213.683	-274.6167	732.1778	1820.861
6	GDPD	-1.445938	-0.275174	0.993225	2.380883	-12036.37	-2624.733	7566.089	18707.41
7	TOALL	-0.710258	-0.11695	0.528396	1.235526	-17824.72	-3503.722	12066	29116.78
8	GDPS	-0.660672	-0.108778	0.491385	1.14883	-5498.956	-1064.1	3756.556	9034.617
9	PGDPAVE	0.38017	0.067886	-0.267493	-0.629798	0.006545	0.001223	-0.004491	-0.010662
10	ICTAX	-1.012104	-0.200771	0.675431	1.630688	-750.5367	-206.0311	380.9039	1019.321
11	DTAX	0.078156	0.004569	-0.06749	-0.135639	109.2639	15.23833	-76.66222	-163.345
12	IDTAX	-1.476204	-0.304246	0.995776	2.451913	-852.1122	-232.9128	453.2428	1220.828
13	GREV	-0.425034	-0.083686	0.299804	0.735564	-1111.967	-291.9389	627.6389	1670.289
14	PDH	9.233622	1.596664	-6.040292	-13.67725	1.246483	0.246483	-0.753517	-1.753517
15	UNEMPR	8.81988	2.657713	-3.951921	-11.10195	0.292893	0.056355	-0.197867	-0.473538
16	GDP_GAP	-42.6041	-6.496938	32.57749	75.39566	-6537.406	-1560.632	3809.54	9672.792

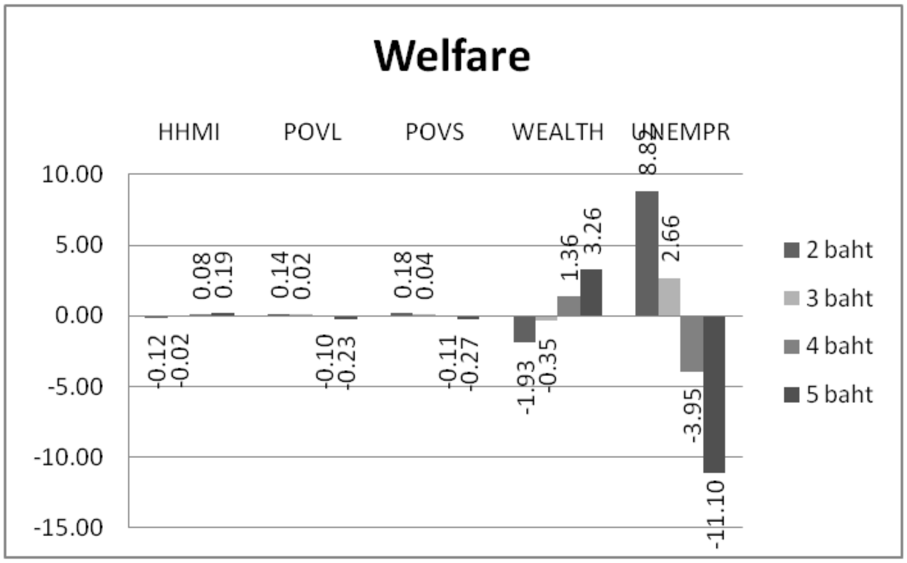


Figure E.3.1: Percentage change of welfare variables (Scenario 3)

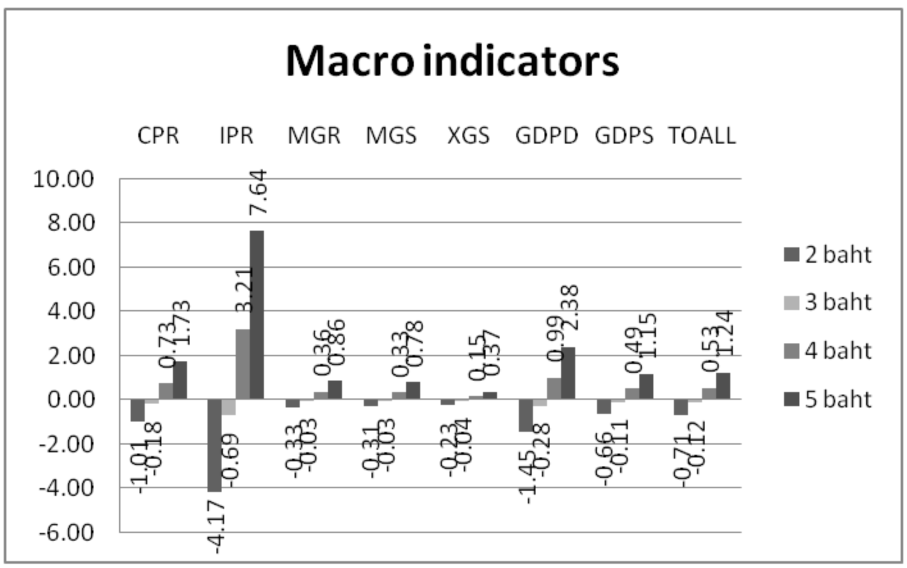


Figure E.3.2: Percentage change of selected macro variables (Scenario 3)

E.4 Scenario 4

Scenario 4: World crude oil price increased by 50%, counter with tax decrease of 25% ,50%, 75% and 100%

		Average percentage change				Average absolute change			
EQ		50%	100%	150%	200%	50%	100%	150%	200%
1	CAG	-0.122016	0.091145	0.316439	0.555255	-48.62222	32.38944	117.9711	208.64
2	TOAG	-0.134349	0.100292	0.34836	0.611426	-182.4722	120.8778	441.4278	781.1722
3	PGDPAG	0.130994	-0.097398	-0.337665	-0.591074	0.002169	-0.001408	-0.005171	-0.009136
4	CMA	-0.359663	0.254672	0.904866	1.595488	-1043.067	644.3222	2429.117	4323.6
5	IMA	-1.630555	1.253227	4.389453	7.816262	-1809.961	1037.897	4129.538	7501.001
6	TOMA	-0.274696	0.205619	0.714781	1.256195	-3630.889	2251.167	8481.444	15100.5
7	PGDPMA	0.291721	-0.216206	-0.748954	-1.309098	0.004571	-0.003293	-0.01154	-0.02021
8	ICO	-0.994916	0.74117	2.604252	4.611754	-632.8594	416.97	1542.864	2755.166
9	TOCO	-0.543086	0.408566	1.422478	2.506397	-233.9628	169.6128	599.5161	1059.016
10	PGDPCO	0.079833	-0.059412	-0.206038	-0.360838	0.001667	-0.001182	-0.004181	-0.007347
11	CUT	-0.205549	0.160625	0.550821	0.968176	-23.40344	15.74183	57.42289	101.9667
12	TOUT	-0.168113	0.125592	0.436296	0.766002	-224.9833	143.4556	532.95	945.95
13	PGDPUT	0.106443	-0.06988	-0.252104	-0.44042	0.001902	-0.001119	-0.004241	-0.007466
14	CTR	-0.286287	0.20564	0.726023	1.278416	-121.1361	73.18056	278.5778	496.4189
15	TOTR	-0.232938	0.175278	0.607818	1.067515	-756.7389	486.5389	1802.961	3200.933
16	PGDPTR	0.103053	-0.077746	-0.268193	-0.469348	0.001406	-0.001091	-0.003721	-0.006499
17	CSE	-0.376561	0.27772	0.971975	1.711114	-418.0611	276.285	1012.672	1796.213
18	ISE	-1.208614	0.921496	3.219455	5.70889	-16.93093	4.729817	27.98573	53.04677
19	TOSE	-0.161338	0.12051	0.418661	0.734985	-950.5	655.7111	2354.25	4155.633
20	PGDPSE	-0.021475	0.01494	0.053214	0.093575	-0.000415	0.000283	0.001015	0.001788
21	MFG	-0.407894	0.286785	1.030395	1.829601	-192.1817	104.3867	421.4144	761.6328
22	MIG	-0.520389	0.383422	1.344686	2.370668	-1392.306	846.3889	3225.206	5761.617
23	MEN	2.321875	-1.659346	-5.683627	-9.752362	1154.769	-619.9056	-2413.379	-4226.223
24	MSR	-0.070915	0.052629	0.183147	0.32143	-45.53222	29.06111	107.8133	191.1917
25	XGR	-0.083848	0.055983	0.202814	0.357591	-370.7056	205.5	810.0667	1446.767
26	XSR	-0.034956	0.026056	0.090432	0.158564	-35.59444	24.26889	87.40833	154.2028
27	CPI	0.053045	-0.037119	-0.13192	-0.231865	0.056083	-0.03795	-0.136806	-0.241011
28	HHMI	-0.039439	0.026554	0.095867	0.168902	-5.559444	3.229444	12.455	22.16944
29	POVL	0.045296	-0.03135	-0.111898	-0.196767	0.546556	-0.357778	-1.307944	-2.308833
30	POVS	0.059508	-0.034604	-0.133265	-0.237027	0.000433	-0.000446	-0.001369	-0.002343
31	WEALTH	-0.641444	0.44328	1.595908	2.825364	-65.44306	35.70567	143.0708	257.4559
32	PTAX	-0.358372	0.268426	0.933903	1.642678	-65	42.51944	156.6056	278.0344
33	ATAX	-1.524396	1.156829	4.065318	7.234838	-203.218	65.5925	355.7816	670.3218
34	PICTAX	-0.197786	0.132344	0.479722	0.846665	-57.41833	28.30611	118.3983	213.4311
35	BICTAX	-0.420956	0.282882	1.0264	1.815095	-199.4878	81.77444	378.2539	691.975
36	ODTAX	0.385584	-0.256322	-0.926244	-1.626751	291.0361	-137.0711	-583.3922	-1049.546
37	OIDTAX	-0.111837	0.074714	0.270724	0.477434	-31.63556	13.37167	60.57611	110.2561
38	CUTAX	-0.350862	0.25442	0.904757	1.605887	-92.51444	55.39667	214.16	385.1378
39	OREV	-0.114714	0.087055	0.300569	0.527221	-33.04333	22.07556	80.37167	142.2178
40	DTDI	-1.346411	1.028417	3.5974	6.388524	-3950.15	2601.95	9683.656	17370.5
41	NTC	-0.016277	0.012021	0.041861	0.073416	-111.5056	79.31667	280.5	493.2
42	NPC	-0.079805	0.059007	0.205551	0.360702	-5357.778	3502.444	12850.94	22742.39
43	SACC	-1.386192	1.050528	3.686791	6.551552	-1091.33	416.1839	2040.828	3798.697
44	SACP	-1.51056	1.147495	4.030032	7.170297	-599.1617	208.6433	1080.872	2026.514
45	PE_HD	14.73319	14.73319	14.73319	14.73319	1.051914	1.051914	1.051914	1.051914
46	EMP_AG	-0.139861	0.092023	0.335592	0.592408	-19.33389	12.73333	46.41611	81.93056
47	EMP_MA	-0.095041	0.065186	0.233704	0.411581	-4.936722	3.138778	11.62944	20.58833
48	EMP_CON	-0.274831	0.184175	0.667805	1.179413	-5.037222	2.554333	10.54344	18.983
49	EMP_UTI	-0.221808	0.165875	0.576437	1.012565	-0.20665	0.225112	0.683214	1.170873

50	EMP_TRA	-0.048885	0.034971	0.123289	0.216604	-0.502172	0.34055	1.227917	2.165261
51	EMP_SER	-0.058355	0.043298	0.150662	0.264386	-3.638944	2.172722	8.305278	14.79439

ID									
1	CPR	-0.33448	0.240388	0.849232	1.496317	-1654.283	1041.922	3895.772	6926.839
2	IPR	-1.396487	1.046798	3.694053	6.575347	-2459.733	1459.6	5700.389	10309.22
3	MGR	-0.120763	0.111602	0.387122	0.711858	-429.6889	330.9	1233.261	2297.05
4	MGS	-0.11297	0.102224	0.354976	0.650529	-475.2222	359.9611	1341.072	2488.222
5	XGS	-0.074668	0.049952	0.180877	0.318927	-406.3	229.7444	897.4778	1600.972
6	GDPD	-0.479871	0.322836	1.171687	2.073104	-4045.078	2371.344	9152.578	16348.82
7	TOALL	-0.23455	0.174606	0.608183	1.069039	-5979.444	3827.278	14212.5	25243.17
8	GDPS	-0.21819	0.16231	0.565444	0.993861	-1841.789	1196.683	4414.011	7830.906
9	PGDPAVE	0.125548	-0.087756	-0.311788	-0.547644	0.002167	-0.001463	-0.005276	-0.00929
10	ICTAX	-0.335936	0.219201	0.804997	1.425664	-256.9072	110.0817	496.6522	905.4044
11	DTAX	0.023879	-0.024508	-0.071899	-0.117524	34.11944	-26.99167	-86.73944	-144.1478
12	IDTAX	-0.500804	0.312347	1.185383	2.126575	-299.8561	121.4817	572.9578	1058.608
13	GREV	-0.145623	0.091662	0.348654	0.628357	-391.3	171.9556	780.7389	1441.822
14	PDH	2.933378	-2.072025	-7.077427	-12.08083	0.396263	-0.259388	-0.915039	-1.570428
15	UNEMPR	3.140266	-0.86563	-5.064384	-9.479831	0.097077	-0.064054	-0.233499	-0.412361
16	GDP_GAP	-14.99372	8.549142	33.37224	59.67587	-2203.295	1174.673	4738.577	8517.919

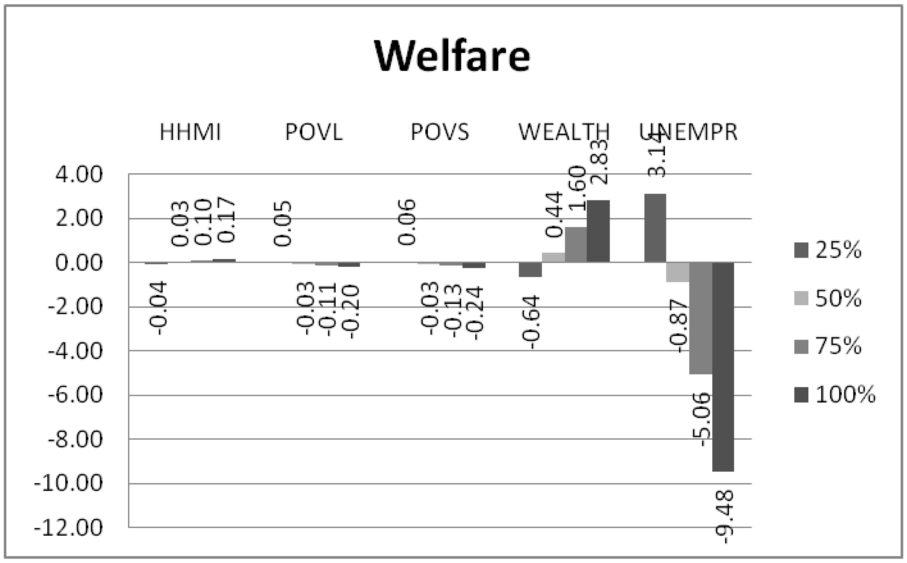


Figure E.4.1: Percentage change of welfare variables (Scenario 4)

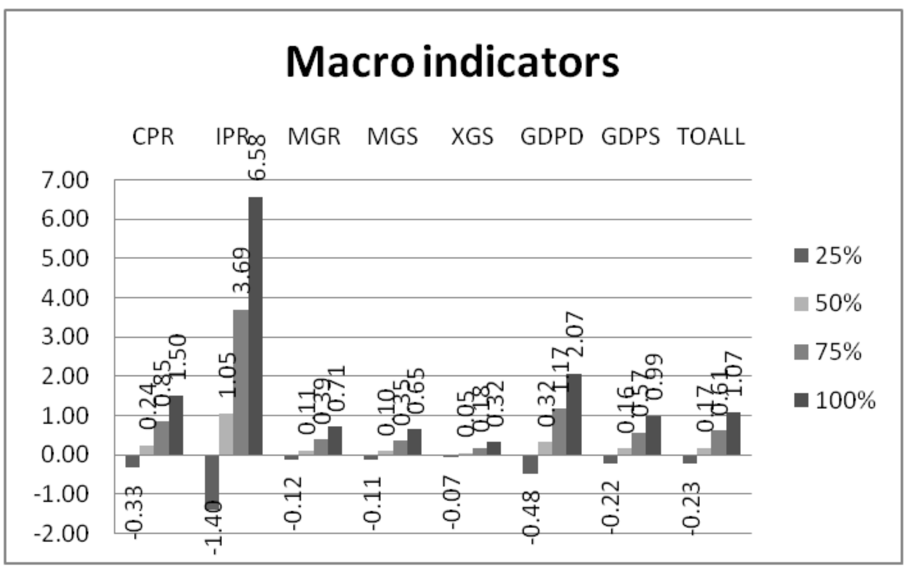


Figure E.4.2: Percentage change of selected macro variables (Scenario 4)

E.5 Scenario 5

Scenario 5: Reduction of automobile sales

EQ		Average percentage change				Average absolute change			
		50%	100%	150%	200%	50%	100%	150%	200%
1	CAG	0.001	0.003	0.005	0.007	0.573	1.213	1.939	2.777
2	TOAG	-0.102	-0.215	-0.343	-0.491	-132.622	-280.706	-448.400	-641.717
3	PGDPAG	-0.002	-0.003	-0.005	-0.008	0.000	0.000	0.000	0.000
4	CMA	-0.012	-0.025	-0.040	-0.057	-32.544	-68.867	-109.961	-157.267
5	IMA	0.020	0.043	0.069	0.098	20.446	43.312	69.254	99.212
6	TOMA	-0.208	-0.440	-0.702	-1.003	-2586.333	-5471.111	-8733.611	-12488.720
7	PGDPMA	0.038	0.081	0.130	0.186	0.001	0.001	0.002	0.003
8	ICO	0.000	0.000	0.000	0.000	0.063	0.150	0.271	0.442
9	TOCO	-0.411	-0.869	-1.385	-1.978	-175.364	-370.545	-590.729	-843.478
10	PGDPCO	-0.001	-0.002	-0.003	-0.005	0.000	0.000	0.000	0.000
11	CUT	0.007	0.015	0.024	0.034	0.765	1.622	2.593	3.716
12	TOUT	-0.127	-0.269	-0.430	-0.615	-161.600	-342.022	-546.261	-781.600
13	PGDPUT	0.066	0.140	0.223	0.320	0.001	0.002	0.004	0.006
14	CTR	-0.139	-0.294	-0.469	-0.672	-55.589	-117.632	-187.844	-268.732
15	TOTR	-0.185	-0.392	-0.627	-0.896	-572.811	-1211.839	-1934.711	-2767.056
16	PGDPTR	0.088	0.186	0.298	0.427	0.001	0.003	0.004	0.006
17	CSE	-0.243	-0.515	-0.821	-1.174	-260.635	-551.224	-879.689	-1257.594
18	ISE	0.015	0.032	0.051	0.073	0.161	0.342	0.546	0.783
19	TOSE	-0.122	-0.258	-0.412	-0.590	-700.228	-1482.011	-2366.978	-3386.872
20	PGDPSE	-0.007	-0.014	-0.023	-0.032	0.000	0.000	0.000	-0.001
21	MFG	-0.034	-0.072	-0.115	-0.164	-14.723	-31.139	-49.697	-71.051
22	MIG	-0.001	-0.001	-0.002	-0.003	-1.489	-3.100	-4.889	-6.883
23	MEN	-0.238	-0.503	-0.802	-1.147	-107.442	-227.238	-362.647	-518.437
24	MSR	-0.054	-0.114	-0.182	-0.261	-32.939	-69.734	-111.413	-159.480
25	XGR	-0.005	-0.010	-0.016	-0.023	-19.256	-40.750	-65.039	-93.011
26	XSR	-0.026	-0.056	-0.089	-0.128	-26.124	-55.317	-88.396	-126.576
27	CPI	0.008	0.017	0.027	0.039	0.008	0.018	0.029	0.041
28	HHMI	-0.003	-0.006	-0.010	-0.014	-0.393	-0.831	-1.329	-1.899
29	POVL	0.006	0.012	0.020	0.028	0.069	0.147	0.235	0.336
30	POVS	0.005	0.010	0.015	0.022	0.000	0.000	0.000	0.000
31	WEALTH	-0.066	-0.139	-0.222	-0.318	-6.213	-13.149	-21.003	-30.051
32	PTAX	-0.425	-0.897	-1.430	-2.041	-73.760	-155.834	-248.393	-354.602
33	ATAX	-10.947	-21.769	-32.45	-42.98	-1207.191	-2400.740	-3579.152	-4740.528
34	PICTAX	-0.011	-0.023	-0.037	-0.053	-2.886	-6.106	-9.745	-13.935
35	BICTAX	-0.024	-0.050	-0.079	-0.113	-9.463	-20.013	-31.944	-45.669
36	ODTAX	-0.120	-0.254	-0.405	-0.580	-81.011	-171.429	-273.756	-391.643
37	OIDTAX	-0.006	-0.013	-0.021	-0.030	-1.511	-3.198	-5.104	-7.299
38	CUTAX	-0.060	-0.128	-0.204	-0.292	-15.021	-31.792	-50.781	-72.663
39	OREV	-0.115	-0.243	-0.388	-0.555	-31.728	-67.151	-107.246	-153.447
40	DTDI	-1.023	-2.154	-3.420	-4.862	-2868.472	-6040.356	-9592.400	-13635.640
41	NTC	-0.122	-0.259	-0.414	-0.592	-827.589	-1751.522	-2797.467	-4002.928
42	NPC	-0.599	-1.264	-2.012	-2.869	-38662.83	-81610.33	-129952.50	-185303.90
43	SACC	NA	NA	NA	NA	NA	NA	NA	NA
44	SACP	-10.857	-21.604	-32.23	-42.71	-3608.746	-7181.203	-10713.250	-14199.630
45	PE_HD	NA	NA	NA	NA	NA	NA	NA	NA
46	EMP_AG	-0.009	-0.019	-0.031	-0.044	-1.251	-2.650	-4.229	-6.049
47	EMP_MA	-0.004	-0.008	-0.013	-0.018	-0.193	-0.407	-0.650	-0.930
48	EMP_CON	-0.015	-0.032	-0.052	-0.074	-0.255	-0.540	-0.863	-1.233
49	EMP_UTI	-0.168	-0.355	-0.567	-0.811	-0.181	-0.383	-0.612	-0.875

50	EMP_TRA	-0.024	-0.050	-0.080	-0.115	-0.239	-0.506	-0.809	-1.158
51	EMP_SER	-0.044	-0.094	-0.150	-0.215	-2.579	-5.459	-8.723	-12.487
52	PDH (REG)	-0.035	-0.074	-0.119	-0.170	-0.005	-0.010	-0.015	-0.022
ID									
1	CPR	-0.073	-0.155	-0.248	-0.354	-347.433	-734.911	-1172.972	-1677.100
2	IPR	0.013	0.027	0.043	0.061	20.661	43.789	70.056	100.422
3	MGR	-0.036	-0.076	-0.122	-0.174	-123.650	-261.478	-417.222	-596.356
4	MGS	-0.039	-0.082	-0.131	-0.188	-156.583	-331.211	-528.639	-755.850
5	XGS	-0.009	-0.019	-0.030	-0.043	-45.389	-96.061	-153.433	-219.589
6	GDPD	-0.027	-0.057	-0.090	-0.129	-215.572	-455.961	-727.694	-1040.406
7	TOALL	-0.178	-0.377	-0.602	-0.861	-4328.944	-9158.167	-14620.560	-20909.390
8	GDPS	-0.166	-0.350	-0.559	-0.800	-1338.233	-2831.250	-4520.089	-6464.694
9	PGDPAVE	0.019	0.041	0.065	0.093	0.000	0.001	0.001	0.002
10	ICTAX	-0.019	-0.039	-0.063	-0.089	-12.350	-26.121	-41.689	-59.606
11	DTAX	-0.070	-0.147	-0.235	-0.336	-93.367	-197.542	-315.454	-451.256
12	IDTAX	-2.350	-4.691	-7.025	-9.355	-1282.464	-2559.772	-3832.649	-5102.427
13	GREV	-0.577	-1.158	-1.746	-2.345	-1422.594	-2856.272	-4306.128	-5779.794
14	PDH	NA	NA	NA	NA	NA	NA	NA	NA
15	UNEMPR	0.358	0.757	1.210	1.731	0.014	0.029	0.047	0.067
16	GDP_GAP	7.409	15.676	25.028	35.798	1122.656	2375.294	3792.380	5424.287

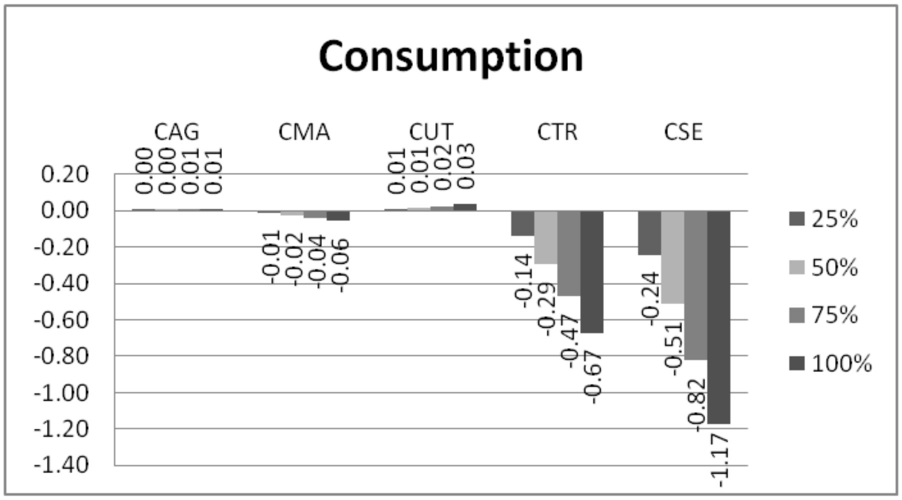


Figure E.5.1: Percentage change in consumption variables (Scenario 5)

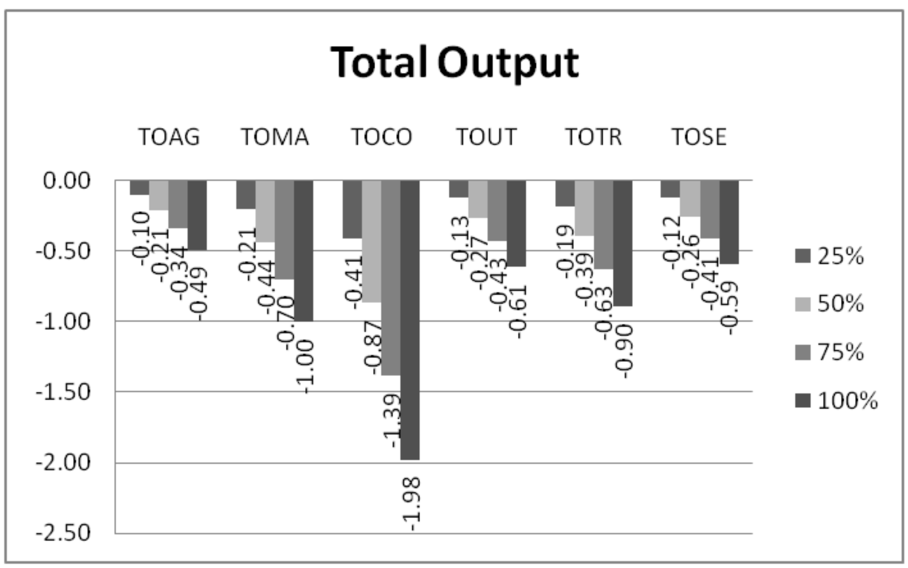


Figure E.5.2: Percentage change in total output variables (Scenario 5)

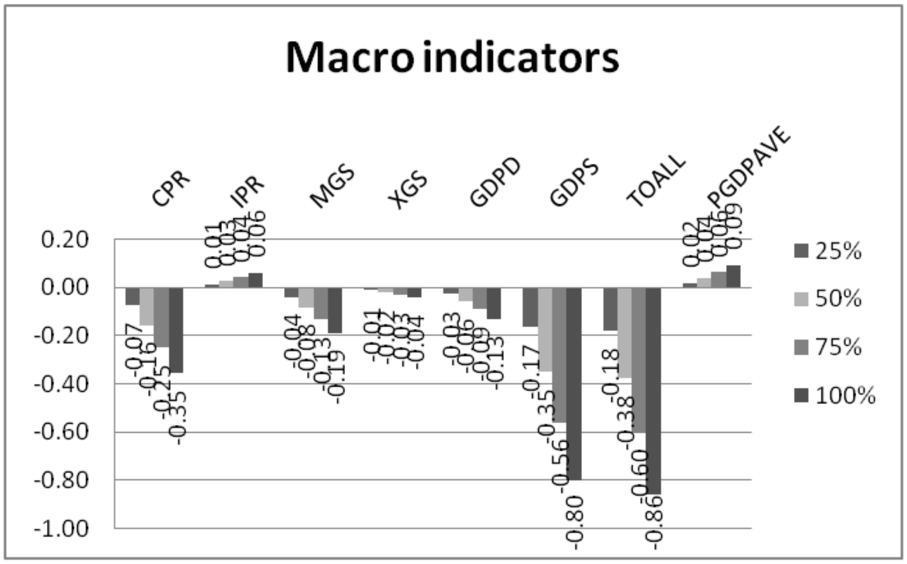


Figure E.5.3: Percentage change in selected macro variables (Scenario 5)

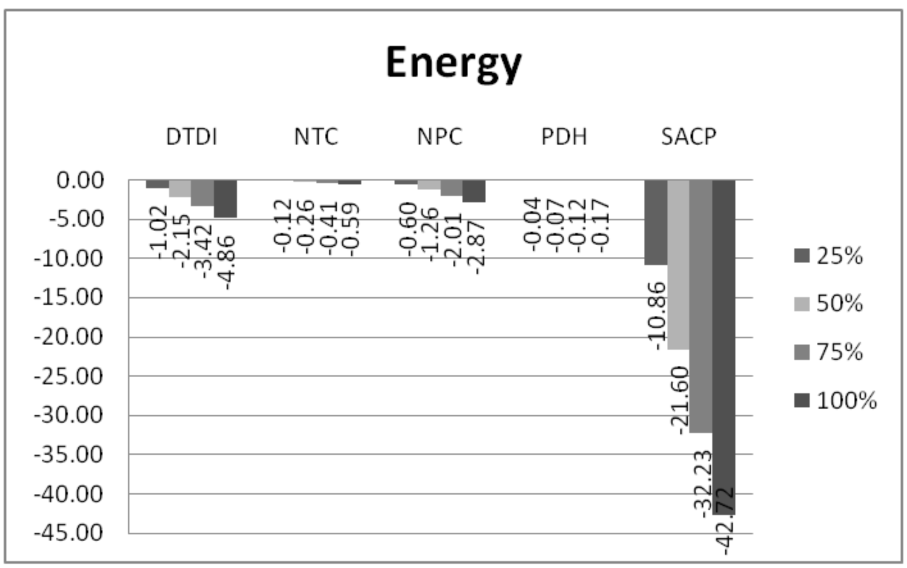


Figure E.5.4: Percentage change in energy variables (Scenario 5)

E.6 Scenario 6

Scenario 6: World crude oil price increased by 50%, endogenized i

EQ		Average percentage change				Average absolute change			
		50%	100%	150%	200%	50%	100%	150%	200%
1	CAG	-0.012	0.326	0.695	1.101	-6.107	123.263	264.367	419.518
2	TOAG	-0.235	0.136	0.542	0.988	-314.761	168.244	695.328	1275.200
3	PGDPAG	0.013	-0.348	-0.739	-1.166	0.000	-0.005	-0.012	-0.018
4	CMA	-0.091	0.881	1.946	3.122	-285.278	2408.394	5356.389	8614.928
5	IMA	-0.158	4.512	9.840	15.996	-296.508	4381.748	9711.876	15859.080
6	TOMA	-3.396	-2.658	-1.849	-0.954	-42535.39	-33419.56	-23430.72	-12391.33
7	PGDPMA	0.713	-0.094	-0.964	-1.908	0.011	-0.001	-0.015	-0.029
8	ICO	-0.080	2.703	5.815	9.331	-64.142	1635.873	3536.221	5684.069
9	TOCO	-0.949	0.555	2.217	4.071	-402.223	240.047	949.929	1742.008
10	PGDPCO	0.008	-0.212	-0.452	-0.713	0.000	-0.004	-0.009	-0.015
11	CUT	0.117	0.700	1.343	2.062	11.907	74.644	143.948	221.287
12	TOUT	-0.294	0.171	0.679	1.238	-386.333	201.839	844.294	1551.794
13	PGDPUT	0.329	0.049	-0.246	-0.556	0.006	0.001	-0.004	-0.009
14	CTR	-0.307	0.470	1.320	2.258	-129.066	180.856	519.626	893.452
15	TOTR	-0.431	0.215	0.923	1.705	-1373.206	610.744	2782.567	5179.739
16	PGDPTR	0.206	-0.081	-0.392	-0.732	0.003	-0.001	-0.005	-0.010
17	CSE	-0.555	0.480	1.616	2.875	-609.944	493.975	1705.893	3048.666
18	ISE	-7.945	-4.780	-1.213	2.853	-90.923	-57.369	-19.658	23.186
19	TOSE	-0.282	0.164	0.651	1.188	-1645.206	908.694	3698.267	6770.517
20	PGDPSE	-0.014	0.044	0.106	0.174	0.000	0.001	0.002	0.003
21	MFG	-0.137	0.976	2.217	3.614	-70.504	412.773	950.816	1556.364
22	MIG	-0.041	1.398	2.985	4.751	-167.867	3435.378	7404.617	11819.270
23	MEN	-1.948	-7.940	-14.035	-20.243	-822.923	-3522.641	-6267.976	-9063.995
24	MSR	-0.579	-0.385	-0.173	0.060	-358.237	-239.968	-111.068	30.548
25	XGR	0.000	0.220	0.458	0.718	-16.044	897.094	1885.094	2965.300
26	XSR	-0.061	0.035	0.141	0.256	-61.618	33.667	137.352	251.080
27	CPI	0.162	0.021	-0.132	-0.299	0.171	0.023	-0.137	-0.311
28	HHMI	-0.023	0.080	0.193	0.315	-3.319	10.591	25.635	42.074
29	POVL	0.105	-0.015	-0.145	-0.287	1.257	-0.165	-1.704	-3.381
30	POVS	0.047	-0.102	-0.262	-0.438	0.000	-0.001	-0.002	-0.004
31	WEALTH	-0.934	0.767	2.640	4.725	-92.053	68.833	245.998	443.142
32	PTAX	-0.600	0.392	1.482	2.690	-106.528	65.009	253.444	462.271
33	ATAX	-0.846	3.454	8.342	13.966	-123.809	328.054	840.423	1428.243
34	PICTAX	0.000	0.520	1.084	1.704	-3.624	133.572	282.478	445.839
35	BICTAX	0.000	1.111	2.326	3.669	-19.928	433.821	928.815	1474.773
36	ODTAX	-0.333	-1.323	-2.382	-3.521	-204.544	-874.349	-1590.257	-2359.783
37	OIDTAX	0.000	0.293	0.611	0.959	-2.507	70.266	149.058	235.274
38	CUTAX	-0.971	-0.011	1.064	2.278	-246.481	-8.797	257.088	557.311
39	OREV	-1.167	-0.850	-0.504	-0.122	-324.892	-237.814	-142.641	-37.750
40	DTDI	-2.347	1.399	5.637	10.489	-6703.939	3725.283	15524.340	29029.870
41	NTC	-0.009	0.036	0.084	0.138	-62.611	239.861	568.628	928.839
42	NPC	-0.044	0.176	0.415	0.678	-3027.722	11116.280	26517.560	43424.170
43	SACC	-0.769	3.135	7.553	12.614	-656.326	1855.532	4693.263	7935.961
44	SACP	-0.838	3.425	8.268	13.838	-367.784	979.378	2505.878	4255.810
45	PE_HD	14.733	14.733	14.733	14.733	1.052	1.052	1.052	1.052
46	EMP_AG	0.002	0.366	0.761	1.193	0.297	50.723	105.363	165.233
47	EMP_MA	-0.002	0.250	0.524	0.824	-0.207	12.559	26.403	41.567
48	EMP_CON	0.000	0.723	1.510	2.377	-0.303	11.829	25.022	39.526
49	EMP_UTI	-0.388	0.225	0.897	1.638	-0.383	0.282	1.011	1.816

50	EMP_TRA	-0.052	0.080	0.224	0.381	-0.535	0.800	2.251	3.841
51	EMP_SER	-0.477	-0.317	-0.142	0.049	-28.266	-19.004	-8.915	2.165
52	RD3M	19.414	19.414	19.414	19.414	0.409	0.409	0.409	0.409
ID									
1	CPR	-0.203	0.706	1.703	2.806	-1018.461	3281.144	7990.233	13197.880
2	IPR	-0.188	3.757	8.233	13.374	-451.572	5960.261	13228.430	21566.330
3	MGR	-0.300	0.117	0.646	1.313	-1061.300	325.494	2087.433	4311.633
4	MGS	-0.343	0.039	0.519	1.119	-1419.556	85.528	1976.372	4342.178
5	XGS	-0.012	0.184	0.396	0.629	-77.656	930.772	2022.428	3216.361
6	GDPD	0.000	1.268	2.657	4.195	-128.150	10086.640	21264.730	33638.390
7	TOALL	-1.904	-1.267	-0.570	0.201	-46657.33	-31290.06	-14460.44	4127.833
8	GDPS	-1.468	-0.874	-0.223	0.496	-11978.73	-7201.433	-1970.794	3805.022
9	PGDPAVE	0.385	0.050	-0.312	-0.705	0.007	0.001	-0.005	-0.012
10	ICTAX	-0.003	0.874	1.830	2.885	-23.553	567.394	1211.298	1920.613
11	DTAX	-0.171	-0.234	-0.292	-0.341	-228.089	-306.934	-378.937	-439.154
12	IDTAX	-0.392	0.917	2.385	4.047	-232.843	463.330	1242.924	2125.786
13	GREV	-0.414	-0.024	0.419	0.928	-1032.311	-90.239	978.417	2206.178
14	PDH	0.302	-7.335	-14.972	-22.609	0.052	-0.948	-1.948	-2.948
15	UNEMPR	2.664	-3.971	-11.164	-19.041	0.085	-0.169	-0.445	-0.747
16	GDP_GAP	79.828	116.321	156.236	200.515	11850.560	17288.080	23235.510	29833.350

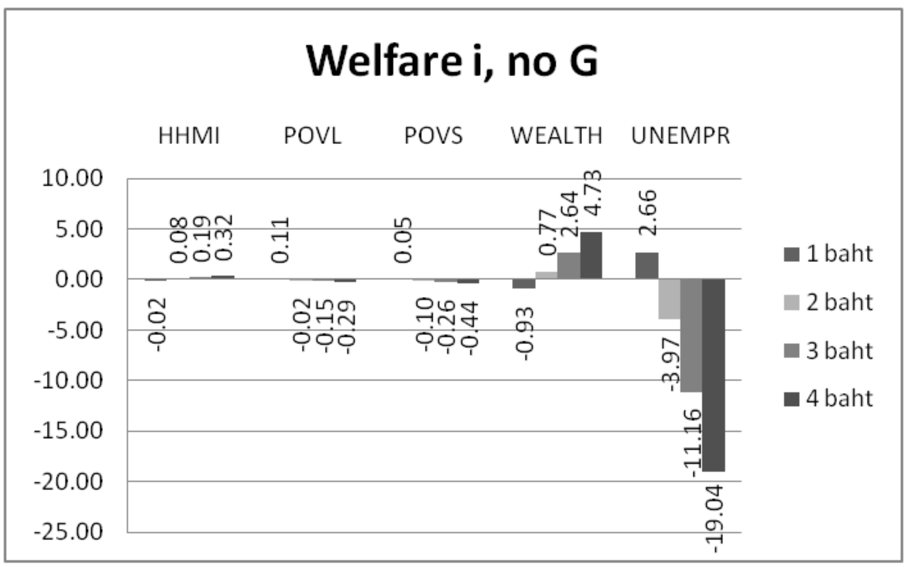


Figure E.6.1: Percentage change of welfare variables (Scenario 6)

E.7 Scenario 7

Scenario 7: World crude oil price increased by 50%, endogenized I, increase G

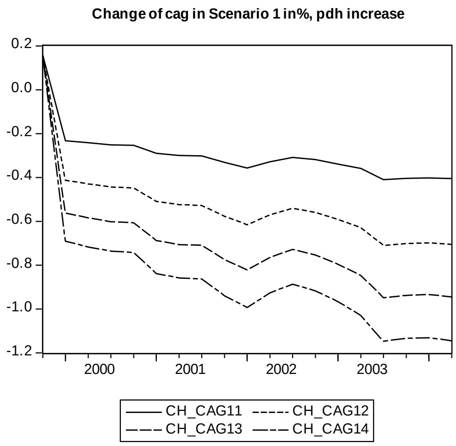
		Average percentage change				Average absolute change			
EQ		50%	100%	150%	200%	50%	100%	150%	200%
1	CAG	-0.012	0.326	0.695	1.101	-6.107	123.263	264.367	419.518
2	TOAG	-0.236	0.135	0.540	0.987	-316.422	166.594	693.700	1273.600
3	PGDPAG	0.013	-0.348	-0.739	-1.166	0.000	-0.005	-0.012	-0.018
4	CMA	0.299	1.269	2.332	3.507	792.133	3481.439	6424.833	9678.461
5	IMA	-0.158	4.512	9.840	15.996	-296.508	4381.748	9711.876	15859.080
6	TOMA	-3.398	-2.660	-1.851	-0.957	-42566.720	-33450.500	-23461.440	-12421.940
7	PGDPMA	0.714	-0.093	-0.963	-1.908	0.011	-0.001	-0.015	-0.029
8	ICO	0.319	3.108	6.225	9.749	178.748	1882.129	3786.217	5938.249
9	TOCO	-0.954	0.550	2.212	4.066	-404.402	237.866	947.744	1739.819
10	PGDPCO	0.008	-0.212	-0.452	-0.713	0.000	-0.004	-0.009	-0.015
11	CUT	0.219	0.800	1.442	2.160	22.838	85.473	154.669	231.895
12	TOUT	-0.296	0.169	0.677	1.237	-388.367	199.844	842.322	1549.839
13	PGDPUT	0.468	0.185	-0.112	-0.426	0.008	0.003	-0.002	-0.007
14	CTR	-0.064	0.712	1.560	2.497	-32.193	277.154	615.314	988.487
15	TOTR	-0.462	0.184	0.892	1.674	-1470.256	514.400	2686.944	5084.900
16	PGDPTR	0.239	-0.048	-0.360	-0.701	0.003	-0.001	-0.005	-0.010
17	CSE	-0.427	0.608	1.743	3.002	-473.122	630.343	1841.771	3184.049
18	ISE	-7.945	-4.780	-1.213	2.853	-90.923	-57.369	-19.658	23.186
19	TOSE	-0.284	0.162	0.650	1.186	-1653.956	900.033	3689.683	6762.006
20	PGDPSE	0.016	0.073	0.135	0.203	0.000	0.001	0.003	0.004
21	MFG	0.779	1.889	3.125	4.518	324.515	806.153	1342.408	1945.996
22	MIG	0.188	1.628	3.215	4.981	406.294	4009.828	7979.467	12394.570
23	MEN	-1.955	-7.947	-14.040	-20.248	-826.022	-3525.513	-6270.619	-9066.412
24	MSR	-0.581	-0.387	-0.175	0.058	-359.341	-241.058	-112.145	29.485
25	XGR	0.185	0.403	0.639	0.897	751.528	1655.906	2634.544	3704.733
26	XSR	-0.062	0.035	0.140	0.256	-61.934	33.334	137.027	250.756
27	CPI	0.172	0.030	-0.123	-0.290	0.181	0.033	-0.127	-0.302
28	HHMI	0.046	0.149	0.260	0.381	5.931	19.723	34.645	50.949
29	POVL	0.087	-0.033	-0.163	-0.304	1.042	-0.377	-1.912	-3.586
30	POVS	-0.043	-0.190	-0.350	-0.524	0.000	-0.002	-0.003	-0.005
31	WEALTH	-0.247	1.456	3.332	5.420	-27.504	133.590	310.985	508.382
32	PTAX	-0.600	0.391	1.481	2.689	-106.621	64.915	253.351	462.178
33	ATAX	-0.668	3.637	8.531	14.162	-105.133	347.263	860.232	1448.729
34	PICTAX	0.438	0.954	1.514	2.130	111.339	247.559	395.425	557.663
35	BICTAX	0.936	2.045	3.257	4.597	359.531	812.259	1306.168	1850.962
36	ODTAX	-0.221	-1.213	-2.275	-3.417	-128.687	-800.214	-1517.934	-2289.376
37	OIDTAX	0.247	0.538	0.853	1.198	57.934	130.056	208.155	293.624
38	CUTAX	-0.866	0.095	1.170	2.384	-220.403	17.367	283.343	583.661
39	OREV	-1.163	-0.846	-0.500	-0.118	-323.810	-236.741	-141.582	-36.701
40	DTDI	-2.359	1.386	5.624	10.475	-6738.989	3689.361	15487.470	28991.920
41	NTC	-0.007	0.038	0.086	0.140	-49.833	252.456	581.050	941.083
42	NPC	-0.035	0.185	0.424	0.687	-2431.667	11705.610	27099.720	43998.440
43	SACC	-0.607	3.301	7.723	12.789	-552.378	1962.043	4802.645	8048.590
44	SACP	-0.661	3.606	8.455	14.031	-311.930	1036.802	2565.064	4316.989
45	PE_HD	14.733	14.733	14.733	14.733	1.052	1.052	1.052	1.052
46	EMP_AG	0.352	0.713	1.104	1.532	48.801	98.741	152.863	212.176
47	EMP_MA	0.160	0.410	0.682	0.980	7.978	20.652	34.400	49.461
48	EMP_CON	0.610	1.329	2.112	2.974	9.879	21.945	35.067	49.496

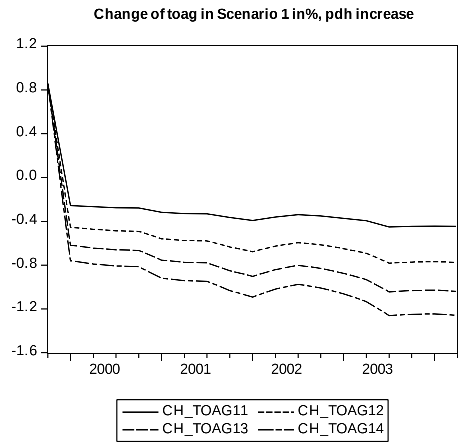
49	EMP_UTI	-0.390	0.223	0.895	1.636	-0.385	0.280	1.009	1.814
50	EMP_TRA	-0.011	0.121	0.264	0.421	-0.117	1.213	2.658	4.242
51	EMP_SER	-0.478	-0.318	-0.144	0.048	-28.352	-19.090	-8.999	2.082
52	RD3M	19.414	19.414	19.414	19.414	0.409	0.409	0.409	0.409
ID									
1	CPR	0.077	0.985	1.981	3.082	303.544	4597.678	9300.983	14502.410
2	IPR	-0.038	3.910	8.388	13.531	-208.678	6206.522	13478.440	21820.510
3	MGR	-0.014	0.403	0.931	1.598	-95.200	1290.478	3051.239	5274.172
4	MGS	-0.101	0.281	0.760	1.359	-454.544	1049.417	2939.089	5303.644
5	XGS	0.138	0.332	0.542	0.773	689.578	1689.228	2771.572	3955.500
6	GDPD	1.069	2.336	3.723	5.260	8462.144	18667.160	29835.030	42197.880
7	TOALL	-1.909	-1.273	-0.576	0.195	-46800.060	-31431.780	-14601.220	3988.333
8	GDPS	-1.473	-0.879	-0.228	0.491	-12018.330	-7240.794	-2009.833	3766.306
9	PGDPAVE	0.407	0.072	-0.290	-0.684	0.007	0.001	-0.005	-0.012
10	ICTAX	0.736	1.609	2.562	3.614	470.869	1059.817	1701.593	2408.624
11	DTAX	0.252	0.187	0.126	0.074	342.194	259.625	183.679	119.273
12	IDTAX	-0.242	1.067	2.534	4.196	-153.821	542.234	1321.734	2204.529
13	GREV	-0.132	0.256	0.697	1.205	-355.844	582.467	1647.161	2870.739
14	PDH	0.302	-7.335	-14.972	-22.609	0.052	-0.948	-1.948	-2.948
15	UNEMPR	-2.366	-8.953	-16.094	-23.915	-0.113	-0.364	-0.638	-0.938
16	GDP_GAP	137.142	173.567	213.411	257.616	20480.460	25907.930	31844.840	38431.580

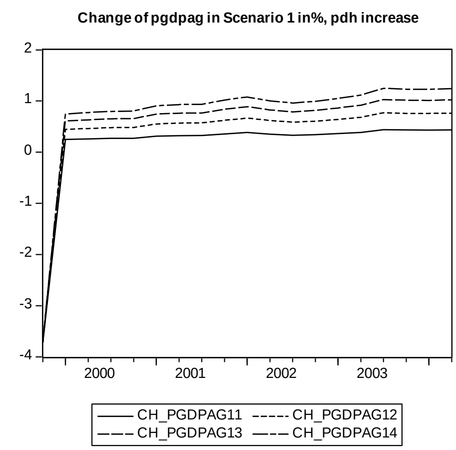
Figure E.7.1: Percentage change of welfare variables (Scenario 7)

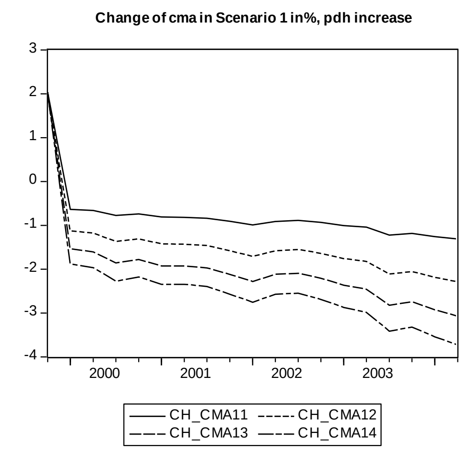
APPENDIX F

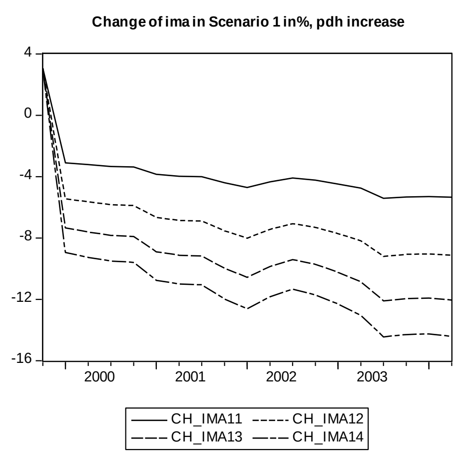
SCENARIO 1 RESULTS GRAPH

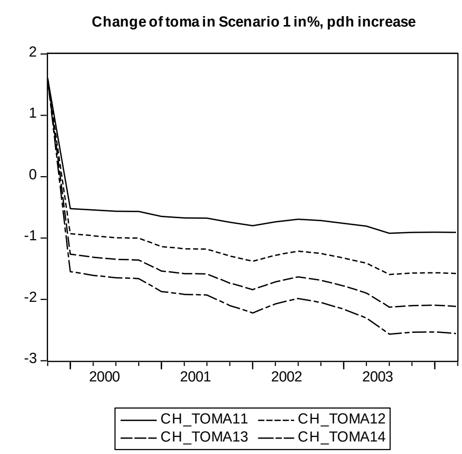


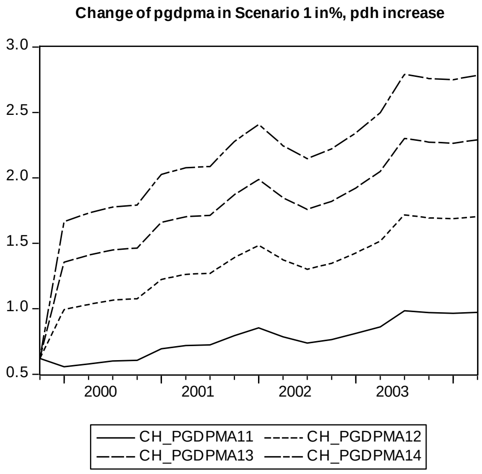


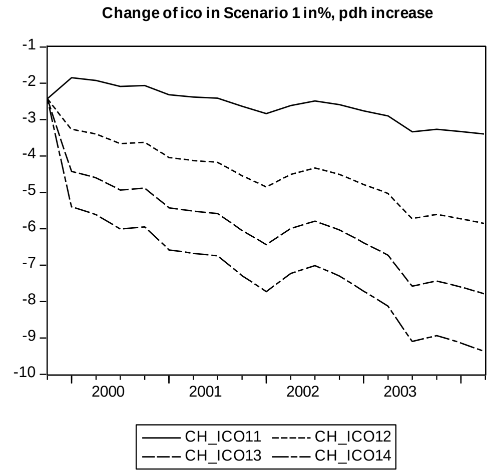


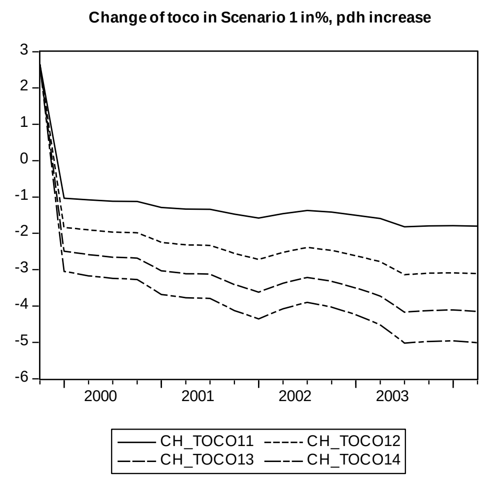


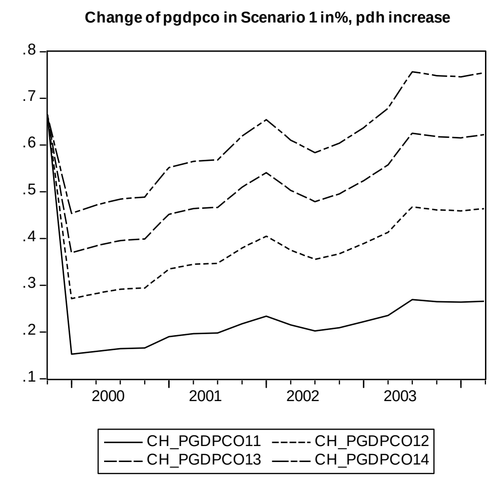


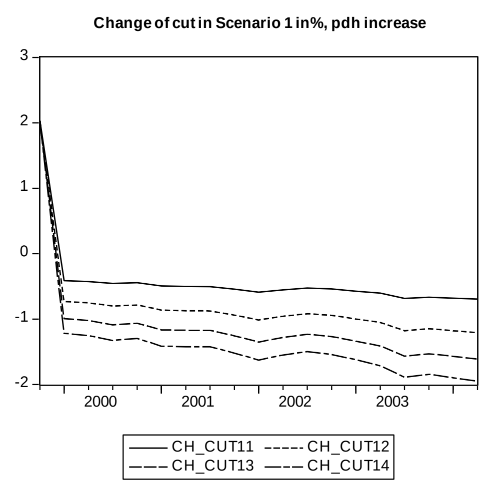


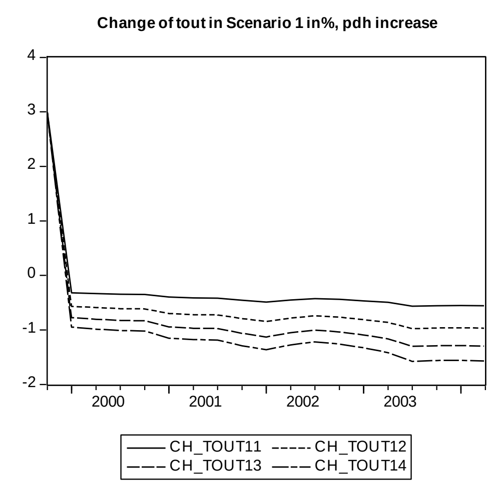

Change of pgdpma in Scenario 1 in%, pdh increase
3.0
2.5
2.0
1.5
1.0
0.5
2000
2001
2002
2003
CH_PGDPMA11
CH_PGDPMA12
CH_PGDPMA13
CH_PGDPMA14

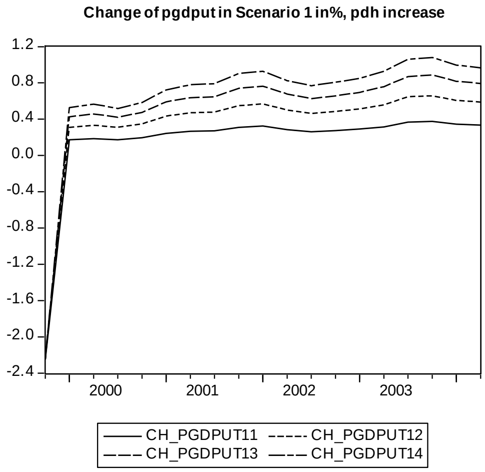

Change of ico in Scenario 1 in%, pdh increase
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
2000
2001
2002
2003
CH_ICO11
CH_ICO12
CH_ICO13
CH_ICO14


Change of toco in Scenario 1 in%, pdh increase
3
2
1
0
-1
-2
-3
-4
-5
-6
2000
2001
2002
2003
CH_TOCO11
CH_TOCO12
CH_TOCO13
CH_TOCO14

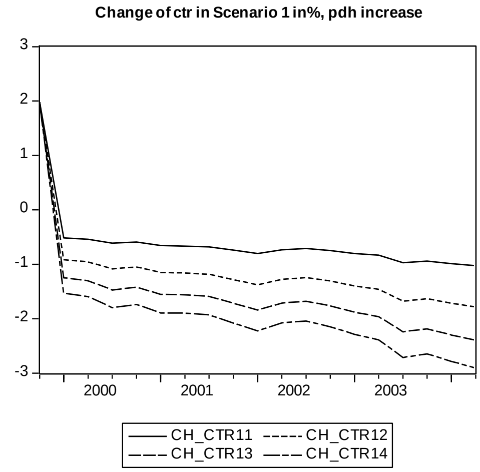

Change of pgdpco in Scenario 1 in%, pdh increase
.8
.7
.6
.5
.4
.3
.2
.1
2000
2001
2002
2003
CH_PGDPCO11
CH_PGDPCO12
CH_PGDPCO13
CH_PGDPCO14


Change of cut in Scenario 1 in%, pdh increase
3
2
1
0
-1
-2
2000
2001
2002
2003
CH_CUT11
CH_CUT12
CH_CUT13
CH_CUT14

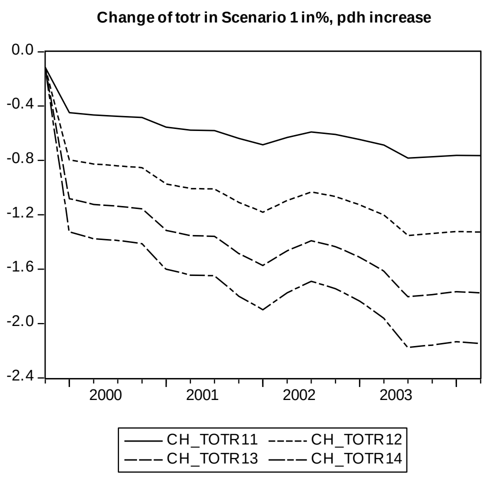

Change of tout in Scenario 1 in%, pdh increase
4
3
2
1
0
-1
-2
2000
2001
2002
2003
CH_TOUT11
CH_TOUT12
CH_TOUT13
CH_TOUT14



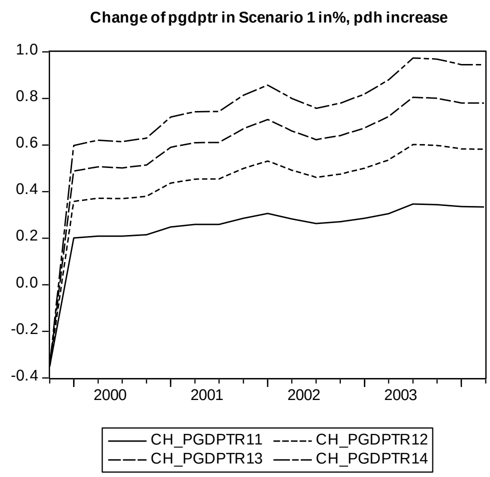
Change of pgdput in Scenario 1 in%, pdh increase
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.6
-2.0
-2.4
2000
2001
2002
2003
CH_PGDPUT11
CH_PGDPUT12
CH_PGDPUT13
CH_PGDPUT14



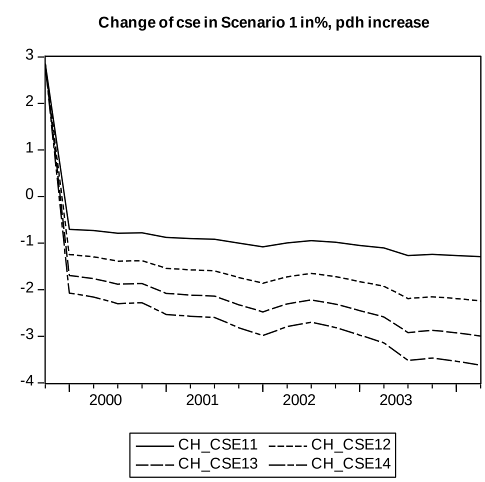
Change of ctr in Scenario 1 in%, pdh increase
3
2
1
0
-1
-2
-3
2000
2001
2002
2003
CH_CTR11
CH_CTR12
CH_CTR13
CH_CTR14



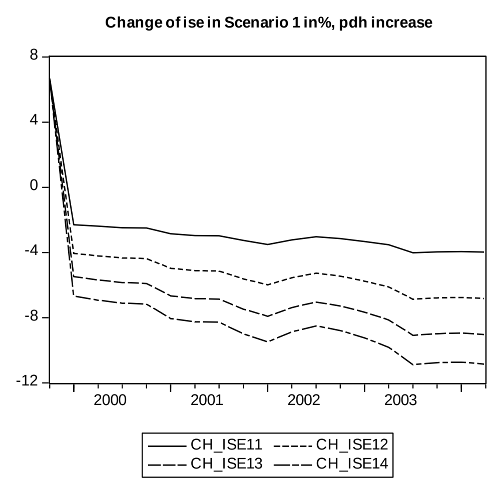
Change of totr in Scenario 1 in%, pdh increase
0.0
-0.4
-0.8
-1.2
-1.6
-2.0
-2.4
2000
2001
2002
2003
CH_TOTR11
CH_TOTR12
CH_TOTR13
CH_TOTR14



Change of pgdptr in Scenario 1 in%, pdh increase
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
2000
2001
2002
2003
CH_PGDPTR11
CH_PGDPTR12
CH_PGDPTR13
CH_PGDPTR14

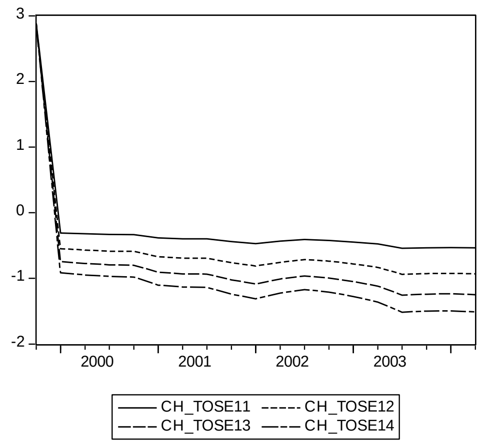


Change of cse in Scenario 1 in%, pdh increase
3
2
1
0
-1
-2
-3
-4
2000
2001
2002
2003
CH_CSE11
CH_CSE12
CH_CSE13
CH_CSE14

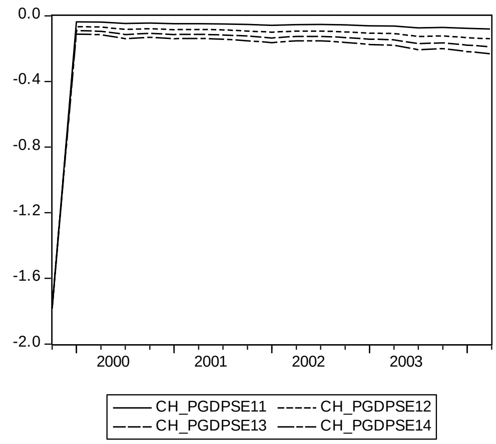


Change of ise in Scenario 1 in%, pdh increase
8
4
0
-4
-8
-12
2000
2001
2002
2003
CH_ISE11
CH_ISE12
CH_ISE13
CH_ISE14

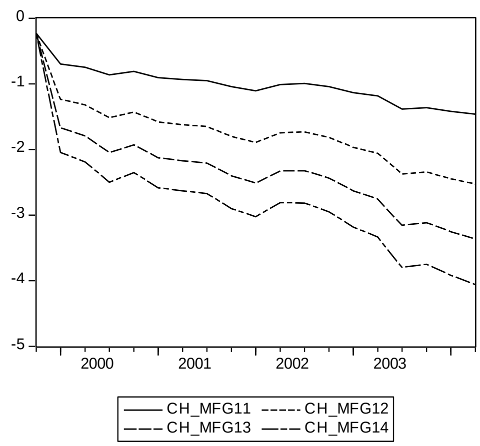
Change of tose in Scenario 1 in%, pdh increase



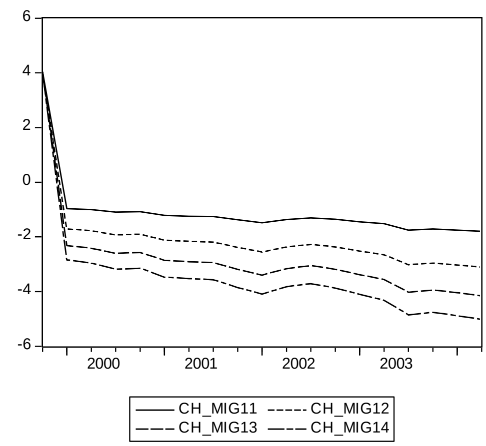
Change of pgdpse in Scenario 1 in%, pdh increase



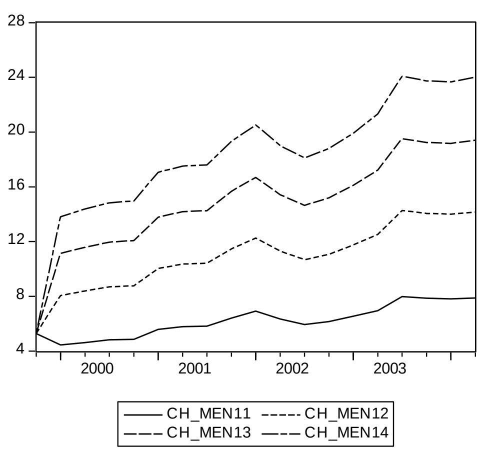
Change of mfg in Scenario 1 in%, pdh increase



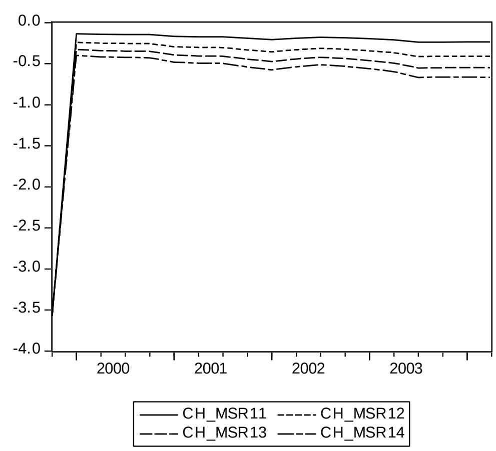
Change of mig in Scenario 1 in%, pdh increase



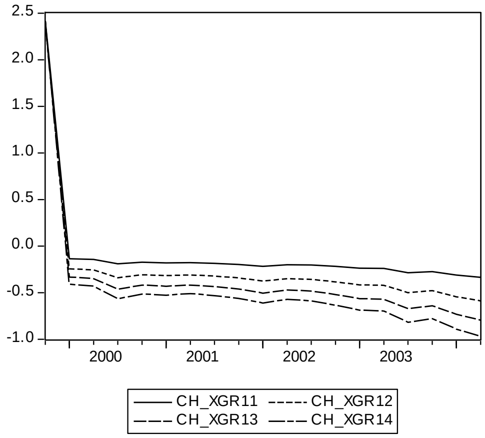
Change of men in Scenario 1 in%, pdh increase



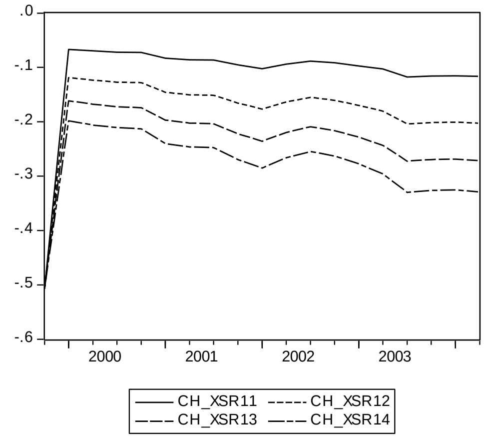
Change of msr in Scenario 1 in%, pdh increase



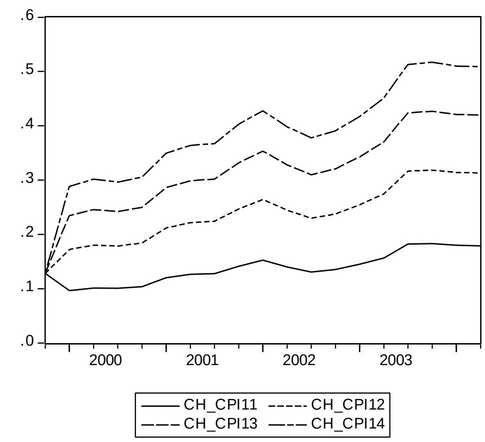
Change of xgr in Scenario 1 in%, pdh increase



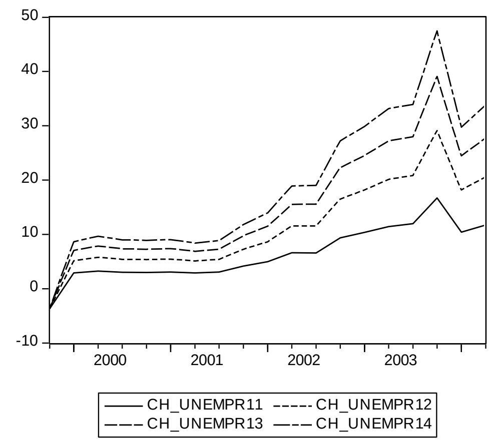
Change of xsr in Scenario 1 in%, pdh increase



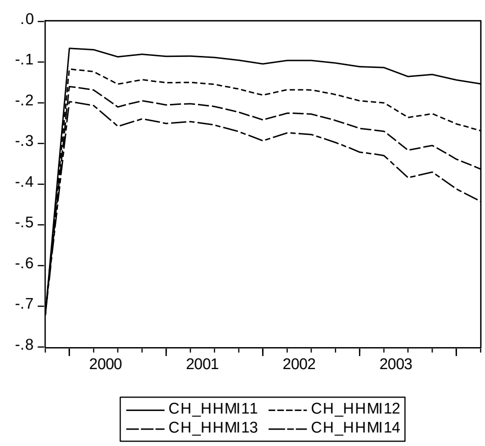
Change of cpi in Scenario 1 in%, pdh increase



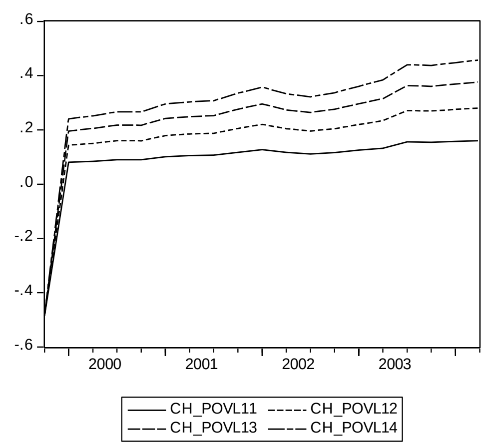
Change of unempr in Scenario 1 in%, pdh increase

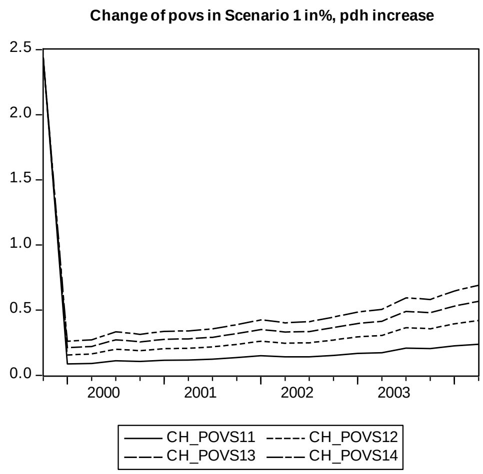


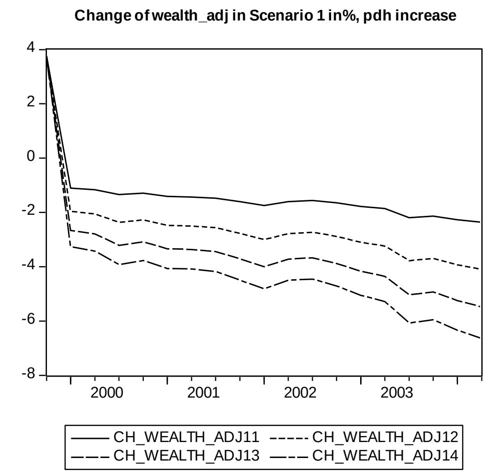
Change of hhmi in Scenario 1 in%, pdh increase

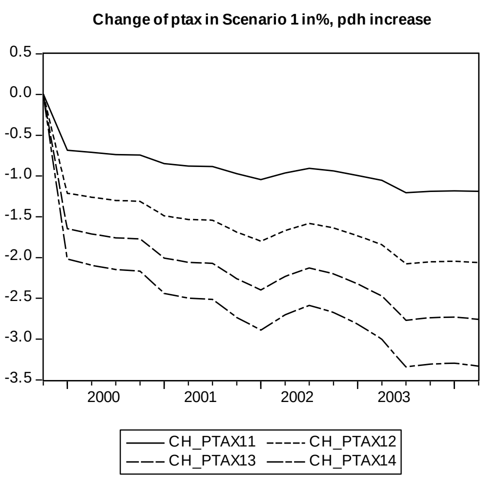


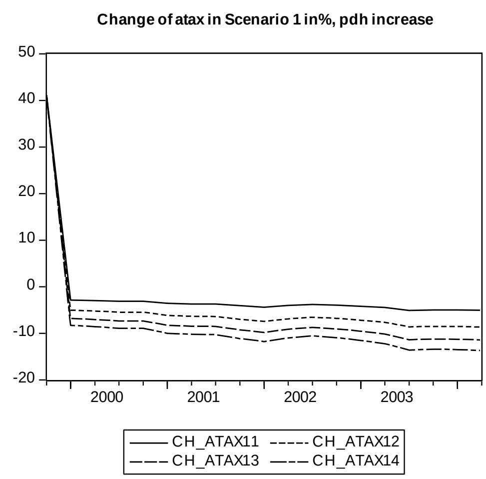
Change of povl in Scenario 1 in%, pdh increase

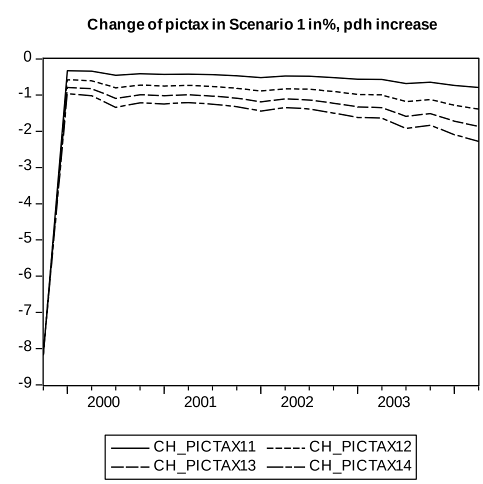


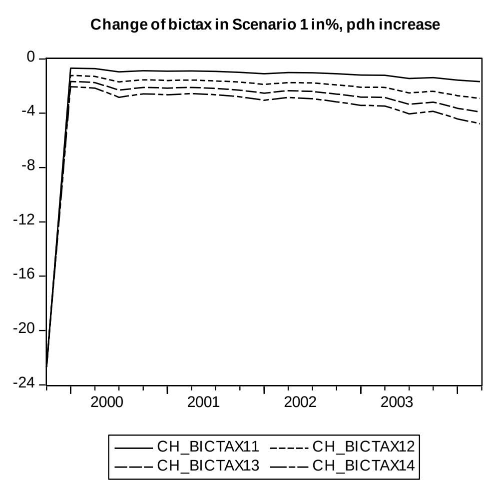

Change of povs in Scenario 1 in%, pdh increase
2.5
2.0
1.5
1.0
0.5
0.0
2000
2001
2002
2003
CH_POVS11
CH_POVS12
CH_POVS13
CH_POVS14

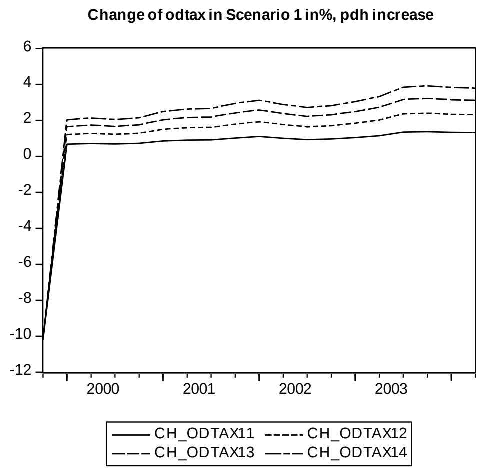

Change of wealth_adj in Scenario 1 in%, pdh increase
4
2
0
-2
-4
-6
-8
2000
2001
2002
2003
CH_WEALTH_ADJ11
CH_WEALTH_ADJ12
CH_WEALTH_ADJ13
CH_WEALTH_ADJ14

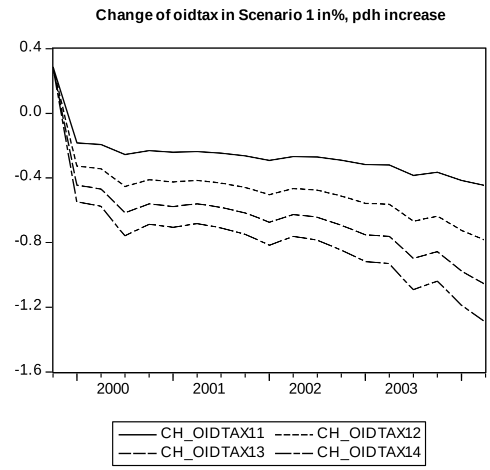

Change of ptax in Scenario 1 in%, pdh increase
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
2000
2001
2002
2003
CH_PTAX11
CH_PTAX12
CH_PTAX13
CH_PTAX14

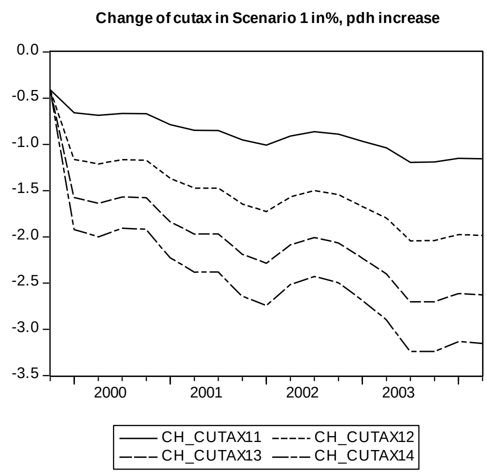

Change of atax in Scenario 1 in%, pdh increase
50
40
30
20
10
0
-10
-20
2000
2001
2002
2003
CH_ATAX11
CH_ATAX12
CH_ATAX13
CH_ATAX14

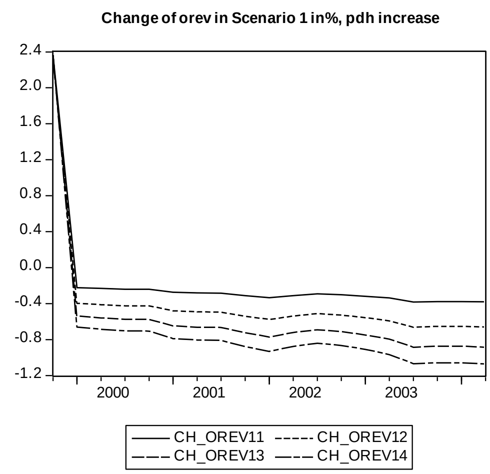

Change of pictax in Scenario 1 in%, pdh increase
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
2000
2001
2002
2003
CH_PICTAX11
CH_PICTAX12
CH_PICTAX13
CH_PICTAX14

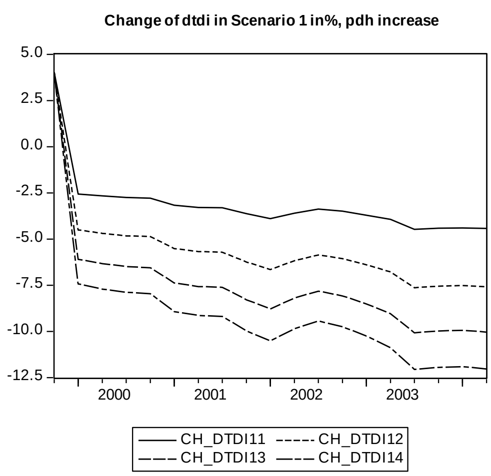

Change of bictax in Scenario 1 in%, pdh increase
0
-4
-8
-12
-16
-20
-24
2000
2001
2002
2003
CH_BICTAX11
CH_BICTAX12
CH_BICTAX13
CH_BICTAX14

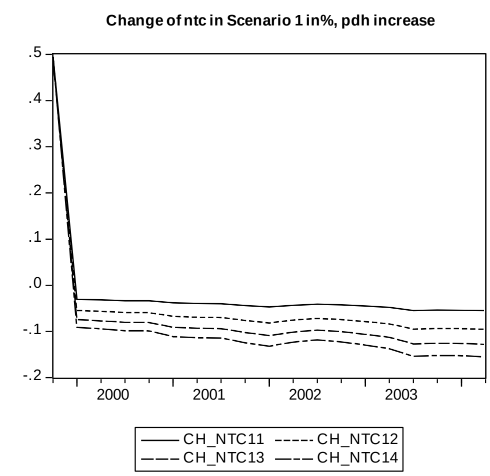

Change of odtax in Scenario 1 in%, pdh increase
CH_ODTAX11
CH_ODTAX12
CH_ODTAX13
CH_ODTAX14


Change of oidtax in Scenario 1 in%, pdh increase
CH_OIDTAX11
CH_OIDTAX12
CH_OIDTAX13
CH_OIDTAX14

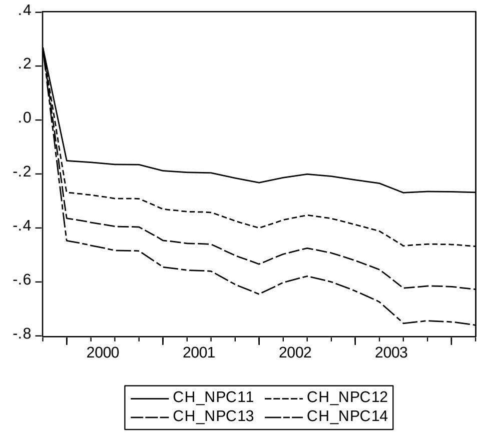

Change of cutax in Scenario 1 in%, pdh increase
CH_CUTAX11
CH_CUTAX12
CH_CUTAX13
CH_CUTAX14


Change of orev in Scenario 1 in%, pdh increase
CH_OREV11
CH_OREV12
CH_OREV13
CH_OREV14

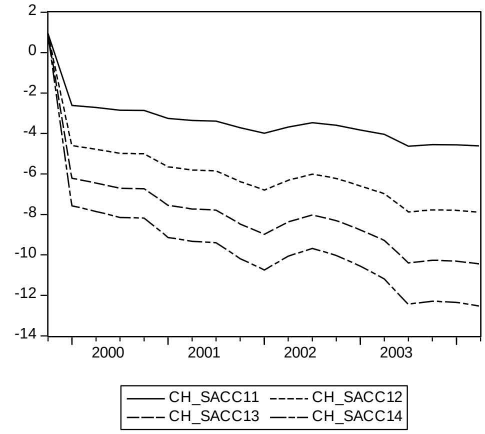

Change of dtdi in Scenario 1 in%, pdh increase
CH_DTDI11
CH_DTDI12
CH_DTDI13
CH_DTDI14


Change of ntc in Scenario 1 in%, pdh increase
CH_NTC11
CH_NTC12
CH_NTC13
CH_NTC14

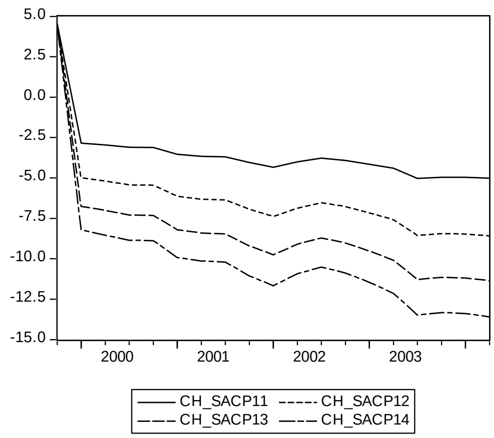
Change of npc in Scenario 1 in%, pdh increase



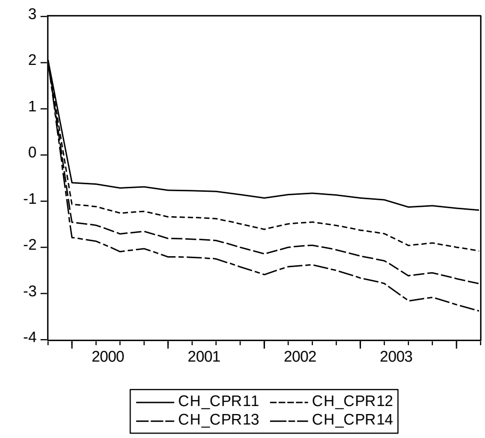
Change of sacc in Scenario 1 in%, pdh increase



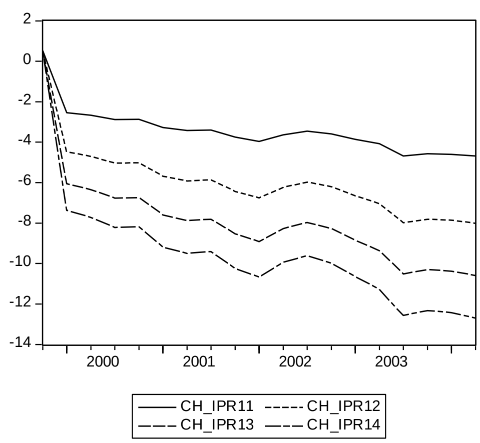
Change of sacp in Scenario 1 in%, pdh increase



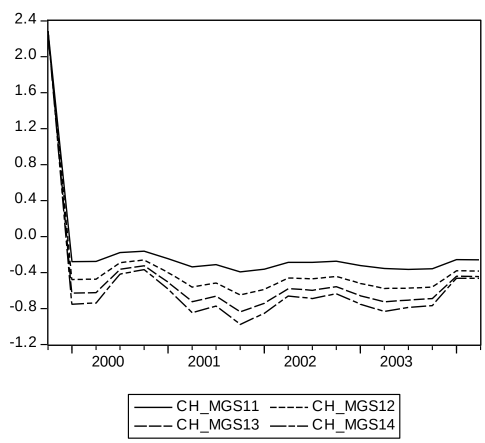
Change of cpr in Scenario 1 in%, pdh increase

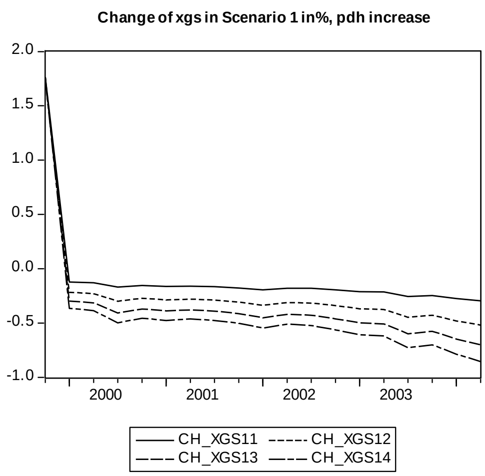


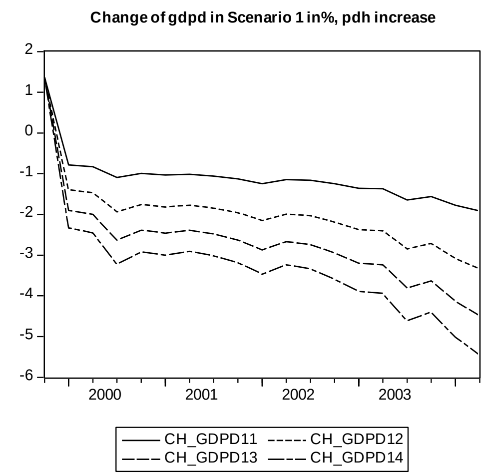
Change of ipr in Scenario 1 in%, pdh increase

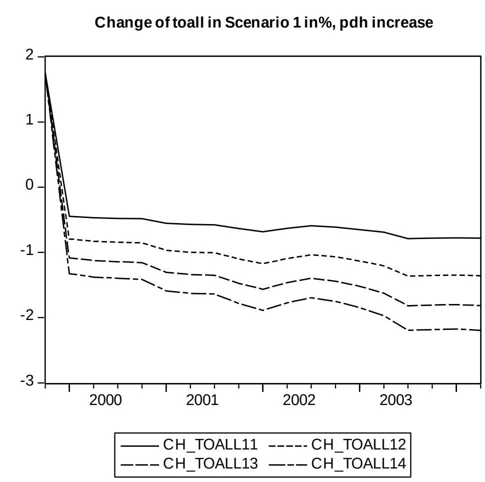


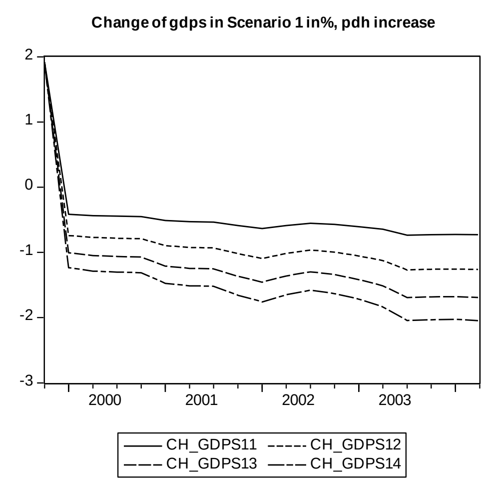
Change of mgs in Scenario 1 in%, pdh increase

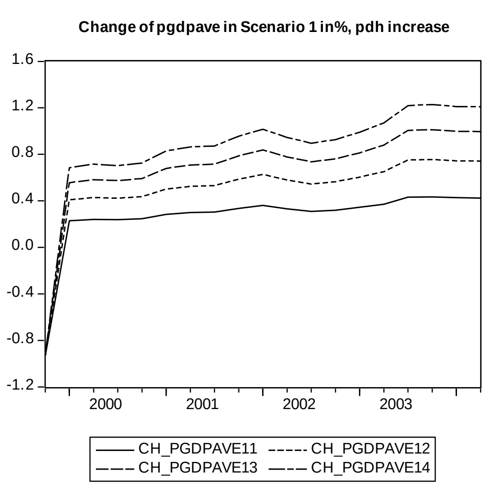


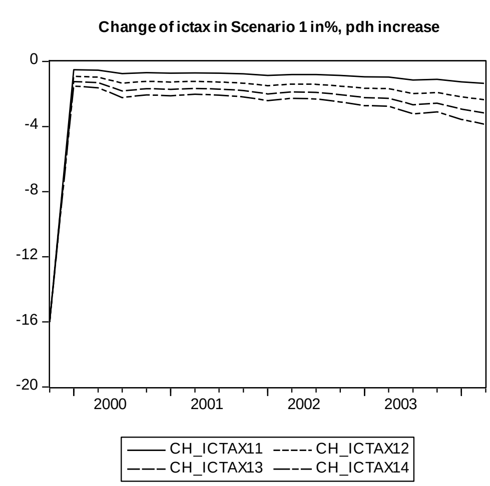

Change of xgs in Scenario 1 in%, pdh increase
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
2000
2001
2002
2003
CH_XGS11
CH_XGS12
CH_XGS13
CH_XGS14


Change of gdpd in Scenario 1 in%, pdh increase
2
1
0
-1
-2
-3
-4
-5
-6
2000
2001
2002
2003
CH_GDPD11
CH_GDPD12
CH_GDPD13
CH_GDPD14

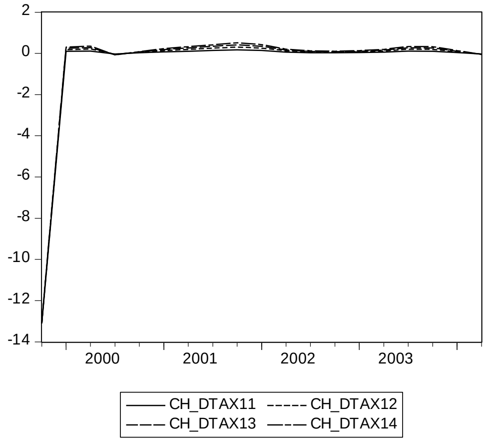

Change of toall in Scenario 1 in%, pdh increase
2
1
0
-1
-2
-3
2000
2001
2002
2003
CH_TOALL11
CH_TOALL12
CH_TOALL13
CH_TOALL14


Change of gdps in Scenario 1 in%, pdh increase
2
1
0
-1
-2
-3
2000
2001
2002
2003
CH_GDPS11
CH_GDPS12
CH_GDPS13
CH_GDPS14

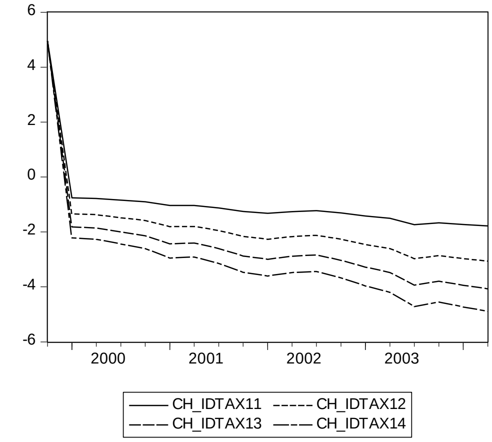

Change of pgdpave in Scenario 1 in%, pdh increase
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
2000
2001
2002
2003
CH_PGDPAVE11
CH_PGDPAVE12
CH_PGDPAVE13
CH_PGDPAVE14


Change of ictax in Scenario 1 in%, pdh increase
0
-4
-8
-12
-16
-20
2000
2001
2002
2003
CH_ICTAX11
CH_ICTAX12
CH_ICTAX13
CH_ICTAX14

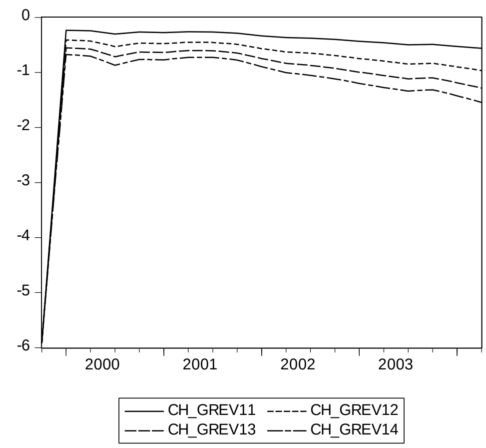
Change of dtax in Scenario 1 in%, pdh increase



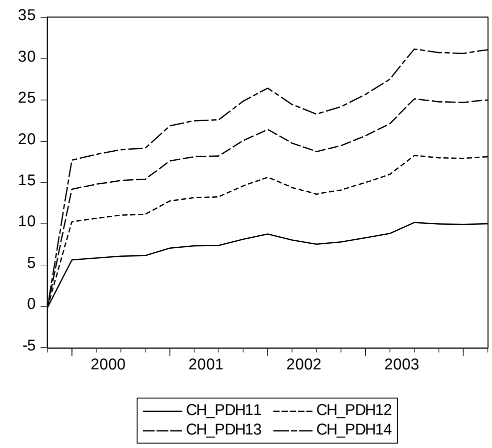
Change of idtax in Scenario 1 in%, pdh increase



Change of grev in Scenario 1 in%, pdh increase



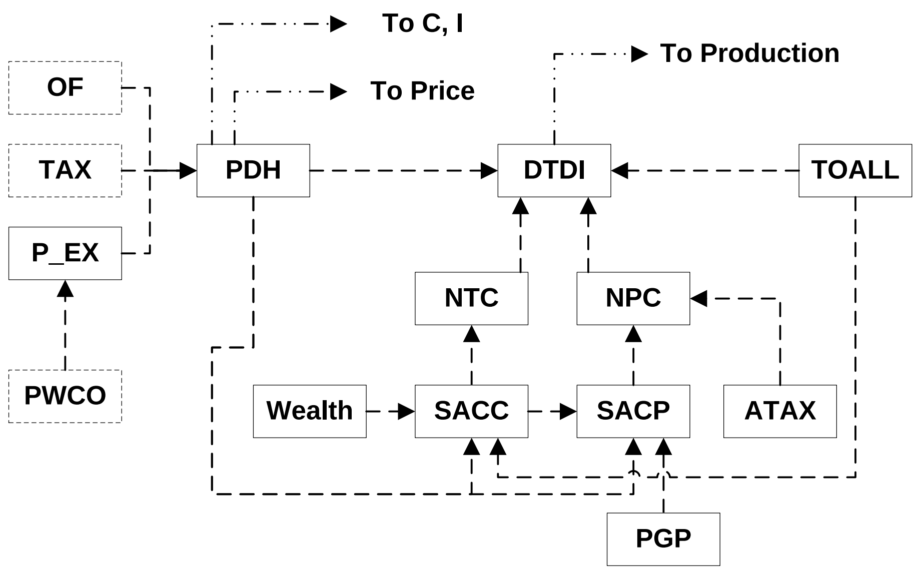
Change of pdh in Scenario 1 in%, pdh increase



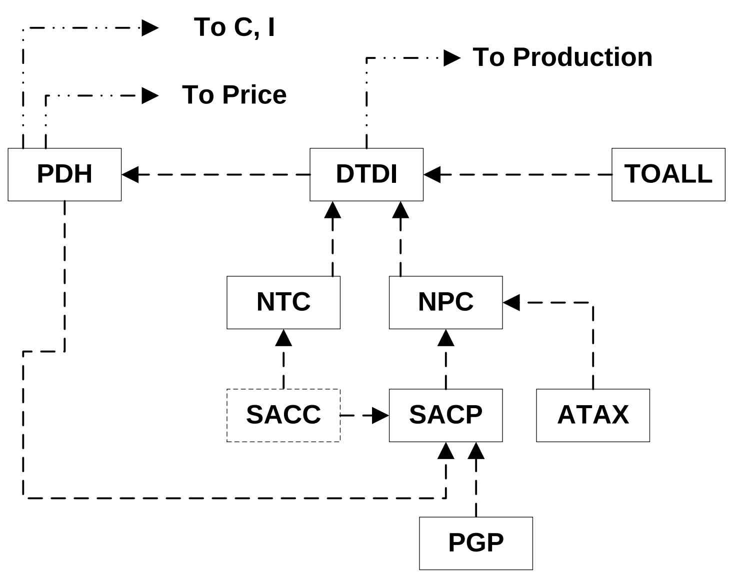
APPENDIX G

FLOW CHARTS

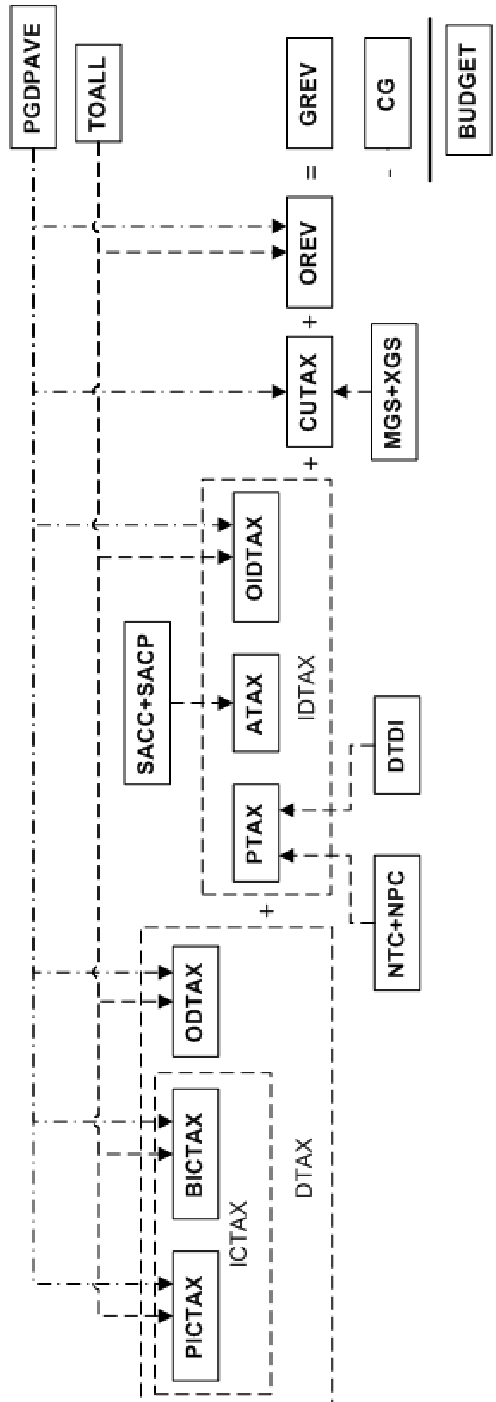
G.1 Energy block flow chart (Scenarios 1-4)



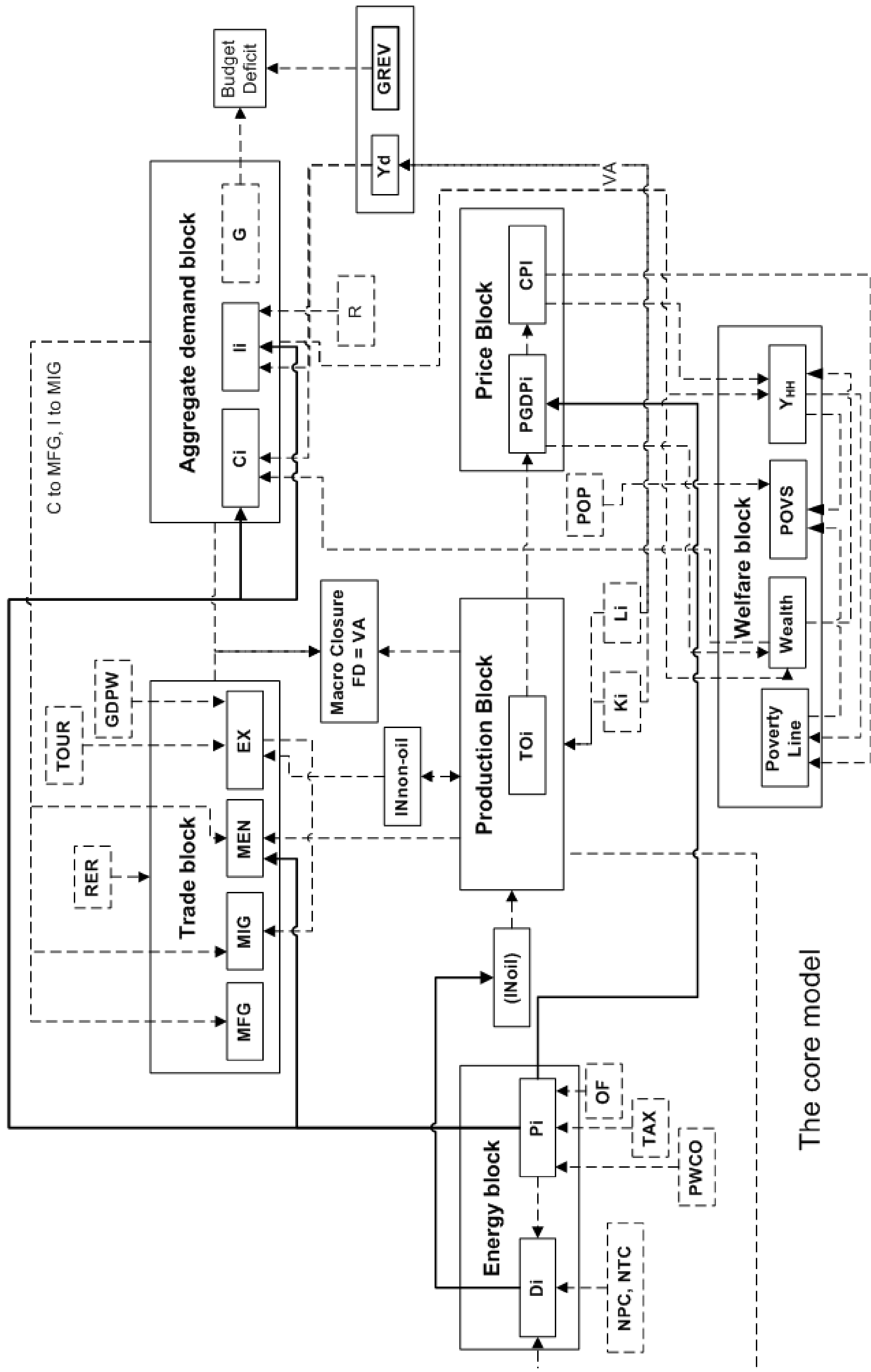
G.2 Energy block flow chart (Scenario 5)



G.3 Fiscal block flow chart



G.4 Core model flow chart



APPENDIX H
SUMMARY OF MODELER'S PROCESSES AND TECHNIQUES

H.1 Introduction

A person cannot become a good modeler by learning from books and research papers alone, but instead must actually spend some time getting actual experience in model building. Textbooks contain theories but are only guidelines to acceptable model specifications. No single model can serve as a default model. A core model must be built and customized according to its purpose, size, and type of data.

This appendix aims to summarize the processes and techniques used and also to share the author's experiences in building this dissertation's macroeconometric model using EVIEWS. The data preparation processes were done mostly directly with the workfile. Once the data were ready, the rest of the processes, from generating extra series to displaying the results, were done by writing EVIEWS program files. There is no direct interaction with the workfile itself. Thus, the programs are executed from a fresh EVIEWS workfile every time (a modified workfile is not saved when closed).

The details of the theories can be found in Chapter 3: Macroeconometric Framework. The EVIEWS core code can be found in Appendix E.

H.2 Data preparation in EVIEWS

1. Importing data: the procedure are as follow,
    a. Open a blank workfile and specify a frequency and data range

b. From a work file, choose file, import, Excel (or fetch from DB).

2. Importing irregular frequency: this method is used for the data that has irregular dates arranged in the first column. The procedures are as follow,
   a. Arrange data in Excel, including date-series (name it as "date" at cell A1), beginning at cell A2.
   b. Format date-series using format cell, custom, yyyy-mm-dd (or Mon dd, YYYY or Month dd, YYYY).
   c. Create a workfile as an irregular date and enter the number of observations.
   d. Import the Excel data into the workfile, enter the number of series, including date-series (number of series = all series + date series), data begins at cell A2.
   e. Change the format of date-series, double click "date-series," properties, numeric display, day-date format to yyyy-mm-dd.
   f. Copy the date-series column from Excel, double click date-series in workfile, select row from bottom, click edit+/- and paste in.
   g. Select Proc (main window), restructure/resize current page, specify date-series name ("date" in this case).
   h. Change to the default frequency (see 3 below)
3. Frequency conversion: a set of data must be converted to have the same frequency by interpolation (from low to higher frequency). Quadratic-match-sum method must be used for stock data while quadratic-match-average method must be used for flow data. After the method is specified, EVIEWS automatically converts the frequency from both low-to-high and high-to-low when fetched. The procedure is as follows,

a. From an EVIEWS workfile of any frequency (if a set of data has different frequency from an intended frequency, it must first be imported to a different workfile), export the data to a database file (.DB)
b. From the database file, select All, select a series, choose Option (main window), date-freq conversion and choose Quadratice-match-sum or quadratic-match-average.
c. From the working workfile, choose fetch from DB.

4. Seasonal adjustment: series of frequencies of less than one year are likely to have a seasonal effect. The seasonal adjustment is done using Census X12 in EVIEWS. The processes are as follow:
   a. Double click a series, select Proc, Seasonal Adjustment.
   b. The modified series is generated with _sa (by default) in the workfile.
5. Exponential smoothing: A double exponential smoothing technique is applied to time series through a program, not directly through a workfile. The command used is ".smooth" with a mean parameter.
6. Augmented Dickey-Fuller unit root test: (See section 3.3.2), The processes are as followed,
   a. Double click a series, View, Unit Root Test.

H.3 Model building process from EVIEWS

1. Load a working workfile using command "load" followed by a specific directory and file name. The path of the working folder should not contain

any spaces. It is recommended to have a simple path name, i.e., C:\eviewsfiles\filename.

2. Generate some needed series, including the series to be used as the identity, using command "genr."
3. Use two-stage least square regression to fit each equation individually. In this dissertation the process and targeted parameter values are as follow:
    a. Find a set of instrumental variables for each equation that give a very high R^2 (See section 3.4.1) by first using an ordinary least square on each dependent variable, and one-by-one eliminate any insignificant exogenous variables. R^2 should be more than 0.9, and the p-value for each exogenous should be less than 0.1. Then, that set of IV is used in 2SLS for that dependent variable only.
    b. Find a combination of explanatory variables (according to hypothesis or with an economic reason) that gives
        i. Coefficients with the right sign.
        ii. High R^2 (at least 0.9 or above).
        iii. Low p-value for each explanatory variable (See section 3.4).
        iv. No autocorrelation. The Durbin-Watson statistic (DW) is only an indicator. In many cases in which the DW is below 1.5, the correlogram (Equation window, View, Residual tests, Correlogram-Q-stats) shows no significant autocorrelation.
        v. Good baseline fit. A baseline should have no structural breaks (actual and baseline go in opposite directions). However, at some points there are some lags between the actual and baseline or some minor ripples that show that the

baseline is trying follow the actual. This is normal. Baseline can be evaluated from the mean absolute percent error (MAPE). Most should be lower than 5 and not exceed 10. However, this depends on the quality and frequency of data as well.

4. Declare a model using command “model” and append each equation into the model using command “modelname.append”.
5. Run the model for the baseline using the command “modelname.solve” with an option of “d=s” for static simulation. In static simulation, the starting range should be some period after the worksheet range (for example, if the worksheet range starts from 1993:1-, the simulation should start from 1995:1) because if the lag specification in each equation uses the actual data, the more lag specified, the more starting data will be lost.
6. It is recommended that graphs should be generated using commands (“graph”, “.addtext”, etc) for a large model.

H.4 Model calibration techniques

Along with the individual calibration process, there are many tradeoffs that should be kept in mind among the problems. For example, for a series with higher fluctuations, it would be easier to solve the wrong sign problem, but it would be harder to have a fitted baseline. Second, the inclusion of some variables, such as the lag of s dependent variable, would solve autocorrelations and improve the baseline but it would dampen the magnitude of change when a model is shocked. Last, specification of lagged explanatory variables may solve both the sign and the significance problem but dampen the magnitude of change when a model is shocked. The following are solution guides for equation calibrations when facing the following problems.

1. Not all parameters have the right sign.
    a. Include or exclude explanatory variables according to theory. Observe the R^2 and DW values to see if it is relevant as well.
    b. Change the amount of lag of each explanatory variable and observe the direction of the significance of the parameter. If the parameter's sign is still wrong but has less significance, keep that lag and try changing the lag of other variable.
    c. Incorporate a time trend series, T. There is some risk that it will correct the wrong sign if that parameter is not very significant.
    d. Incorporate or remove a constant, C. However, absence of C can result in a bad baseline.
    e. Incorporate some dummy variables. (However, the chance of changing the sign is very low.)
    f. Use lagged endogenous variables, if explainable, as a last resort. Otherwise, the variable would draw more information to itself (significance) and likely change the sign of other variables (also make them less significant).
2. Not all parameters are significant.
    a. Repeat the steps a. to e. from above but beware of changing signs. Problems of wrong sign and insignificance should be solved at the same time.
    b. When all parameters have the right sign, but the p-value is still too high (however, this value should be 0.5 or less), last-step fine tuning can be done by changing the lag of each instrument and

observing the direction of significance. Keep the lag if the result is better, and try excluding the instrument if the result is worse. Changing the lag of the instrument will change the significance level but is very unlikely to change any sign. Thus, it is useful to more instruments in the set than needed.

   c.

3. Unfitted baseline.
   a. Include a constant, C, in the equation. It is likely that this will solve the problem of having "ripple" baselines.
   b. Use a lagged endogenous variable. It is likely to solve the problem of a "diverted" baseline.
   c. Incorporate a dummy variable for a structural break. There is some slight risk that a dummy variable could change the significance level of some parameter.
4. Autocorrelation problems.
   a. Incorporate more explanatory variables.
   b. Specify the AR process. Because the AR process might change the sign or significance of another parameter, if autocorrelation persists after inclusion of some more variables, it is recommended to include the AR process (AR(1) in most cases), then again calibrate with the technique above.
   c. Use lagged endogenous variables, if explainable, as a last resort.
5. Some variables do not change when shocked (for scenarios).
   a. Use the starting sample period later than before.
   b. Specify smaller lags, particularly for variables that link the overridden variable (shocked variable) to that endogenous variable.

APPENDIX I

EVIEWS 6.0 PROGRAM CODE

```
'==========LOAD WORKFILE=============

load C:\eviewswork\beforeb\tmodel1b

'==Define Model=======
model thai

'###############################  Generate data
########################################
smpl 1993:1 2006:2

'============From Consumption==============

genr gdpag=gdp1+gdp2
genr gdpma=gdp4
genr gdpco=gdp6
genr gdput=gdp3+gdp5
genr gdptr=gdp9
genr gdppr=gdp7+gdp8+gdp10+gdp11+gdp16
genr gdppu=gdp12+gdp13+gdp14+gdp15
genr gdpse=gdppu+gdppr

genr wealth_adj=wealth*100/core

genr cag=c1
genr cma=c3+c4+c5
genr cma1=c3
genr cma2=c4+c5
genr cse=c6+c8+c9
genr cut=c2
genr ctr=c7
genr cpr=cag+cut+cma+cse+ctr

genr ima=i1+i2+i3
genr ise=i5
genr ico=i4
genr ipr = ima+ico+ise

genr kag=k1
genr kma=k3
genr kco=k4
```

```
genr kut=k2+k5
genr ktr=k6
genr kpr=k7+k8+k9+k11
genr kpu=k10
genr kse=kpr+kpu

genr mgr=mgr_na_sa
genr msr=msr_na_sa
genr xgr=xgr_na_sa
genr xsr=xsr_na_sa
genr gdpw=gdpw_na_sa
genr tour=tour_na_sa
genr cgr=cgr_na_sa
genr cg=cg_na_sa

genr emp = emp_na_sa
genr emp_ag = emp_ag_na_sa
genr emp_nag = emp_nag_na_sa
genr emp_ma = emp_ma_na_sa
genr emp_uti = emp_ele_na_sa
genr emp_con = emp_con_na_sa
genr emp_tra = emp_tra_na_sa
genr emp_com = emp_com_na_sa
genr emp_ser = emp_ser_na_sa
genr emp_oth = emp_oth_na_sa
genr lf = lf_na_sa
genr lf_sha = lf_sha_na_sa
genr unemp_per = unemp_per_na_sa
genr unemp_rate = unemp_rate_na_sa
genr unemp_lfw = unemp_lfw_na_sa
genr unemp_nfw = unemp_nfw_na_sa
genr unemp_ilf = unemp_ilf_na_sa

genr im_mcg=mgr*ep_mcg_af
genr im_mcl=mgr*ep_mcl_af
genr im_mco=mgr*ep_mco_af
genr im_mel=mgr*ep_mel_af
genr im_men=mgr*ep_men_af
genr im_mng=mgr*ep_mng_af
genr im_mot=mgr*ep_mot_af
genr im_mpp=mgr*ep_mpp_af
genr im_mrm=mgr*ep_mrm_af
genr im_msg=mgr*ep_msg_af

genr mfg=im_mcg+im_mot
```

```
genr mig=im_mrm+im_msg
genr men=im_men

genr mgr_fin=mfg+mig+men

genr mgs = mgr_fin + msr
genr xgs = xgr + xsr
genr dd=cpr+ipr-xgs+mgs

genr
gdpn=gdpn1+gdpn2+gdpn3+gdpn4+gdpn5+gdpn6+gdpn7+gdpn8+gdpn9+gdpn10+gd
pn11+gdpn12+gdpn13+gdpn14+gdpn15+gdpn16

'=====From Price=====

genr pgdpag=(gdpn1_sa+gdpn2_sa)/(gdp1+gdp2)
genr pgdpma=(gdpn4_sa/gdp4)
genr pgdpco=(gdpn6_sa/gdp6)
genr pgdput=(gdpn3_sa+gdpn5_sa)/(gdp3+gdp5)
genr pgdptr=(gdpn9_sa/gdp9)
genr
pgdpse=(gdpn7sa+gdpn8_sa+gdpn10_sa+gdpn11_sa+gdpn12_sa+gdpn13sa+gdpn14_
sa+gdpn15_sa+gdpn16_sa)/(gdp7+gdp8+gdp10+gdp11+gdp12+gdp13+gdp14+gdp15
+gdp16)

genr
pgdpave1=(pgdpag*gdpag+pgdpma*gdpma+pgdpco*gdpco+pgdput*gdput+pgdptr*g
dptr+pgdpse*gdpse)/(gdpag+gdpma+gdpco+gdput+gdptr+gdpse)

'===== From Production =======

genr zag=1.612
genr toag=zag*gdpag

genr sag_ag=0.094
genr sma_ag=0.013
genr sco_ag=0.005
genr sut_ag=0
genr str_ag=0.013
genr sse_ag=0.012

genr zma=4.13
genr toma=zma*gdpma

genr sag_ma=0.461
```

```
genr sma_ma=0.235
genr sco_ma=0.324
genr sut_ma=0.338
genr str_ma=0.166
genr sse_ma=0.013

genr zco=2.13
genr toco=zco*gdpco

genr sag_co=0
genr sma_co=0.014
genr sco_co=0.159
genr sut_co=0.002
genr str_co=0.016
genr sse_co=0.001

genr zut=2.86
genr tout=zut*gdput

genr sag_ut=0
genr sma_ut=0.021
genr sco_ut=0
genr sut_ut=0.017
genr str_ut=0.016
genr sse_ut=0.001

genr ztr=3.88
genr totr=ztr*gdptr

genr sag_tr=0
genr sma_tr=0.014
genr sco_tr=0.154
genr sut_tr=0.012
genr str_tr=0.496
genr sse_tr=0.247

genr zse=2.04
genr tose=zse*gdpse

genr sag_se=0.083
genr sma_se=0.044
genr sco_se=0.039
genr sut_se=0.016
genr str_se=0.033
genr sse_se=0.068
```

```
genr inag =
sag_ag*toag+sma_ag*toma+sco_ag*toco+sut_ag*tout+sse_ag*tose+str_ag*totr
genr intag = str_ag*totr
genr inma =
sag_ma*toag+sma_ma*toma+sco_ma*toco+sut_ma*tout+sse_ma*tose+str_ma*totr
genr intma = str_ma*totr
genr inco=
sag_co*toag+sma_co*toma+sco_co*toco+sut_co*tout+sse_co*tose+str_co*totr
genr intco = str_co*totr
genr inut=
sag_ut*toag+sma_ut*toma+sco_ut*toco+sut_ut*tout+sse_ut*tose+str_ut*totr
genr intut = str_ut*totr
genr intr= sag_tr*toag+sma_tr*toma+sco_tr*toco+sut_tr*tout+sse_tr*tose+str_tr*totr
genr inttr = str_tr*totr
genr inse=
sag_se*toag+sma_se*toma+sco_se*toco+sut_se*tout+sse_se*tose+str_se*totr
genr intse = str_se*totr

genr toall = toag+toma+toco+tout+totr+tose

'**********Final GDP for supply and demand*********************

genr gdps = (toag/zag)+(toma/zma)+(toco/zco)+(tout/zut)+(totr/ztr)+(tose/zse)
genr gdpd_nofac = cpr+ipr+cgr+xgs-mgs
'====Factor to calibrate GDP from demand and supply===
genr gdp_factor = gdps-gdpd_nofac
genr gdpd = gdpd_nofac + gdp_factor
genr gdp_gap=gdps-gdpd

genr
pgdpave=(pgdpag*gdpag+pgdpma*gdpma+pgdpco*gdpco+pgdput*gdput+pgdptr*gd
ptr+pgdpse*gdpse-
pgdpave1*gdp_gap)/(gdpag+gdpma+gdpco+gdput+gdptr+gdpse+gdp_gap)
genr inf_rate=(pgdpave1-pgdpave1(-1))/pgdpave1(-1)

'=====From fiscal======

genr atax=atax_na_sa
genr bictax=bictax_na_sa
genr pictax=pictax_na_sa
genr odtax=odtax_na_sa
genr ptax=ptax_na_sa
genr oidtax=oidtax_na_sa
genr imtax=imtax_na_sa
```

```
genr extax=extax_na_sa
genr ocutax=ocutax_na_sa
genr grev2=grev2_na_sa
genr grev=grev_na_sa
genr orev=orev_na_sa

genr ictax = pictax + bictax
genr dtax = ictax+odtax
genr idtax = ptax + atax + oidtax
genr cutax = imtax + extax + ocutax
genr grev = dtax + idtax + cutax + orev
genr grev_factor = grev2 - grev
genr grev_fin = grev+grev_factor

genr gdp_def=cg/cgr
genr budget = grev_fin-cg

'=====From energy======

genr cf_hd = p_cf_hd*pdh/100
genr mm_hd = p_mm_hd*pdh/100
genr mtax_hd = p_mtax_hd*pdh/100
genr of_hd = p_of_hd*pdh/100
genr pw_hd = p_pw_hd*pdh/100
genr tax_hd = p_tax_hd*pdh/100
genr vat_hd = p_vat_hd*pdh/100
genr pe_hd = p_pe_hd*pdh/100

genr pdh_fac=pdh-(pe_hd+tax_hd+mtax_hd+of_hd+vat_hd+mm_hd)
genr pdh_calc = pe_hd+tax_hd+mtax_hd+of_hd+vat_hd+mm_hd
group pdhtwo pdh_calc pdh-pdh_fac

genr dtgp=dtgp_na_sa
genr dtgr=dtgr_na_sa
genr dtdi=dtdi_na_sa
genr dtfo=dtfo_na_sa
genr dtjp=dtjp_na_sa
genr dtlpg=dtlpg_na_sa
genr dtke=dtke_na_sa
genr det=det_na_sa

genr dtp=dtgp+dtgr+dtke+dtdi+dtjp+dtfo+dtlpg
genr dd98 = d98q1+d98q2+d98q3+d98q4

'=====From Welfare======
```

```
genr yi=hhmi/3.6

'==============Exponential Smoothing=========================

smpl 1993:1 2004:2

'==Core Endo===============

smpl 1993:1 2004:2

cag.smooth(n,0.4,e) cagsm
group smcag cag cagsm
genr cag=cagsm

toag.smooth(n,0.3,e) toagsm
group smtoag toag toagsm
genr toag=toagsm

cma.smooth(n,0.5,e) cmasm
group smcma cma cmasm
genr cma = cmasm

ima.smooth(n,0.5,e) imasm
group smima ima imasm
genr ima = imasm

toma.smooth(n,0.7,e) tomasm
group smtoma toma tomasm
genr toma = tomasm

pgdpma.smooth(n,0.7,e) pgdpmasm
group smpgdpma pgdpma pgdpmasm
genr pgdpma = pgdpmasm

ico.smooth(n,0.7,e) icosm
group smico ico icosm
genr ico=icosm

toco.smooth(n,0.5,e) tocosm
group smtoco toco tocosm
genr toco=tocosm

pgdpco.smooth(n,0.5,e) pgdpcosm
group smpgdpco pgdpco pgdpcosm
```

```
genr pgdpco=pgdpcosm

cut.smooth(n,0.5,e) cutsm
group smcut cut cutsm
genr cut=cutsm

tout.smooth(n,0.7,e) toutsm
group smtout tout toutsm
genr tout=toutsm

pgdput.smooth(n,0.5,e) pgdputsm
group smpgdput pgdput pgdputsm
genr pgdput=pgdputsm

ctr.smooth(n,0.6,e) ctrsm
group smctr ctr ctrsm
genr ctr=ctrsm

totr.smooth(n,0.7,e) totrsm
group smtotr totr totrsm
genr totr=totrsm

pgdptr.smooth(n,0.5,e) pgdptrsm
group smpgdptr pgdptr pgdptrsm
genr pgdptr=pgdptrsm

cse.smooth(n,0.5,e) csesm
group smcse cse csesm
genr cse=csesm

ise.smooth(n,0.5,e) isesm
group smise ise isesm
genr ise=isesm

tose.smooth(n,0.5,e) tosesm
group smtose tose tosesm
genr tose=tosesm

pgdpse.smooth(n,0.5,e) pgdpsesm
group smpgdpse pgdpse pgdpsesm
genr pgdpse=pgdpsesm

mfg.smooth(n,0.5,e) mfgsm
group smmfg mfg mfgsm
genr mfg=mfgsm
```

```
mig.smooth(n,0.7,e) migsm
group smmig mig migsm
genr mig=migsm

men.smooth(n,0.7,e) mensm
group smmen men mensm
genr men=mensm

msr.smooth(n,0.3,e) msrsm
group smmsr msr msrsm
genr msr=msrsm

xgr.smooth(n,0.5,e) xgrsm
group smxgr xgr xgrsm
genr xgr=xgrsm

xsr.smooth(n,0.3,e) xsrsm
group smxsr xsr xsrsm
genr xsr=xsrsm

'========== FISCAL =====================

ptax.smooth(n,0.3,e) ptaxsm
group smptax ptax ptaxsm
genr ptax=ptaxsm

pictax.smooth(n,0.5,e) pictaxsm
group smpictax pictax pictaxsm
genr pictax=pictaxsm

bictax.smooth(n,0.3,e) bictaxsm
group smbictax bictax bictaxsm
genr bictax=bictaxsm

odtax.smooth(n,0.5,e) odtaxsm
group smodtax odtax odtaxsm
genr odtax=odtaxsm

oidtax.smooth(n,0.4,e) oidtaxsm
group smoidtax oidtax oidtaxsm
genr oidtax=oidtaxsm

cutax.smooth(n,0.5,e) cutaxsm
group smcutax cutax cutaxsm
```

```
genr cutax=cutaxsm

orev.smooth(n,0.1,e) orevsm
group smorev orev orevsm
genr orev=orevsm

'==Energy Endo=================

smpl 1993:1 2004:2

dtdi.smooth(n,0.4,e) dtdism
group smdtdi dtdi dtdism
genr dtdi=dtdism

pe_hd.smooth(n,0.4,e) pe_hdsm
group smpe_hd pe_hd pe_hdsm
genr pe_hd=pe_hdsm

'==Welfare Endo=================

emp_ag.smooth(n,0.4,0.7) emp_agsm
group smemp_ag emp_ag emp_agsm
genr emp_ag=emp_agsm

emp_ma.smooth(n,0.5,e) emp_masm
group smemp_ma emp_ma emp_masm
genr emp_ma=emp_masm

emp_con.smooth(n,0.5,0.3) emp_consm
group smemp_con emp_con emp_consm
genr emp_con=emp_consm

emp_uti.smooth(n,0.5,0.5) emp_utism
group smemp_uti emp_uti emp_utism
genr emp_uti=emp_utism

emp_tra.smooth(n,0.3,e) emp_trasm
group smemp_tra emp_tra emp_trasm
genr emp_tra=emp_trasm

emp_ser.smooth(n,0.5,e) emp_sersm
group smemp_ser emp_ser emp_sersm
genr emp_ser=emp_sersm

lf.smooth(n,0.3,e) lfsm
```

```
group smlf lf lfsm
genr lf = lfsm

wealth_adj.smooth(n,0.3,e) wealth_adjsm
group smwealth_adj wealth_adj wealth_adjsm
genr wealth_adj=wealth_adjsm


'==Exo====================

rd3m.smooth(n,0.0.5,e) rd3msm
group smrd3m rd3m rd3msm
genr rd3m = rd3msm

nfdi.smooth(n,0.3,e) nfdism
group smnfdi nfdi nfdism
genr nfdi=nfdism

rer.smooth(n,0.5,e) rersm
group smrer rer rersm
genr rer=rersm

exr.smooth(n,0.5,e) exrsm
group smexr exr exrsm
genr exr=exrsm

tour.smooth(n,e,e) toursm
group smtour tour toursm
genr tour=toursm

cgr.smooth(n,0.4,e) cgrsm
group smcgr cgr cgrsm
genr cgr=cgrsm

cg.smooth(n,0.4,e) cgsm
group smcg cg cgsm
genr cg=cgsm

pwco.smooth(n,0.4,e) pwcosm
group smpwco pwco pwcosm
genr pwco=pwcosm


'========== Identity (Before
regression)========================================
```

```
genr cpr=cag+cut+cma+cse+ctr
genr ipr = ima+ico+ise
genr mgr_fin=mfg+mig+men
genr mgs = mgr_fin + msr
genr xgs = xgr + xsr
genr dd=cpr+ipr+cgr
genr gdpd = cpr+ipr+cgr+xgs-mgs+gdp_factor
genr gdp_gap = gdpd-gdps

genr gdpag= toag/zag
genr gdpma= toma/zma
genr gdpco= toco/zco
genr gdput= tout/zut
genr gdptr= tout/ztr
genr gdpse= tose/zse

genr toall = toag+toma+toco+tout+totr+tose
genr gdps = (toag/zag)+(toma/zma)+(toco/zco)+(tout/zut)+(totr/ztr)+(tose/zse)

genr
pgdpave1=(pgdpag*gdpag+pgdpma*gdpma+pgdpco*gdpco+pgdput*gdput+pgdptr*g
dptr+pgdpse*gdpse)/(gdpag+gdpma+gdpco+gdput+gdptr+gdpse)
genr
pgdpave=(pgdpag*gdpag+pgdpma*gdpma+pgdpco*gdpco+pgdput*gdput+pgdptr*gd
ptr+pgdpse*gdpse+pgdpave1*gdp_gap)/(gdpag+gdpma+gdpco+gdput+gdptr+gdpse+
gdp_gap)
genr inf_rate=(pgdpave1-pgdpave1(-1))/pgdpave1(-1)

genr ictax = pictax + bictax
genr dtax = ictax+odtax
genr idtax = ptax + atax + oidtax
genr grev = dtax + idtax + cutax + orev
genr grev_fin = grev+grev_factor
genr budget = grev_fin-cg

genr pdh=pe_hd+tax_hd+mtax_hd+of_hd+vat_hd+mm_hd+pdh_fac

genr yi=hhmi/3.6
genr emp_all =
emp_ag+emp_ma+emp_uti+emp_con+emp_tra+emp_ser+emp_com+emp_oth
genr unempr = (1-(emp_all/lf))*100


'=========Display IV==========
```

```
group iv_all gdpw pop nfdi pwco rer exr tour cinfex bmcap kag kco ktr kma kse kut
gfin ndgl ndgl_bot ndgl_com ndgl_gob ndfl gbond glenf gcb pmgs pxgs ca_ir ca_ip
cpb_fdi cpb_fpo cpb_fot res_as res_forex

'################################## Individual equation fit
######################################

'==Fitting period sample====
smpl 1993:1 2004:2

'===========Agriculture Sector=============

'**eq1 CAG
equation eq_cag.tsls log(cag) c log(gdpd(-1)*(1-RH)) log(pdh(-0)) t d98q1+d98q2 @
pop(-1) exr(-0)  tour(-0) bmcap(-0) kag(-1) kco(-0)  ktr(-1) kma(-0) kse(-1) kut(-1)
gfin(-0) pxgs(-1) ca_ir(-1) cpb_fpo(-1)
series u_cag=resid

'**eq2 TOAG
equation eq_toag.tsls log(toag) c log(kag(-1)/emp_ag(-1)) log(inag(-2)) log(dtdi(-0))
ar(1) @ pop(-0) nfdi(-1) exr(-1) tour(-0) kag(-0) kco(-0) ktr(-0) kma(-1) kse(-1)
ndgl_bot(-0) ndgl_com(-1) pmgs(-0) pxgs(-1) ca_ir(-1)  cpb_fpo(-0) cpb_fot(-0)
res_as(-1) res_forex(-0)
series u_toag=resid


'**eq3 eq3 PGDPAG
equation eq_pgdpag.tsls log(pgdpag) c log(cag(-0)) log(toag(-1)) log(pdh(-0))
log(pgdpag(-1)) ar(1) t d97q1+d01q2+d03q2 @ pop(-1) nfdi(-0) pwco(-0) ktr(-0)
kma(-0) ndgl_com(-1) ndgl_gob(-1) ndfl(-1) pxgs(-1) ca_ip(-0) cpb_fdi(-0) cpb_fot(-
1) res_as(-1) res_forex(-1)
series u_pgdpag=resid

'===========Manufacturing Sector=============

'**eq4 eq4 CMA
equation eq_cma.tsls log(cma) log(cma(-1)) log(gdpd(-0)*(1-RH)) log(wealth_adj)
log(pdh(-0)) ar(1) @ rd3m(-0) cinfex(-1) kco(-0) kse(-1) kut(-0) pop(-0)
series u_cma=resid

'**eq5 eq5 IMA
equation eq_ima.tsls log(ima) log(gdpd(-1)) log(ima(-1)) log(rd3m(-2)) log(pdh(-0))
ar(1) @ pop pwco rer exr tour cinfex bmcap kma kse gfin ndfl pmgs pxgs cpb_fdi
cpb_fot
```

```
series u_ima=resid

'**eq6 TOMA
equation eq_toma.tsls log(toma) log(kma(-1)/emp_ma(-1)) log(dtdi(-0)) log(inma(-1))
log(rd3m) ar(1) t  @ pop rer exr cinfex kco kse kut(-1)
series u_toma=resid

'**eq7 PGDPMA
equation eq_pgdpma.tsls log(pgdpma) pgdpma(-1) log(cma(-1)) log(toma(-0))
log(pdh(-0)) ar(1) @ gdpw pwco rer exr bmcap kag kco kma kse gbond
series u_pgdpma=resid

'===========Construction Sector=============

'**eq8 ICO
equation eq_ico.tsls log(ico) c log(ico(-1)) log(gdpd) log(rd3m(-1)) log(pdh)
d964+d971+d972 @ pop(-1) rer(-0) exr(-0) bmcap(-0) kag(-0) kco(-0) ktr(-0) kse(-1)
gfin(-1) ndgl_bot(-0) ndfl(-1) gbond(-1) pmgs(-1) cpb_fpo(-0)
series u_ico=resid

'**eq9 TOCO
equation eq_toco.tsls log(toco) c log(kco(-2)/emp_con(-2)) log(inco(-1)) log(dtdi)
ar(1) @ gdpw(-0) pop(-0) pwco(-0) rer(-0) exr(-0) tour(-0) bmcap(-1) ktr(-0) kma(-0)
kse kut gfin ndgl_bot ndfl gbond pmgs pxgs cpb_fdi cpb_fpo
series u_toco=resid

'**eq10 PGDPCO
equation eq_pgdpco.tsls log(pgdpco) c log(pgdpco(-1)) log(ico(-1)) log(toco(-1))
log(pdh(-0))  @ gdpw(-0) rer(-1) exr(-0) bmcap(-0) ktr(-0) kma(-0) kse(-0) kut(-0)
ndgl_com(-1) ndgl_gob(-0) ndfl(-0) ca_ir(-1) cpb_fdi
series u_pgdpco=resid

'===========Utilities Sector=============

'**eq11 CUT
equation eq_cut.tsls log(cut) c log(gdpd(-0)*(1-rh)) log(pdh(-0))/log(pgdpave(0))
log(pop(-0)) ar(1) ar(2) @ pop nfdi pwco rer exr tour bmcap kag kco ktr kse gfin pmgs
pxgs ca_ir cpb_fdi cpb_fot res_as res_forex
series u_cut=resid

'**eq12 TOUT
equation eq_tout.tsls log(tout) c log(kut(-2)/emp_uti(-2)) log(dtdi) ar(1) t @ gdpw(-0)
pop(-1) pwco(-1) rer(-0) exr(-0) tour kag kco ktr kse gfin ndgl_bot ndgl_gob pmgs
pxgs ca_ir cpb_fdi
series u_tout=resid
```

```
'**eq13 PGDPUT
equation eq_pgdput.tsls log(pgdput) c log(cut(-0)) log(tout(-0)) log(pdh) d971 ar(1) @ pop(-1) nfdi(-0) pwco(-1) rer(-1) exr(-0) tour(-0) kco(-0) ktr(-1) kma(-0) kse(-0) gfin(-0) ndgl_gob(-0) pxgs(-0) cpb_fdi(-0) res_as(-0) res_forex(-0)
series u_pgdput=resid

'===========Transportation Sector=============

'**eq14 CTR
equation eq_ctr.tsls log(ctr) c log(gdpd(-0)*(1-rh)) log(dtdi(-0)) log(tour(-0)) ar(1) d00q1 @ gdpw(-0) pop(-0) nfdi(-0) rer(-1) cinfex(-0) kag(-0) kco(-0) ktr(-0) kma(-1) kse(-0) kut pmgs pxgs ca_ir ca_ip cpb_fdi
series u_ctr=resid

'**eq15 TOTR
equation eq_totr.tsls log(totr) c log(ktr(-0)/emp_tra(-0)) log(intr(-2)) log(dtdi(-0)) ar(1) @ gdpw pop pwco rer exr tour bmcap kag kco ktr kse ndgl_bot gbond pmgs ca_ir cpb_fdi cpb_fpo cpb_fot
series u_totr=resid

'**eq16 PGDPTR
equation eq_pgdptr.tsls log(pgdptr) c log(pgdptr(-1)) log(ctr(-0)) log(totr(-0)) log(pdh(-1)) ar(1) @  gdpw(-1) pwco(-1) cinfex(-0) bmcap(-0) kag(-2) ktr(-0) kut(-0) pmgs(-0) pxgs(-0) ca_ip(-1) cpb_fpo(-0) cpb_fot(-0) gdpw
series u_pgdptr=resid

'===========Service Sector=============

'**eq17 CSE
equation eq_cse.tsls log(cse) c log(gdpd(-0)*(1-rh)) log(dtdi(-0)) ar(1) t @ pop(-0) pwco(-0) rer(-0) exr(-0) tour(-0) cinfex(-0) bmcap(-0) kag(-0) kco(-0) ktr(-0) kma kse gfin(-0) ndgl_bot(-0) gbond(-0) pmgs(-0) pxgs(-0) cpb_fpo(-1) res_as(-1) res_forex(-1)
series u_cse=resid

'**eq18 ISE
equation eq_ise.tsls log(ise) c log(ise(-1)) log(gdpd(-1)) log(rd3m(-0)) log(pdh(-0)) ar(1) t  d96q2+d96q4 @ pop(-1) nfdi(-1) rer(-0) exr(-0) tour(-0) kco(-0) ktr(-0) kma(-0) kse(-0) kut(-0) gfin(-1) pmgs(-0) pxgs(-0) res_as(-1) res_forex(-0)
series u_ise=resid

'**eq 19 TOSE
```

```
equation eq_tose.tsls log(tose) c log(kse(-0)/emp_ser(-1)) log(inse(-2)) log(dtdi(-0)) ar(1) d96q2+d01q2 @  pop nfdi pwco rer exr cinfex bmcap kco ktr kma kse kut gfin ndgl_com ndfl pmgs pxgs ca_ip cpb_fot res_as res_forex
series u_tose=resid

'**eq 20 PGDPSE
equation eq_pgdpse.tsls log(pgdpse) c log(cse(-0)) log(tose(-0)) log(pdh(-1)) ar(1) @ pop nfdi rer exr tour bmcap kco ndgl_bot pxgs ca_ip res_as res_forex
series u_pgdpse=resid

'==========Import equations==============

'**eq 21 MFG
equation eq_mfg.tsls log(mfg) log(mfg(-1)) log(dd(-0)) log(exr(-0)) ar(1) @ gdpw pop rer exr tour kag kco ktr kse kut gfin ndgl_com ndgl_gob ca_ir ca_ip cpb_fdi
series u_mfg=resid

'**eq 22 MIG
equation eq_mig.tsls log(mig) c log(ima(-0)) log(xgr(-0)) log(rer(-0)) ar(1) @ gdpw pop exr tour cinfex kag kco kma kse kut ndgl_bot ndgl_com  ndfl gbond pxgs ca_ip cpb_fpo
series u_mig=resid

'**eq 23 MEN
equation eq_men.tsls log(men) log(toall(-0)) log(pdh(-0)) log(rer(-0)) ar(1) d012 @ gdpw(-0) pop(-0) rer(-1) tour(-0) kag(-0) kco(-0) ktr(-0) kma(-0) kse(-1) kut(-0) gfin(-1) ndfl gbond cpb_fpo
series u_men=resid

'**eq 24 MSR
equation eq_msr.tsls log(msr) c  log(toall(-0)) log(rer(-2)) ar(1) t @ gdpw(-0) pop(-0) nfdi(-2) pwco(-0) rer(-0) exr(-2) tour(-1) bmcap(-0) kag(-0) kco(-2) ktr(-0) kma(-0) kut(-0) ndgl_bot(-0) ndgl_com(-0) cpb_fdi(-0)
series u_msr=resid

'=========Export equations===============

'**eq 25 XGR
equation eq_xgr.tsls log(xgr) c log(xgr(-1)) log(gdpw(-1)) log(gdpd(-0)) log(toma(-1)) log(rer(-1)) ar(1) t @  gdpw(-1) pop(-1) rer(-0) tour(-0) cinfex(-0) kag(-1) kco(-0) kma(-1) kse kut gfin ndgl_bot pxgs ca_ir ca_ip cpb_fot
series u_xgr=resid

'**eq 26 XSR
```

```
equation eq_xsr.tsls log(xsr) c log(tose(-0)) log(tour(-0)) log(rer(-0)) ar(1) t @ gdpw(-2) pop(-1) pwco(-0) cinfex(-0)  kag(-1) kco(-0) ktr(-0) kse(-1) kut(-1) gfin(-0) ndgl_bot(-1)  pmgs(-0) pxgs(-0) ca_ir(-1) cpb_fpo(-0)
series u_xsr=resid

'==============Price equations====================

'**eq 27 CPI
equation eq_cpi.tsls log(cpi) c log(pgdpave) ar(1) @ pop exr kag kco ktr kma kse kut
series u_cpi=resid

'==============  Welfare  ============================

'**eq28 HHMI
equation eq_we_hhmi.tsls log(hhmi)  log(gdpd(-0)) log(cpi(-1)) log(wealth_adj(-0)) t ar(1) @ gdpw pop rer exr kag kco ktr ndgl_gob pxgs ca_ir cpb_fot
series u_we_hhmi=resid

'**eq29 POVL
equation eq_we_povl.tsls log(povl) c log(cpi(-0)) log(hhmi(-0)) ar(1) t @  rmlr pop rer exr kag kco ktr kma kse
series u_we_povl=resid

'**eq30 POVS
equation eq_we_povs.tsls log(povs) log(pop(-0)) log(povs(-1)) povl(-0)-yi(-0) log(povl(-0)) ar(1) @ nfdi pwco rer exr cinfex kco ktr kma kse kut ndgl_bot ndgl_com pxgs cpb_fdi cpb_fpo res_as res_forex
series u_we_povs=resid

'**eq31 WEALTH
equation eq_we_wealth.tsls log(wealth_adj) c log(pgdpave(-0)) log(gdpd(-0)*(1-rh)) t ar(1) d971 @ gdpw pop(-1) nfdi(-0) exr rer cinfex(-0)  kag(-0)  kco(-0)  ktr(-0) kse(-0) kut(-1) ndgl_com ca_ir ca_ip cpb_fdi res_as res_forex
series u_we_wealth=resid

'=========Fiscal equations ==================

'**eq32 PTAX
equation eq_ptax.tsls log(ptax) c log(dtdi(-0)) log(ntc(-0)+npc(-0)) ar(1) t @ gdpw(-1) pop pwco(-1) exr tour bmcap kco(-1) ktr  kut ndgl_bot ndfl pmgs pxgs ca_ir cpb_fpo
series u_ptax=resid

'**eq33 ATAX
equation eq_atax.tsls log(atax) c log(sacc+sacp) ar(1) t @ gdpw pop nfdi rer exr kag ktr kse kut ndgl_com ndgl_gob pmgs ca_ip cpb_fdi cpb_fpo cpb_fot
```

```
series u_atax=resid

'**eq34 PICTAX
equation eq_pictax.tsls log(pictax) c log(gdpd(-0)) log(pgdpave(-1)) ar(1) d97q1@
pop(-0) rer(-1) exr(-1) tour(-1) bmcap(-2) kag(-1) kco(-0) kma(-1)  kse(-0) gfin(-0)
pxgs(-1) cpb_fdi(-0) cpb_fot(-0) res_as(-1) res_forex
series u_pictax=resid

'**eq35 BICTAX
equation eq_bictax.tsls log(bictax) log(gdpd(-0)) log(pgdpave(-1)) d964 ar(1) @ rer
exr tour kco ktr kma kse kut ndgl_bot ndgl_com pxgs  cpb_fdi cpb_fpo cpb_fot res_as
res_forex
series u_bictax=resid

'**eq36 ODTAX
equation eq_odtax.tsls log(odtax) c log(toall(-0)) log(pgdpave(-0)) ar(1) @ pop nfdi
pwco rer tour cinfex bmcap kag kco ktr kma kse ndgl_gob gbond ca_ip cpb_fpo
cpb_fot
series u_odtax=resid

'**eq37 OIDTAX
equation eq_oidtax.tsls log(oidtax) log(gdpd(-0)) log(pgdpave(-1)) log(oidtax(-1))
ar(1) @ pop(-1) nfdi(-1) rer(-1) exr(-1) kag(-0) kco(-0) kse(-0) kut(-0) ndgl_bot(-0)
gbond(-0) pmgs(-1) ca_ir(-0) cpb_fpo(-0) cpb_fot(-0) res_forex(-0)
series u_oidtax=resid

'**eq38 CUTAX
equation eq_cutax.tsls log(cutax) log(pgdpave)  log(mgs(-0)+xgs(-0)) ar(1) ar(2) @
gdpw pop nfdi rer exr tour bmcap kco ktr kma kut ndgl_gob pmgs pxgs ca_ip cpb_fdi
cpb_fot
series u_cutax=resid

'**eq39 OREV
equation eq_orev.tsls log(orev) log(toall) log(pgdpave) ar(1) @ gdpw pop cinfex
bmcap kag ktr kma kut gfin ndgl_com ndgl_gob pmgs cpb_fdi cpb_fpo
series u_orev=resid

'==============Energy============================

'**eq40 DTDI
equation eq_en_dtdi.tsls log(dtdi) log(pdh(-0)) log(toall(-0)) log(ntc(-1)) log(npc(-0))
ar(1) @ pop(-1) rer(-1) exr(-1) kag(-0) kco(-1) ktr(-0) kse(-0) ndfl(-1) pxgs cpb_fpo
series u_en_dtdi=resid

'**eq41 NTC
```

equation eq_en_ntc.tsls log(ntc) log(ntc(-1)) log(sacc(-0)) ar(1) @ gdpw pop rer exr tour kag kco ktr kma kse kut gfin pxgs ca_ir
series u_en_ntc=resid

'**eq42 NPC
equation eq_en_npc.tsls log(npc) log(npc(-1)) log(sacp(-0)) log(atax(-1)) ar(1) @ pop(-1) nfdi(-1) rer(-1) exr(-0) cinfex kag kco ktr kma kse gfin ndgl_gob ndfl ca_ir cpb_fdi
series u_en_npc=resid

'**eq43 SACC
equation eq_en_sacc.tsls log(sacc) log(sacc(-1)) log(toall(-0)) log(wealth_adj(-0)) log(pdh(-0)) ar(1) @ pop(-0) nfdi(-0) rer(-0) exr(-0) tour(-1) cinfex(-0) bmcap(-1) kag(-0) kco(-0) ktr(-0) kma(-0) ndgl_bot(-0) ndfl(-0) cpb_fpo(-1)
series u_en_au_sacc=resid

'**eq44 SACP
equation eq_en_sacp.tsls log(sacp) c (log(pdh(-1))-log(pgp(-1))) log(sacc(-0)) ar(1) @ pop(-1) rer(-0) exr(-0) cinfex(-1) bmcap(-0) kco(-1) kut gfin gbond pmgs
series u_en_sacp=resid

'**eq45 PE_HD
equation eq_en_pe_hd.tsls log(pe_hd) log(pwco(-0)) log(pe_hd(-1)) ar(1) @ nfdi pwco rer exr kag kco ktr kma kse ndgl_bot ca_ip
series u_en_pe_hd=resid

'==All employment

'***eq46 EMPAG
equation eq_empag.tsls log(emp_ag) c log(emp_ag(-1)) log(emp_ma(-0)) log(gdpd) ar(1) d972 @ pop(-0) nfdi(-0) rer(-0) exr(-0) cinfex(-0) bmcap(-1) kag(-0) kco(-0) ktr(-0) kse(-0) cpb_fdi(-1) res_as(-0) res_forex(-0)

'***eq47 EMPMA
equation eq_empma.tsls log(emp_ma) c log(mig(-0)) log(gdpd(-0)) ar(1) t @ pop pwco rer exr tour cinfex kco kma kse kut ndgl_bot ndgl_com ndfl gbond pxgs cpb_fpo res_as res_forex

'***eq48 EMPCO
equation eq_empco.tsls log(emp_con) c log(kco(-1)) log(gdpd(-0)) ar(1) @ gdpw(-0) pop(-1) cinfex(-0) kag(-0) kco(-1) kut(-0) ndgl_bot(-0) ndgl_gob(-1) res_as(-1) res_forex

'***eq49 EMPUT

```
equation eq_emput.tsls log(emp_uti) c log(emp_uti(-1)) log(tout(-0)) ar(1) t @ gdpw(-0) rer(-0) kco(-1) ktr(-1) kma(-1) kse(-0) ndgl_gob(-0) pmgs pxgs(-1) ca_ip cpb_fdi cpb_fpo cpb_fot(-1)

'***eq50 EMPTR
equation eq_emptr.tsls log(emp_tra) log(ktr(-1)) log(ctr(-0)) ar(1) @  pop pwco rer exr tour bmcap kag kco ktr kse kut gfin ndgl_bot ndgl_gob ndfl pxgs ca_ip cpb_fot res_as res_forex

'***eq51 EMPSE
equation eq_empse.tsls log(emp_ser) log(toall(-0)) log(cse(-1)) ar(1) @ gdpw pop pwco rer exr kut pxgs ca_ir cpb_fot res_as res_forex

'########################  Append equations to Thai model
##########################################

thai.append :eq_cag
thai.append :eq_toag
thai.append :eq_pgdpag
thai.append :eq_cma
thai.append :eq_ima
thai.append :eq_toma
thai.append :eq_pgdpma
thai.append :eq_ico
thai.append :eq_toco
thai.append :eq_pgdpco
thai.append :eq_cut
thai.append :eq_tout
thai.append :eq_pgdput
thai.append :eq_ctr
thai.append :eq_totr
thai.append :eq_pgdptr
thai.append :eq_cse
thai.append :eq_ise
thai.append :eq_tose
thai.append :eq_pgdpse
thai.append :eq_mfg
thai.append :eq_mig
thai.append :eq_men
thai.append :eq_msr
thai.append :eq_xgr
thai.append :eq_xsr
thai.append :eq_cpi
thai.append :eq_ptax
thai.append :eq_atax
```

```
thai.append :eq_pictax
thai.append :eq_bictax
thai.append :eq_odtax
thai.append :eq_oidtax
thai.append :eq_cutax
thai.append :eq_orev
thai.append :eq_en_dtdi
thai.append :eq_en_ntc
thai.append :eq_en_npc
thai.append :eq_en_pe_hd
thai.append :eq_en_sacp
thai.append :eq_en_sacc
thai.append :eq_empag
thai.append :eq_empma
thai.append :eq_empco
thai.append :eq_emput
thai.append :eq_emptr
thai.append :eq_empse
thai.append :eq_we_hhmi
thai.append :eq_we_povl
thai.append :eq_we_povs
thai.append :eq_we_wealth

'================Identity===================================

'=====Demand Identity========

thai.append cpr = cag+cut+cma+cse+ctr
thai.append ipr = ima+ico+ise
thai.append mgr_fin=mfg+mig+men
thai.append mgs = mgr_fin + msr
thai.append xgs = xgr + xsr
thai.append dd=cpr+ipr+cgr
thai.append gdpd = cpr+ipr+cgr+xgs-mgs+gdp_factor
thai.append gdp_gap = gdpd-gdps

'=====Supply Identity=========

thai.append gdpag= toag/zag
thai.append gdpma= toma/zma
thai.append gdpco= toco/zco
thai.append gdput= tout/zut
thai.append gdptr= tout/ztr
thai.append gdpse= tose/zse
thai.append toall = toag+toma+toco+tout+totr+tose
```

```
thai.append gdps = (toag/zag)+(toma/zma)+(toco/zco)+(tout/zut)+(totr/ztr)+(tose/zse)

'=====Price Identity==========

thai.append
pgdpave1=(pgdpag*gdpag+pgdpma*gdpma+pgdpco*gdpco+pgdput*gdput+pgdptr*g
dptr+pgdpse*gdpse)/(gdpag+gdpma+gdpco+gdput+gdptr+gdpse)
thai.append
pgdpave=(pgdpag*gdpag+pgdpma*gdpma+pgdpco*gdpco+pgdput*gdput+pgdptr*gd
ptr+pgdpse*gdpse+pgdpave1*gdp_gap)/(gdpag+gdpma+gdpco+gdput+gdptr+gdpse+
gdp_gap)
thai.append inf_rate=(pgdpave1-pgdpave1(-1))/pgdpave1(-1)

'=======Fiscal Identity===================

thai.append ictax = pictax + bictax
thai.append dtax = ictax+odtax
thai.append idtax = ptax + atax + oidtax
thai.append grev = dtax + idtax + cutax + orev
thai.append grev_fin = grev+grev_factor
thai.append budget = grev_fin-cg

'=======Energy Identity===================

thai.append pdh=pe_hd+tax_hd+mtax_hd+of_hd+vat_hd+mm_hd+pdh_fac

'======Welfare Identity================

thai.append yi=hhmi/3.6
thai.append emp_all =
emp_ag+emp_ma+emp_uti+emp_con+emp_tra+emp_ser+emp_com+emp_oth
thai.append unempr = (1-(emp_all/lf))*100

'###################SCENARIO 0 Baseline same trend####################

genr bictax_a = bictax
genr cag_a = cag
genr cma_a = cma
genr cpi_a = cpi
genr cpr_a = cpr
genr cse_a = cse
genr ctr_a = ctr
genr cut_a = cut
genr cutax_a = cutax
genr dd_a = dd
```

```
genr det_a = det
genr dtax_a = dtax
genr dtdi_a = dtdi
genr dtfo_a = dtfo
genr dtgp_a = dtgp
genr dtgr_a = dtgr
genr dtke_a = dtke
genr dtlpg_a = dtlpg
genr dtp_a = dtp
genr gdp_factor_a = gdp_factor
genr gdpag_a = gdpag
genr gdpco_a = gdpco
genr gdpd_a = gdpd
genr gdpma_a = gdpma
genr gdps_a = gdps
genr gdpse_a =gdpse
genr gdptr_a =gdptr
genr gdput_a =gdput
genr grev_a = grev
genr grev_fin_a = grev_fin
genr hhmi_a = hhmi
genr ico_a = ico
genr ictax_a = ictax
genr idtax_a = idtax
genr ima_a = ima
genr ipr_a = ipr
genr ise_a = ise
genr men_a = men
genr mfg_a = mfg
genr mgr_fin_a = mgr_fin
genr mgs_a = mgs
genr mig_a = mig
genr msr_a = msr
genr odtax_a = odtax
genr oidtax_a = oidtax
genr orev_a = orev
genr pgdpag_a = pgdpag
genr pgdpave_a = pgdpave
genr pgdpco_a = pgdpco
genr pgdpma_a = pgdpma
genr pgdpse_a = pgdpse
genr pgdptr_a = pgdptr
genr pgdput_a = pgdput
genr pictax_a = pictax
genr povl_a = povl
```

```
genr povs_a = povs
genr toag_a = toag
genr toall_a = toall
genr toco_a = toco
genr toma_a = toma
genr tose_a = tose
genr totr_a = totr
genr tout_a = tout
genr unemp_rate_a = unemp_rate
genr xgr_a = xgr
genr xgs_a = xgs
genr xsr_a = xsr
genr atax_a =atax
genr cgr_a =cgr
genr dtjp_a =dtjp
genr emp_ag_a =emp_ag
genr emp_con_a =emp_con
genr emp_uti_a =emp_uti
genr emp_ma_a =emp_ma
genr emp_ser_a =emp_ser
genr emp_tra_a =emp_tra
genr exr_a =exr
genr gdpd_nofac_a =gdpd_nofac
genr gdpw_a =gdpw
genr grev_factor_a =grev_factor
genr inag_a =inag
genr inco_a =inco
genr inma_a =inma
genr inse_a =inse
genr intr_a =intr
genr inut_a =inut
genr kag_a =kag
genr kma_a =kma
genr kco_a =kco
genr ktr_a =ktr
genr kse_a =kse
genr kut_a =kut
genr npc_a =npc
genr ntc_a =ntc
genr pdh_a =pdh
genr pgp_a =pgp
genr pgr_a =pgr
genr pmgs_a =pmgs
genr pop_a =pop
genr ptax_a =ptax
```

```
genr pwco_a =pwco
genr rd3m_a =rd3m
genr rer_a =rer
genr rh_a =rh
genr t_a =t
genr tour_a =tour
genr wealth_adj_a =wealth_adj

smpl 2005:1 2006:4

genr atax = atax(-1)+(atax(-8)-atax(-9))
graph br_atax atax atax_a

genr cgr = cgr(-1)+(cgr(-8)-cgr(-9))
graph br_cgr cgr cgr_a

genr dtjp = dtjp(-1)+(dtjp(-18)-dtjp(-19))
graph br_dtjp dtjp dtjp_a

genr emp_ag = emp_ag(-1)+(emp_ag(-16)-emp_ag(-17))
graph br_emp_ag emp_ag emp_ag_a

genr emp_con = emp_con(-1)+(emp_con(-8)-emp_con(-9))
graph br_emp_con emp_con emp_con_a

genr emp_uti = emp_uti(-1)+(emp_uti(-11)-emp_uti(-12))
graph br_emp_uti emp_uti emp_uti_a

genr emp_ma = emp_ma(-1)+(emp_ma(-7)-emp_ma(-8))
graph br_emp_ma emp_ma emp_ma_a

genr emp_ser = emp_ser(-1)+(emp_ser(-7)-emp_ser(-8))
graph br_emp_ser emp_ser emp_ser_a

genr emp_tra = emp_tra(-1)+(emp_tra(-10)-emp_tra(-11))
graph br_emp_tra emp_tra emp_tra_a

genr exr = exr(-1)+( exr(-14)- exr(-15))
graph br_exr exr exr_a

genr gdpw = gdpw(-1)+( gdpw(-12)- gdpw(-13))
graph br_gdpw gdpw gdpw_a

genr inag = inag(-1)+( inag(-16)- inag(-16))
graph br_inag inag inag_a
```

```
genr inco = inco(-1)+( inco(-8)- inco(-9))
graph br_inco inco inco_a

genr inma = inma(-1)+( inma(-8)- inma(-9))
graph br_inma inma inma_a

genr inse = inse(-1)+( inse(-8)- inse(-9))
graph br_inse inse inse_a

genr intr = intr(-1)+( intr(-16)- intr(-17))
graph br_intr intr intr_a

genr inut = inut(-1)+( inut(-8)- inut(-9))
graph br_inut inut inut_a

genr kag = kag(-1)+( kag(-8)- kag(-9))
graph br_kag kag kag_a

genr kma = kma(-1)+( kma(-8)- kma(-9))
graph br_kma kma kma_a

genr kco = kco(-1)+( kco(-8)- kco(-9))
graph br_kco kco kco_a

genr ktr = ktr(-1)+( ktr(-8)- ktr(-9))
graph br_ktr ktr ktr_a

genr kse = kse(-1)+( kse(-8)- kse(-9))
graph br_kse kse kse_a

genr kut = kut(-1)+( kut(-8)- kut(-9))
graph br_kut kut kut_a

genr pdh = pdh(-1)+( pdh(-4)- pdh(-5))
graph br_pdh pdh pdh_a

genr pgp = pgp(-1)+( pgp(-12)- pgp(-13))
graph br_pgp pgp pgp_a

genr pgr = pgr(-1)+( pgr(-12)- pgr(-13))
graph br_pgr pgr pgr_a

genr pmgs = pmgs(-1)+( pmgs(-16)- pmgs(-17))
graph br_pmgs pmgs pmgs_a
```

```
genr pop = pop(-1)+( pop(-16)- pop(-17))
graph br_pop pop pop_a

genr ptax = ptax (-1)+( ptax(-17)- ptax(-18))
graph br_ptax ptax ptax_a

genr pwco = pwco(-1)+(pwco(-12)-pwco(-13))
graph br_pwco pwco pwco_a

genr rd3m = rd3m(-1)+( rd3m(-4)- rd3m(-5))
graph br_rd3m rd3m rd3m_a

genr rer = rer(-1)+( rer(-14)- rer(-15))
graph br_rer rer rer_a

genr rh = rh(-1)
genr t = t(-1)+( t(-8)- t(-9))

genr tour = tour(-1)+( tour(-24)- tour(-25))
graph br_tour tour tour_a

genr wealth_adj = wealth_adj(-1)+( wealth_adj(-16)- wealth_adj(-17))
graph br_wealth_adj wealth_adj wealth_adj_a

smpl 1994:1 2006:2
graph all_xo1.merge br_atax br_cgr br_dtjp br_emp_ag br_emp_con br_emp_uti
br_emp_ma br_emp_ser br_emp_tra br_inag br_inco br_inma br_inse br_intr br_inut
br_kag br_kma br_kco br_ktr br_kse br_kut
all_xo1.addtext(t, font(+b)) Exogenous actual and same trend
all_xo1.align(6,1,2)

'###########################################################################
#########################
'*************Run Baseline sametrend*****************

thai.scenario(n) baseline_sametrend
thai.append ASSIGN @all _1

smpl 1995:1 2006:2
thai.solve(d=s, o=g)


'***********Display results after running baseline with same
trend*****************************
```

```
'==smpl 1994:1 2006:2
smpl 1994:1 2004:4

graph grag_cag cag cag_1
grag_cag.addtext(t, font(14,+b)) Consumption in agriculture
graph grag_toag toag toag_1
grag_toag.addtext(t, font(14,+b)) Total output in agriculture
graph grag_pgdpag pgdpag pgdpag_1
grag_pgdpag.addtext(t, font(14,+b)) Price in agriculture
graph all_ag.merge grag_cag grag_toag grag_pgdpag
all_ag.addtext(t, font(16,+b)) Agriculture
all_ag.align(2,1,2)

graph grma_cma cma cma_1
grma_cma.addtext(t, font(14,+b)) Consumption in manufacturing
graph grma_ima ima ima_1
grma_ima.addtext(t, font(14,+b)) Investment in manufacturing
graph grma_toma toma toma_1
grma_toma.addtext(t, font(14,+b)) Total output in manufacturing
graph grma_pgdpma pgdpma pgdpma_1
grma_pgdpma.addtext(t, font(14,+b)) Price in manufacturing
graph all_ma.merge grma_cma grma_ima grma_toma grma_pgdpma
all_ma.addtext(t, font(16,+b)) Manufacturing
all_ma.align(2,1,2)

graph grco_ico ico ico_1
grco_ico.addtext(t, font(14,+b)) Investment in construction
graph grco_toco toco toco_1
grco_toco.addtext(t, font(14,+b)) Total output in construction
graph grco_pgdpco pgdpco pgdpco_1
grco_pgdpco.addtext(t, font(14,+b)) Price in construction
graph all_co.merge grco_ico grco_toco grco_pgdpco
all_co.addtext(t, font(16,+b)) Construction
all_co.align(2,1,2)

graph grut_cut cut cut_1
grut_cut.addtext(t, font(14,+b)) Consumption in utility
graph grut_tout tout tout_1
grut_tout.addtext(t, font(14,+b)) Total output in utility
graph grut_pgdput pgdput pgdput_1
grut_pgdput.addtext(t, font(14,+b)) Price in utility
graph all_ut.merge grut_cut grut_tout grut_pgdput
all_ut.addtext(t, font(16,+b)) Utility
all_ut.align(2,1,2)
```

```
graph grtr_ctr ctr ctr_1
grtr_ctr.addtext(t, font(14,+b)) Consumption in transportation
graph grtr_totr totr totr_1
grtr_totr.addtext(t, font(14,+b)) Total output in transportation
graph grtr_pgdptr pgdptr pgdptr_1
grtr_pgdptr.addtext(t, font(14,+b)) Price in transportation
graph all_tr.merge grtr_ctr grtr_totr grtr_pgdptr
all_tr.addtext(t, font(16,+b)) Transportation
all_tr.align(2,1,2)

graph grse_cse cse cse_1
grse_cse.addtext(t, font(14,+b)) Consumption in service
graph grse_ise ise ise_1
grse_ise.addtext(t, font(14,+b)) Investment in service
graph grse_tose tose tose_1
grse_tose.addtext(t, font(14,+b)) Total output in service
graph grse_pgdpse pgdpse pgdpse_1
grse_pgdpse.addtext(t, font(14,+b)) Price in service
graph all_se.merge grse_cse grse_ise grse_tose grse_pgdpse
all_se.addtext(t, font(16,+b)) Service
all_se.align(2,1,2)

graph grem_mfg mfg mfg_1
grem_mfg.addtext(t, font(14,+b)) Import of final goods
graph grem_mig mig mig_1
grem_mig.addtext(t, font(14,+b)) Import of intermediate goods
graph grem_men men men_1
grem_men.addtext(t, font(14,+b)) Import value of energy
graph grem_mgr mgr_fin mgr_fin_1
grem_mgr.addtext(t, font(14,+b)) Import of goods (actual and base)

graph grem_msr msr msr_1
grem_msr.addtext(t, font(14,+b)) Import of services (actual and base)
graph grem_xgr xgr xgr_1
grem_xgr.addtext(t, font(14,+b)) Export of goods (actual and base)
graph grem_xsr xsr xsr_1
grem_xsr.addtext(t, font(14,+b)) Export of services (actual and base)

graph gr_mgs mgs mgs_1
gr_mgs.addtext(t, font(14,+b)) Import of goods and services (actual and base)
graph gr_xgs xgs xgs_1
gr_xgs.addtext(t, font(14,+b)) Export of goods and services (actual and base)
```

```
graph all_em.merge grem_mfg grem_mig grem_men grem_mgr grem_msr grem_xgr
grem_xsr gr_mgs gr_xgs
all_em.addtext(t, font(16,+b)) Export & Import
all_em.align(3,1,2)
graph all_of_econ.merge all_ag all_ma all_co all_ut all_tr all_se all_em

'================Fiscal display===========================
graph grfc_atax atax atax_1
grfc_atax.addtext(t, font(14,+b)) Automobile tax (Reg)
graph grfc_ptax ptax ptax_1
grfc_ptax.addtext(t, font(14,+b)) Petroleum  tax (Reg)
graph grfc_pictax pictax pictax_1
grfc_pictax.addtext(t, font(14,+b)) Personal ncome tax (Reg)
graph grfc_bictax bictax bictax_1
grfc_bictax.addtext(t, font(14,+b)) Business income tax (Reg)
graph grfc_ictax ictax ictax_1
grfc_ictax.addtext(t, font(14,+b)) Income tax (PICTAX+BICTAX)
graph grfc_odtax odtax odtax_1
grfc_odtax.addtext(t, font(14,+b)) Other direct tax (Reg)
graph grfc_dtax dtax dtax_1
grfc_dtax.addtext(t, font(14,+b)) Direct tax (ICTAX+ODTAX)
graph grfc_oidtax oidtax oidtax_1
grfc_oidtax.addtext(t, font(14,+b)) Other indirect tax (Reg)
graph grfc_idtax idtax idtax_1
grfc_idtax.addtext(t, font(14,+b)) Indirect tax (PTAX+ATAX+OIDTAX)
graph grfc_cutax cutax cutax_1
grfc_cutax.addtext(t, font(14,+b)) Custom tax (Reg)
graph grfc_orev orev orev_1
grfc_orev.addtext(t, font(14,+b)) Other government revenue (Reg)
graph grfc_grev grev_fin grev_fin_1
grfc_grev.addtext(t, font(14,+b)) Total government revenue
(DTAX+IDTAX+CUTAX+OREV)
graph all_fc.merge grfc_ptax grfc_atax grfc_pictax grfc_bictax grfc_ictax grfc_odtax
grfc_dtax grfc_oidtax grfc_idtax grfc_cutax grfc_orev grfc_grev
all_fc.addtext(t, font(16,+b)) Fiscal
all_fc.align(3,1,2)


'===========Budget deficit check=========================

graph all_bd cg grev_fin grev_fin_1
all_bd.addtext(t, font(14,+b)) Budget deficit

'===========Price display==================================
```

```
graph grpr_pgdpave pgdpave pgdpave_1
grpr_pgdpave.addtext(t, font(14,+b)) PGDP average
graph grpr_cpi cpi cpi_1
grpr_cpi.addtext(t, font(14,+b)) CPI
graph all_pr.merge grpr_pgdpave grpr_cpi
all_pr.addtext(t, font(16,+b)) Price

'=========== Energy display ===================================


graph gren_dtdi dtdi dtdi_1
gren_dtdi.addtext(t, font(14,+b)) Total demand of diesel
graph gren_ntc ntc ntc_1
gren_ntc.addtext(t, font(14,+b)) Number of trucks
graph gren_npc npc npc_1
gren_npc.addtext(t, font(14,+b)) Number of Personal cars
graph gren_sacp sacp sacp_1
gren_sacp.addtext(t, font(14,+b)) Sale of personal cars
graph gren_sacc sacc sacc_1
gren_sacc.addtext(t, font(14,+b)) Sale of commercial cars
graph gren_pe_hd pe_hd pe_hd_1
gren_pe_hd.addtext(t, font(14,+b)) Ex-refinery price of high speed diesel
graph all_en.merge  gren_pe_hd gren_dtdi gren_ntc gren_npc gren_sacc gren_sacp
all_en.addtext(t, font(16,+b)) Demand of petroleum products
all_en.align(3,1,2)
graph grau_npc npc npc_1
grau_npc.addtext(t, font(14,+b)) Number of personal cars
graph grau_ntc ntc ntc_1
grau_ntc.addtext(t, font(14,+b)) Number of trucks
graph all_au.merge grau_npc grau_ntc
all_au.addtext(t, font(16,+b)) Automobile industry
all_au.align(2,1,2)


'=========== Welfare display ===================================

graph grwe_emp_ag emp_ag emp_ag_1
grwe_emp_ag.addtext(t, font(14,+b)) Employment rate agriculture
graph grwe_emp_ma emp_ma emp_ma_1
grwe_emp_ma.addtext(t, font(14,+b)) Employment rate manufacturing
graph grwe_emp_con emp_con emp_con_1
grwe_emp_con.addtext(t, font(14,+b)) Employment rate construction
graph grwe_emp_uti emp_uti emp_uti_1
grwe_emp_uti.addtext(t, font(14,+b)) Employment rate utility
graph grwe_emp_tra emp_tra emp_tra_1
```

```
grwe_emp_tra.addtext(t, font(14,+b)) Employment rate transportation
graph grwe_emp_ser emp_ser emp_ser_1
grwe_emp_ser.addtext(t, font(14,+b)) Employment rate service
graph grwe_emp_all emp_all emp_all_1
grwe_emp_all.addtext(t, font(14,+b)) Employment rate all
graph grwe_unempr unempr unempr_1
grwe_unempr.addtext(t, font(14,+b)) Unemployment rate (r)
graph grwe_hhmi hhmi hhmi_1
grwe_hhmi.addtext(t, font(14,+b)) Household monthly income
graph grwe_povl povl povl_1
grwe_povl.addtext(t, font(14,+b)) Poverty line
graph grwe_povs povs povs_1
grwe_povs.addtext(t, font(14,+b)) Poverty severity
graph grwe_wealth wealth_adj wealth_adj_1
grwe_wealth.addtext(t, font(14,+b)) Wealth
graph all_we.merge grwe_unempr grwe_emp_all grwe_emp_ag grwe_emp_ma
grwe_emp_con grwe_emp_uti grwe_emp_tra grwe_emp_ser  grwe_hhmi grwe_povl
grwe_povs grwe_wealth
all_we.addtext(t, font(16,+b)) Welfare block
all_we.align(4,1,2)

'===========Macro closure check=========================

'==Total private consumption==
graph gr_cpr cpr cpr_1
gr_cpr.addtext(t, font(+b)) Consumption (actual and base)
graph gr_ipr ipr ipr_1
gr_ipr.addtext(t, font(+b)) Investment (actual and base)

'==Graph C, I, X, M ==
graph all_cinx.merge gr_cpr gr_ipr  gr_mgs gr_xgs
all_cinx.align(2,1,2)

'==GDP demand==
graph gr_gdpd gdpd gdpd_1
gr_gdpd.addtext(t, font(+b)) GDPD actual and GDPD baseline (adjusted factor)

'==GDP supply==
graph gr_gdps gdps gdps_1
gr_gdps.addtext(t, font(+b)) GDPS actual and GDPS baseline

'==GDP closure actual==
graph gr_closure_actual gdpd gdps
gr_closure_actual.addtext(t, font(+b)) GDPD & GDPS actual
```

```
'==GDP closure baseline==
graph gr_closure_base gdpd_1 gdps_1
gr_closure_base.addtext(t, font(+b)) GDPD & GDPS baseline

graph all_closure.merge gr_gdpd gr_gdps gr_closure_actual gr_closure_base
all_closure.align(2,1,2)



'##################################DISPLAY##########################
###################

graph base1.merge grag_cag grag_toag grag_pgdpag grma_cma grma_ima grma_toma
base1.align(2,1,2)
graph base2.merge grma_pgdpma grco_ico grco_toco grco_pgdpco grut_cut grut_tout
base2.align(2,1,2)
graph base3.merge grut_pgdput grtr_ctr grtr_totr grtr_pgdptr grse_cse grse_ise
base3.align(2,1,2)
graph base4.merge grse_tose grse_pgdpse grem_mfg grem_mig grem_men grem_mgr
base4.align(2,1,2)
graph base5.merge grem_msr grem_xgr grem_xsr gr_mgs gr_xgs grpr_cpi
base5.align(2,1,2)
graph base6.merge grfc_ptax grfc_atax grfc_pictax grfc_bictax grfc_ictax grfc_odtax
base6.align(2,1,2)
graph base7.merge grfc_dtax grfc_oidtax grfc_idtax grfc_cutax grfc_orev grfc_grev
base7.align(2,1,2)
graph base8.merge gren_pe_hd gren_dtdi gren_ntc gren_npc gren_sacc gren_sacp
base8.align(2,1,2)
graph base9.merge grau_npc grau_ntc  grwe_hhmi grwe_povl grwe_povs
grwe_wealth
base9.align(2,1,2)
graph base10.merge grwe_emp_ag grwe_emp_ma grwe_emp_con grwe_emp_uti
grwe_emp_tra grwe_emp_ser
base10.align(2,1,2)
graph base11.merge grwe_unempr grpr_pgdpave all_bd gr_gdpd gr_gdps
gr_closure_base
base11.align(2,1,2)

'==================Put additional code below
here=====================================

'==================END OF PROGRAM====================
```

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