Dynamic and Stochastic Properties of Macroeconometric models of Brazil

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IPEA/JICA Workshop

August 14-15, 2001

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1. Introduction

This paper discusses the properties of Monthly and Quarterly macroeconometric models of Brazil. Various methods for analyzing the macroeconometric model are not for the direct tests of the model in the statistical sense because they are applied to the model which is a reasonable approximation of the economy. The methods are the ways to understand the workings of the model. As a byproduct they reveal the deficiency of the model occasionally so that they lead to improvements of the model.[1]

The plan of this paper is that we look at the contribution rates to the annual growth rates both actual and estimated case to observe the fit of the model from different perspective. Then we construct hypothetical simulation case that if the large outflows of international capital in 1998 and the devaluation of 1999 did not occur using both Monthly and Quarterly Models. The comparison of the simulated economy and the baseline economy gives quantitative evaluation of the policy decision. Also we can compare the result from two models with different data frequencies. Finally, we present stochastic simulation of both models applying simple method.

2. The Patterns of Expenditure Components

Both models captures the Brazilian economy reasonably in the final tests as reported in Fukuchi(2001) and Tokunaga(2001). The final test or baseline solution means the dynamic simulation using actual exogenous variables within the sample periods. Now, look at the evolution of expenditure components within the sample periods using contribution rates to the annual GDE growth rate, , where Figure 1 shows the actual contribution rates and Figure 2 shows the ones that were calculated from the baseline simulation, in case of Monthly Model. Note that CONS represents consumption expenditure, INV investment expenditure, X Exports, M imports, and GDE gross domestic expenditure. Contribution rates add up to growth rates.

Figure 1. Actual Contribution Rates

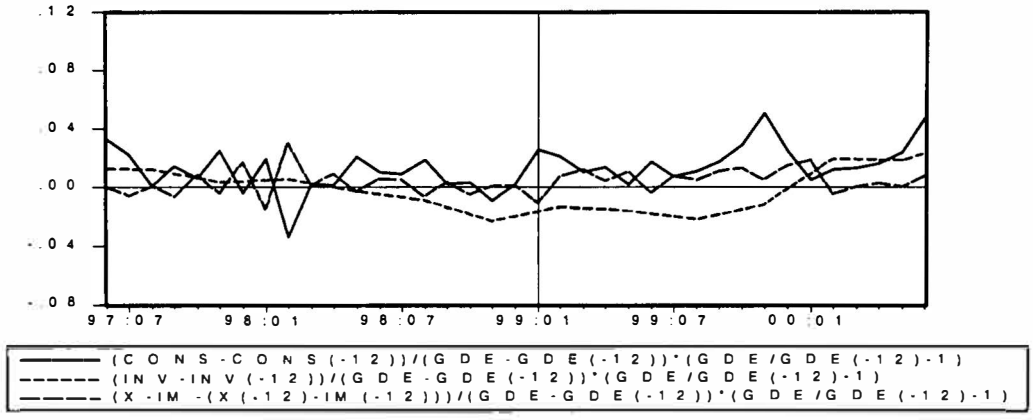
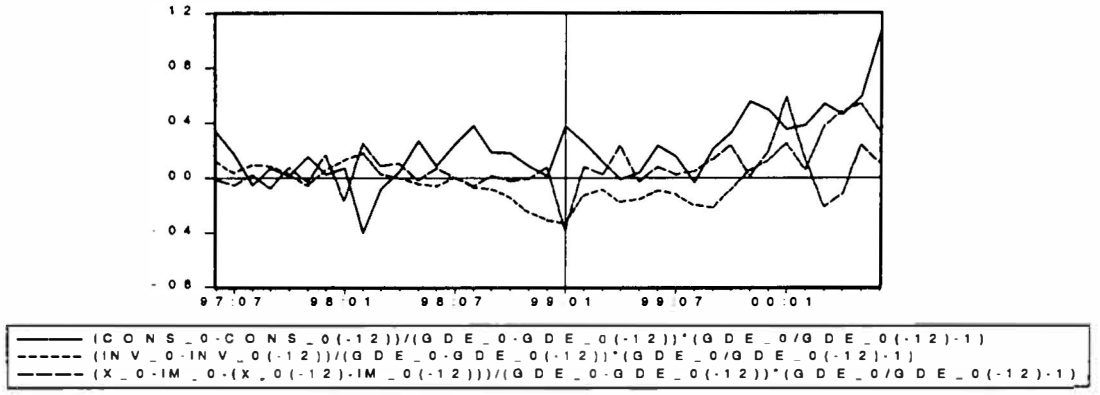


Figure 2. Baseline Contribution Rates



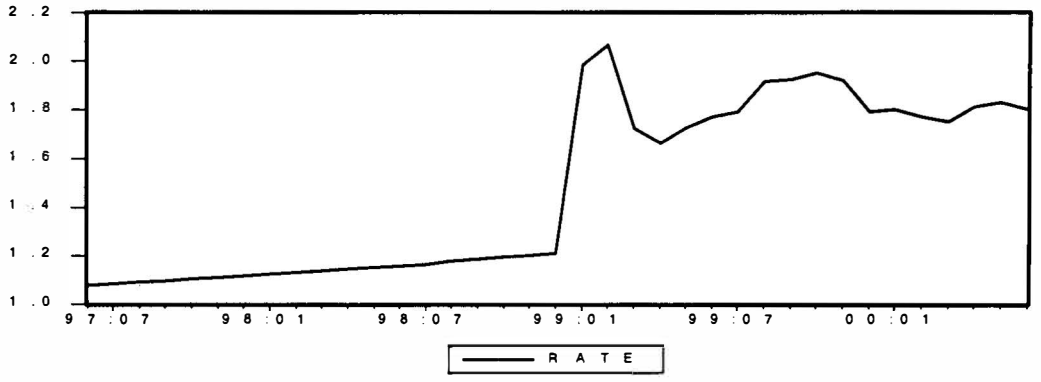
These figures show that the model's explaining power from the different perspective.

2. Simulation Cases

Most simulation takes the form of multiplier analysis that examines the properties of a model considering how the predicted values of the endogenous variables change when one or more exogenous variables are changed. Note that usual definition of the multiplier is that the change of endogenous variable is divided by the change of single exogenous variable but this is not the case for macroeconometric model because sometimes more the one exogenous variables are changed.[ii]

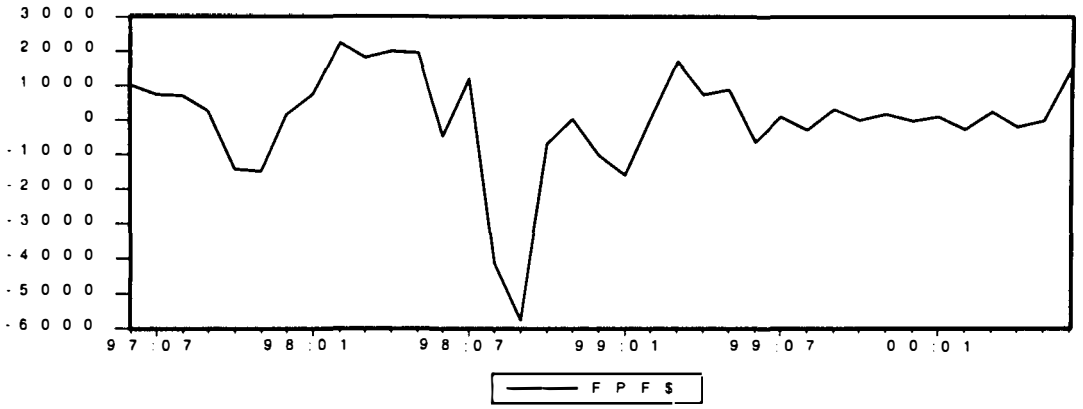
The most drastic change in the sample periods is obviously the exchange rate devaluation of 1999.01.

Figure 3. Nominal Exchange Rate



Before the devaluation, one can point out the large outflows of international capital other than foreign direct investment in August and September of 1998 as a trigger of events that follows.

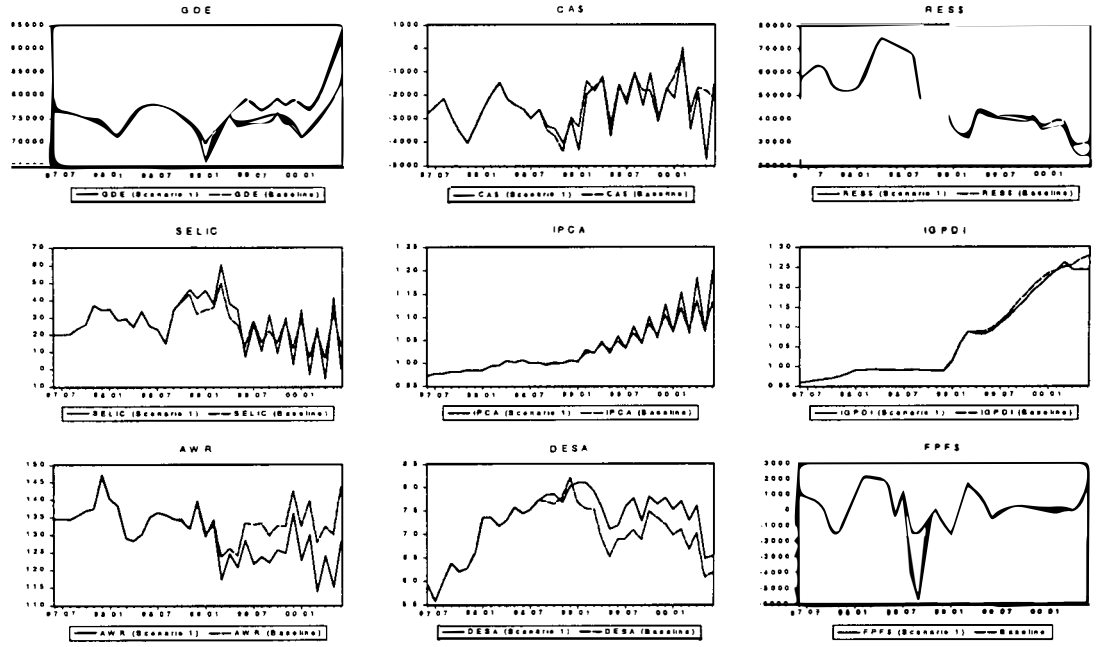
Figure 4. Outflow of Capital



It is natural to assume that these large outflows of capital contributed the decision to devaluate. Let us assume that these outflows are the trigger of the devaluation so that we can construct three cases of simulation, namely no large outflows of capital, no devaluation, and combined effect of the above two.

As a Scenario 1, we postulate that there were no large outflows of capital in August and September of 1998. We simply assumed in these two months sample average of up to July 1988 prevailed. The results are shown in the Figure 5. The results show that large outflows of capital decrease the GDE.

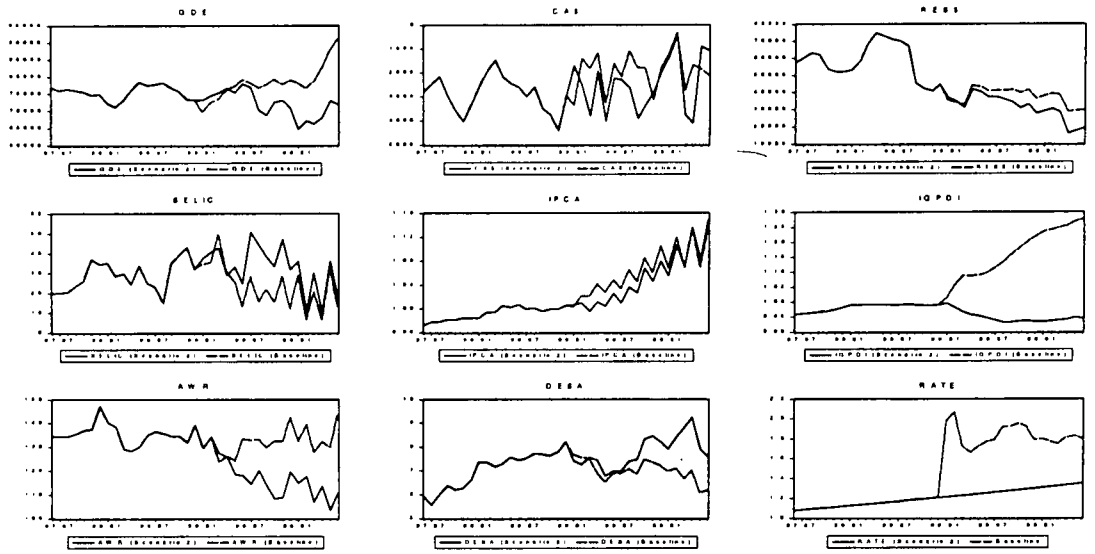
Figure 5. Scenario 1. No Large Outflows of Capital



Note: GDE represents gross domestic expenditure, CA$ current account, RES$ foreign reserves, SELIC short term interest rate, IPCA consumer price index, IGPDI general price index, AWR real wage rate, DESA unemployment rate, FPF$ international capital flow excluding foreign direct investment.

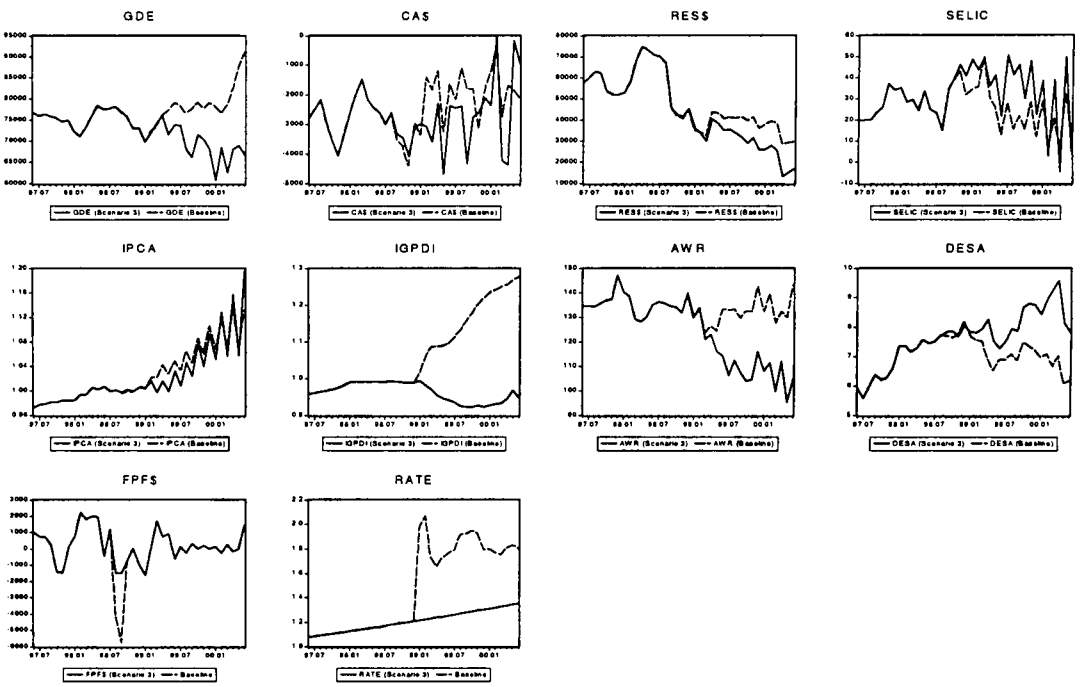
Next, we turn to the devaluation of January of 1999. We assumed that the rate continue to depreciate at the sample trend up to 1998. The results are in the Figure 6.

Figure 6. Scenario 2. No devaluation



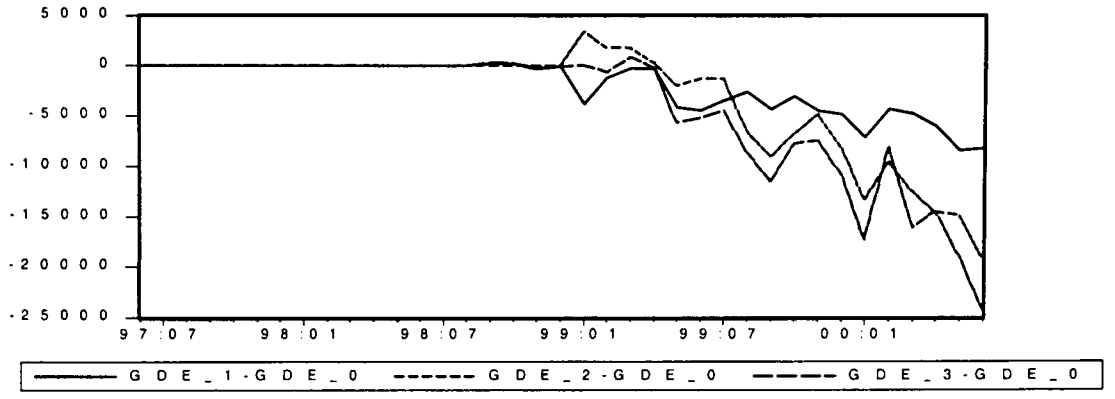
Finally, We have both effects in one case in the Figure 7.

Figure 7. Scenario 3 Combined Effects



We can compare the effects by the GDE.

Figure 8. Simulation Comparison of Monthly Model



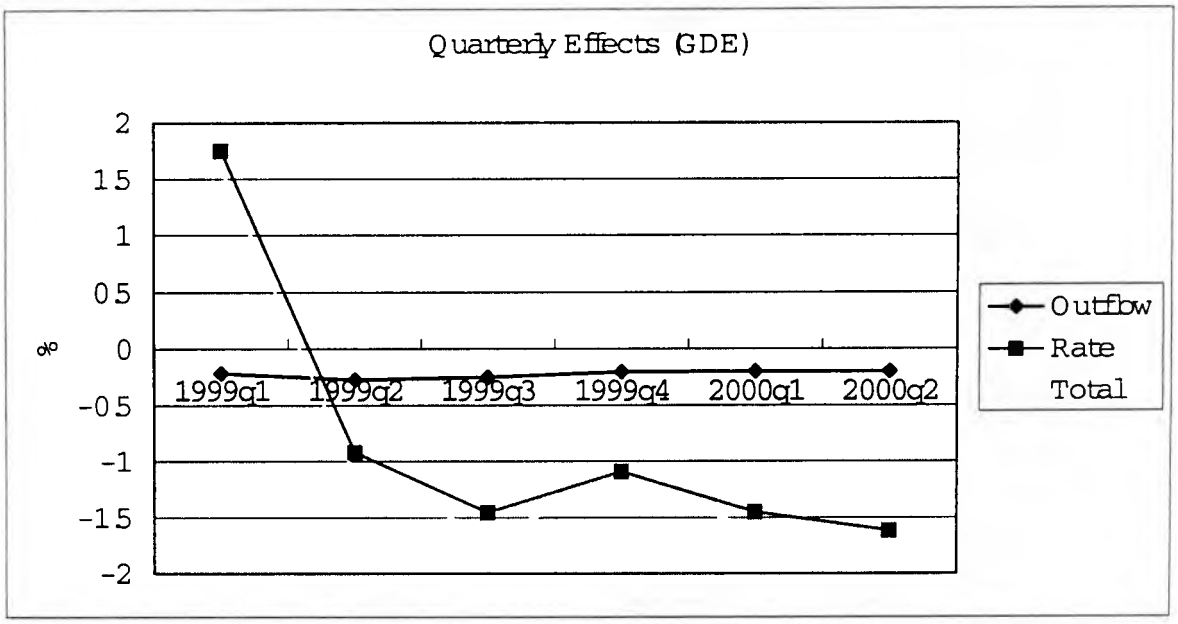
The combined effects are presented relative to the baseline GDP in percentage.

Figure 9. Percent change of Total Effect of Monthly Model

The estimated loss of GDE became significantly large. A possible interpretation will be that if Brazil did not experience the outflows of capital and the devaluation was not implemented, then the economy was in the course of crush.

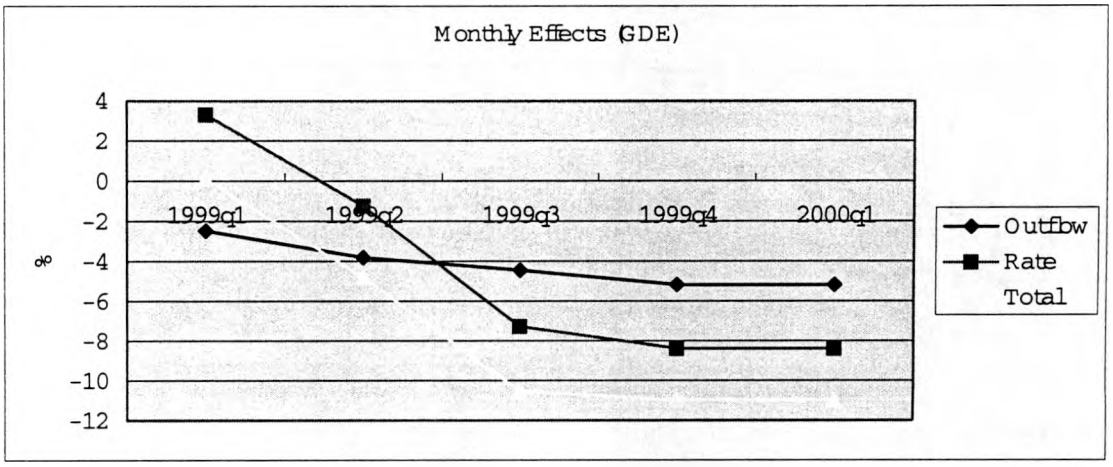
It is interesting to perform similar exercises using the Quarterly Model. The results are in the Figure 10.

Figure 10. Simulation Result of Quarterly Model (% of baseline GDE)



For the comparison, we match the frequency of the Monthly Model into the quarterly figures.

Figure 11. Effect of Monthly Model in Quarterly Frequency (% of baseline GDE)



Also we can accumulate the effects from 1999q1 to 2000q2 for both models.

Figure 12. Accumulated Effects of Quarterly Model (% of baseline GDE)

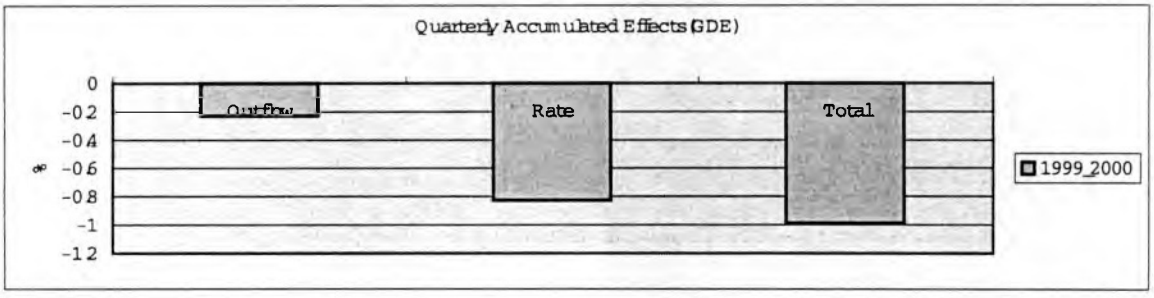
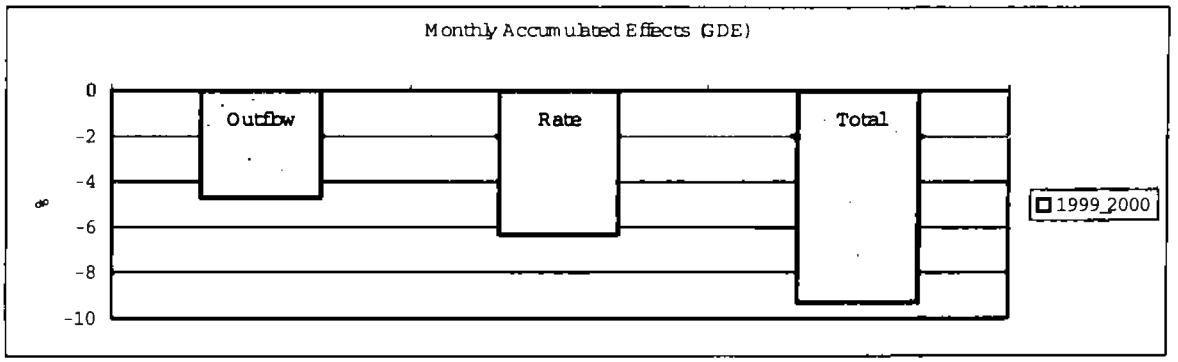


Figure 13. Accumulated Effects of Monthly Model (% of baseline GDE)



The patterns are similar but the magnitudes are different. It needs more careful investigation of both models. If we construct the models independently, it is not surprising that the time aggregation problems may occur. If we require the consistency of time aggregation we must consider applying perfect time aggregation model. However such formulation may impose very restrictive structure to the model.

Monthly Model is constructed for the purpose of obtaining quantitative results to the periods containing the devaluation of 1999. Several key variables are related to propensity to import, export, pass-through, combination of domestic and foreign demands, fiscal-monetary instruments. Here we present these variables in terms of simulation results of combined case and baseline for the source of discussion.

Figure 14. Propensity to Import

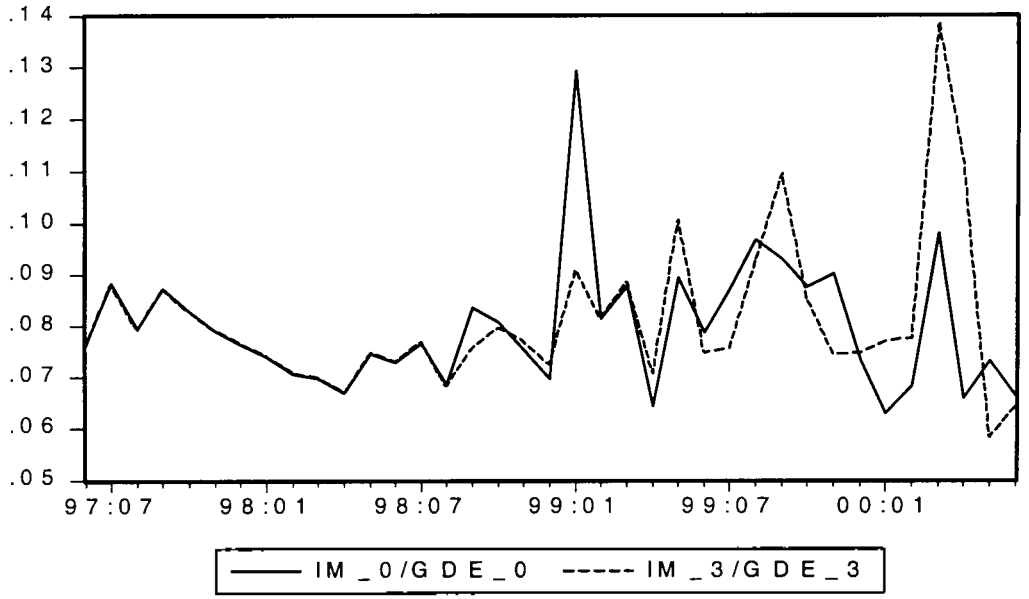


Figure 15. Export Performance

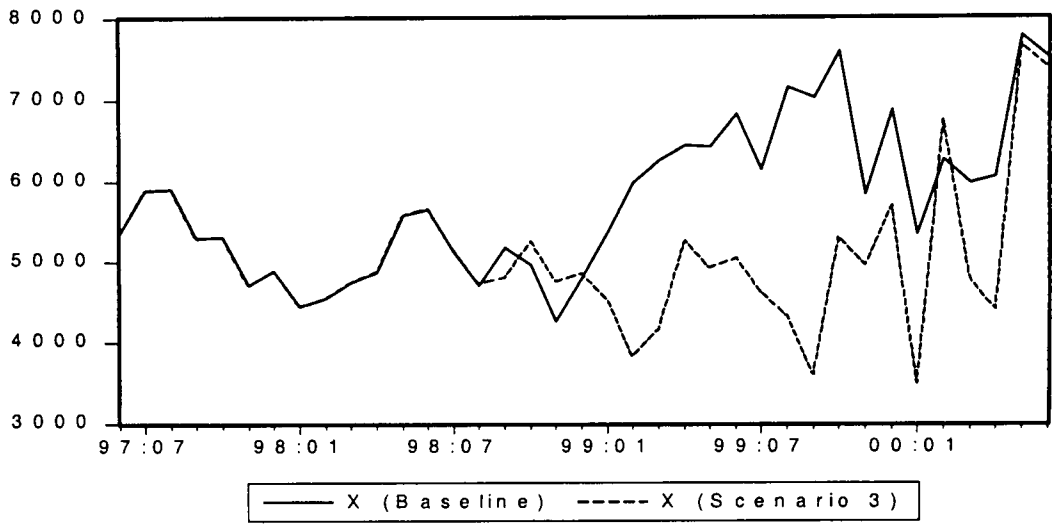


Figure 16. Pass-through Effects

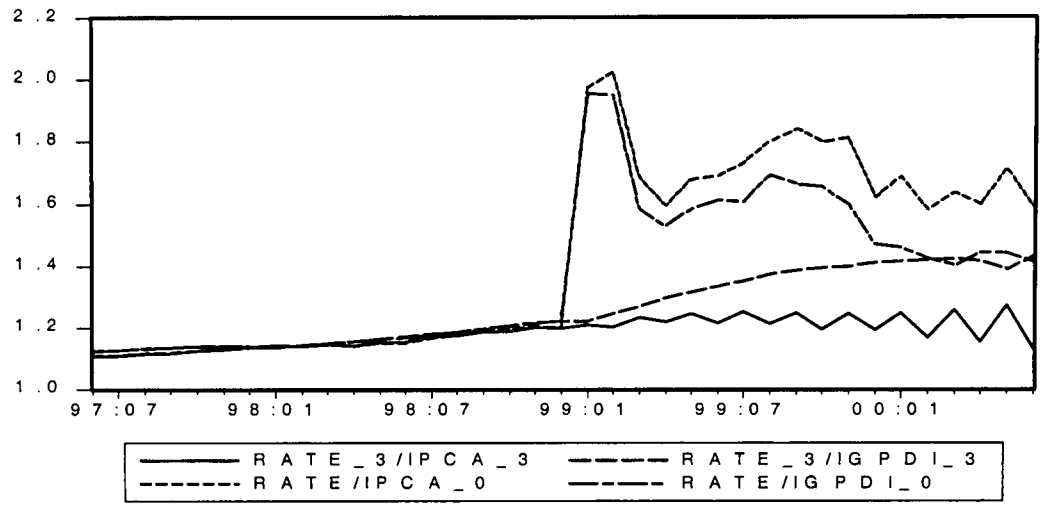


Figure 17. Contribution of Expenditure Components (Combined Case)

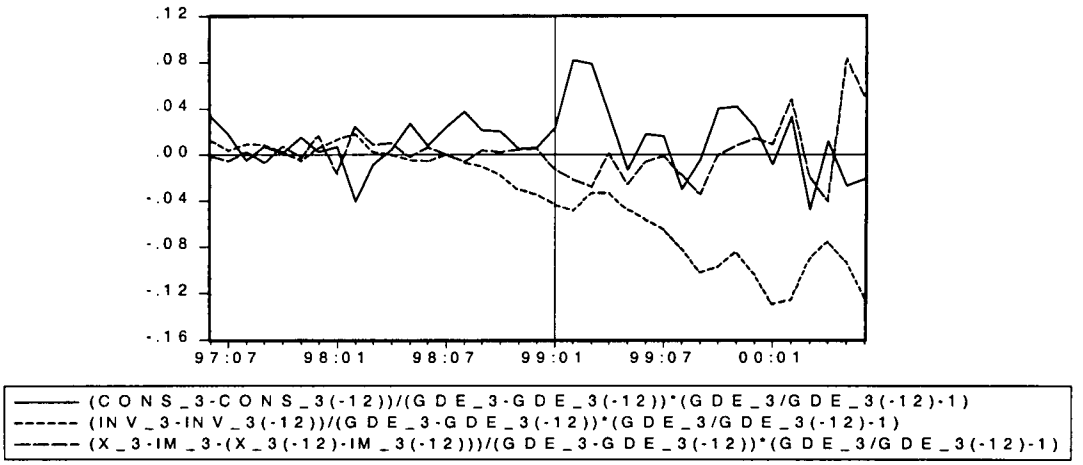
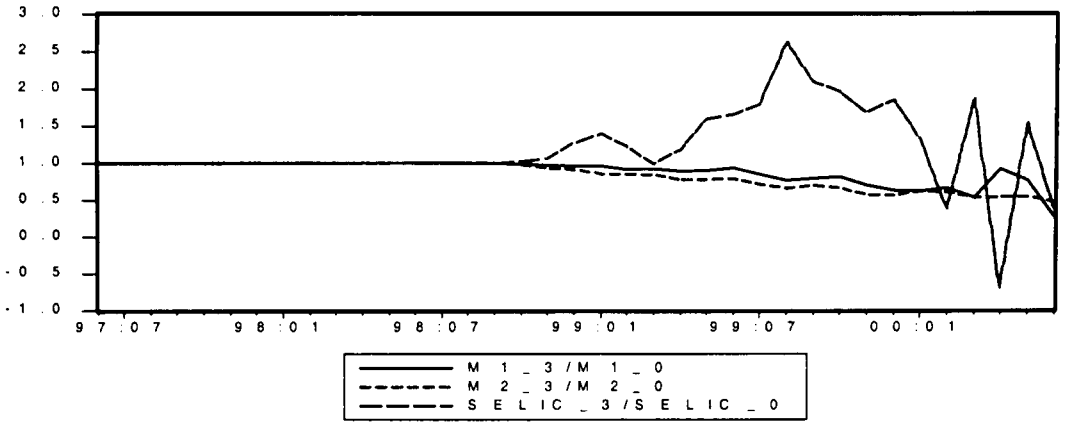


Figure 18. Fiscal & Monetary Instruments.



We can perform other multiplier simulations using other exogenous variables. For example, foreign variable, such as GDP of USA. The GDPUS is increased 1% annually from the 1999.

Figure 19. GDPUS simulation in Quarterly Model.

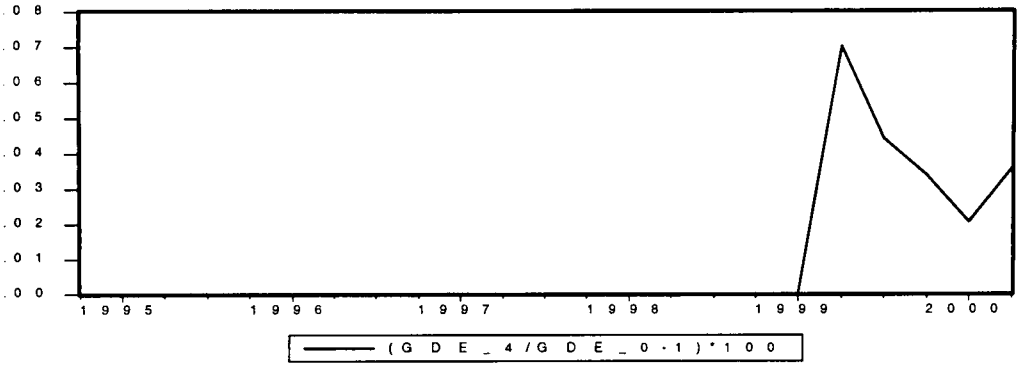
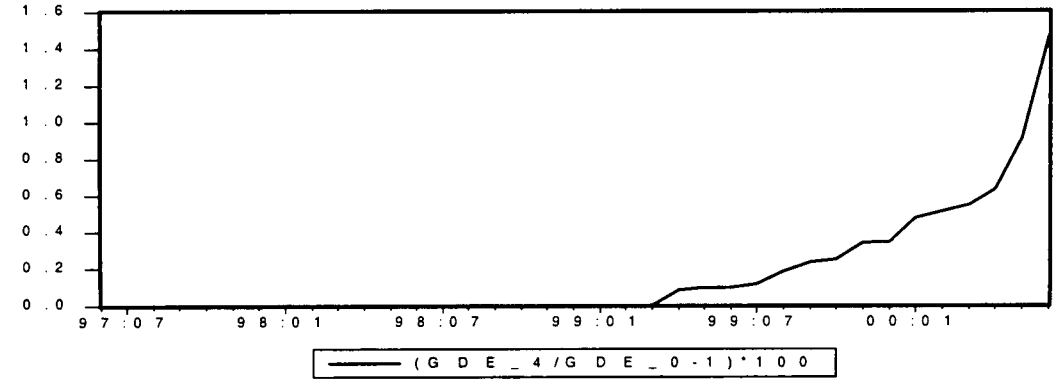


Figure 20. GDPUS simulation of Monthly Model.



In this case the differences in the magnitude of the effects are larger. Obviously, both model requires more careful estimation of corresponding parameters, however it seems the quarterly model requires more interactions among the variables.

4. Stochastic Simulation

Here we present simple run of the Stochastic simulation. In case of Monthly

Model, we had to make SELIC (interest rate) exogenous to perform the stochastic simulation because the variance became too large. On the other hand, Quarterly Model is stable. Note that it does not mean Monthly Model is inferior. As the simulation exercises show the magnitude of various effects are small in Quarterly Model, it appears that Quarterly Model may not capture interactions of the economy well.

Figure 21. Stochastic Simulation of Monthly Model

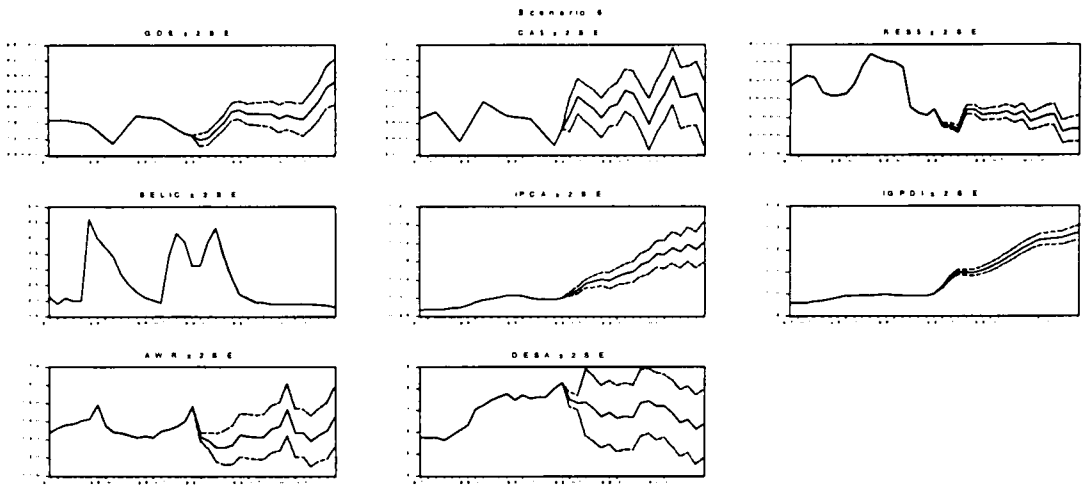
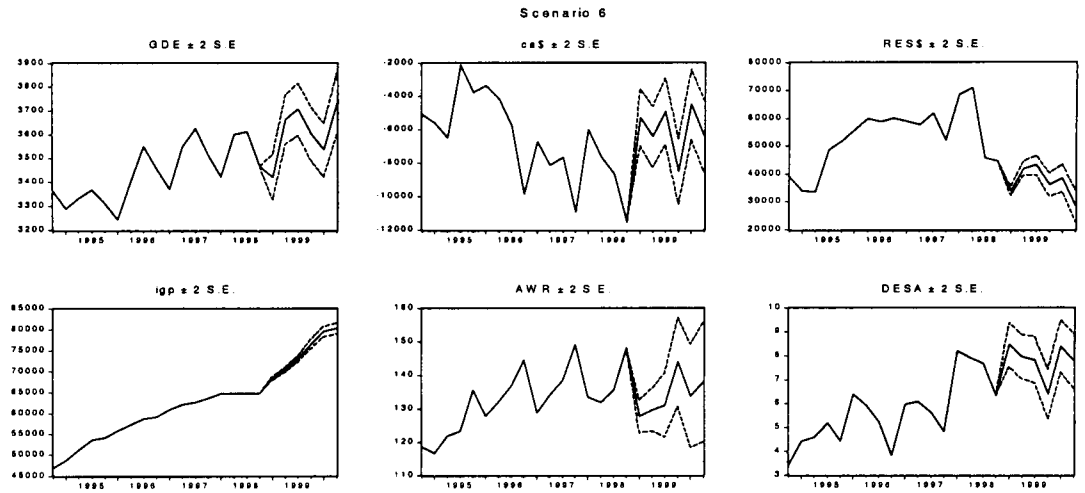


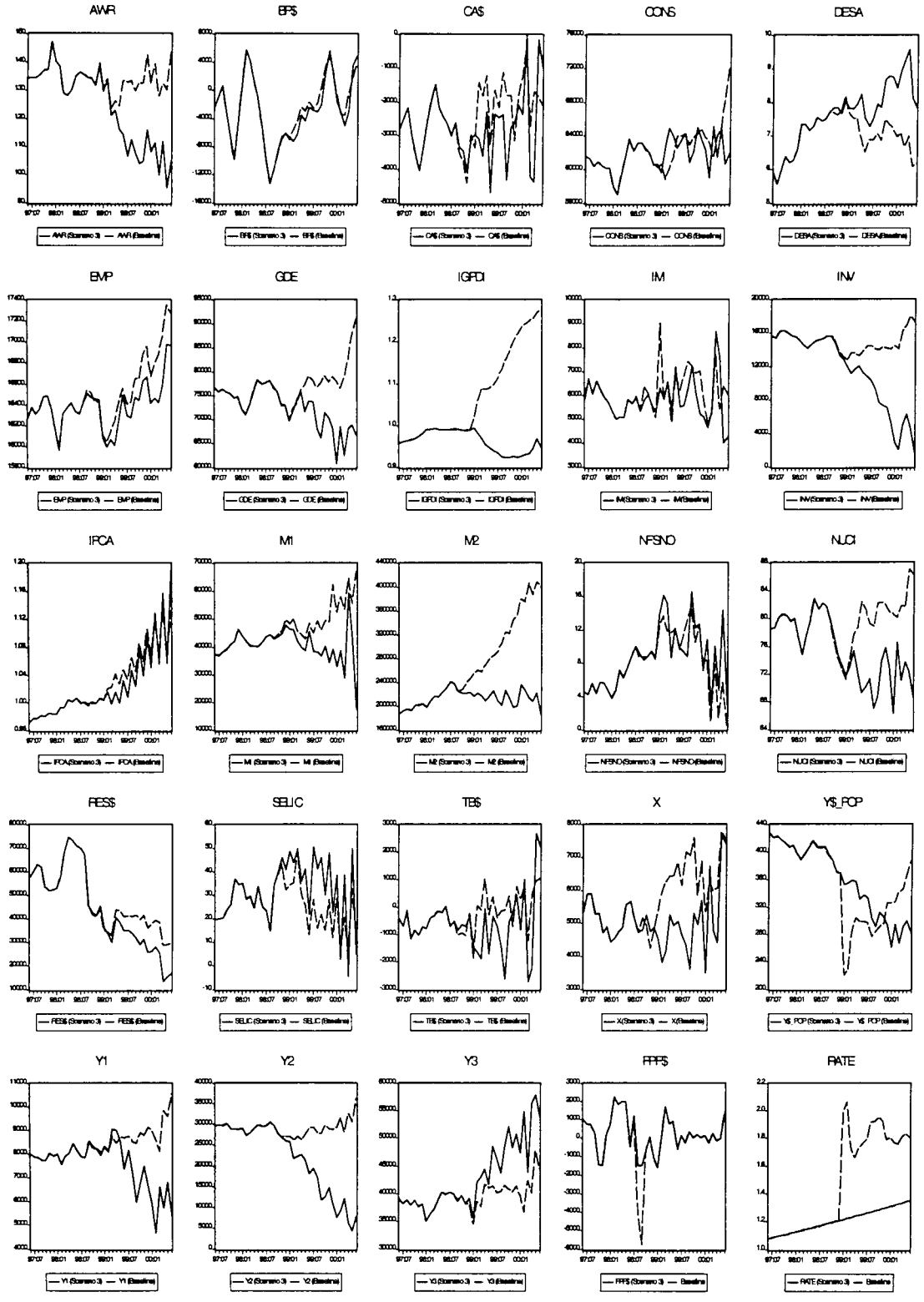
Figure 22. Stochastic Simulation of Quarterly Model



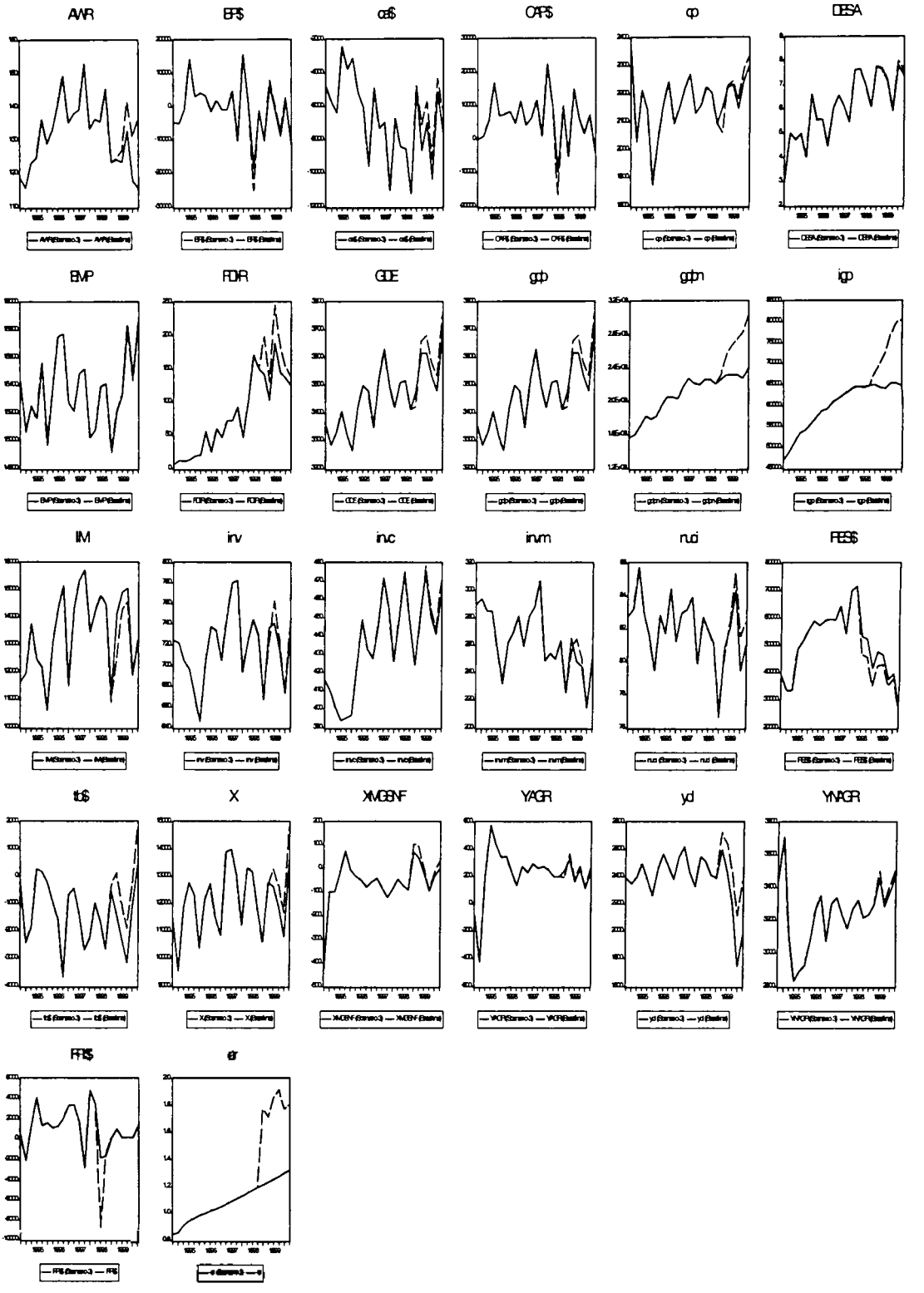
5. Remarks

Here we have done simple exercises, for instance, the devaluation episode was expressed in terms of sudden international capital outflows and exogenous devaluation. It is obviously artificial and needs more careful scenario construction. These simulation exercises show that further improvements are required as in most econometric models but the direction of the research is promising.

Appendix-1 Simulation Results of Monthly Model
Scenario3: Endogenous variables and changed exogenous variables.



Appendix 2. Simulation Results of Quarterly Model
Scenario3: Endogenous variables and changed exogenous variables.



Fukuchi, T., 'Econometric Analysis of Brazilian Economy by Monthly Econometric Model,' IPEA/JICA Workshop, 20001.
Tokunaga, S., 'Econometric Analysis of Brazilian Economy by Quarterly Econometric Model,' IPEA/JICA Workshop, 20001.

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[i] Traditional Macroeconometric model is a product of repetitive work of specification, estimation, and model simulation. Hence models tend to have reasonable properties, at least in the modeler's subjective standard, or the model building will not stop. This means that one should be careful as the examination of properties of macroeconometric model itself does not mean the confirmation of the model

[ii] In a simplest form, a set of exogenous variables different from the baseline gives different predicted endogenous variables so one can take the differences of endogenous variables between the baseline and the simulated case to show the effects. In this method, the values of error terms are set to zero as they are the expected values for the baseline. However, this treatment is appropriate for only linear models. In case of nonlinear model, the following happens. Suppose the economy is near the full employment then expansionary policy will be inflationary but if the predicted value of the model is not near the full employment then the simulation result may not be inflationary. To avoid this kind of problem, one can calculate perfect tracking solution by adding actual residuals of the model baseline calculation.

Note that if one use the chained index data then the multiplier calculation needs more careful treatment, see Laky, M, 'Chained-type data and macro model properties: The DRI/McGraw-Hill experience,' Journal of Economic & Social Measurement, 1988, Vol. 24 Issue 2, 83-109.