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A Small Macroeconometric Model of the Philippine Economy

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No. 62

A Small Macroeconometric Model of the Philippine Economy

Geoffrey Ducanes, Marie Anne Cagas,
Duo Qin, Pilipinas Quising,
Nedelyn Magtibay-Ramos

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A Small Macroeconometric Model of the Philippine Economy

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AND NEDELYN MAGTIBAY-RAMOS**

January 2005

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FOREWORD

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ABSTRACT

This paper describes a small quarterly macroeconometric model of the Philippine economy. The model consists of sectors of private consumption, investment, government, trade, production, prices, money, and labor. The equilibrium-correction form is used for all the behavioral equations. The tracking performance of the model, both within-sample and out-of-sample, is evaluated and found satisfactory. Policy simulations indicate it is crucial that the Philippine government address its debt problem for it to achieve higher future growth. Oil price simulations also show the country is highly vulnerable to external shocks.

I. INTRODUCTION

This paper presents a model of the Philippine economy, which was developed as part of the Asian Development Bank's (ADB) project to develop macroeconomic models of its major debt member countries. These models are to be used for forecasting and policy simulation.

There are several existing Philippine macroeconomic models.¹ The major ones still in use are the PIDS-NEDA Annual Model, NEDA Quarterly Macroeconomic Model (NEDA QMM), and Ateneo Macroeconomic Forecasting Model (AMFM).² The PIDS-NEDA Annual Model is the oldest of the group having been started in the mid-1980s but later modified into several versions, the latest of which is reported in Yap (2000). The main objective of the model is to guide the formulation of the Medium Term Development Plan of the government. Its 2000 version is divided into four blocks: the real sector including output, expenditure, employment, prices, and wages; the fiscal sector; the financial sector; and the external sector. The model is estimated in levels and is basically static with static theories. In many of the equations, serial correlation is addressed by specifying the error term as an autoregressive process.

The NEDA QMM likewise has several versions, the first version having been an intergovernment agency effort completed in 1996, and the most recent one still under revision, see Bautista et al. (2004). The previous version used the Engle-Granger two-step procedure in constructing the model. The most recent one, however, adopts the same econometric approach as the annual model (in levels, mostly static, and essentially the same structure) but tries to improve on the use of economic theories, such as rational expectations.

The AMFM, also a quarterly model, was constructed in 2002 and is also divided into the four major blocks of the real sector, government sector, financial sector, and external sector. The equations for some key variables (such as output, labor demand, import demand, and export supply) are constructed in two stages. The first stage involves solution of the equilibrium values for the key variables using an optimization framework (as in a computable general equilibrium [CGE] model), while the second stage depicts the adjustment of economic variables to these equilibrium values (as in an equilibrium correction model). Other key variables are estimated in levels so that the key equations of the model are a mix of ECM equations and level equations.

A common criticism that can be attached to all these previous models is their frequent use of dummy variables, thus casting doubt on the robustness of their parameter estimates. Some of the

¹ See Yap (2002) for more detailed descriptions, including computable general equilibrium models of the Philippine economy.

² The National Economic and Development Authority (NEDA) is the government agency in charge of coordinating the economic policies of the different agencies of government. The Philippine Institute for Development Studies (PIDS) is a government think tank. The Ateneo de Manila University is a private university.

³ The model is currently undergoing revisions.

behavioral equations in their models also appear poorly specified. We addressed these issues by ensuring that behavioral equations are always economically meaningful and that the parameter estimates are relatively robust and time-invariant. We also use dummy variables as rarely as possible and see to it that variables representing policy instruments have valid properties of exogeneity. We believe our model is a significant improvement in comparison to the three aforementioned Philippine models, especially from the following two aspects.

1. Economic Structure

To reflect the high degree of marketization of the Philippine economy, most equations are demand-oriented especially in the short run. However, several long-run equilibrium equations are supply equations. Gross domestic product (GDP) is modeled from both the production and expenditure sides. The economic link of the two sides is assured by incorporating demand side variables as explanatory variables in the production-side equations and vice versa. For example, whereas second-sector value added is determined by the level of capital and labor in the sector in the long run, in the short run it also depends on private and government consumption and export demand. Since we consider the fiscal sector as the most crucial sector for this economy, we also took extra effort to extend it and link it with other sectors. For instance, the government debt-to-GDP ratio is one of the variables explaining investments, and government tax revenue is one of the determinants of private consumption. Long-run equilibrium equations are only partially estimated and we impose strong but data permissible parameter restrictions where we believe that theory should dominate.³

2. Econometric Methods

The equilibrium/error correction model (ECM) form is used for all the behavioral equations to embed long-run economic theories into adequately specified dynamic equations. The modeling process follows the dynamic specification approach; see Hendry (1995 and 2002). To ensure coefficient invariance, we used recursive estimation methods and/or parameter constancy tests especially for the sample periods where significant policy shifts are known to have occurred. All the behavioral equations in the Philippine model are estimated individually by recursive OLS to ensure within-sample coefficient constancy. We also kept to a minimum the use of dummy variables, except for seasonal dummies, as imposition of occasional dummies often indicates lack of super exogeneity⁴ and significantly reduces the policy simulation capacity of the model.

The rest of the paper is organized as follows. Section II gives a brief overview of the evolution of the Philippine economy in the last two decades and a description of the data set used in the model. Section III discusses the structure of the model and describes all the behavioral equations. Section IV presents two sets of simulation experiments. The first set details the results of ex post static and dynamic simulations as well as ex ante stochastic simulations to evaluate the predictive accuracy of the model. The second set comprises the evaluation of the future economic effects of three kinds of shock to the economy: an interest rate shock, a fiscal shock, and an oil price shock. The final section concludes.

³ See Pagan (1999 and 2003) for more methodological discussion about blending imposed theoretic parameters within estimated structural equations.

⁴ For a detailed description of different types of exogeneity, see Engle et al. (1983). Failure in super exogeneity will make the model suffer from Lucas critique (1976).

II. BRIEF OVERVIEW OF THE ECONOMY AND THE DATA

The Philippines has been largely a market-driven economy especially since the 1980s, which have seen the deregulation of many previously government-controlled industries as well as various reforms in trade, monetary, and exchange rate policies.

A brief background of how the Philippine economy has evolved in recent years follows. (See Gochoco-Bautista and Canlas 2003, Hill 2003, and Sicat and Abdula 2003 for a more comprehensive discussion of the country's recent economic history.) Debt-funded, import-substituting industrialization was the main economic thrust of the pre-Marcos and Marcos years, the latter lasting two decades from the mid-1960s to the mid-1980s. This entailed government creation and takeover of many vital corporations such as for energy, water, and even banking. During this period, the central bank was not truly independent but was instead more like a development bank involved in lending to government corporations. When this strategy failed because of inefficiency, corruption, and external shocks, the government was stuck with a huge amount of debt that up to now is the biggest burden in its budget.

The post-Marcos years beginning 1986 saw the reversal of many of these policies. Privatization of many government corporations was widely pursued (and still ongoing). A new, truly more independent central bank was created in 1993 to replace the old one, with the government absorbing the massive debts incurred by the latter. The exchange rate, which was nominally free-floating but was actually a managed float with a very narrow band, was made after the Asian crisis to be more truly free-floating, or at least a managed float with a much larger band. Tariffs are much lower and near World Trade Organization commitment. The banking, insurance, retail sectors have also been opened to foreign competition.

At present what appears to be the crucial sector for this economy is the fiscal sector where reforms have conspicuously failed to take place. The country is caught in a vicious cycle of fiscal deficits caused in large part by huge interest payments on debts, and huge interest payments on ever-growing debts caused by consistent budget deficits and the absorption by the central government of the losses of still extant state-owned corporations. Interest payments consume about a third of total central government expenditure. If personnel services and maintenance expenditures are added to interest payments, they eat up almost four fifths of total expenditure thus limiting government budget flexibility. This means that modeling the fiscal sector is of paramount importance for the Philippines and thus this macroeconomic model goes into some detail toward that goal.

The data used in the model are quarterly series from 1990 to 2004 and make up most of the data set. For a few variables, data series begin later than 1990. The data is culled mostly from different government statistical agencies such as National Statistical Coordination Board (national accounts variables); National Statistics Office (employment, population, and consumer price index [CPI] variables); Bangko Sentral ng Pilipinas (monetary variables); Bureau of Treasury (government revenue and expenditure variables); and Philippine Atmospheric, Geophysical and Astronomical Services Agency (weather variables). The International Financial Statistics and Datastream are additional sources of data. The national accounts constant variables were rebased to 1994 from 1985 to make the base year more recent and to coincide with the consumer price index (CPI) base year.⁵

⁵ This was done by applying to the 1994 current values the growth rates (backward and forward) from the 1985-based series. The government is set to release in 2005 national income account figures based on 2000 prices.

III. THE STRUCTURE OF THE MODEL

The present model is a small, compact, and highly aggregate macro model. It can be divided into eight blocks: private consumption, investment, government, trade, production, prices, monetary, and labor sectors. There are 48 behavioral and technical equations, 17 identities, and 81 variables in total. The behavioral and technical equations are specified and estimated using PcGive and PcGets software; see Doornik and Hendry (2001) and Hendry and Krolzig (2001). A brief description of the behavioral and technical equations in each block is given below.⁶

A. Private Consumption Block

Constant-price private consumption is formulated in the long run as a homogenous demand function of income and “wealth”, while also being affected by the deposit rate and the unemployment rate. Income is measured as the gross national product (GNP) net of government tax; and wealth is loosely measured by the sum of domestic debt, currency in circulation, and net foreign assets all deflated to real prices. Because foreign remittances have become a significant source of income for many households in the country, we incorporated the ratio of net factor income from abroad to GNP as a short-run factor affecting changes in constant-price private consumption.

Current price private consumption is modeled via its deflator. The deflator is formulated as a function of the consumer price index and the import price deflator.

B. Investment Block

Constant-price investment is formulated as a demand function with long-run unit elasticity with respect to GDP. In the short run, it is also affected by changes in the real domestic lending rate and the total government debt to GDP ratio (proxy for risk). The latter is of particular importance as the country is now experiencing record high debt-to-GDP ratio.

C. Government Block

Government tax revenue is modeled in the long run as linear with respect to gross national product (GNP) while also depending on the tax rate. Government total revenue is modeled as a simple function of government tax revenue.

Total government expenditure is divided between interest payment on debt and noninterest expenditure. Interest expenditure is modeled as a fraction of total debt and depends on the Treasury bill rate and the exchange rate. Noninterest expenditure is formulated in the long run as linear with respect to government total revenue while also being affected by the debt-to-GDP ratio negatively and the unemployment rate positively. When the debt ratio is high, government expenditure shifts to interest payments, while when unemployment is high, the government engages in expansionary spending. In the short run, changes in noninterest expenditures depend on changes in government total revenues and the unemployment rate.

⁶ See the Appendix for the detailed variable list and equation list together with the main test results at the end of each estimated equation.

Central government debt was not modeled as an identity using the deficit because a significant portion of the debt is due to nondeficit financing factors, such as the debt incurred by state-owned enterprises. As such, we decided to model debt as a behavioral equation. Because different variables possibly enter into the determination of foreign and domestic debt (the exchange rate for example has a much bigger impact on foreign debt level), we modeled each separately. Change in government domestic debt is formulated in the long run as linear with respect to the government deficit. In the short run, the acceleration of domestic debt depends on changes in the government deficit and the 91-day T-bill rate. Change in government foreign debt is modeled in the long run as likewise linear with respect to the government deficit while also depending on the exchange rate. In the short run, the acceleration of foreign debt depends on changes in the US lending rate, the interest differential between domestic and US lending rates, and the exchange rate.

The average tax rate of the government is modeled as depending negatively on the revenue-to-GNP ratio and positively on the debt-to-GNP ratio.

The national account component government consumption in current price is explained by government noninterest expenditure with a linear long-run relationship

Constant-price government consumption is modeled through its deflator. The deflator is explained by the price deflator of the third sector with a linear long-run relationship.

In order to facilitate fiscal policy simulation, alternative equations to the government noninterest payment expenditure and government tax revenue equations are also built. The alternative tax revenue equation incorporates a rule by which the government reduces its usual expenditure once it breaches a certain debt-to-GDP ratio or deficit-to-GDP ratio (user-adjustable). The amount of expenditure reduction is related to the size of the breach. The alternative tax revenue equation allows the model user to fix future tax revenue growth by setting the number of years it will take the government to achieve its optimal tax effort ratio (equivalent to the tax rate).

D. Trade Block

Dollar exports is formulated as a simple function of a world trade variable—defined as the imports of the world from the Philippines. The latter is computed from a world trade matrix comprising 30 countries that historically has accounted for about 85 percent of Philippine exports. Current imports is modeled in the long run as a homogenous demand function of domestic demand (sum of private consumption, government consumption, and investments) and external demand (exports), while also depending on relative prices between domestic products (proxied by producer price index) and foreign products (price of world exports). A significant portion of domestic imports is in intermediate and capital goods used by the export industry. Dollar current account balance is formulated as a linear function of the trade balance.

E. Production Block

The long-run supply trend of GDP in constant price is modeled as a homogenous Cobb-Douglas production function (capital in constant prices and employment as arguments).

The primary sector value added in constant price is modeled as a function of the weather (proxied by the rainfall index) and the growth of demand for agricultural output as represented by the sum

of the value added in the secondary and tertiary sectors. This is because the agriculture sector of the Philippines is still relatively backward and depends more on the vagaries of the weather than the level of capital and/or labor in the sector. Agriculture is considered the residual labor sector where workers who cannot find better paying jobs in the other sectors go. Primary sector value added in current price is modeled via its deflator. The deflator depends on the price of imports, world price of exports, and a measure of trade openness (exports plus imports over GDP).

Secondary sector value added in constant price is formulated in the long run as a homogenous production function. In the short run, changes in private consumption (the share of exports to GDP and relative prices among the sectors) also influence second sector value added. Secondary sector value added in current price is modeled via its deflator. The deflator is in the long run a homogenous function of wage, price of investments, and price of imports. In the short run, changes in wage affect current-price secondary sector value added through its deflator.

Tertiary sector value added in constant price is modeled in the long run as linear with respect to constant-price GNP. In the short run, it is affected by relative prices among the three sectors. Tertiary sector value added in current price is also modeled via its deflator. The deflator is modeled in the long run as linear to the secondary sector price deflator. In the short run, its changes depend on changes in import prices and the price deflator of the secondary sector.

Net factor income from abroad in current price is modeled as linear with respect to the unemployment rate. The idea is that high unemployment within the country induces workers to find overseas jobs and thus increases foreign remittances, which comprise the bulk of the factor income of the country.

Constant-price GNP is modeled via its deflator, which depends only on the price deflator of GDP.

F. Price Block

The price deflator of GDP is formulated as a function of the price deflators of its expenditure side components (private consumption, government consumption, investments, exports, and imports). The consumer price index is modeled in the long run as a homogenous function of the price deflators of the secondary and the tertiary sectors, and the money supply (M1) to GDP ratio. In the short run, changes in the consumer price index depend on changes in the price deflators of the three sectors and the import price index.

The producer price index (PPI) is modeled in the long run as a linear function of the second sector price deflator. In the short run, changes in the PPI are due to changes in the price deflators of the first and tertiary sectors as well as the price of imports.

The price deflator of investments is formulated in the long run as a homogenous function of the price deflators of the primary and secondary sectors while also depending on the real interest rate (defined as the lending rate minus the inflation rate). Changes in sector prices affect changes in investment price in the short run.

Export price index is modeled in the long run as a homogenous function of the import price deflator. In the short run, its changes are affected by changes in the price of imports and primary and secondary sector prices.

The import price deflator is modeled as linear with respect to domestic and world export prices.

G. Monetary Block

Currency in circulation ($M0$) is explained by narrow money ($M1$) with a nonlinear long-run relationship to reflect the impact of technical progress, such as electronic transactions, on cash demand.

$M1$ is formulated as a real money demand function with long-run unit elasticity with respect to GNP while also being affected by the overnight borrowing rate.

Net foreign assets (NFA) is modeled in the long run as linear with respect to the balance of trade. In the short run, changes in NFA are influenced by net factor income from abroad and the exchange rate, in addition to changes in the trade balance.

Changes in domestic credit of deposit money banks are modeled in the long run as linear with respect to investments while depending also on the exchange rate. The real lending rate joins in as an additional short-run explanatory variable.

Changes in domestic credit of the central bank are modeled in the long run as linear with respect to the government deficit while depending also on the exchange rate. In the short run, it depends on changes on the Treasury bill rate.

The interest rate on overnight borrowing, considered the country's benchmark rate, is modeled on past period inflation rates and US interest rate, following the Taylor rule (1993). Other interest rates (91-day Treasury bill rate, lending rate, deposit rate) are modeled as a function of the overnight borrowing rate and the depreciation rate of the domestic currency.

H. Employment Block

The labor force is modeled as linear with respect to population but in addition is further influenced by the share of the employed in the population. In the short run, changes in employment level affect changes in the labor force.

Total employment is modeled in the long run as a homogenous demand function of the constant value added in the three sectors while also being affected by the estimated real wage and the share of the primary sector in total GDP. In the short run, changes in total employment are affected by changes in the primary sector value added and changes in the share of the primary and tertiary sectors in total GDP.

Employment in the secondary sector is modeled as a factor demand function in terms of the value added in the secondary sector and the wage rate. In the short run, changes in the price deflator of the second sector, and changes in the share of the primary sector in total employment join in as additional explanatory variables.

Employment in the tertiary sector is modeled via its aggregate with the secondary sector and is linear with respect to the value added in the secondary and tertiary sectors while also being affected by the real wage rate.

IV. SIMULATION EXPERIMENTS

Model simulations are performed in the software package *Winsolve*, see Pierse (2001). Two sets of simulation experiments are carried out here. The first set is designed to evaluate the predictive accuracy of the model. The second set is mainly designed to evaluate the policy simulation capacity of the model.

A. Model Evaluation

The model is evaluated for both within-sample and out-of-sample predictive performance. The evaluation of within-sample performance is mainly via conventional statistics such as the root mean square percentage errors (RMSPE) and the mean percentage errors (MPE). Out-of-sample forecasting performance is evaluated using stochastic simulations.

1. Within-sample Performance

Using historical data, both static and dynamic solutions of the model are obtained.⁷ The RMSPE and MPE of both solutions as compared to the actual values for key macroeconomic variables are reported in Table 1. As easily seen from the table, the model is able to track the historical development of the Philippine economy reasonably well. This even if the simulation runs smack into the Asian financial crisis and hardly any dummy for this period was used. Figures 1 and 2 depict the trajectories of the static and dynamic *ex post* simulations over the period 1997-2003 along with the actual values of 16 macroeconomic variables. These variables are: constant-price value added in the primary sector, constant-price value added in the secondary sector, constant-price value added in the tertiary sector, constant-price private consumption, constant-price investments, employment level, constant-price imports, current account balance, government revenue, government expenditure, domestic debt, foreign debt, money supply (M1), net foreign assets, GDP price deflator, and consumer price index. It can be seen from the figures that both static and dynamic simulations track the actual time paths of the variables reasonably well.

2. Out-of-sample Performance

Out-of-sample performance of the model is evaluated through stochastic simulations. Unlike dynamic simulation that simply projects the variables into the future, stochastic simulations introduce uncertainty into forecasts by adding random shocks into each estimated equation during forecast simulations. The bootstrap method is used here, which draws random shocks from individual equation residuals for a specified sample period. By carrying out a large number of stochastic simulations, we are able to obtain an empirical distribution of the forecasts under the assumption that the uncertainty during the forecasting period resembles that embodied by the residuals of the specified sample period.

⁷ With static solution, the model is solved simultaneously but lagged actual values are used in place of lagged forecast values. As a result, forecast errors do not cumulate dynamically. With dynamic solution, the equations of the model are solved simultaneously, period by period, with the solution values for previous periods being used as lagged values in subsequent periods (see Pierse 2001).

TABLE 1
PREDICTION STATISTICS OF THE PHILIPPINE MODEL, Q21997 TO Q42003^a

VARIABLE	RMSPE STATIC	DYNAMIC	MPE STATIC	DYNAMIC
Primary sector value added constant price	0.018	0.027	-0.001	-0.004
Secondary sector value added constant price	0.018	0.064	0.000	-0.048
Tertiary sector value added constant price	0.006	0.009	0.001	0.004
Private consumption constant price	0.004	0.011	-0.001	-0.009
Investments constant price	0.054	0.078	-0.002	-0.035
Imports constant price	0.077	0.096	-0.004	-0.007
Current account balance ^b	5.932	4.617	1.576	0.940
Employment	0.012	0.021	0.001	0.001
Government expenditure	0.057	0.020	-0.005	-0.001
Government revenue	0.049	0.018	0.001	-0.001
Domestic debt	0.021	0.030	0.000	-0.005
Foreign debt	0.052	0.075	-0.009	-0.068
Money supply (M1)	0.033	0.021	0.006	-0.002
Net foreign assets ^b	4.271	0.487	-0.859	-0.348
GDP price deflator	0.009	0.023	0.000	0.014
Consumer price index	0.006	0.034	0.001	0.018

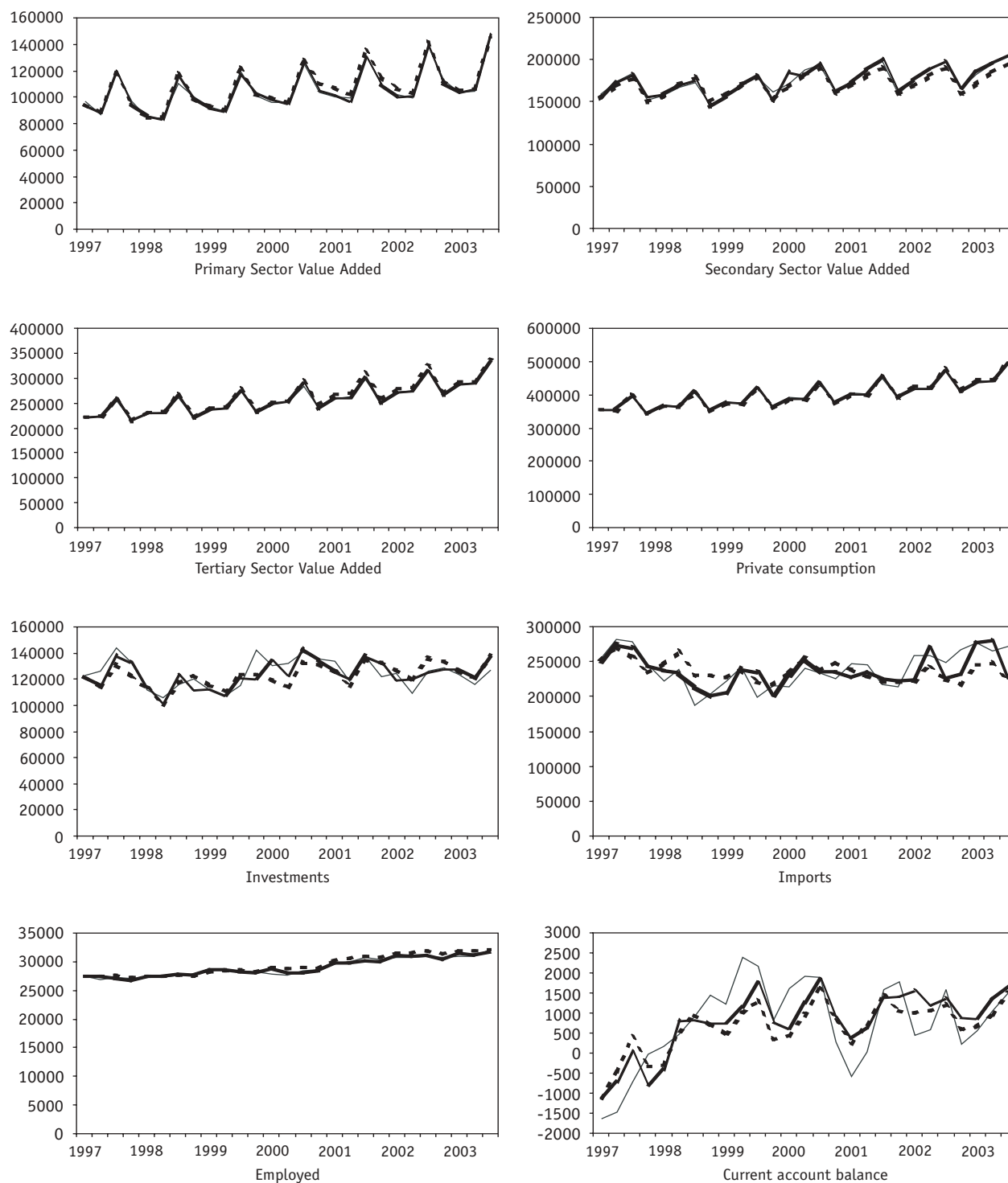
^a The RMSPE and MPE are computed as follows:

where Y^s and Y^a are the simulated and actual values of an endogenous variable, respectively, and T is the number of simulation periods.

$$RMSPE = \sqrt{\frac{1}{T} \sum_{t=1}^T \left(\frac{Y_t^s - Y_t^a}{Y_t^a} \right)^2}; MPE = \frac{1}{T} \sum_{t=1}^T \left(\frac{Y_t^s - Y_t^a}{Y_t^a} \right)$$

^b The current account balance and net foreign assets take values very close to zero and change from negative to positive (and vice versa) in the estimation period, which account for their large RMSPE and MPE. See Figures 1 and 2 for the fit.

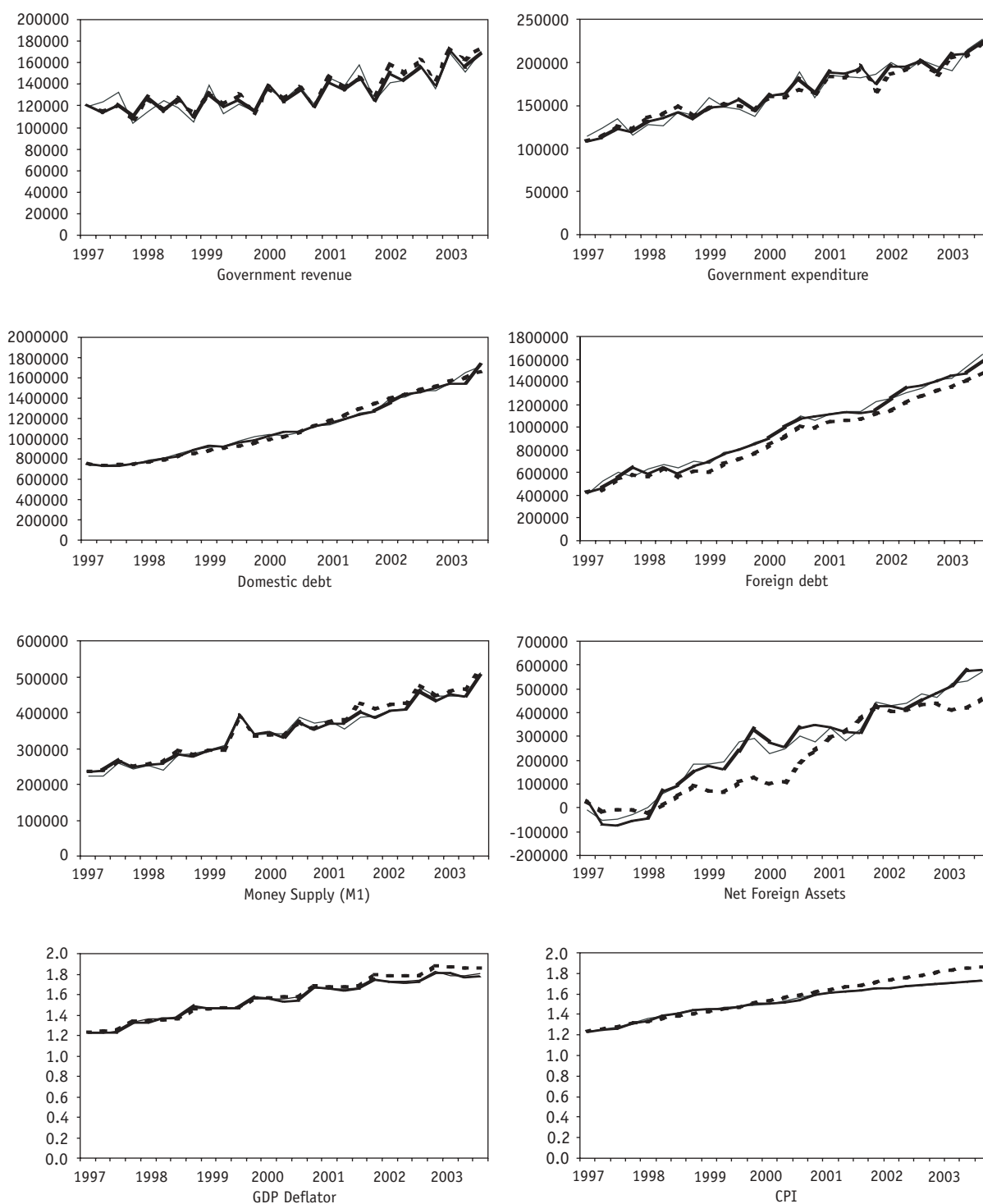
FIGURE 1
STATIC AND DYNAMIC SIMULATION RESULTS: SELECTED REAL SECTOR VARIABLES



Note: Actual ——— Static ——— Dynamic - - - -

See Appendix A for the variable units.

FIGURE 2
STATIC AND DYNAMIC SIMULATION RESULTS: SELECTED FISCAL, MONETARY AND PRICE VARIABLES



Note: Actual ——— Static ——— Dynamic - - - -

See Appendix A for the variable units.

Quantiles are computed to represent the distribution. Figures 3 and 4 present the forecasts, generated by 200 stochastic simulations, of 16 selected variables from the model. Three curves are plotted for each variable: the simulated values at 2 percent quantile, 50 percent quantile, and 97 percent quantile. We could regard the series at the 50 percent quantile as the approximate mean forecasting values, and the series at the 2 percent quantile and at the 97 percent quantile approximately as the 95 percent confidence interval.⁸ As illustrated in the figures, the model generally exhibits good forecasting performance.

B. Impact Analysis

We look at the impact of three sets of shocks. We first look at a nominal shock as represented by a shock on the benchmark rate of the central bank. Then we consider a fiscal shock in the form of a change in the revenue and expenditure patterns of the government. Finally, we look at an external shock in the form of rising oil prices.

1. Interest Rate Shock

This simulation looks at the impact of raising the benchmark central bank overnight borrowing rate to 10 percent, first for only two quarters, 2004Q4 and 2005Q1, and then for the entire forecast period from 2004Q4 to 2010Q4 from a base value of 8 percent for the entire forecast period.⁹ The former is what is referred to here as the impulse shock and the latter the step shock.

Figure 5 shows the effect of the interest rate shock on investments, GDP, and inflation. Note that in the model investments depend negatively on the lending rate, which in turn follows the movement of the overnight borrowing rate. As the figure shows, the impulse shock reduces the growth rate of investments immediately after the shock although it recovers after about a year and then growth is higher than it would have been for about a year also, before finally tapering off. The effect of the step shock lingers but also erodes and, unlike in the impulse shock, there is no period when growth would have been significantly higher than it would have been without the shock.

The impulse shock lowers GDP growth very slightly for about 4 years (around 0.03 of a percentage point) before tapering off. The effect of the step shock is higher (average of slightly higher than one tenth of one percentage point) and lingers before showing signs of leveling off at the end of the simulation period.

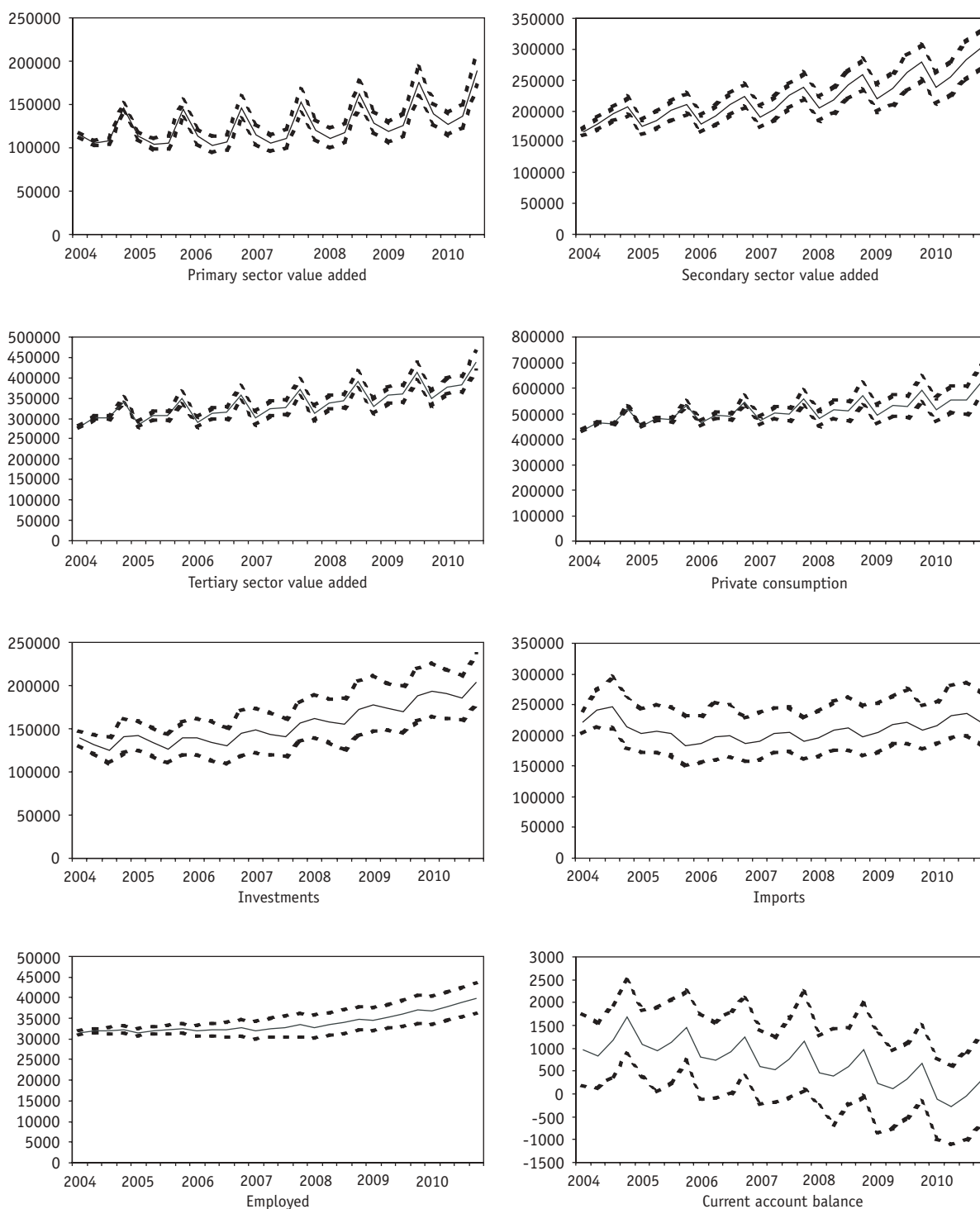
The impulse shock reduces inflation slightly compared to the base run for about a year after the shock, but this is short-lived as inflation becomes higher for about two years after that before declining again and leveling off toward the end of the simulation period. The step shock reduces inflation initially for about two years but then inflation increases after that before declining again.

The effects of the interest rate hike on the real variables appear high, especially compared to a similar experiment done with ADB's PRC model (see He et al. 2004). The high debt levels in the

⁸ The distribution should be approximately symmetric, as we have allowed for the use of antithetic stochastic shocks. For the detailed description of the stochastic simulations, see Pierse (2001).

⁹ This involved exogenizing the overnight borrowing rate, which is endogenous in the model.

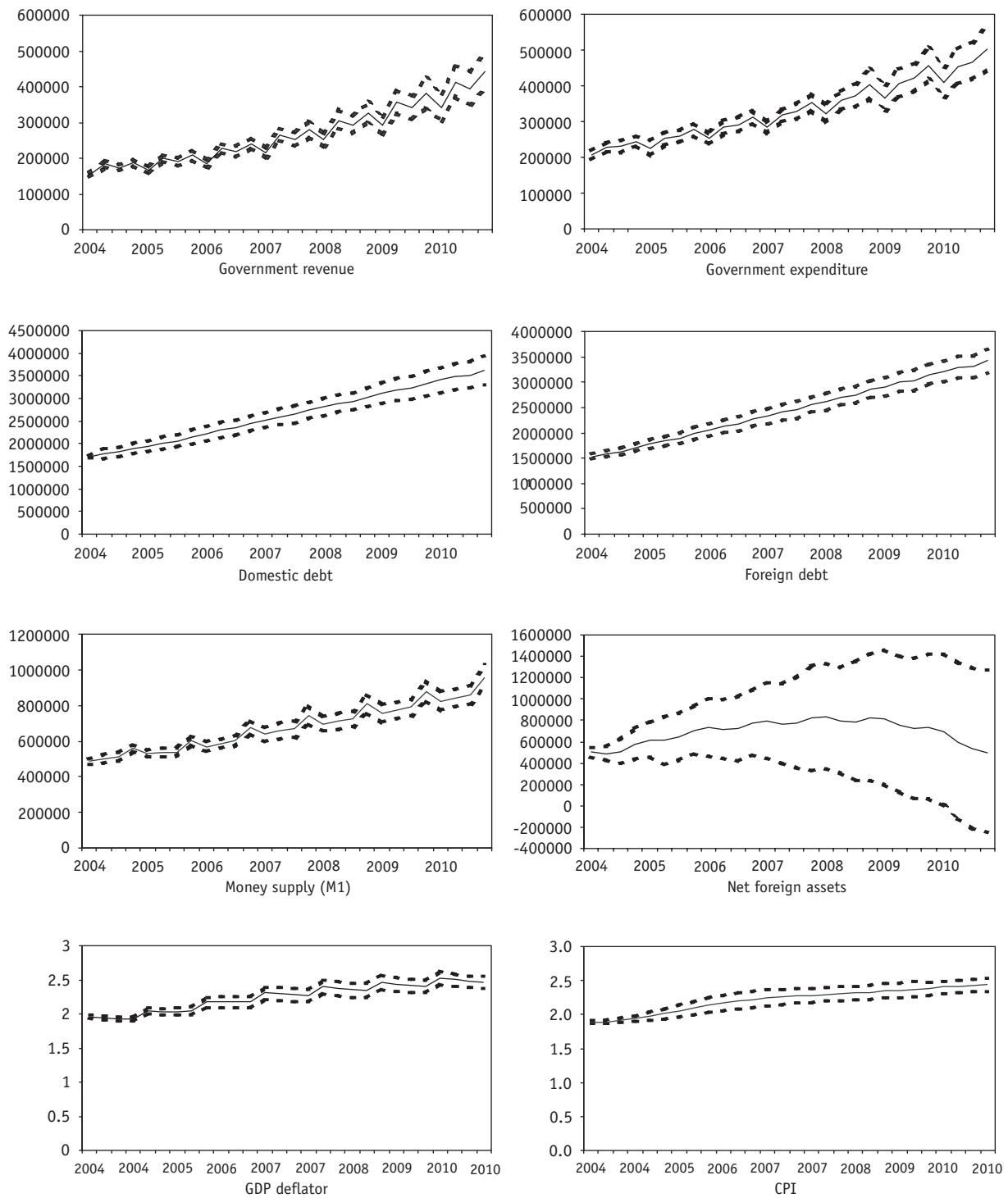
FIGURE 3
STOCHASTIC SIMULATION RESULTS: SELECTED REAL SECTOR VARIABLES



Note: 2% quantile — — — 50% quantile ——— 97% quantile - - - -

See Appendix A for the variable units.

FIGURE 4
 STOCHASTIC RESULTS: SELECTED FISCAL, MONETARY AND PRICE VARIABLES



Note: 2% quantile — — — 50% quantile ——— 97% quantile

See Appendix A for the variable units.

country and persistent public deficits may account for this. Favero and Giavazzi (2003) in the case of Brazil suggest that when the country's fundamentals are weak and the risk of default high, monetary policy can have perverse effects. Following their framework and applying it to the Philippines with modifications, the mechanism can be described as follows: With a significant portion of the public debt short term, an increase by the central bank of its benchmark rate raises domestic debt service payments. As budget deficits continue, the debt level further rises and so does the risk of default. This results in a higher risk perception and higher interest rates on debts sourced from abroad, and thus even higher debt, especially if currency depreciation also occurs. Investments also decline as a result of the higher risk. The currency depreciation exerts inflationary pressure, which would cause the central bank to further raise interest rates, and so on. The result is a lingering and even perverse (higher inflation) effect of an interest rate hike.

2. Fiscal Simulations

As noted above, the fiscal situation is deemed most critical for the Philippine economy. The central government debt-to-GDP ratio is at an all-time high of about 78 percent, and with no immediate solution to the chronic budget deficit, it is feared a fiscal crisis is looming. Very high debt levels affect the country negatively on several fronts. First, it raises the perceived risk of default of the country and as a result, investments go down. Second, higher debt levels mean increasingly higher interest payment allocations by the government and thus lower allocation for other more important items such as infrastructure and social expenditures. These are reflected in the model.

Two simulation scenarios, illustrating two ways the government could address the budget deficit problem, are run and compared to the base run where the government is assumed to just continue on its current path.

- (i) **Simulation Scenario 1:** Government sets an upper-bound limit for the debt-to-GDP ratio of 70 percent and for the government deficit to GDP ratio of 4 percent.¹⁰ The government reacts to a breach of either of these upper bounds by reducing government noninterest payment expenditure by the fraction of the excess, or in case both are breached by the fraction of the higher excess. For instance, if government deficit for a quarter is 6 percent of GDP and the debt-to-GDP ratio is less than 70 percent, then government expenditure in the following quarter is reduced by 2 percent.
- (ii) **Simulation Scenario 2:** In addition to what is in Scenario 1, the government is also able to maintain an annual increase in tax collection of 15 percent. This is not unreasonably high as figures higher than these have been achieved in the mid-1990s, moreover, tax efficiency is so low that there is a very large room for improvement.

Figure 6 shows the evolution of the debt-to-GDP ratio under the base run and the two alternative simulation scenarios as well as the effect of the two simulations on GDP growth and investment growth. As the dashed lines in the second graph show, GDP growth would be initially (slightly) lower when government expenditure is reduced as a response to too-high debt or deficit

¹⁰ The model allows for these bounds to be easily adjusted.

FIGURE 5
IMPACT ANALYSIS: INTEREST RATE SIMULATIONS

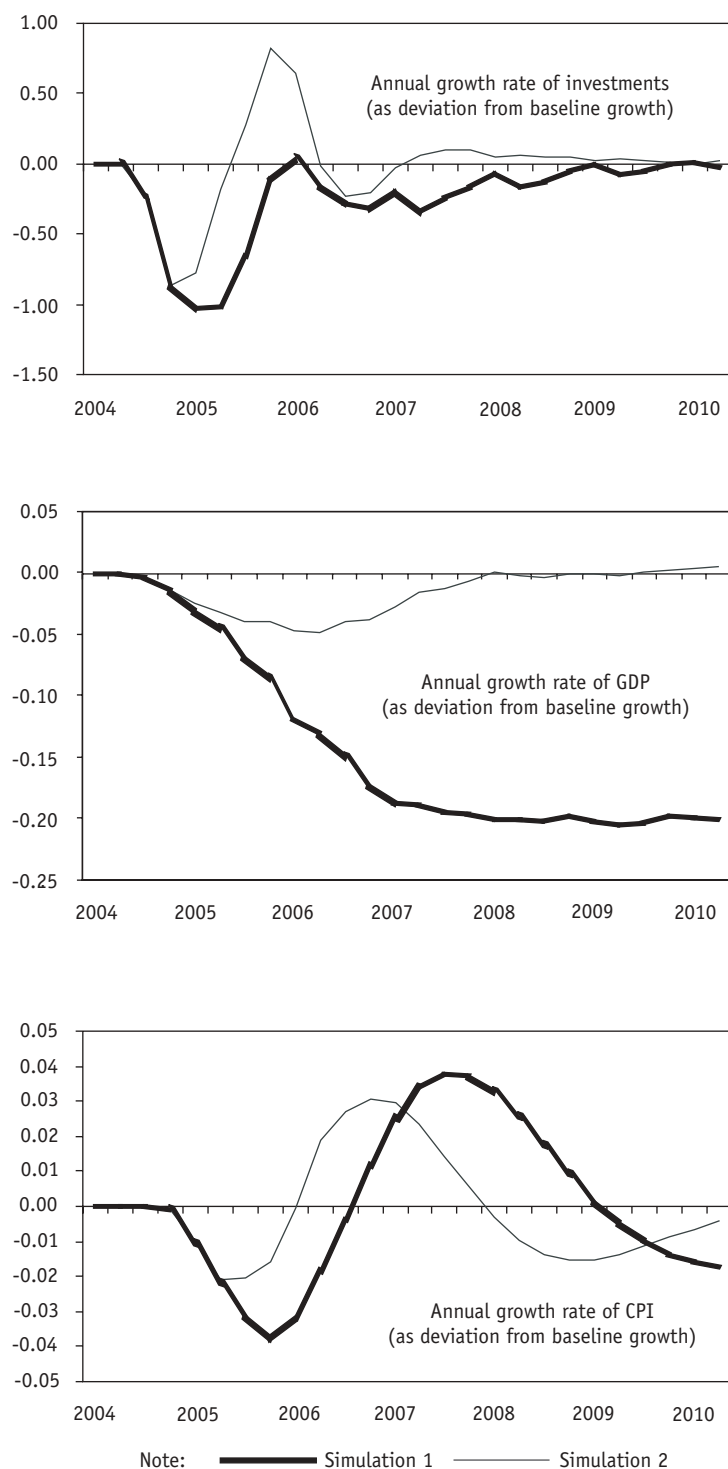
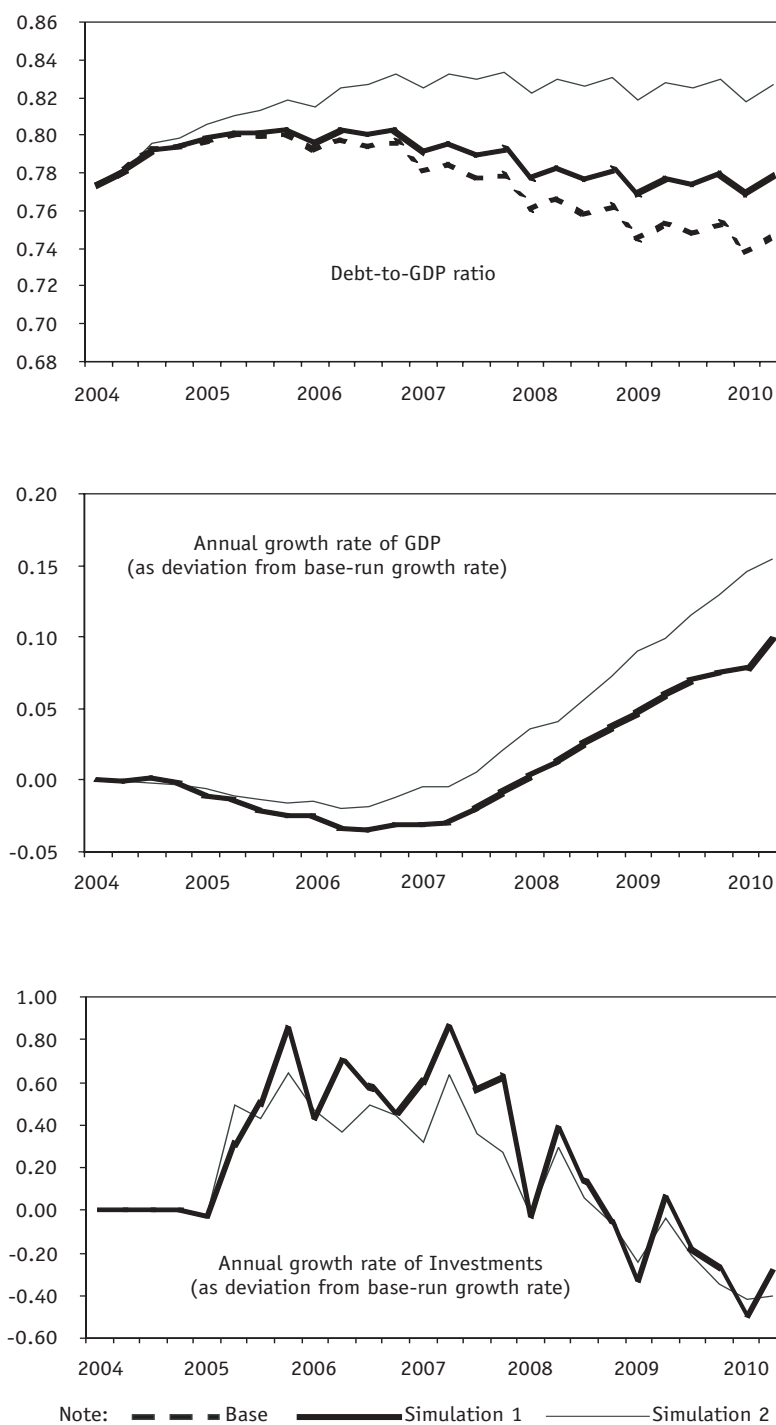


FIGURE 6
IMPACT ANALYSIS: FISCAL SIMULATIONS



but then afterward becomes significantly higher. At the end of the forecast period GDP growth is about 0.15 of a percentage point higher. Under Scenario 2, when an increase in tax collection accompanies the reduction in expenditure, GDP growth is even initially slightly lower than in Scenario 1 but then also catches up and becomes much higher than base growth although not as high as in Scenario 1.¹¹ These show the importance of reining in the government's deficit problems. The increase in GDP growth under the two scenarios can be traced primarily to the increase in investments for most of the period as shown in the last graph.

3. Oil Price Shock

As a final simulation exercise, we look at the effects of both impulse and step oil price shocks to the economy. The Philippines, being a small open economy highly dependent on oil imports, is seen as highly vulnerable to drastic upward swings in world oil prices. The base run assumes that Brent oil price per barrel is at \$45 for 2004Q4 and then declines to \$35 per barrel by 2005Q1 up to the end of the simulation period. The impulse shock assumes the \$45 dollar per barrel lasts for two quarters from 2004Q4 to 2005Q1 then down to \$35 per barrel in Q22005 up to the end of the simulation period, while the step shock assumes the \$45 dollar per barrel is constant from Q42004 to the end of the simulation period.

Figure 7 shows the effects of the oil shocks to GDP growth, inflation, and private consumption. The impulse shock reduces GDP growth by about a fifth of a percentage point for about a year after the shock before tapering off. The step shock reduces GDP growth by an average of about six tenths of a percentage point up to the end of the simulation period.

The impulse shock increases inflation by about a tenth of a percentage point for three years before tapering off. The effect of the step shock is much larger and pervasive, reaching a high of almost two percentage points before settling at about a third of a percentage point by the end of the simulation period. The average increase in inflation for the entire simulation period due to the step shock is 0.55 percentage point.

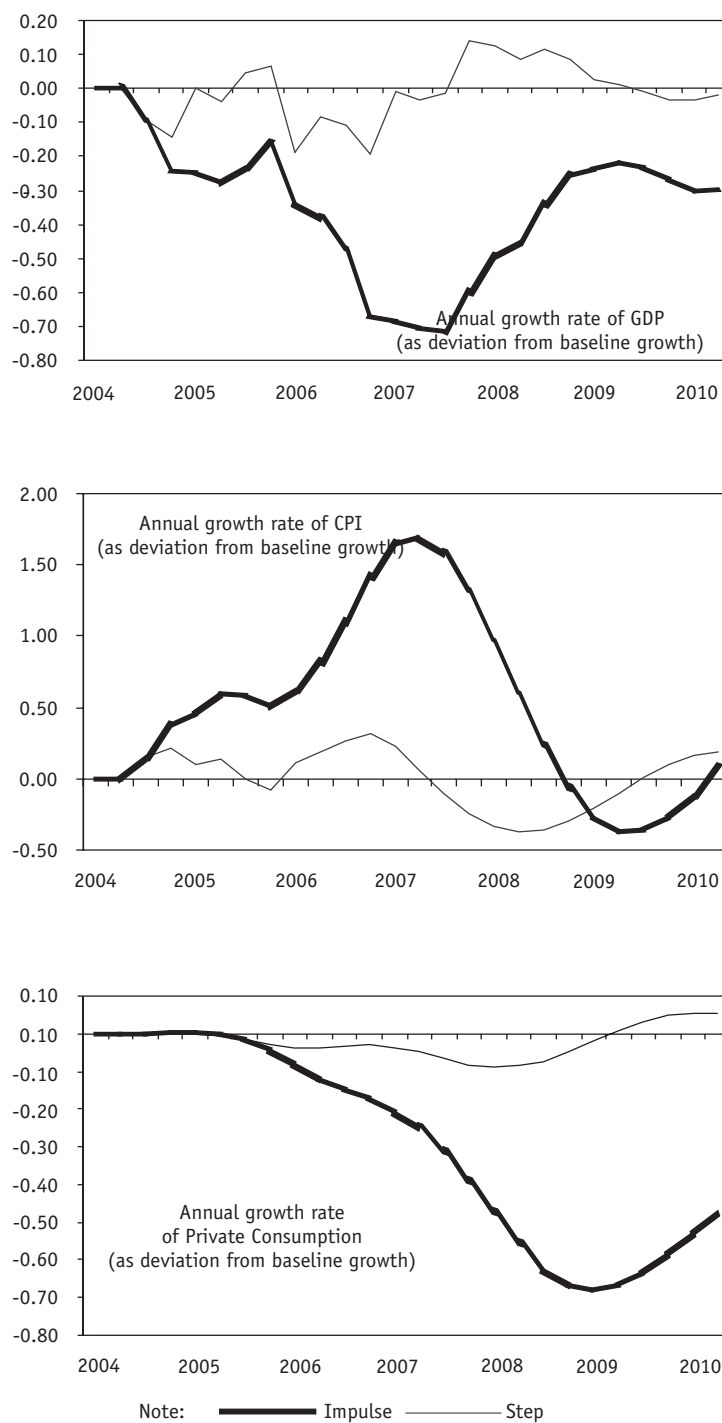
The impulse shock reduces private consumption growth slightly by about a tenth of a percentage point for about 3 years before tapering off. However, the step shock has a huge effect on private consumption growth, cutting it increasingly until it settles at about half a percentage point at the end of the simulation period.

V. CONCLUSION

This paper describes an ADB quarterly macroeconometric model of the Philippines. The model exhibits a number of desirable properties that the authors believe accords it distinct advantage over other existing macroeconometric models of the Philippines. During the modeling process, great efforts have been made to try to achieve the best possible blend of well-established a priori long-run theories, short-run shock variables through a posteriori data guidance, and special features

¹¹ The lower growth under Scenario 2 compared to Scenario 1 (at least up to 2010) can be attributed to the lower private consumption growth that occurs in the former as disposable incomes decline because of higher taxes. Historically, private consumption has been a strong driving force of the Philippine economy.

FIGURE 7
IMPACT ANALYSIS: OIL PRICE SIMULATIONS



of the Philippine economy. The resulting model demonstrates good forecasting capacity and versatile potential for policy simulations.

The satisfactory within-sample forecasting capacity of the model is illustrated by conventional measures of the predictive accuracy of the model such as root mean square percentage error and mean absolute percentage error, which were computed for several key variables in both static and dynamic runs of the model. The out-of-sample forecasting capacity of the model is illustrated by the reasonably narrow uncertainty bands of the forecasts generated by stochastic simulations.

The policy simulation potential of the model is illustrated by three types of simulations: interest rate shocks, fiscal policy shocks, and world oil price shocks. The first set of simulations shows the importance of maintaining a low interest rate regime in the country. The second set of simulations shows that addressing the deficit and debt problems is very important if the Philippine government hopes to achieve and maintain higher growth of its economy in the medium and longer term. The oil price simulations show the vulnerability of the Philippine economy to external shocks.

APPENDIX SPECIFICATION AND STRUCTURE OF THE MODEL

A. List of Variables

1. Endogenous Variables

Consumption block

PCONc_PHI	Private consumption in constant price (million 1994 pesos)
PCON_PHI	Private consumption in current price (million pesos)

Investment block

INVc_PHI	Investments in constant price (million 1994 pesos)
STKc_PHI	Inventories in constant price (million 1994 pesos)
STK_PHI	Inventories in current price (million pesos)

Government block

GREV_PHI	Government total revenue (million pesos)
GTAX_PHI	Government tax revenue (million pesos)
GCON_PHI	Government consumption in current price (million pesos)
GCONc_PHI	Government consumption in constant price (million 1994 pesos)
GPAY_PHI	Government expenditure less interest payments (million pesos)
GINT_PHI	Government interest payments (million pesos)
DDEBT_PHI	Domestic debt (million pesos)
FDEBT_PHI	Foreign debt (million pesos)

Trade block

X\$_PHI	Exports (million US dollars)
M_PHI	Imports (million pesos)
CAB\$_PHI	Current account balance (million US dollars)

Production block

GDPcLR_PHI	Long-run supply trend of constant GDP (million 1994 pesos)
VA1c_PHI	Value added of primary sector in constant price (million 1994 pesos)
VA1_PHI	Value added of primary sector in current price (million pesos)
VA2c_PHI	Value added of secondary sector in constant price (million 1994 pesos)
VA2_PHI	Value added of secondary sector in current price (million pesos)
VA3c_PHI	Value added of tertiary sector in constant price (million 1994 pesos)
VA3_PHI	Value added of tertiary sector in current price (million pesos)
NFIA_PHI	Net factor income from abroad in current price (million pesos)
GNPc_PHI	Gross national product in constant price (million 1994 pesos)

Price block

P#GDP_PHI	Price deflator of GDP (1994=1)
P#C_PHI	Consumer price index (1994=1)
P#P_PHI	Producer price index (1994=1)
P#INV_PHI	Price deflator of investments (1994=1)
P#X_PHI	Price deflator of exports (1994=1)
P#M_PHI	Price deflator of imports (1994=1)
P#WX_PHI	World price of exports

Monetary block

M0_PHI	Currency in circulation (million pesos)
M1_PHI	Narrow money (million pesos)
M3_PHI	Broad money (million pesos)
NFA_PHI	Net foreign assets (million pesos)
DCDMB_PHI	Domestic credit of deposit money banks (million pesos)
DCCB_PHI	Domestic credit of central bank (million pesos)
IROB%_PHI	Overnight borrowing rate of the central bank
IRD%_PHI	Deposit rate
IRL%_PHI	Lending rate
IRTB%_PHI	91-day Treasury bill rate

Employment block

LF_PHI	Labor force (thousands)
EMP_PHI	Total employed (thousands)
EMP2_PHI	Employed in the second sector (thousands)
EMP3_PHI	Employed in the third sector (thousands)

Identities

GDPc_PHI	Gross domestic product in constant price (million 1994 pesos)
GDP_PHI	Gross domestic product
GNP	Gross national product
NFIAc	Net factor income from abroad in constant price (million 1994 pesos)
INV_PHI	Investments in fixed assets in current price
K_PHI	Stock of fixed investment assets in current price
Kc_PHI	Stock of fixed investment assets in constant price (million 1994 pesos)
UCC%_PHI	User cost of capital (percent)
GEXP_PHI	Government expenditure (million pesos)
GDEF_PHI	Government deficit (million pesos)
X_PHI	Exports in current price (million pesos)
Xc_PHI	Exports in constant price (million 1994 pesos)
Mc_PHI	Imports in constant price (million 1994 pesos)
M\$_PHI	Imports in current price (million dollars)
P#P\$_PHI	Producer price index dollarized
WAGE_PHI	Unit wage cost
MQ_PHI	Quasi-money (million pesos)
UEMP%_PHI	Unemployment rate

EMP1_PHI	Employed in the primary sector (thousands)
TDEBTr_PHI	Total debt-to-GDP ratio of previous year
GDEFr_PHI	Government deficit-to-GDP ratio of previous year
TEFT%_PHI	Tax effort ratio of previous year
BEFT%_PHI	Base tax effort ratio

2. Exogenous Variables

DEPK%_PHI	Annual depreciation rate of fixed assets
ER_PHI	Peso-dollar exchange rate
IRL%_USA	US lending rate
P#C_USA	Consumer price index, US
P#OIL\$	Brent oil price spot rate (US dollars per barrel)
P#WX\$	World export price index dollarized
POP_PHI	Population (thousands)
RAIN_PHI	Rainfall index
TAX%_PHI	Tax rate
WT\$_PHI	World imports from the Philippines

B. Estimated Model

The estimated behavioral and linking equations and the identities of the Philippine model are presented below. In the equations, a vector of the standard error (SE) and stability statistic is provided for each parameter estimate. Below the equations, the standard deviation of the residuals (*sigma*) and the coefficient of determination (R^2) are reported. In addition, the test-statistic and the probability value (bracketed number) for five diagnostic tests are also reported. These tests are (i) Lagrange-multiplier test for r^{th} residual correlation, (ii) Doornik and Hansen test for normality of residuals, (iii) White's test for heteroskedasticity using squares, (iv) Ramsey RESET test for model misspecification, and (v) parameter instability tests for the variance and for all parameters in the model simultaneously based on Hansen (1992). Note that in the equations, the variable *SQ1* denotes a dummy for quarter 1, *SQ2* a dummy for quarter 2, and so on. Variables that begin with DSH followed by a date denote one quarter dummies while those that begin with DST followed by a date denote dummies for more than one quarter.

1. Consumption Block

(i) Private Consumption in Constant Price

$$\Delta \ln(PCONc_PHI) = \begin{bmatrix} 0.1227 \\ 0.0327 \\ 0.0546 \end{bmatrix} - \begin{bmatrix} 0.2611 \\ 0.0027 \\ 0.3827 \end{bmatrix} * SQ1 - \begin{bmatrix} 0.0474 \\ 0.0031 \\ 0.46099 \end{bmatrix} * SQ2 - \begin{bmatrix} 0.1168 \\ 0.0017 \\ 0.3923 \end{bmatrix} * SQ3 + \begin{bmatrix} 0.0906 \\ 0.0311 \\ 0.3151 \end{bmatrix} * (NFIAC_PHI / GNPc_PHI) - \begin{bmatrix} 0.0636 \\ 0.0141 \\ 0.0345 \end{bmatrix} * PCONcECM_PHI_1$$

$$PCONcECM_PHI = \ln(PCONc_PHI) - 0.8 * \ln(GNPc_PHI - [GTAX_PHI / (GNP_PHI / GNPc_PHI)]) - 0.2 * [\ln(DDEBT_PHI_1 + MO_PHI_1 + NFA_PHI_1) / P\#C_PHI_1] + 0.05 * [0.5 * (UEMP\%_PHI + UEMP\%_PHI_1)] + 0.005 * [IRD\%_PHI_1 - 100 * D4 \ln(P\#C_PHI_1)]$$

sigma	0.0036
R2	0.9988
Autocorrelation F(3,29)	= 3.1041 [0.0582]
Normality Chi^2(2)	= 1.4000 [0.4966]
Homoscedasticity F(7,27)	= 0.9004 [0.5205]
RESET F(1,34)	= 1.2779 [0.2662]
Stability	
variance	0.1049
joint parameter constancy	2.4605

(ii) *Private Consumption in Current Price*

$$\Delta_4 \ln(PCON_PHI) = \Delta_4 \ln(PCONc_PHI) + \begin{bmatrix} 0.9779 \\ 0.0179 \\ 0.18345 \end{bmatrix} * \Delta_4 \ln(P\#C_PHI) + \begin{bmatrix} 0.0249 \\ 0.0112 \\ 0.0949 \end{bmatrix} * \Delta \ln(P\#M_PHI_1) \\ - \begin{bmatrix} 0.03345 \\ 0.0091 \\ 0.1784 \end{bmatrix} * \Delta_4 \ln(P\#M_PHI) - \begin{bmatrix} 0.1640 \\ 0.0659 \\ 0.4155 \end{bmatrix} * PCONECM_PHI_4$$

PCONECM_PHI	=	ln(PCON_PHI) - ln(PCONc_PHI) - 0.86*ln(P#C_PHI) - 0.07*ln(P#M_PHI_5)
sigma	0.0049	
R2	—	
Autocorrelation F(3,36)	=	0.5541 [0.6487]
Normality Chi^2(2)	=	0.6156 [0.7351]
Homoscedasticity F(8,30)	=	1.0293 [0.4363]
RESET F(1,38)	=	0.3620 [0.5510]
Stability		
variance	0.2813	
joint parameter constancy	1.0662	

2. Investment Block

(i) *Investment in Constant Price*

$$\Delta \ln(INVc_PHI) = - \begin{bmatrix} 0.5198 \\ 0.1268 \\ 0.1926 \end{bmatrix} + \begin{bmatrix} 1.1086 \\ 0.2078 \\ 0.1321 \end{bmatrix} * \Delta_3 \ln(GDPc_PHI) - \begin{bmatrix} 0.3114 \\ 0.0995 \\ 0.2414 \end{bmatrix} * \Delta[(DDEBT_PHI(-3) + FDEBT_PHI(-3)) / GDP_PHI(-3)] \\ - \begin{bmatrix} 0.0080 \\ 0.0064 \\ 0.0381 \end{bmatrix} * \Delta[IRL\%_PHI(-1) - \Delta_4 \ln(P\#C(-1))] - \begin{bmatrix} 0.3405 \\ 0.0878 \\ 0.1956 \end{bmatrix} * INVcECM_PHI_1$$

INVcECM_PHI	=	ln(INVc_PHI) - ln(GDPc_PHI)
sigma	0.0578	
R2	0.6920	
Autocorrelation F(3,25)	=	0.0918 [0.9640]
Normality Chi^2(2)	=	2.2117 [0.3309]
Homoscedasticity F(6,21)	=	0.5443 [0.8115]

RESET F(1,27) = 0.0684 [0.7953]

Stability

variance 0.1133

joint parameter constancy 0.8749

(ii) Inventories in Constant Price

$$\begin{aligned} \Delta STKc_PHI = & GDPc_PHI * [(STKc_PHI_1 / GDPc_PHI_1)] + \begin{bmatrix} 0.0297 \\ 0.0061 \\ 0.1768 \end{bmatrix} - \begin{bmatrix} 0.4778 \\ 0.0839 \\ 0.1188 \end{bmatrix} * \Delta_3 \ln(P \# GDP_PHI_4) \\ & - \begin{bmatrix} 0.1034 \\ 0.0305 \\ 0.1041 \end{bmatrix} * \Delta_3 \ln(ER_PHI) - \begin{bmatrix} 0.1889 \\ 0.0498 \\ 0.2839 \end{bmatrix} * STKcECM_PHI_1 \\ & + \begin{bmatrix} 0.1674 \\ 0.0635 \\ 0.1306 \end{bmatrix} * \Delta_2 [\ln(PCONc_PHI_3 + GCONc_PHI_3 + INvc_PHI_3 + Xc_PHI_3 - Mc_PHI_3) \\ & - \ln(GDPcLR_PHI_3)] \\ & + \begin{bmatrix} 0.1153 \\ 0.0602 \\ 0.0722 \end{bmatrix} * \Delta_2 [\ln(PCONc_PHI_5 + GCONc_PHI_5 + INvc_PHI_5 + Xc_PHI_5 - Mc_PHI_5) \\ & - \ln(GDPcLR_PHI_5)] \end{aligned}$$

STKcECM_PHI = STKc_PHI/GDPc_PHI - [ln(PCONc_PHI + GCONc_PHI + INvc_PHI + Xc_PHI - Mc_PHI) - ln(GDPcLR_PHI)]

sigma 0.0141

R2 0.5884

Autocorrelation F(3,27) = 0.3309 [0.8031]

Normality Chi^2(2) = 0.4832 [0.7854]

Homoscedasticity F(10,19) = 1.1909 [0.3553]

RESET F(1,29) = 1.0383 [0.3167]

Stability

variance 0.2123

joint parameter constancy 1.2020

(iii) Inventories in Current Price

$$\Delta STK_PHI = \begin{bmatrix} 729.422 \\ 478.3 \\ 0.1312 \end{bmatrix} + \begin{bmatrix} 0.6698 \\ 0.0337 \\ 0.0965 \end{bmatrix} * \Delta(STKc_PHI * P \# INV_PHI) - \begin{bmatrix} 1.1425 \\ 0.1671 \\ 0.2797 \end{bmatrix} * STKECM_PHI_1$$

STKECM_PHI = STK_PHI - 0.70*(STKc_PHI*P#INV_PHI)

sigma 2810.05

R2 0.9349

Autocorrelation F(3,30) = 0.4185 [0.7410]

Normality Chi^2(2) = 0.4790 [0.7870]

Homoscedasticity F(4,28) = 0.4600 [0.7644]

RESET F(1,32) = 0.2639 [0.6110]

Stability

variance 0.2023

joint parameter constancy 0.6152

3. Government Block

(i) Government Revenue

$$\Delta \ln(\text{GREV_PHI}) = \begin{bmatrix} 0.1161 \\ 0.0223 \\ 0.0860 \end{bmatrix} + \begin{bmatrix} 0.9347 \\ 0.0431 \\ 0.1432 \end{bmatrix} * \Delta \ln(\text{GTAX_PHI}) + \begin{bmatrix} 0.0316 \\ 0.1816 \\ 0.1191 \end{bmatrix} * \text{DST2002Q3} - \begin{bmatrix} 0.9745 \\ 0.0161 \\ 0.0682 \end{bmatrix} * \text{GREVECM_PHI_1}$$

$$\text{GREVECM_PHI} = \ln(\text{GREV_PHI}) - \ln(\text{GTAX_PHI})$$

Sigma 0.0346
 R2 0.9442
 Autocorrelation F(3,25) = 1.3762 [0.2730]
 Normality Chi^2(2) = 3.8701 [0.1444]
 Homoscedasticity F(5,22) = 2.2084 [0.0900]
 RESET F(1,27) = 3.5454 [0.0705]
 Stability
 variance 0.4598
 joint parameter constancy 1.3423

(ii) Government Tax Revenues

$$\begin{aligned} \Delta \ln(\text{GTAX_PHI}) = & - \begin{bmatrix} 0.2710 \\ 0.0929 \\ 0.06116 \end{bmatrix} * (\ln(\text{GTAX_PHI}) - \ln(\text{GTAX_PHI_2})) - \begin{bmatrix} 0.2110 \\ 0.0538 \\ 0.0807 \end{bmatrix} * \text{SQ1} + \begin{bmatrix} 0.1753 \\ 0.0279 \\ 0.0584 \end{bmatrix} * \text{SQ2} \\ & + \begin{bmatrix} 0.6448 \\ 0.1097 \\ 0.0374 \end{bmatrix} * \Delta \ln(\text{GNP_PHI}) + \begin{bmatrix} 0.8331 \\ 0.3045 \\ 0.0753 \end{bmatrix} * \Delta \ln(\text{GNP_PHI_1}) \\ & + \begin{bmatrix} 0.4470 \\ 0.1569 \\ 0.1217 \end{bmatrix} * \Delta \ln(\text{GNP_PHI_2}) - \begin{bmatrix} 0.5769 \\ 0.1023 \\ 0.0513 \end{bmatrix} * \text{GTAXECM} \end{aligned}$$

$$\text{GTAXECM_PHI} = \ln(\text{GTAX_PHI}) - \ln(\text{GNP_PHI}) - 0.095 * \text{TAX\%_PHI} + 5.17$$

sigma 0.0333
 R2 —
 Autocorrelation F(3,22) = 0.5576 [0.6808]
 Normality Chi^2(2) = 2.9366 [0.2303]
 Homoscedasticity F(10,14) = 1.1246 [0.3831]
 RESET F(1,24) = 0.0946 [0.7600]
 Stability
 variance 0.25084
 joint parameter constancy 1.6218

(iii) Government Tax Revenues (alternative)

$$\begin{aligned} \ln(GTAX_PHI) = & ifle(200402) * (\ln(GTAX_PHI_1) - \begin{bmatrix} 0.2710 \\ 0.0929 \\ 0.06116 \end{bmatrix} * (\ln(GTAX_PHI) - \ln(GTAX_PHI_2)) - \begin{bmatrix} 0.2110 \\ 0.0538 \\ 0.0807 \end{bmatrix} * SQ1 \\ & + \begin{bmatrix} 0.1753 \\ 0.0279 \\ 0.0584 \end{bmatrix} * SQ2 + \begin{bmatrix} 0.6448 \\ 0.1097 \\ 0.0374 \end{bmatrix} * \Delta \ln(GNP_PHI) + \begin{bmatrix} 0.8331 \\ 0.3045 \\ 0.0753 \end{bmatrix} * \Delta \ln(GNP_PHI_1) + \begin{bmatrix} 0.4470 \\ 0.1569 \\ 0.1217 \end{bmatrix} * \Delta \ln(GNP_PHI_2) \\ & - \begin{bmatrix} 0.5769 \\ 0.1023 \\ 0.0513 \end{bmatrix} * GTAXECM + (DST2004Q2) * \ln((TAX\%_PHI_4 / BEFT\%_PHI) ^ (1 / YRStxGAP) * \\ & (GDP_PHI_1 + GDP_PHI_2 + GDP_PHI_3 + GDP_PHI_4) / (GDP_PHI_5 + GDP_PHI_6 \\ & + GDP_PHI_7 + GDP_PHI_8))) + \ln(GTAX_PHI_4) \end{aligned}$$

$$GTAXECM_PHI = \ln(GTAX_PHI) - \ln(GNP_PHI) - 0.095 * TAX\%_PHI + 5.17$$

4. Government Consumption in Current Price

$$\begin{aligned} \Delta_4 \ln(GCON_PHI) = & \begin{bmatrix} 0.5480 \\ 0.1074 \\ 0.1672 \end{bmatrix} * \Delta_4 \ln(GCON_PHI_1) - \begin{bmatrix} 0.0997 \\ 0.0285 \\ 0.2012 \end{bmatrix} + \begin{bmatrix} 0.2911 \\ 0.0779 \\ 0.1882 \end{bmatrix} * \Delta_4 \ln(GPAY_PHI) - \begin{bmatrix} 0.0312 \\ 0.0173 \\ 0.0116 \end{bmatrix} * DST2003Q3 \\ & - \begin{bmatrix} 0.5896 \\ 0.1255 \\ 0.1096 \end{bmatrix} * GCONECM_PHI_4 \end{aligned}$$

$$GCONECM_PHI = \ln(GCON_PHI) - \ln(GPAY_PHI)$$

Sigma	0.0321
R2	0.8118
Autocorrelation F(3,20)	= 1.1620 [0.3489]
Normality Chi^2(2)	= 0.6760 [0.3201]
Homoscedasticity F(7,15)	= 0.2606 [0.9602]
RESET F(1,22)	= 0.2826 [0.6004]
Stability	
variance	0.2242
joint parameter constancy	1.1232

(i) Government Noninterest Payment Expenditure

$$\begin{aligned} \ln(GPAY_PHI) = & [\ln(GPAY_PHI_4) + \begin{bmatrix} 0.0825 \\ 0.0161 \\ 0.0965 \end{bmatrix} + \begin{bmatrix} 0.6166 \\ 0.1572 \\ 0.1998 \end{bmatrix} * \Delta_4 \ln(GREV_PHI) + \begin{bmatrix} 0.0227 \\ 0.0063 \\ 0.0736 \end{bmatrix} * \Delta_2 UEMP\%_PHI_3 \\ & - \begin{bmatrix} 0.9088 \\ 0.1448 \\ 0.0795 \end{bmatrix} * GPAYECM_PHI_4] \end{aligned}$$

$$GPAYECM_PHI = \ln(GPAY_PHI) - \ln(GREV_PHI) + 0.24 * [(DDEBT_PHI_4 + FDEBT_PHI_4) / GNP_PHI_4] - 0.04 * UEMP\%_PHI_1$$

sigma 0.0703
 R2 0.6128
 Autocorrelation F(3,25) = 0.8108 [0.4999]
 Normality Chi^2(2) = 4.9365 [0.0847]
 Homoscedasticity F(6,21) = 0.2500 [0.9538]
 RESET F(1,27) = 0.4187 [0.5230]
 Stability
 variance 0.2765
 joint parameter constancy 0.9869

(ii) Government Noninterest Payment Expenditure (alternative)

$$\ln(GPAY_PHI) = [\ln(GPAY_PHI_4) + \begin{bmatrix} 0.0825 \\ 0.0161 \\ 0.0965 \end{bmatrix} + \begin{bmatrix} 0.6166 \\ 0.1572 \\ 0.1998 \end{bmatrix} \Delta_4 \ln(GREV_PHI) + \begin{bmatrix} 0.0227 \\ 0.0063 \\ 0.0736 \end{bmatrix} \Delta_2 UEMP\%_PHI_3 \\ - \begin{bmatrix} 0.9088 \\ 0.1448 \\ 0.0795 \end{bmatrix} * GPAYECM_PHI_4] + (DST2004Q2) * \min[1, (TDEBTr_PHI - 0.75 + GDEFr_PHI + 0.04)] \\ * \log[1 - 0.25 * \max(TDEBTr_PHI - 0.75, -GDEFr_PHI - 0.04)]]$$

$$GPAYECM_PHI = \ln(GPAY_PHI) - \ln(GREV_PHI) + 0.24 * [(DDEBT_PHI_4 + FDEBT_PHI_4) / GNP_PHI_4] - 0.04 * UEMP\%_PHI_1$$

5. Government Interest Payment Expenditure

$$\frac{GINT_PHI * 100}{DDEBT_PHI + FDEBT_PHI} = \begin{bmatrix} 0.0283 \\ 0.0013 \\ 0.1395 \end{bmatrix} * ER_PHI + \begin{bmatrix} 0.0394 \\ 0.0064 \\ 0.1699 \end{bmatrix} * IRTB\%_PHI + \begin{bmatrix} 0.2107 \\ 0.0639 \\ 0.0962 \end{bmatrix} * SQ3$$

sigma 0.1376
 R2 —
 Autocorrelation F(3,36) = 0.4748 [0.7033]
 Normality Chi^2(2) = 4.7449 [0.0933]
 Homoscedasticity F(4,34) = 0.9600 [0.4691]
 RESET F(1,38) = 0.1527 [0.6997]
 Stability
 variance 0.4417
 joint parameter constancy 0.9410

6. Domestic Debt

$$\Delta^2 DDEBT_PHI = 7388.86 + \begin{bmatrix} 3828.0 \\ 0.2604 \end{bmatrix} + \begin{bmatrix} 1.4700 \\ 0.3093 \\ 0.2070 \end{bmatrix} * \Delta GDEF_PHI_1 - \begin{bmatrix} 1.1947 \\ 0.1556 \\ 0.3119 \end{bmatrix} * DDEBTECM_PHI_1 \\ + 8489.14 * \Delta [0.25 * (IRTB\%_PHI_3 + IRTB\%_PHI_4 + IRTB\%_PHI_5 + IRTB\%_PHI_6)] \\ \begin{bmatrix} 4462.0 \\ 0.3979 \end{bmatrix}$$

$$\text{DDEBTECM_PHI} = \Delta \text{DDEBT_PHI} + \text{GDEF_PHI_1}$$

sigma	21355.9
R2	0.7076
Autocorrelation F(3,27)	= 1.0733 [0.3769]
Normality Chi^2(2)	= 0.2554 [0.9945]
Homoscedasticity F(6,23)	= 1.6129 [0.1887]
RESET F(1,29)	= 0.1523 [0.6992]
Stability	
variance	0.0785
joint parameter constancy	1.0005

7. Foreign Debt

$$\Delta^2 \text{FDEBT_PHI} = \begin{bmatrix} 7638.41 \\ 6351.0 \\ 0.0758 \end{bmatrix} + \begin{bmatrix} 15125 \\ 3168.0 \\ 0.0463 \end{bmatrix} * \Delta^2 \text{ER_PHI} + \begin{bmatrix} 5504.4 \\ 4455.0 \\ 0.3332 \end{bmatrix} * \Delta(\text{IRL\%_PHI} - \text{IRL\%_USA}) + \begin{bmatrix} 54321.7 \\ 16900 \\ 0.0694 \end{bmatrix} * \Delta \text{IRL\%_USA} \\ - \begin{bmatrix} 1.74598 \\ 0.1972 \\ 0.0859 \end{bmatrix} * \text{FDEBTECM_PHI_1}$$

FDEBTECM_PHI	=	$\Delta \text{DFDEBT_PHI} + \text{GDEF_PHI} - 10021 * \Delta \text{ER_PHI}$
sigma	35268.6	
R2	0.7527	
Autocorrelation F(3,26)	=	0.4736 [0.7033]
Normality Chi^2(2)	=	5.0872 [0.0786]
Homoscedasticity F(8,20)	=	0.3681 [0.9253]
RESET F(1,28)	=	1.3708 [0.2515]
Stability		
variance	0.1090	
joint parameter constancy	0.7842	

8. Government Consumption in Constant Price

$$\ln(\text{GCONc_PHI}) = \ln(\text{GCON_PHI}) - \ln(\text{GCON_PHI_1} / \text{GCONc_PHI_1}) - \begin{bmatrix} 0.1968 \\ 0.0141 \\ 0.24555 \end{bmatrix} + \begin{bmatrix} 0.3537 \\ 0.0333 \\ 0.1897 \end{bmatrix} * \text{SQ1} + \begin{bmatrix} 0.1571 \\ 0.0133 \\ 0.1328 \end{bmatrix} * \text{SQ2} \\ + \begin{bmatrix} 0.13397 \\ 0.0155 \\ 0.1581 \end{bmatrix} * \text{SQ3} - \begin{bmatrix} 1.7417 \\ 0.4602 \\ 0.2078 \end{bmatrix} * \Delta \ln(\text{VA3_PHI} / \text{VA3c_PHI}) + \begin{bmatrix} 0.3970 \\ 0.1167 \\ 0.1943 \end{bmatrix} * \text{GCONcECM_PHI_1}$$

$$\text{GCONcECM_PHI} = \ln(\text{GCON_PHI}) - \ln(\text{GCONc_PHI}) - \ln(\text{VA3_PHI} / \text{VA3c_PHI})$$

sigma	0.0279
R2	—
Autocorrelation F(4,34)	= 1.7646 [0.1725]
Normality Chi^2(2)	= 0.1828 [0.9127]
Homoscedasticity F(6,30)	= 2.7377 [0.0305]*
RESET F(1,36)	= 8.5123 [0.0060]**

Stability

variance 0.1937
 joint parameter constancy 1.6331**

D. Trade Block

1. Exports

$$\ln(X\$_PHI) = \begin{bmatrix} 0.0527 \\ 0.0236 \\ 0.0949 \end{bmatrix} + \begin{bmatrix} 0.7389 \\ 0.0932 \\ 0.3133 \end{bmatrix} * \ln(WT\$_PHI) + \begin{bmatrix} 0.1727 \\ 0.0323 \\ 0.0397 \end{bmatrix} * DST90Q197Q4 - \begin{bmatrix} 0.1068 \\ 0.0313 \\ 0.1591 \end{bmatrix} * DST00Q110Q4 - \begin{bmatrix} 0.5786 \\ 0.1046 \\ 0.0690 \end{bmatrix} * (\ln(X\$_PHI_1) - \ln(WT\$_PHI_1))$$

sigma 0.0496
 R2 0.7058
 Autocorrelation F(3,20) = 0.3425 [0.8474]
 Normality Chi^2(2) = 0.5798 [0.7483]
 Homoscedasticity F(5,17) = 0.4233 [0.8581]
 RESET F(1,22) = 0.0559 [0.8143]
 Stability
 variance 0.1293
 joint parameter constancy 1.0285

2. Imports

$$\Delta \ln(M_PHI) = - \begin{bmatrix} 0.2730 \\ 0.0601 \\ 0.2073 \end{bmatrix} + \begin{bmatrix} 0.1707 \\ 0.0919 \\ 0.0877 \end{bmatrix} * \Delta_5 \ln(X_PHI) + \begin{bmatrix} 0.5040 \\ 0.1391 \\ 0.1529 \end{bmatrix} * \Delta \ln(X_PHI) - \begin{bmatrix} 0.6095 \\ 0.1378 \\ 0.1788 \end{bmatrix} * MECM_PHI_1 + \begin{bmatrix} 0.4228 \\ 0.2110 \\ 0.2303 \end{bmatrix} * \Delta_2 \ln(PCON_PHI_2 + GCON_PHI_2 + INV_PHI_2)$$

$$MECM_PHI = \ln(M_PHI) - 0.6 * \ln(X_PHI) - 0.4 * \ln(PCON_PHI + GCON_PHI + INV_PHI) - 6 * [P\#P_PHI / (P\#WX\$_PHI * ER_PHI)]$$

sigma 0.0631
 R2 0.6446
 Autocorrelation F(3,28) = 0.7928 [0.5082]
 Normality Chi^2(2) = 4.2113 [0.1218]
 Homoscedasticity F(8,22) = 0.5447 [0.8103]
 RESET F(1,30) = 0.6133 [0.4397]
 Stability
 variance 0.1231
 joint parameter constancy 0.8399

3. Current Account Balance

$$\Delta CAB\$_PHI = 281.602 + \begin{bmatrix} 0.9578 \\ 94.360 \\ 0.1311 \end{bmatrix} * \Delta \ln(X\$_PHI - M\$_PHI) - \begin{bmatrix} 0.6937 \\ 0.1777 \\ 0.1373 \end{bmatrix} * CAB\$ECM_PHI_1$$

$$CAB\$ECM_PHI = CAB\$_PHI - (X\$_PHI - M\$_PHI)$$

sigma 382.196
 R2 0.8278
 Autocorrelation F(3,27) = 1.4714 [0.2445]
 Normality Chi^2(2) = 5.5125 [0.0635]
 Homoscedasticity F(4,25) = 0.6799 [0.6124]
 RESET F(1,29) = 0.9634 [0.3344]
 Stability
 variance 0.2082
 joint parameter constancy 0.5228

E. Production Block

1. Long-run Supply Trend of GDP in Constant Price

$$\ln(GDPcLR_PHI) = 0.95 + 0.0689 * \ln(TIME) + 0.64 * \ln(EMP_PHI) + 0.36 * \ln(Kc_PHI) + 0.0286 * DST(2000Q1)$$

2. Value Added in the Primary Sector in Constant Price

$$\begin{aligned} \Delta_4 \ln(VA1c_PHI) = & - \begin{bmatrix} 0.8101 \\ 0.1095 \\ 0.0870 \end{bmatrix} + \begin{bmatrix} 0.0916 \\ 0.0081 \\ 0.1660 \end{bmatrix} * \Delta_4 \ln(RAIN_PHI_1) + \begin{bmatrix} 1.8134 \\ 0.3485 \\ 0.1013 \end{bmatrix} * \Delta_4 \ln(VA3c_PHI_1) + \begin{bmatrix} 0.2418 \\ 0.0430 \\ 0.1097 \end{bmatrix} * \Delta \ln(VA3c_PHI_4) \\ & + \begin{bmatrix} 0.0664 \\ 0.0363 \\ 0.1012 \end{bmatrix} * \Delta_3 \ln(VA2c_PHI_2) - \begin{bmatrix} 0.2469 \\ 0.0356 \\ 0.0866 \end{bmatrix} * VA1cECM_PHI_4 \end{aligned}$$

$$VA1cECM_PHI = \ln(VA1c_PHI) - 0.31 * \ln(RAIN_PHI_1) - \ln(VA2c_PHI_1 + VA3c_PHI_1)$$

sigma 0.0195
 R2 0.8411
 Autocorrelation F(3,23) = 1.0295 [0.3980]
 Normality Chi^2(2) = 0.5826 [0.7473]
 Homoscedasticity F(10,15) = 0.8513 [0.5920]
 RESET F(1,25) = 1.3205 [0.2614]
 Stability
 variance 0.1251
 joint parameter constancy 0.9690

3. Value Added in the Primary Sector in Current Price

$$\begin{aligned}\Delta \ln(VA1_PHI) = & \Delta \ln(VA1c_PHI) - 0.3642 - 0.0277 * SQ2 + 0.0594 * SQ3 + 0.1592 * \Delta \ln(P \# M_PHI_1) \\ & (0.1338) \quad (0.0148) \quad (0.0203) \quad (0.0954) \\ & - 0.10997 * \Delta[(X_PHI + M_PHI) / GDP_PHI] + 0.1314 * \ln(P \# WX\$_2 * ER_PHI_2) \\ & (0.0536) \quad (0.0472) \\ & - 0.5155 * \ln(VA1_PHI_1 / VA1c_PHI_1) \\ & (0.1809)\end{aligned}$$

sigma 0.0249
R2 0.7455
Autocorrelation F(3,22) = 2.3965 [0.0955]
Normality Chi^2(2) = 0.9507 [0.6217]
Homoscedasticity F(11,13) = 2.0427 [0.1107]
RESET F(1,24) = 9.7810 [0.0046]**
Stability
variance 0.0949
joint parameter constancy 2.0085

4. Value Added in the Secondary Sector in Constant Price

$$\begin{aligned}\Delta \ln(VA2c_PHI) = & - 0.1132 + 0.7775 * \Delta \ln(PCONc_PHI) - 0.2109 * \Delta_2(Xc_PHI / GDPc_PHI) + 0.1139 * SQ4 \\ & (0.0168) \quad (0.0464) \quad (0.0682) \quad (0.0072) \\ & + 0.2247 * ((Xc_PHI / GDPc_PHI) - (Xc_PHI_2 / GDPc_PHI_2)) + 0.0657 * (DSH2000Q1 - DSH2000Q2) \\ & (0.0727) \quad (0.0139) \\ & + 0.3194 * \Delta \ln((VA3_PHI_2 / VA3c_PHI_2) / (VA2_PHI_2 / VA2c_PHI_2)) \\ & (0.1411) \\ & + 0.6463 * \Delta \ln((VA3_PHI_4 / VA3c_PHI_4) / (VA2_PHI_4 / VA2c_PHI_4)) - 0.2236 * VA2cECM_PHI_1 \\ & (0.1260) \quad (0.0463)\end{aligned}$$

$$\begin{aligned}VA2cECM_PHI & = \ln(VA2c_PHI) - 0.64 * \ln[Kc_PHI * (VA2_PHI / GDP_PHI)] - 0.36 * \ln(EMP2_PHI) \\ - & 0.15 * \ln(TIME)\end{aligned}$$

sigma 0.0128
R2 0.9887
Autocorrelation F(3,21) = 1.0010 [0.4119]
Normality Chi^2(2) = 1.5609 [0.4582]
Homoscedasticity F(12,11) = 0.436 [0.9161]
RESET F(1,23) = 0.5403 [0.4697]
Stability: tests not performed because of impulse dummy among explanatory variables

5. Value Added in the Secondary Sector in Current Price

$$\begin{aligned}\ln(VA2_PHI) = & \ln(VA2c_PHI) + \ln(VA2_PHI_2 / VA2c_PHI_2) - \begin{bmatrix} 0.2437 \\ 0.0702 \\ 0.06799 \end{bmatrix} * \Delta \ln(VA2_PHI_1 / VA2c_PHI_1) \\ & - \begin{bmatrix} 0.4723 \\ 0.05798 \\ 0.3489 \end{bmatrix} * \Delta \ln(VA2_PHI_2 / VA2c_PHI_2) - \begin{bmatrix} 0.2557 \\ 0.0500 \\ 0.2803 \end{bmatrix} + 0.0859 * SQ1 + \begin{bmatrix} 0.18905 \\ 0.0059 \\ 0.0967 \end{bmatrix} * \Delta_2 \ln(P \# INV_PHI) \\ & - \begin{bmatrix} 0.0315 \\ 0.0157 \\ 0.0723 \end{bmatrix} * \Delta \ln(WAGE_PHI_2) - \begin{bmatrix} 0.1891 \\ 0.03597 \\ 0.29105 \end{bmatrix} * VA2ECM_PHI_1\end{aligned}$$

$$\begin{aligned}
\text{VA2ECM_PHI} &= \ln(\text{VA2_PHI}) - \ln(\text{VA2c_PHI}) - 0.65 * \ln(\text{P\#INV_PHI}) - 0.2 * \ln(\text{P\#M_PHI}_1) - \\
&\quad 0.15 * \ln(\text{WAGE_PHI}) \\
\text{sigma} &0.0120 \\
\text{R2} &0.9393 \\
\text{Autocorrelation } F(3,31) &= 0.4225 [0.7382] \\
\text{Normality } \chi^2(2) &= 0.2705 [0.8735] \\
\text{Homoscedasticity } F(11,22) &= 0.4715 [0.9014] \\
\text{RESET } F(1,33) &= 1.2670 [0.2684] \\
\text{Stability} & \\
\quad \text{variance} &0.1623 \\
\quad \text{joint parameter constancy} &1.2881
\end{aligned}$$

6. Value Added in the Tertiary Sector in Constant Price

$$\begin{aligned}
\Delta \ln(\text{VA3c_PHI}) &= -\frac{0.0328}{(0.0261)} - \frac{0.2501}{(0.0102)} * \text{SQ1} - \frac{0.0453}{(0.0039)} * \text{SQ2} - \frac{0.0993}{(0.0038)} * \text{SQ3} - \frac{0.0161}{(0.0040)} * \text{DSH2000Q4} \\
&\quad + \frac{0.0074}{(0.0042)} * \text{DSH2001Q1} + \frac{0.1911}{(0.0324)} * \Delta \ln[\text{GNP_PHI} / (\text{VA2_PHI} / \text{VA2c_PHI})] \\
&\quad - \frac{0.0324}{(0.0068)} * \Delta_2 \ln[(\text{VA1_PHI} / \text{VA1c_PHI}) / (\text{VA2_PHI} / \text{VA2c_PHI})] \\
&\quad - \frac{0.1016}{(0.0388)} * \Delta \ln[(\text{VA3_PHI} / \text{VA3c_PHI}) / (\text{VA2_PHI} / \text{VA2c_PHI})] - \frac{0.1177}{(0.0212)} * \text{VA3cECM_PHI}_1
\end{aligned}$$

$$\text{VA3cECM_PHI} = \ln(\text{VA3c_PHI}) - \ln[\text{GNP_PHI} / (\text{VA2_PHI} / \text{VA2c_PHI})] - 0.13 * \ln(\text{TIME}) + \ln[(\text{VA3_PHI} / \text{VA3c_PHI}) / (\text{VA2_PHI} / \text{VA2c_PHI})]$$

$$\begin{aligned}
\text{sigma} &0.0038 \\
\text{R2} &0.9991 \\
\text{Autocorrelation } F(4,31) &= 2.3908 [0.0721] \\
\text{Normality } \chi^2(2) &= 0.6292 [0.7301] \\
\text{Homoscedasticity } F(13,21) &= 0.5353 [0.8763] \\
\text{RESET } F(1,34) &= 3.1455 [0.0851] \\
\text{Stability: tests not performed because of impulse dummy among explanatory variables}
\end{aligned}$$

7. Value Added in the Tertiary Sector in Current Price

$$\begin{aligned}
\ln(\text{VA3_PHI}) &= \ln(\text{VA3c_PHI}) + \frac{0.4286}{\begin{bmatrix} 0.1144 \\ 0.1291 \end{bmatrix}} * \Delta \ln(\text{VA3_PHI} / \text{VA3c_PHI}) + \frac{0.0097}{\begin{bmatrix} 0.00345 \\ 0.15097 \end{bmatrix}} + \frac{0.0653}{\begin{bmatrix} 0.0037 \\ 0.2502 \end{bmatrix}} * \text{SQ1} - \frac{0.0583}{\begin{bmatrix} 0.0080 \\ 0.1898 \end{bmatrix}} * \text{SQ3} \\
&\quad + \frac{0.1055}{\begin{bmatrix} 0.04775 \\ 0.0869 \end{bmatrix}} * \Delta \ln(\text{VA2_PHI}_2 / \text{VA2c_PHI}_2) + \frac{0.0424}{\begin{bmatrix} 0.0131 \\ 0.1631 \end{bmatrix}} * \Delta_4 \ln(\text{P\#M_PHI}) - \frac{0.0560}{\begin{bmatrix} 0.0237 \\ 0.0852 \end{bmatrix}} * \text{VA3cECM_PHI}_1
\end{aligned}$$

$$\begin{aligned}
\text{VA3ECM_PHI} &= \ln(\text{VA3_PHI}) - \ln(\text{VA3c_PHI}) - \ln(\text{VA2_PHI}_1 / \text{VA2c_PHI}_1) \\
\text{sigma} &0.0073 \\
\text{R2} &0.7121
\end{aligned}$$

Autocorrelation F(3,32) = 2.9901 [0.0455]*
 Normality Chi^2(2) = 1.1489 [0.5630]
 Homoscedasticity F(6,28) = 1.2151 [0.3280]
 RESET F(1,34) = 0.9546 [0.3355]
 Stability
 variance 0.5793*
 joint parameter constancy 1.5135

8. Net Factor Income from Abroad in Current Price

$$\Delta(NFIA_PHI) = - \frac{0.6368}{(0.1107)} \Delta NFIA_PHI_1 - \frac{18808.2}{(8554)} + \frac{10526.8}{(5007)} SQ1 + \frac{7736.38}{(3103)} SQ2 + \frac{12795.9}{(5454)} DSH200004 \\ + \frac{1353.62}{(835.5)} \Delta UEMP\%_PHI_2 - \frac{0.0496}{(0.0202)} NFIAECM_PHI_1$$

$$NFIAECM_PHI = NFIA_PHI - 38000 * UEMP\%_PHI$$

sigma 4717.1
 R2 0.6200
 Autocorrelation F(3,30) = 0.3319 [0.8023]
 Normality Chi^2(2) = 37.356 [0.0000]**
 Homoscedasticity F(9,23) = 0.6932 [0.7081]
 RESET F(1,32) = 0.0562 [0.8140]
 Stability: tests not performed because of impulse dummy among explanatory variables

9. Gross National Product in Constant Price

$$\ln(GNPc_PHI) = \ln(GNP_PHI) - \left(\frac{0.0134}{\begin{bmatrix} 0.0001 \\ 0.0247 \end{bmatrix}} + \frac{0.9914}{\begin{bmatrix} 0.0097 \\ 0.0898 \end{bmatrix}} \right) \Delta \ln(P \# GDP_PHI) - \frac{0.0606}{\begin{bmatrix} 0.0005 \\ 0.0762 \end{bmatrix}} SQ1 + \frac{0.0094}{\begin{bmatrix} 0.0002 \\ 0.1190 \end{bmatrix}} SQ3 \\ - \frac{0.1732}{\begin{bmatrix} 0.0060 \\ 0.1414 \end{bmatrix}} GNPcECM_PHI_1$$

$$GNPcECM_PHI = \ln(GNP_PHI) - \ln(GNPc_PHI) - 0.98326 * \ln(P \# GDP_PHI)$$

sigma 0.0005
 R2 0.9984
 Autocorrelation F(3,26) = 2.2927 [0.1016]
 Normality Chi^2(2) = 4.4759 [0.1067]
 Homoscedasticity F(6,22) = 0.4358 [0.8470]
 RESET F(1,28) = 0.1031 [0.7506]
 Stability
 variance 0.3947
 joint parameter constancy 0.8819

F. Price Block

1. GDP Deflator

$$\Delta \ln(P \# GDP_PHI) = \begin{bmatrix} 0.0580 \\ 0.0026 \\ 0.18995 \end{bmatrix} * SQ1 + \begin{bmatrix} 0.0335 \\ 0.0139 \\ 0.1271 \end{bmatrix} * \Delta \ln(P \# X_PHI / P \# M_PHI) - \begin{bmatrix} 0.2124 \\ 0.0374 \\ 0.12185 \end{bmatrix} * P \# GDPECM_PHI_1 \\ + \begin{bmatrix} 0.2346 \\ 0.05855 \\ 0.1459 \end{bmatrix} * \Delta [\ln(PCON_PHI + GCON_PHI + INV_PHI) / (PCONc_PHI + GCONc_PHI + INVc_PHI)]$$

$$P \# GDPECM_PHI = \ln(P \# GDP_PHI) - \ln[(PCON_PHI + GCON_PHI + INV_PHI) / (PCONc_PHI + GCONc_PHI + INVc_PHI)] + 0.14 + 0.15 * (P \# X_PHI / P \# M_PHI)$$

sigma 0.0060
R2 0.8828
Autocorrelation F(3,28) = 0.9853 [0.4139]
Normality Chi^2(2) = 7.0421 [0.0296]*
Homoscedasticity F(7,23) = 1.9538 [0.1066]
RESET F(1,30) = 0.2014 [0.6569]
Stability
variance 0.5804*
joint parameter constancy 1.0694

2. Consumer Price Index

$$\Delta \ln(P \# C_PHI) = \begin{bmatrix} 0.3074 \\ 0.0839 \\ 0.1081 \end{bmatrix} * \Delta \ln(P \# C_PHI_1) - \begin{bmatrix} 0.0175 \\ 0.0075 \\ 0.1117 \end{bmatrix} * SQ1 - \begin{bmatrix} 0.0193 \\ 0.0084 \\ 0.0529 \end{bmatrix} * SQ2 + \begin{bmatrix} 0.0206 \\ 0.0115 \\ 0.1571 \end{bmatrix} * \Delta \ln(P \# M_PHI) \\ + \begin{bmatrix} 0.0650 \\ 0.0212 \\ 0.1716 \end{bmatrix} * \Delta \ln(VA1_PHI / VA1c_PHI) + \begin{bmatrix} 0.4419 \\ 0.0977 \\ 0.0819 \end{bmatrix} * \Delta \ln(VA3_PHI / VA3c_PHI) \\ + \begin{bmatrix} 0.2001 \\ 0.0870 \\ 0.0778 \end{bmatrix} * \Delta \ln(VA3_PHI_1 / VA3c_PHI_1) + \begin{bmatrix} 0.1114 \\ 0.0319 \\ 0.1969 \end{bmatrix} * \Delta \ln(VA3_PHI_2 / VA3c_PHI_2) \\ - \begin{bmatrix} 0.1208 \\ 0.0390 \\ 0.2178 \end{bmatrix} * P \# CECM_PHI_1$$

$$P \# CECM_PHI = \ln(P \# C_PHI) - 0.16 * \ln(VA1_PHI / VA1c_PHI) - 0.30 * \ln(VA2_PHI / VA2c_PHI) - 0.54 * \ln(VA3_PHI_3 / VA3c_PHI_3) - 0.05 * (M1_PHI_3 / GDP_PHI_3)$$

sigma 0.0080
R2 —
Autocorrelation F(3,30) = 0.6903 [0.5651]
Normality Chi^2(2) = 3.5516 [0.5050]
Homoscedasticity F(16,16) = 0.9046 [0.5783]
RESET F(1,32) = 0.2837 [0.5979]
Stability
variance 0.3911
joint parameter constancy 1.4386

3. Producer Price Index

$$\Delta \ln(P \# P_PHI) = - \begin{bmatrix} 0.1248 \\ 0.0325 \\ 0.0627 \end{bmatrix} + \begin{bmatrix} 0.1451 \\ 0.0332 \\ 0.1259 \end{bmatrix} * \Delta \ln(P \# M_PHI) + \begin{bmatrix} 0.2358 \\ 0.0514 \\ 0.3485 \end{bmatrix} * \Delta \ln(VA1_PHI / VA1c_PHI) \\ + \begin{bmatrix} 0.6201 \\ 0.1514 \\ 0.0677 \end{bmatrix} * \Delta_4 \ln(VA3_PHI / VA3c_PHI) - \begin{bmatrix} 0.2091 \\ 0.0557 \\ 0.0727 \end{bmatrix} * P \# PECM_PHI + \begin{bmatrix} 0.2352 \\ 0.0429 \\ 0.1357 \end{bmatrix} * \Delta \ln(P \# INV_PHI_3)$$

$$P \# PECM_PHI = \ln(P \# P_PHI) - \ln(VA2_PHI / VA2c_PHI)$$

sigma 0.0126
 R2 0.7311
 Autocorrelation F(3,22) = 0.5591 [0.6476]
 Normality Chi^2(2) = 3.9676 [0.1375]
 Homoscedasticity F(10,14) = 0.3491 [0.9500]
 RESET F(1,24) = 0.6748 [0.4195]
 Stability
 variance 0.0452
 joint parameter constancy 1.4507

4. Investment Deflator

$$\Delta \ln(P \# INV_PHI) = - \begin{bmatrix} 0.0235 \\ 0.0056 \\ 0.2129 \end{bmatrix} + \begin{bmatrix} 0.3544 \\ 0.0809 \\ 0.0822 \end{bmatrix} * \Delta \ln(VA1_PHI_1 / VA1c_PHI_1) - \begin{bmatrix} 0.4069 \\ 0.1131 \\ 0.2294 \end{bmatrix} * \Delta \ln(VA3_PHI / VA3c_PHI) \\ + \begin{bmatrix} 1.5749 \\ 0.1085 \\ 0.1208 \end{bmatrix} * \Delta \ln(VA3_PHI(-1) / VA3c_PHI(-1)) - \begin{bmatrix} 0.2509 \\ 0.0754 \\ 0.0455 \end{bmatrix} * P \# INVECM_PHI_1$$

$$P \# INVECM_PHI = \ln(P \# INV_PHI) - 0.46 * \ln(VA2_PHI_2 / VA2c_PHI_2) - 0.54 * \ln(VA2_PHI_2 / VA2c_PHI_2) - 0.005 * (0.25 * [(IRL\%_PHI_2 - 100 * \Delta_4 \ln(P \# C_PHI_2)) + (IRL\%_PHI_3 - 100 * \Delta_4 \ln(P \# C_PHI_3)) + (IRL\%_PHI_4 - 100 * \Delta_4 \ln(P \# C_PHI_4)) + (IRL\%_PHI_5 - 100 * \Delta_4 \ln(P \# C_PHI_5))])$$

sigma 0.0188
 R2 0.9020
 Autocorrelation F(3,21) = 0.3429 [0.7945]
 Normality Chi^2(2) = 0.0577 [0.9716]
 Homoscedasticity F(12,11) = 1.5452 [0.2041]
 RESET F(1,23) = 5 0.0062 [0.9376]
 Stability
 variance 0.1210
 joint parameter constancy 0.9495

5. Exports Deflator

$$\begin{aligned} \Delta \ln(P \# X_PHI) = & \begin{bmatrix} 0.3009 \\ 0.1357 \\ 0.0935 \end{bmatrix} * \Delta \ln(P \# X_PHI_1) - \begin{bmatrix} 0.2989 \\ 0.0629 \\ 0.0954 \end{bmatrix} + \begin{bmatrix} 0.0740 \\ 0.0406 \\ 0.1323 \end{bmatrix} * SQ3 + \begin{bmatrix} 0.8246 \\ 0.1425 \\ 0.0966 \end{bmatrix} * \Delta \ln(P \# M_PHI) \\ & + \begin{bmatrix} 0.7692 \\ 0.3707 \\ 0.1065 \end{bmatrix} * \Delta \ln(VA2_PHI / VA2c_PHI) + \begin{bmatrix} 1.6025 \\ 0.5018 \\ 0.0710 \end{bmatrix} * \Delta \ln(VA2_PHI_1 / VA2c_PHI_1) \\ & + \begin{bmatrix} 1.0265 \\ 0.3163 \\ 0.4359 \end{bmatrix} * \Delta \ln(VA2_PHI_3 / VA2c_PHI_3) + \begin{bmatrix} 0.6643 \\ 0.1943 \\ 0.2599 \end{bmatrix} * \Delta_3 \ln(VA1_PHI / VA1c_PHI) \\ & - \begin{bmatrix} 0.5399 \\ 0.1450 \\ 0.0955 \end{bmatrix} * P \# XECM_PHI_1 \end{aligned}$$

$$P \# XECM_PHI = \ln(P \# X_PHI) - \ln(P \# M_PHI) - 0.14 * \ln(TIME)$$

sigma 0.0537
 R2 0.7379
 Autocorrelation F(3,27) = 0.8958 [0.4560]
 Normality Chi^2(2) = 0.8986 [0.6381]
 Homoscedasticity F(15,14) = 0.5836 [0.8439]
 RESET F(1,29) = 0.4467 [0.5092]
 Stability
 variance 0.1043
 joint parameter constancy 1.6733

6. Imports Deflator

$$\begin{aligned} \Delta \ln(P \# M_PHI) = & - \begin{bmatrix} 0.0475 \\ 0.0149 \\ 0.1502 \end{bmatrix} * (SQ1 + SQ2 + SQ3) + \begin{bmatrix} 0.5993 \\ 0.1498 \\ 0.3334 \end{bmatrix} * \Delta \ln(P \# WX\$ * ER_PHI) + \begin{bmatrix} 0.2382 \\ 0.0729 \\ 0.3864 \end{bmatrix} * \Delta_2 \ln(P \# X_PHI) \\ & - \begin{bmatrix} 0.2872 \\ 0.1356 \\ 0.1053 \end{bmatrix} * \Delta \ln(P \# WX\$_2 * ER_PHI_2) - \begin{bmatrix} 0.2196 \\ 0.0725 \\ 0.3049 \end{bmatrix} * P \# MECM_PHI_1 \end{aligned}$$

$$P \# MECM_PHI = \ln(P \# M_PHI) - 0.67 * \ln(P \# X_PHI_3) - 0.33 * \ln(P \# OILS\$)$$

sigma 0.0462
 R2 —
 Autocorrelation F(3,34) = 0.6358 [0.5971]
 Normality Chi^2(2) = 4.0345 [0.8526]
 Homoscedasticity F(9,27) = 0.8147 [0.6074]
 RESET F(1,36) = 0.1212 [0.7298]
 Stability
 variance 0.2183
 joint parameter constancy 0.8595

7. World Price of Exports

$$\begin{aligned} \Delta \ln(P \# WX_PHI) = & 0.1506 + 0.4739 \Delta \ln(P \# WX_PH_1) + 0.3463 \Delta \ln(P \# WX_PH_2) \\ & \begin{bmatrix} 0.0549 \\ 0.1726 \end{bmatrix} \begin{bmatrix} 0.1662 \\ 0.0273 \end{bmatrix} \begin{bmatrix} 0.1671 \\ 0.0501 \end{bmatrix} \\ & + 0.1880 \Delta \ln(P \# OIL\$_PHI * ER_PHI) - 0.0933 \Delta \ln(P \# OIL\$_PHI_2 * ER_PHI_2) \\ & \begin{bmatrix} 0.0516 \\ 0.1760 \end{bmatrix} \begin{bmatrix} 0.0511 \\ 0.1145 \end{bmatrix} \\ & - 0.0456 SQ2 - 0.0425 SQ3 - 0.1423 P \# WXECCM_PHI_1 \\ & \begin{bmatrix} 0.0185 \\ 0.0838 \end{bmatrix} \begin{bmatrix} 0.0189 \\ 0.2051 \end{bmatrix} \begin{bmatrix} 0.0629 \\ 0.1905 \end{bmatrix} \end{aligned}$$

$$P \# WXECCM_PHI = \ln(P \# WXA_PHI) - 0.4065 \ln(P \# OIL\$_2 * ER_PHI_2)$$

sigma 0.0417
 R2 0.5094
 Autocorrelation F(3,27) = 1.5976 [0.2173]
 Normality Chi^2(2) = 2.5325 [0.2819]
 Homoscedasticity F(9,20) = 2.0188 [0.1117]
 RESET F(1,29) = 0.0185 [0.8928]
 Stability
 variance 0.4055
 joint parameter constancy 1.2082

G. Monetary Block

1. Currency in Circulation

$$\begin{aligned} \Delta \ln(MO_PHI) = & 0.1545 + 0.5262 \Delta \ln(M1_PHI) - 0.2364 SQ1 - 0.1879 SQ2 - 0.1816 SQ3 + 0.1860 DSH1999Q4 \\ & (0.0215) (0.1253) (0.0282) (0.0194) (0.0220) (0.0299) \\ & - 0.1720 DSH2000Q1 - 0.2435 MOECM_PHI_1 \\ & (0.0316) (0.0928) \end{aligned}$$

$$MOECM_PHI = \ln(MO_PHI) - \ln[(1 - 0.14 \ln(TIME)) * M1_PHI]$$

sigma 0.0248
 R2 0.9795
 Autocorrelation F(4,36) = 1.1831 [0.3347]
 Normality Chi^2(2) = 0.3897 [0.8230]
 Homoscedasticity F(9,30) = 0.5047 [0.8594]
 RESET F(1,39) = 0.0314 [0.8603]
 Stability: tests not performed because of impulse dummy among explanatory variables

2. Narrow Money

$$\begin{aligned} \Delta \ln(M1_PHI) = & \Delta \ln(P \# C_PHI) - 0.4492 + 0.7888 \Delta \ln(GNPc_PHI) - 0.01385 \Delta IROB\%_PHI + 0.1518 DSH1999Q4 \\ & \begin{bmatrix} 0.1077 \\ 0.0946 \end{bmatrix} \begin{bmatrix} 0.0846 \\ 0.2603 \end{bmatrix} \begin{bmatrix} 0.0054 \\ 0.1419 \end{bmatrix} (0.0352) \\ & - 0.5692 M1ECM_PHI_1 \\ & \begin{bmatrix} 0.1365 \\ 0.0945 \end{bmatrix} \end{aligned}$$

$$M1ECM_PHI = \ln(M1_PHI/P\#C_PHI) - \ln(GNPc_PHI) + 0.0146 * IROB\%_PHI$$

$$\sigma = 0.0332$$

$$R^2 = 0.8872$$

$$\text{Autocorrelation } F(2,17) = 2.0339 [0.1615]$$

$$\text{Normality } \chi^2(2) = 2.5186 [0.2838]$$

$$\text{Homoscedasticity } F(7,11) = 0.6564 [0.7040]$$

$$\text{RESET } F(1,18) = 0.0454 [0.8836]$$

Stability: tests not performed because of impulse dummy among explanatory variables

3. Broad Money

$$\Delta \ln(M3_PHI) = - \begin{bmatrix} 0.1521 \\ 0.0588 \\ 0.2268 \end{bmatrix} + \begin{bmatrix} 0.8655 \\ 0.1377 \\ 0.0873 \end{bmatrix} * \Delta \ln(NFA_PHI + DCDMB_PHI + DCCB_PHI) - \begin{bmatrix} 0.2964 \\ 0.1125 \\ 0.2177 \end{bmatrix} * M3ECM_PHI_1$$

$$M3ECM_PHI = \ln(M3_PHI) - \ln(NFA_PHI + DCDMB_PHI + DCCB_PHI)$$

$$\sigma = 0.0282$$

$$R^2 = 0.5896$$

$$\text{Autocorrelation } F(3,29) = 1.0146 [0.4005]$$

$$\text{Normality } \chi^2(2) = 2.6285 [0.2687]$$

$$\text{Homoscedasticity } F(4,27) = 1.8102 [0.1560]$$

$$\text{RESET } F(1,31) = 0.0203 [0.8878]$$

Stability

$$\text{variance} = 0.1802$$

$$\text{joint parameter constancy} = 0.6234$$

4. Net Foreign Assets

$$\Delta^2 NFA_PHI = \begin{bmatrix} 7460.3 \\ 9888.0 \\ 0.2193 \end{bmatrix} + \begin{bmatrix} 8182.1 \\ 3370.0 \\ 0.2604 \end{bmatrix} * \Delta ER_PHI_2 + \begin{bmatrix} 3.5674 \\ 1.0020 \\ 0.0942 \end{bmatrix} * \Delta^2 NFIA_PHI_2 + \begin{bmatrix} 0.5107 \\ 0.1697 \\ 0.1002 \end{bmatrix} * \Delta(X_PHI - M_PHI) \\ + \begin{bmatrix} 0.3288 \\ 0.1811 \\ 0.0868 \end{bmatrix} * \Delta(X_PHI_1 - M_PHI_1) - \begin{bmatrix} 0.7477 \\ 0.1480 \\ 0.1722 \end{bmatrix} * NFAECM_PHI_1$$

$$NFAECM_PHI = \Delta NFA_PHI - X_PHI + M_PHI$$

$$\sigma = 33755.7$$

$$R^2 = 0.7628$$

$$\text{Autocorrelation } F(3,22) = 1.9034 [0.1586]$$

$$\text{Normality } \chi^2(2) = 5.6163 [0.0603]$$

$$\text{Homoscedasticity } F(10,14) = 5.6163 [0.0603]$$

$$\text{RESET } F(1,24) = 0.0202 [0.8881]$$

Stability

$$\text{variance} = 0.1939$$

$$\text{joint parameter constancy} = 1.0515$$

5. Domestic Credit of Deposit Money Banks

$$\Delta^2 DCDMB_PHI = \begin{bmatrix} 60961 \\ 13460 \\ 0.1756 \end{bmatrix} + \begin{bmatrix} 1.5865 \\ 0.5704 \\ 0.1068 \end{bmatrix} * \Delta INV_PHI - \begin{bmatrix} 8082.16 \\ 2836.0 \\ 0.0696 \end{bmatrix} * \Delta_2 (IRL\%_PHI_1 - \Delta_4 CPI_PHI_1) \\ - \begin{bmatrix} 5847.51 \\ 1943.0 \\ 0.1197 \end{bmatrix} * \Delta_4 ER_PHI_2 - \begin{bmatrix} 1.0781 \\ 0.1739 \\ 0.2119 \end{bmatrix} * DCDMBECM_PHI_1$$

$$DCDMBECM_PHI = \Delta DCDMB_PHI - INV_PHI_1 + 4862 * ER_PHI_3$$

sigma 40218.7
 R2 0.6505
 Autocorrelation F(3,24) = 1.0349 [0.3949]
 Normality Chi^2(2) = 0.2924 [0.8640]
 Homoscedasticity F(8,18) = 0.9013 [0.5360]
 RESET F(1,26) = 0.0505 [0.5045]
 Stability
 variance 0.0784
 joint parameter constancy 0.8710

6. Domestic Credit of Central Bank

$$\Delta^2 DCCB_PHI = 79544.4 - 5308.48 * \Delta IRTB\%_PHI_2 - 8091.30 * \Delta IRTB\%_PHI_5 - 1.3638 * DCCBECM_PHI_1 \\ \begin{bmatrix} 9994.0 \\ 0.0722 \end{bmatrix} \begin{bmatrix} 3047.0 \\ 0.0897 \end{bmatrix} \begin{bmatrix} 2852.0 \\ 0.1985 \end{bmatrix} \begin{bmatrix} 0.1369 \\ 0.0723 \end{bmatrix}$$

$$DCCBECM_PHI = \Delta DCCB_PHI - GDEF_PHI_1 + 2088 * ER_PHI_1$$

sigma 32811.5
 R2 0.7697
 Autocorrelation F(3,29) = 1.3933 [0.2671]
 Normality Chi^2(2) = 0.7274 [0.6951]
 Homoscedasticity F(6,25) = 0.8050 [0.6270]
 RESET F(1,28) = 0.0002 [0.9893]
 Stability
 variance 0.1120
 joint parameter constancy 0.6541

7. Overnight Borrowing Rate

$$\Delta IROB\%_{_PHI} = \begin{bmatrix} 2.7506 \\ 0.9203 \\ 0.2237 \end{bmatrix} + \begin{bmatrix} 1.0977 \\ 0.2215 \\ 0.3522 \end{bmatrix} * \Delta_4 (P\#C_PHI_1 / P\#C_PHI_5) * 100$$

$$- \begin{bmatrix} 0.7410 \\ 0.2104 \\ 0.2956 \end{bmatrix} * \Delta_4 (P\#C_PHI_2 / P\#C_PHI_6) * 100 + \begin{bmatrix} 0.7137 \\ 0.1459 \\ 0.2283 \end{bmatrix} * IRL\%_{_USA_1}$$

sigma 1.1100
R2 0.8482
Autocorrelation F(3,19) = 0.4501 [0.6446]
Normality Chi^2(2) = 0.3551 [0.1694]
Homoscedasticity F(8,13) = 1.0972 [0.4141]
RESET F(1,21) = 7.9738 [0.0108]
Stability
variance 0.2085
joint parameter constancy 0.9674

8. Deposit Rate

$$\Delta IRD\%_{_PHI} = - \begin{bmatrix} 1.2098 \\ 0.5739 \\ 0.0308 \end{bmatrix} + \begin{bmatrix} 0.3246 \\ 0.0790 \\ 0.2705 \end{bmatrix} * \Delta IROB\%_{_PHI} - \begin{bmatrix} 0.6492 \\ 0.1052 \\ 0.02866 \end{bmatrix} * IRD\%_{_PHI_1} + \begin{bmatrix} 0.5432 \\ 0.0922 \\ 0.0307 \end{bmatrix} * IROB\%_{_PHI_1}$$

$$+ \begin{bmatrix} 0.28785 \\ 0.0774 \\ 0.04997 \end{bmatrix} * \Delta ER_PHI_1$$

sigma 0.7644
R2 0.7386
Autocorrelation F(3,19) = 2.4514 [0.0948]
Normality Chi^2(2) = 0.5230 [0.7699]
Homoscedasticity F(8,13) = 2.0263 [0.1240]
RESET F(1,21) = 0.2017 [0.6579]
Stability
variance 0.1702
joint parameter constancy 0.7474

(i) Lending Rate

$$\Delta IRL\%_{_PHI} = \begin{bmatrix} 1.3062 \\ 0.7300 \\ 0.1416 \end{bmatrix} - \begin{bmatrix} 0.3031 \\ 0.0829 \\ 0.1422 \end{bmatrix} * IRL\%_{_PHI_1} + \begin{bmatrix} 0.2194 \\ 0.0919 \\ 0.1633 \end{bmatrix} * IROB\%_{_PHI_1} + \begin{bmatrix} 8.0652 \\ 4.4860 \\ 0.3036 \end{bmatrix} * \Delta \ln(ER_PHI)$$

$$+ \begin{bmatrix} 0.3621 \\ 0.1355 \\ 0.3587 \end{bmatrix} * \Delta IRTB\%_{_PHI} + \begin{bmatrix} 0.1972 \\ 0.1061 \\ 0.2607 \end{bmatrix} * \Delta IRTB\%_{_PHI_1}$$

$$IRL\%_{_ECM_PHI} = IRL\%_{_PHI} - 0.8 * IRTB\%_{_PHI}$$

sigma 0.8639
R2 0.7614
Autocorrelation F(3,18) = 0.5168 [0.6760]

Normality $\chi^2(2)$ = 3.2919 [0.1928]
 Homoscedasticity $F(10,10)$ = 1.1910 [0.3938]
 RESET $F(1,20)$ = 0.0330 [0.8577]
 Stability
 variance 0.1023
 joint parameter constancy 1.0672

(ii) 91-day T-bill Rate

$$\begin{aligned} \Delta IRTB\%_{_PHI} = & -0.9605 + 0.3696 * \Delta IROB\%_{_PHI} + 23.1942 * \Delta \ln(ER_PHI_1) + 13.0883 * \Delta^2 \ln(ER_PHI) \\ & \begin{bmatrix} 0.1983 \\ 0.0638 \end{bmatrix} \begin{bmatrix} 0.0906 \\ 0.3907 \end{bmatrix} \begin{bmatrix} 3.6900 \\ 0.0462 \end{bmatrix} \begin{bmatrix} 3.5510 \\ 0.08598 \end{bmatrix} \\ & - 0.5344 * IRTB\%ECM_PHI_1 \\ & \begin{bmatrix} 0.1011 \\ 0.0333 \end{bmatrix} \end{aligned}$$

ITRB%ECM_PHI = IRTB%_PHI - IROB%_PHI

sigma 0.8490
 R2 0.8057
 Autocorrelation $F(3,18)$ = 1.6235 [0.2191]
 Normality $\chi^2(2)$ = 0.4909 [0.7824]
 Homoscedasticity $F(8,12)$ = 0.5685 [0.7849]
 RESET $F(1,20)$ = 0.1420 [0.7103]
 Stability
 variance 0.1008
 joint parameter constancy 1.1877

H. Employment Block

1. Labor Force

$$\begin{aligned} \Delta \ln(LF_PHI) = & -1.5835 + 0.7521 * \Delta \ln(EMP_PHI) + 0.0353 * SQ2 - 0.9117 * LFECM_PHI_1 \\ & \begin{bmatrix} 0.1292 \\ 0.0961 \end{bmatrix} \begin{bmatrix} 0.0875 \\ 0.3164 \end{bmatrix} \begin{bmatrix} 0.0032 \\ 0.1837 \end{bmatrix} \begin{bmatrix} 0.0749 \\ 0.0942 \end{bmatrix} \end{aligned}$$

LFECM_PHI = $\ln(LF_PHI) - \ln(POP_PHI) - 0.3 * \ln(EMP_PHI)$

sigma 0.0074
 R2 0.9531
 Autocorrelation $F(3,29)$ = 1.3190 [0.2872]
 Normality $\chi^2(2)$ = 3.4265 [0.1803]
 Homoscedasticity $F(5,26)$ = 1.2920 [0.2976]
 X-Homoscedasticity $F(8,23)$ = 1.2090 [0.3371]
 RESET $F(1,31)$ = 0.6049 [0.4426]
 Stability
 variance 0.2114
 joint parameter constancy 0.9721

2. Total Employed

$$\Delta \ln(EMP_PHI) = - \begin{bmatrix} 0.2837 \\ 0.03835 \\ 0.18215 \end{bmatrix} + \begin{bmatrix} 0.1661 \\ 0.0203 \\ 0.2027 \end{bmatrix} * \Delta \ln(VA1c_PHI) + \begin{bmatrix} 1.2169 \\ 0.1928 \\ 0.4063 \end{bmatrix} * \Delta_3(VA1c_PHI_1 / GDPc_PHI_1) \\ + \begin{bmatrix} 0.7745 \\ 0.2398 \\ 0.3120 \end{bmatrix} * \Delta_3(VA3c_PHI_1 / GDPc_PHI_1) - \begin{bmatrix} 0.2886 \\ 0.0378 \\ 0.1736 \end{bmatrix} * EMP3ECM_PHI_1$$

$$EMP3ECM_PHI = \ln(EMP_PHI) - 0.26 * \ln(VA1c_PHI) - 0.37 * \ln(VA2c_PHI_2) - 0.37 * \ln(VA3c_PHI_1) + 0.13 * \ln(WAGE_PHI_2 / P\#GDP_PHI_2) - 2.2 * (VA1c_PHI_3 / GDPc_PHI_3)$$

sigma 0.0095
R2 0.7187
Autocorrelation F(3,32) = 0.1771 [0.9111]
Normality Chi^2(2) = 2.7159 [0.2572]
Homoscedasticity F(8,26) = 2.2639 [0.0551]
RESET F(1,34) = 0.0337 [0.8555]
Stability
variance 0.2484
joint parameter constancy 1.2865

3. Employed in the Tertiary Sector

$$EMP3_PHI = -EMP2_PHI + \exp[\ln(EMP2_PHI + EMP3_PHI) - 0.3120 - 0.0320 * DSH1998Q3 - 0.1240 * EMP3ECM_PHI_1] \\ (0.0701) \quad (0.0118) \quad (0.0268)$$

$$EMP3ECM_PHI = \ln(EMP3_PHI + EMP2_PHI) - \ln(VA2c_PHI_1 + VA3c_PHI_1) + 0.06 * [\ln(WAGE_PHI_1) - \ln(P\#GDP_PHI_1)]$$

sigma 0.0114
R2 0.4931
Autocorrelation F(3,34) = 1.8257 [0.1611]
Normality Chi^2(2) = 5.0232 [0.0811]
Homoscedasticity F(3,33) = 0.6663 [0.5788]
RESET F(1,36) = 0.0593 [0.8089]
Stability: tests not performed because of impulse dummy among explanatory variables

4. Employed in the Secondary Sector

$$\Delta \ln(EMP2_PHI) = 0.161996 + \begin{bmatrix} 0.0199 \\ 0.2169 \end{bmatrix} * \begin{bmatrix} 0.0797 \\ 0.0272 \\ 0.0896 \end{bmatrix} * \Delta \ln(VA2c_PHI) - \begin{bmatrix} 1.0152 \\ 0.2642 \\ 0.0999 \end{bmatrix} * \Delta(EMP1_PHI / EMP_PHI) \\ - \begin{bmatrix} 0.1730 \\ 0.0683 \\ 0.1138 \end{bmatrix} * \Delta_2 \ln(VA2_PHI / VA2c_PHI) - \begin{bmatrix} 0.0145 \\ 0.0068 \\ 0.0714 \end{bmatrix} * \Delta_3 \ln(WAGE_PHI) - \begin{bmatrix} 0.4613 \\ 0.0553 \\ 0.1763 \end{bmatrix} * EMP2ECM_PHI_1$$

$$EMP2ECM_PHI = \ln(EMP2_PHI) - 0.64 * \ln(VA2c_PHI_1) - 0.4 * \ln(WAGE_PHI)$$

sigma 0.0168
R2 0.7193

Autocorrelation F(4,38) = 0.3088 [0.8703]
 Normality Chi^2(2) = 6.8307 [0.0329]*
 Homoscedasticity F(10,31) = 0.6155 [0.7888]
 RESET F(1,41) = 1.3625 [0.2498]
 Stability
 variance 0.0664
 joint parameter constancy 0.8788

I. Identities

1. Investment Block

$$INV_PHI = INVC_PHI * P\#INV_PHI$$

$$K_PHI = K_PHI(-1) * [1 - DEPK\%_PHI/400] + INV_PHI$$

$$Kc_PHI = K_PHI / P\#INV_PHI$$

$$UCC\%_PHI = [IRL\%_PHI/4 - 100 * ([P\#INV_PHI + P\#INV_PHI(-1) + P\#INV_PHI(-2) + P\#INV_PHI(-3)] / [P\#INV_PHI(-1) + P\#INV_PHI(-2) + P\#INV_PHI(-3) + P\#INV_PHI(-4)] - 1) + DEPK\%_PHI/4] * [0.25 * (P\#INV_PHI + P\#INV_PHI(-1) + P\#INV_PHI(-2) + P\#INV_PHI(-3))] / P\#GDP_PHI / (1 - TAX\%_PHI/100)$$

2. Government Block

$$GEXP_PHI = GPAY_PHI + GINT_PHI$$

$$GDEF_PHI = GREV_PHI - GEXP_PHI$$

$$TDEBT_PHI = (DDEBT_PHI_1 * SQ1 + DDEBT_PHI_2 * SQ2 + DDEBT_PHI_3 * SQ3 + DDEBT_PHI_4 * SQ4 + FDEBT_PHI_1 * SQ1 + FDEBT_PHI_2 * SQ2 + FDEBT_PHI_3 * SQ3 + FDEBT_PHI_4 * SQ4) / [(GDP_PHI_1 + GDP_PHI_2 + GDP_PHI_3 + GDP_PHI_4) * SQ1 + (GDP_PHI_2 + GDP_PHI_3 + GDP_PHI_4 + GDP_PHI_5) * SQ2 + (GDP_PHI_3 + GDP_PHI_4 + GDP_PHI_5 + GDP_PHI_6) * SQ3 + (GDP_PHI_4 + GDP_PHI_5 + GDP_PHI_6 + GDP_PHI_7) * SQ4]$$

$$GDEFr_PHI = [(GDEF_PHI_1 + GDEF_PHI_2 + GDEF_PHI_3 + GDEF_PHI_4) * SQ1 + (GDEF_PHI_2 + GDEF_PHI_3 + GDEF_PHI_4 + GDEF_PHI_5) * SQ2 + (GDEF_PHI_3 + GDEF_PHI_4 + GDEF_PHI_5 + GDEF_PHI_6) * SQ3 + (GDEF_PHI_4 + GDEF_PHI_5 + GDEF_PHI_6 + GDEF_PHI_7) * SQ4] / [(GDP_PHI_1 + GDP_PHI_2 + GDP_PHI_3 + GDP_PHI_4) * SQ1 + (GDP_PHI_2 + GDP_PHI_3 + GDP_PHI_4 + GDP_PHI_5) * SQ2 + (GDP_PHI_3 + GDP_PHI_4 + GDP_PHI_5 + GDP_PHI_6) * SQ3 + (GDP_PHI_4 + GDP_PHI_5 + GDP_PHI_6 + GDP_PHI_7) * SQ4]$$

$$TEFT\%_PHI = 100 * [(GTAX_PHI_1 + GTAX_PHI_2 + GTAX_PHI_3 + GTAX_PHI_4) * SQ1 + (GTAX_PHI_2 + GTAX_PHI_3 + GTAX_PHI_4 + GTAX_PHI_5) * SQ2 + (GTAX_PHI_3 + GTAX_PHI_4 + GTAX_PHI_5 + GTAX_PHI_6) * SQ3 + (GTAX_PHI_4 + GTAX_PHI_5 + GTAX_PHI_6 + GTAX_PHI_7) * SQ4] / [(GDP_PHI_1 + GDP_PHI_2 + GDP_PHI_3 + GDP_PHI_4) * SQ1 + (GDP_PHI_2 + GDP_PHI_3 + GDP_PHI_4 + GDP_PHI_5) * SQ2 + (GDP_PHI_3 + GDP_PHI_4 + GDP_PHI_5 + GDP_PHI_6) * SQ3 + (GDP_PHI_4 + GDP_PHI_5 + GDP_PHI_6 + GDP_PHI_7) * SQ4]$$

$$BEFT\%_PHI = DST90Q104Q1 * TEFT\%_PHI + DST2004Q1 * BEFT\%_PHI_1$$

3. Trade Block

$$X_PHI = X\$_PHI * ER_PHI$$

$$Xc_PHI = X_PHI / P\#X_PHI$$

$$Mc_PHI = M_PHI / P\#M_PHI$$

$$M\$_PHI = M_PHI / ER_PHI$$

4. Production Block

$$GDPc_PHI = VA1c_PHI + VA2c_PHI + VA3c_PHI$$

$$GDP_PHI = GDPc_PHI * P\#GDP_PHI$$

$$GNP_PHI = GDP_PHI + NFIA_PHI$$

$$NFIAc_PHI = GNPc_PHI - GDPc_PHI$$

5. Price Block

$$P\#INV_PHI(-2) + P\#INV_PHI(-3) + P\#INV_PHI(-4)] - 1) + DEPK\%_PHI/4] * [0.25*(P\#INV_PHI + P\#INV_PHI(-1) + P\#INV_PHI(-2) + P\#INV_PHI(-3))] / P\#GDP_PHI / (1 - TAX\%_PHI/100)$$

$$P\#P\$_PHI = P\#P_PHI/ER_PHI$$

$$WAGE_PHI = [GDP_PHI - UCC\%_PHI * K_PHI/100] / (EMP_PHI/1000)$$

$$P\#WX\$ = DST90Q104Q2 * P\#WX\$ + DST2004Q2 * P\#Wxa_PHI/ER_PHI$$

6. Monetary Block

$$MQ_PHI = M3_PHI - M1_PHI$$

7. Employment Block

$$UEMP\%_PHI = (LF_PHI - EMP_PHI) / LF_PHI * 100$$

$$EMP1_PHI = EMP_PHI - EMP2_PHI - EMP3_PHI$$

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