# Monetary and Fiscal Policy during Real Plan in Brazil: An Estimation of a Reaction Function for the Central Bank and Central Government

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## 1. Introduction

The Brazilian economy was rapidly changes such as exchange rate regime and a new framework for monetary policy from the past structure of the hyperinflation period and had a low growth rate in the 1990s. It is important to have a systematic view of the national economy as a whole, and to analyze to the monetary and fiscal policy with the reaction functions, and analyze the mechanisms both brake and accelerator. Thus we first present a prototype quarterly econometric model for the Brazilian economy, and secondly conduct to estimate of the Reaction Function for the Central Bank and Central Government.

The structure of this paper is as follows. In section 2, we sketch the structure and briefly report the results of estimation the Model including of reaction function. Section 3 reports the results of final test of this Model. Section 4 shows the results of simulation analysis for monetary and fiscal policy. Finally we conclude this paper in section 5.

## 2. Structure of the Model

We construct a quarterly econometric model for the Brazilian economy (1994Q4-2000Q2) with 31 endogenous variables. The aggregate demand is given by individually estimated equations for aggregate consumption, aggregate investment, exports of goods and services, while aggregate supply is determined by a production function for non-primary sector. The aggregate demand and aggregate supply will be adjusted by capacity utilization. The main differences compared with the previous model [Tokunaga (2001), Gamma model in IPEA (1998)] are as follows : (1) the revision of estimation period to recent five years (from the PLANO REAL to recent year, 1994Q4-2000Q2). The period of data for data base is from 1994Q1 to 2000Q2 because of lags for some estimated equation. (2) GDP is divided by primary sector and non-primary sector. (3) The consumer's price index, IPCA, was endogenous explained in price sector. (4) We changed the real wage rate to AWR and the unemployment rate to DESA, and estimate two variables in order to determine in labor market endogenously. (5) The foreign direct investment (FDI$) and foreign portfolio investment (FPF$) in capital account balance were estimated. Furthermore, the balance of payment variables such as current balance, balance-of-payment, the foreign currency

reserve are endogenously explained like Gamma model. (6) The reaction function sector including nominal interest rate (SELIC), money supply (M2), necessity of financial sector (NFSNO) is endogenously explained in order to analyze of the monetary and fiscal policy.

The estimated results of this model are as follows. The model contains sixteen behavioral equations and fifteen identities (see Appendix A and B). The number of endogenous variables is 31. We are estimated by OLS estimations because we do not contain any current endogenous variables in the explaining variables. The sample period for estimation is from 1994 Q4 to 2000Q2 in order to analyze the monetary and fiscal policy during Real Plan which introduced on July 1st, 1994.

This model consists of seven sectors: (A) final demand sector, (B) supply and capital stock sector, (C) income sector, (D) labor sector, (E) price sector, and (F) balance of payments sector, and (G) reaction function sector in flowchart of Figure A1.

The final demand sector is consisting of private consumption (CP), government consumption (CG), investment for construction (INVC), investment for machinery and equipment (INVM), exports (X), and Imports (IM). GDE is defined by each components of aggregate demand. Due to lack of data, we cannot estimate the investment for inventories.

While the aggregate supply sector is consisting of GDP for primary sector (Y1) and GDP for non-primary sector (Y23) that specifies the production function. The domestic capital stock is determined by definition and the rate of capacity utilization (NUCI) is estimated by GDE, GDP for non-primary sector, SELIC, and FDI. In income sector, we define the disposable income (YD) by definition equation (14).

The labor sector consists of a real wage rate (AWR), employment (EMP) and unemployment rate (DESA). A real wage rate is determined by an eclectic-type equation of equation (17).

In price sector, a general price index (IGPDI) is determined by the exchange rate, money supply, the real wage rate, the growth rate of GDE and the capital stock per employment.

The balance of payment sector defines trade balance (TB$), current account balance (CA$), capital account balance (CAP$), balance of payment (BP$), and foreign reserve (RES$). The foreign investments for both direct (FDI$) and portfolio (FPF$) are estimated.

In reaction function sector, three variables (SELIC, M2, NFSNO) that are the monetary and fiscal instrument were treated as endogenous.

### 2.1 Final Demand Sector

First, we estimated the final demand sector. The final demand is given by individually estimated equation for private consumption, aggregate investment for machinery and construction, exports and imports. The government consumption and net non-factor services (SERNF$) are as exogenous variables in this sector.

In equation (1), the real private consumption expenditure per economic active population (CP/PTO) is estimated as a function of real disposable income per economic active population (YD/PTO), nominal interest rate (SELIC), real wide money supply (M2/IPCA), necessity of financial sector (NFSNO), nominal exchange rate (RATE) and time trend (@TREND).

The real total private investment expenditure (INV) is divided by for machinery and construction. We estimate the real private investment expenditure for machinery and equipment (INVM) over capital stock (KR) of equation (2) as a function of the growth rate of GDP for non-primary sector (Y23), interest rate, capacity utilization rate (NUCI), accumulation of FDI (SFDIR), imports ration (IM/GDE), rate of unemployment (DESA) and its own lagged value. The positive influence of capacity utilization rate implies the lagged effect of demand growth. Furthermore we estimate the real private investment expenditure for construction (INVC) over capital stock of equation (3) as a function of the growth rate of GDP, interest rate, capacity utilization rate and its own lagged value. The total investment of equation (4) showed a increasing trend in 1996-98, but it still stagnated at low level after the devaluation.

In equation (5), export (X) which is normalized by lagged GDP, depends positively on the growth rate of the U. S. GDP, lagged capacity utilization rate, GDP for primary sector ratio (Y1/GDP), real exchange rate (RATE/IGPDI) and the lagged value of X/KR. As expected, the real exchange rate exerts a strong positive effect on export. While import, which is normalized by lagged GDP, depends positively on the growth rate of GDE, lagged foreign currency holding ratio (RES$/KR) and the lagged value of M/KR as expected, but negatively on real interest rate and real exchange rate in equation (6). The exchange rate shows a negative effect as expected. Import in 1995-1998 has a steady increasing trend, but stagnates after the devaluation in 1999.

The government consumption and net non-factor services are treated as exogenous variables in this model. Finally, in this sector real GDE is determined by summing-up these expenditure items.

### 2.2 Supply and Capital Stock Sector

Next, we estimate the aggregate supply side. The real GDP is divided by for primary sector and non-primary sector. The production function for GDP of non-primary sector (Y23) per employment (EMP) is mainly estimated by the real capital stock (KR) multiplied by the capacity utilization rate per employment (EMP) as Cobb-Douglas-type function in equation (9). This equation also includes in money supply ratio and accumulated FDI ratio. The domestic capital stock is calculated according to definition in equation (12). In equation (13), the capacity utilization rate index (NUCI) which has a cyclical tendency during 1994-2000 except a big devaluation in 1999, is determined based on the growth rate of the GDE, GDP of non-primary sector over employment, the real

interest rate, the growth rate of FDI and its own lagged value. It is mainly determined by both aggregate demand and aggregate supply.

### 2.3 Income Sector

The disposable income (YD) is defined by the nominal GDP as equation (14).

### 2.4 Labor Sector

Next, we estimate the unemployment rate function (DESA) of equation (15). The unemployment rate is influenced positively by GDE per employment (GDE/EMP) and capital intensity of labor (KR/EMP), and negatively by the capacity utilization rate. The employment (EMP) is defined by the multiplication of economically active population (PTO) with (1-DESA) in equation (16).

The real wages index (AWR) of equation (17) is determined by the growth rate of employment, the capacity utilization rate, the unemployment rate, price growth, real exchange rate and its own lagged value. Thus the real wage rate is determined by an eclectic-type equation.

### 2.5 Price Sector

We estimate the general price index (IGPDI) of equation (18) as a function of the real exchange rate (RATE/IGPDI), narrow money supply (M1), real wages index, GDE, capital intensity of labor (KR/EMP) and the time trend. Especially the influence of exchange rates dominates to explain a steep increase after 1999. The consumer price index (IPCA) of equation (19) is estimated as a function of the growth rate of nominal exchange rate (RATE), the real exchange rate (RATE/IGPDI), wide money supply (M2), import price index (PIM), nominal interest rate (SELIC), necessity of financial sector (NFSNO) and the time trend.

### 2.6 Balance of Payment Sector

Finally, the balance of payment sector defines trade balance (TB$), current account balance (CA$), capital account balance (CAP$), balance of payment (BP$), and foreign reserve (RES$). We estimate the foreign direct investments (FDI$) of equation (22) as a function of GDE, the U.S.GDP, the growth rate of the nominal exchange rate (RATE) and its own lagged value, and the foreign portfolio investments (FPF$) of equation (23) as a function of the nominal exchange rate (RATE) and the difference between the nominal interest rate of Brazil and the U. S. interest rate.

### 2.7 Reaction Function Sector

In the previous paper [Tokunaga (2001)], three variables (SELIC, M2, NFSNO) which are the monetary and fiscal instrument, were treated as exogenous. But government changes these instruments to achieve the economic targets. So, we estimate the three reaction functions. The results of three equations are equation (29) to equation (31).

Equation (29) shows the result of estimation of the interest rate (SELIC). SELIC is positively influenced by GDE, necessity of financial sector, FDI ratio and its own lagged value, and negatively influenced by M2, real

exchange rate and balance-of-payment. Therefore the reaction of central bank is higher SELIC when GDE is increasing, and the reaction of central bank is higher SELIC when NFSNO is increasing. However, as the reaction coefficient of SELIC to M2 is negative, central bank seek higher SELIC, when M2 is decreasing. As the reaction coefficient of SELIC to balance of payment is negative, SELIC tends to be lower when the surplus of balance of payment is bigger. These are good reactions of the central bank.

Equation (30) shows the result of estimation of M2. The wide money supply (M2) is positively influenced by current account balance and its own lagged value, and negatively influenced by price growth, SELIC growth, and GDE growth, exchange rate and capital account. Therefore, M2 tends to increase when the growth rate of GDE is lower, as the reaction coefficient of M2 to GDE is negative. As the reaction coefficient of M2 to IPCA is negative, M2 tends to decrease when the growth rate of IPCA is higher (inflation occurs). These are reasonable reactions of the central bank.

Equation (31) shows the result of estimation of the nominal financial sector requirement (NFSNO). The NFSNO is positively influenced by GDE, SELIC and GDP for non-primary sector growth, and negatively influenced by price growth, and NUCI. Thus, as the reaction coefficient of NFSNO to IGPDI is negative, NFSNO tends to be lower when the IGPDI is higher (inflation occurs). Furthermore, NFSNO tends to increase when the GDE is increasing, as the reaction coefficient of NFSNO to GDE is positive. These are reasonable reaction of the central government.

## 3. Final Test of the Model

The historical simulations of the final tests are very important to evaluate how well this model can simulate the economy. Based on the results of this constructed 31 equations model in which treated NFSNO, M2, and SELIC as endogenous, we conduct a final test over the period from 1994Q4 to 2000Q2, using the dynamic Gauss-Seidel method. Figure 1 through Figure 8 show the main results of the final test. Figure 6, Figure 7 and Figure 8 show the results of the final test of this model for three variables (SELIC, M2, NFSNO). We find that this model is good performance from these results. As the results of this final test suggest that this model is good performance, we will carry some policy simulations for monetary and fiscal policy.

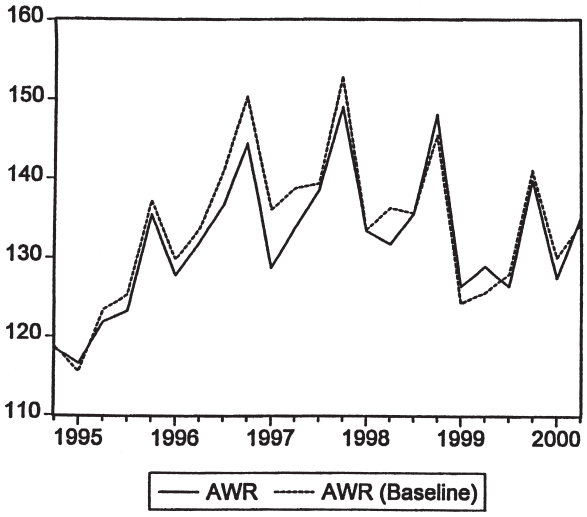


Figure 1 Result of final test of wage rate (AWR)

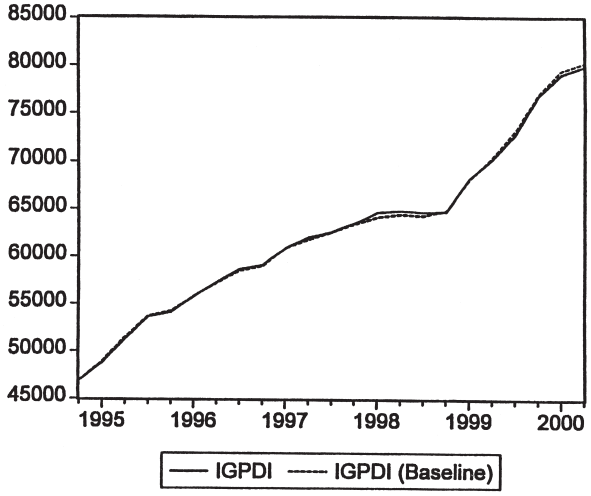


Figure 2 Result of final test of general price index (IGPDI)

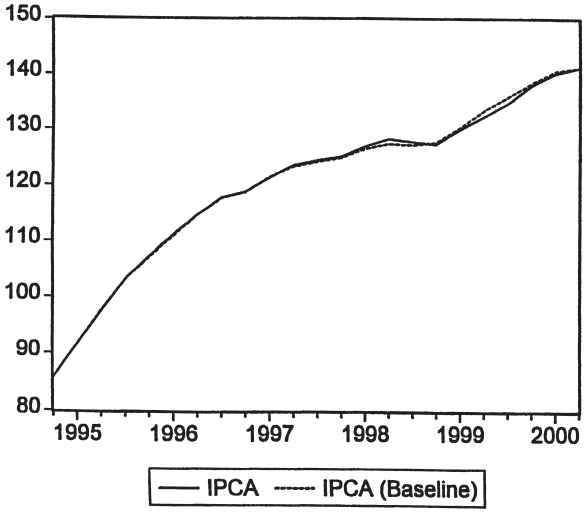


Figure 3 Result of final test of consumer price index (IPCA)

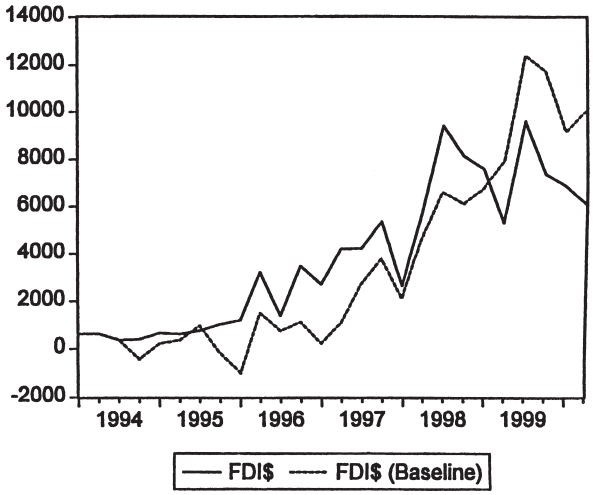


Figure 4 Result of final test of foreign direct investment (FDI$)

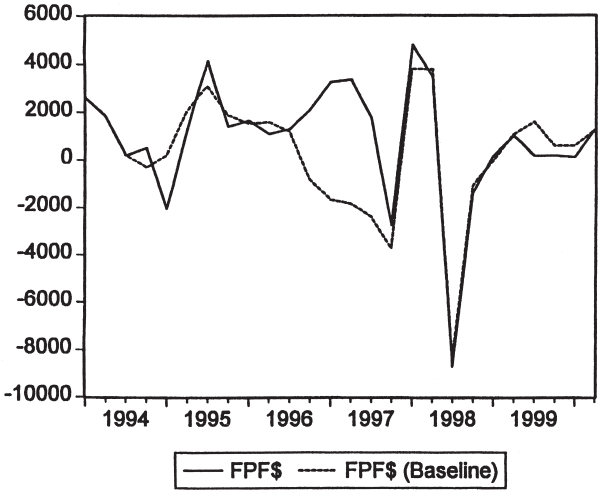


Figure 5 Result of final test of foreign portfolio investment (FPF$)

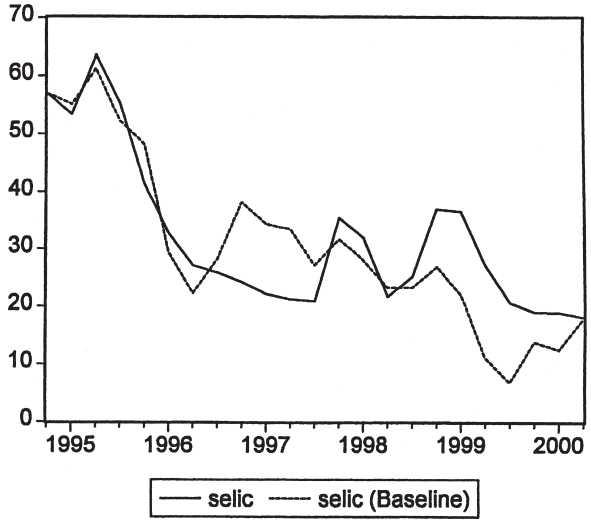


Figure 6 Result of final test of nominal interest rate (SELIC)

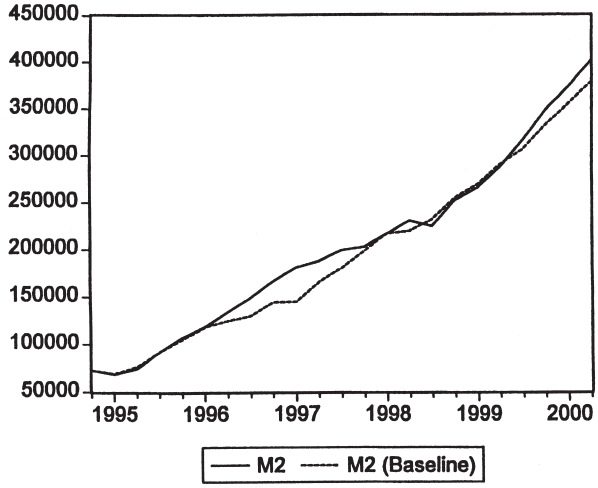


Figure 7 Result of final test of money supply (M2)

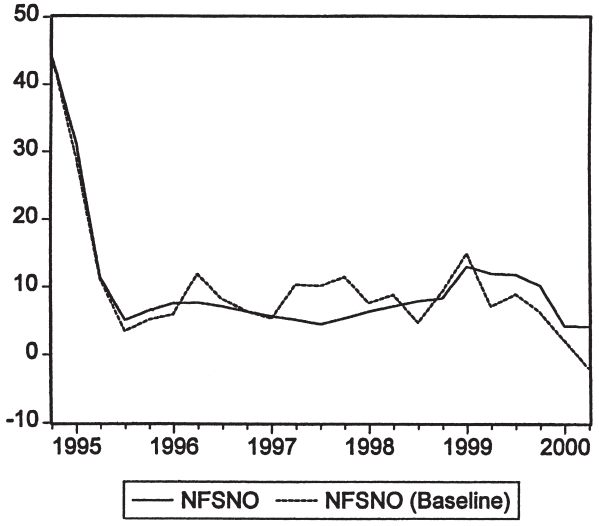


Figure 8 Result of final test of necessity of financial sector (NFSNO)

## 4. Simulation Analysis

We tried the following simulations for a period of 1994Q4-2000Q2 in order to analyze of monetary and fiscal policy in Real Plan. The two simulation cases are conducted using this model. Exchange rate is an exogenous in the following two cases.

Case (1) NFSNO is held constant after 1994Q3.

Case (2) SELIC is held constant after 1994Q3.

The Real Plan was a stabilization program first announced in December 1993, and then implemented in following three sequential steps: (1) the emergency fiscal adjustment; (2) the elimination of the inflationary inertia, through the conversion of prices and salaries to a stable unit of account (the URV-the Unit of Real Value); and (3) monetary reform through the transformation of the URV into the new currency, the Real as the exchange rate "anchor". The Real was then introduced in July 1994.

Case (1) : NFSNO is held constant after 1994 Q3. This implies the increase in NFSNO for this period (without lower NFSNO). This causes the cyclical change of SELIC and M2, and the decrease of GDE and rate of capacity utilization (NUCI) for 94Q4-97Q3 period and the increase with a cyclical change for 97Q4-2000Q2 period in Figure 9a and Figure 9b. The private consumption, investment, exports, and imports follow the similar pattern. The consumer price index is increasing rapidly. Thus, we found that this simulation without lower NFSNO (if the government continues high NFSNO policy) shows the decrease of GDE and high inflation for 94Q4-97Q3 period and up and down business cycle of GDE and high inflation for 97Q4-2000Q2 period.

Case (2) : SELIC is held constant after 1994Q3. This implies the higher SELIC for this period. That is, this is the tight monetary policy. As the effect of this policy is big, this causes the decrease of M2, NFSNO, and NUCI for this period in Figure 10b. Thus, GDE, the private consumption, investment are decreasing rapidly for this period in Figure 10a. The variables of labor market follow the similar pattern. The consumer price index is decreasing by degree. Thus, we found that this simulation without lower SELIC (if central bank continues high SELIC policy) shows the decrease of GDE and low inflation for this period, and conclude that this simulation shows the effects

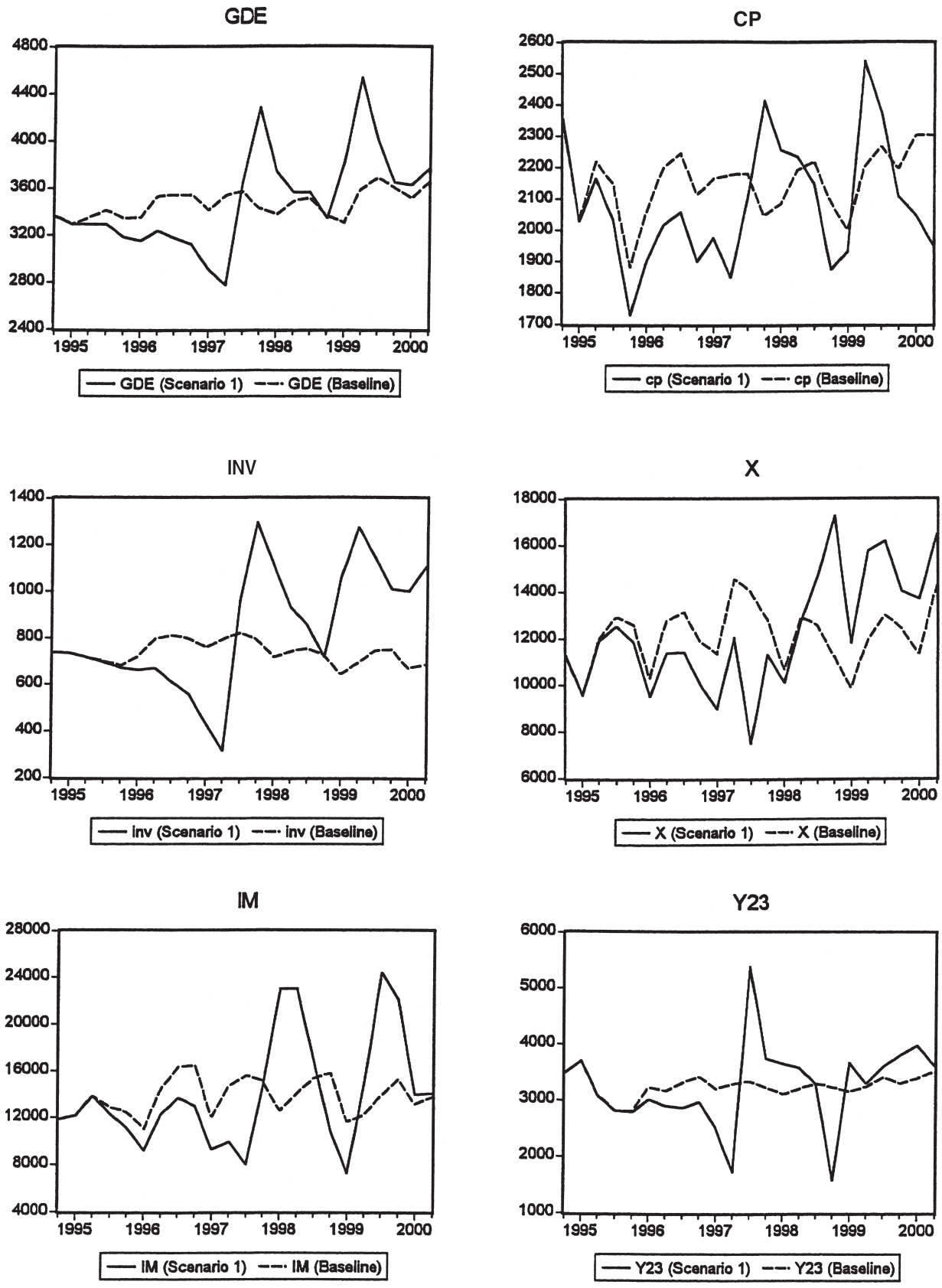


Figure 9a Policy Simulation (NFSNO is held constant after 1994Q3, Case-1)

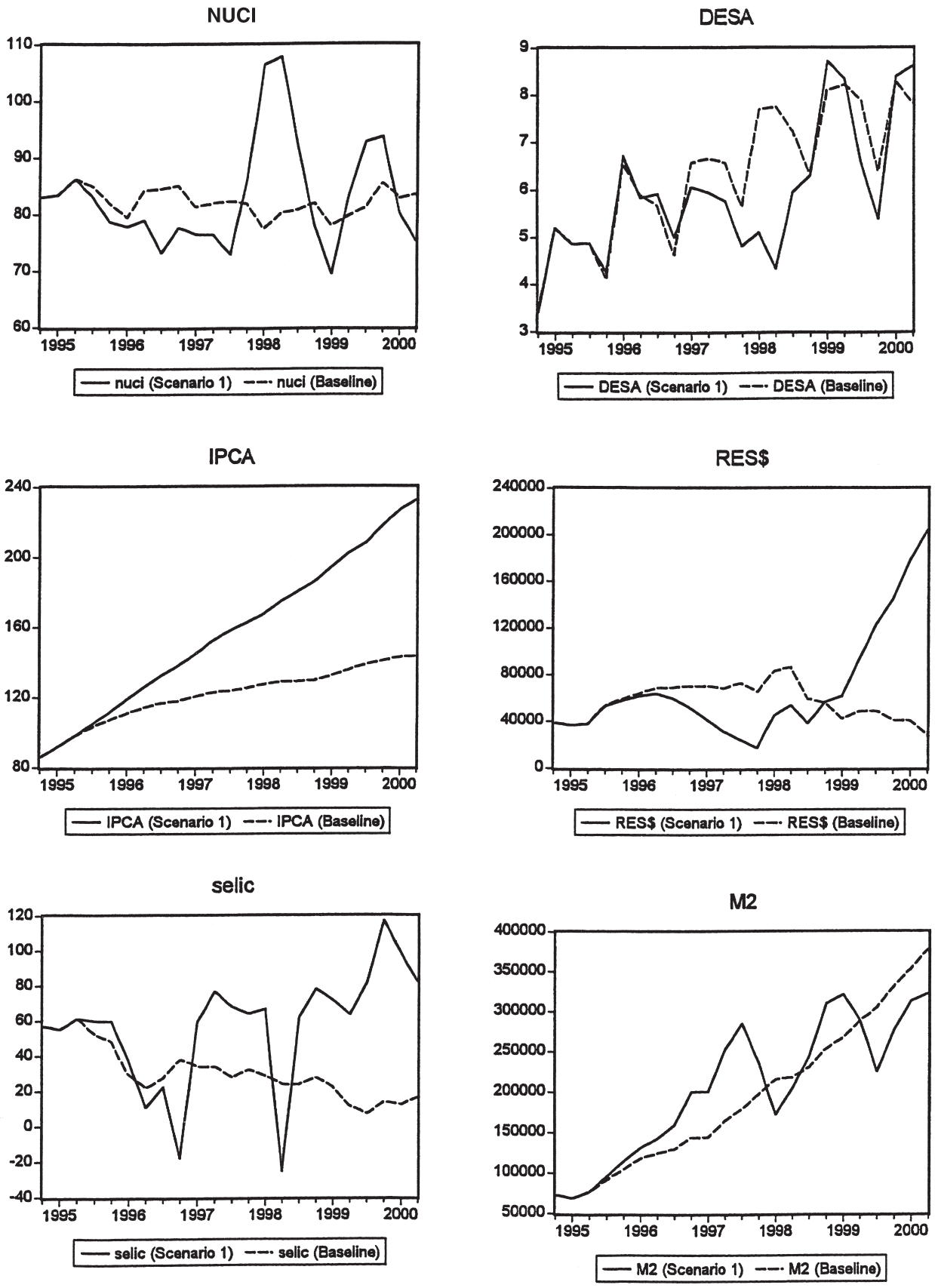


Figure 9b Policy Simulation (NFSNO is held constant after 1994Q3, Case-1)

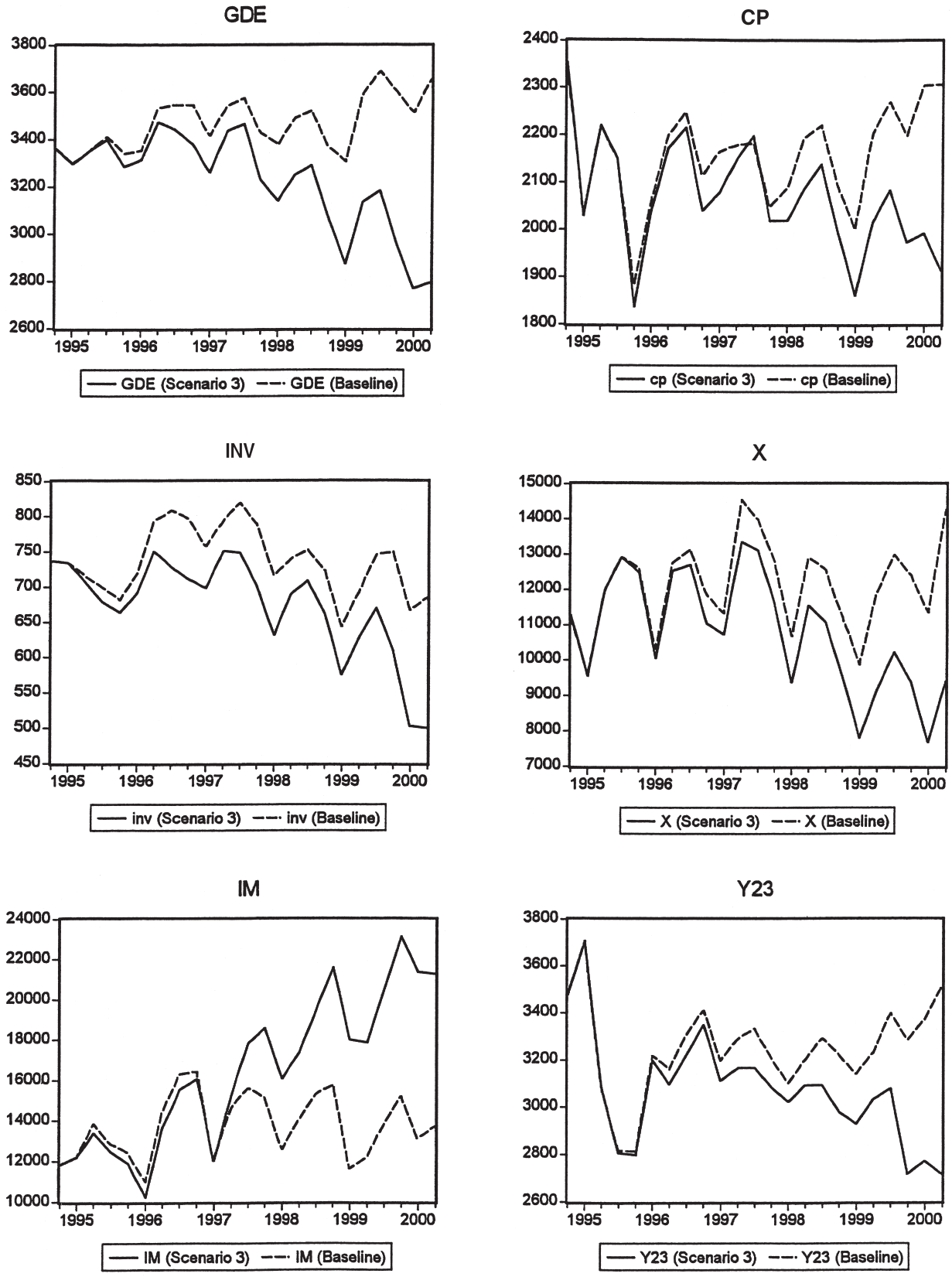


Figure 10a Policy Simulation (SELIC is held constant after 1994Q3, Case-2)

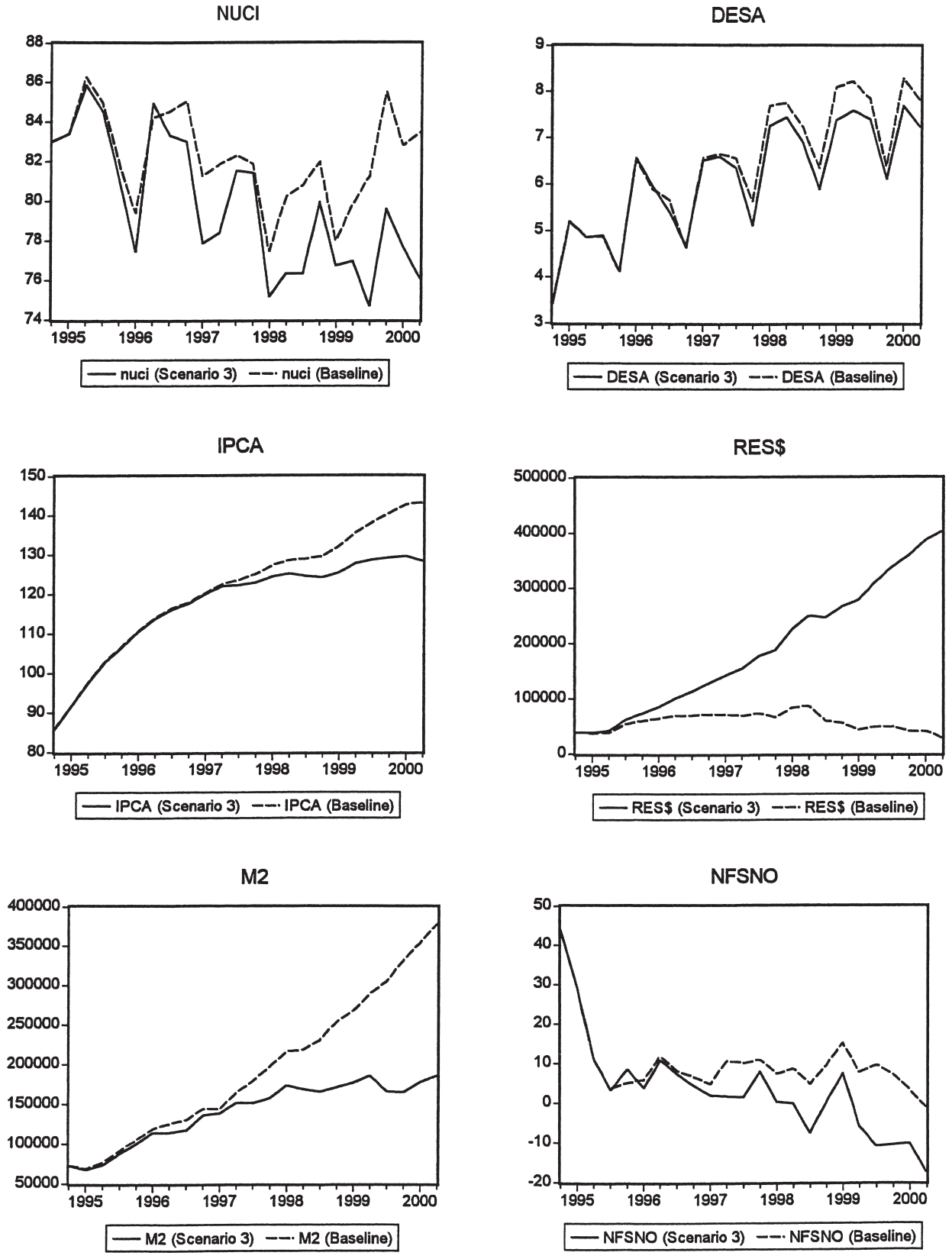


Figure 10b Policy Simulation (SELIC is held constant after 1994Q3, Case-2)

of tight monetary policy as we expected.

## 5. Conclusion

In this paper, we have constructed the prototype quarterly econometric model for the Brazilian economy (1994Q4-2000Q2) with 31 endogenous variables in order to analyze the monetary and fiscal policy during Brazil's Real Plan, and estimated the central bank and the central government reaction functions for three variables (SELIC, M2, and NFSNO). We found that this model including reaction function was good performance from a good final test result. Finally, we tried the following two simulations for the period of 1994Q4-2000Q2 using this model: Case (1) NFSNO is held constant after 1994Q3 and case (2) SELIC is held constant after 1994Q3. We found that two simulations show the effects of fiscal and monetary policy as we expected.

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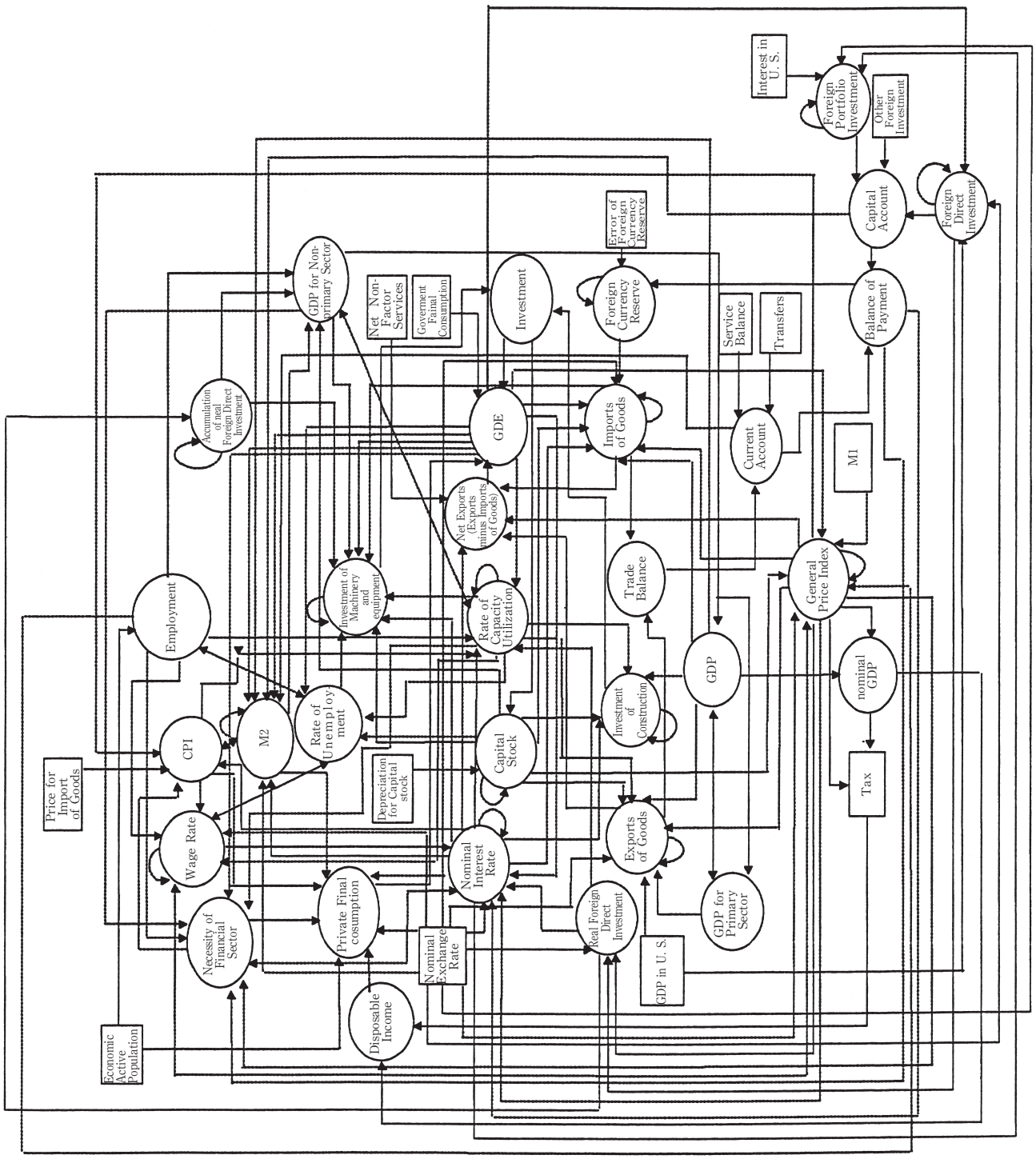


Figure A1 Flowchart of the Brazilian Quarterly Econometric Model

## Appendix A : A Brazilian Quarterly Econometric Model

### A : Final Demand Sector

(1) Private Final Consumption Expenditure (CP)

$$\begin{aligned}CP/PTO = {} & 0.1322 + 0.2903^{*}(YD(-1)/PTO(-1)) - 0.0060^{*}(SELIC(-3)/SELIC(-4)) \\ & (5.03)\quad (2.19)\qquad\qquad (-3.16) \\ & + 1.11E\text{-}05^{*}(M2(-3)/IPCA(-3)) - 0.0002^{*}(NFSNO(-1)) - 0.0149^{*}(RATE/RATE(-1)) \\ & (1.62)\qquad\qquad (-1.28)\qquad\qquad (-2.69) \\ & - 0.0006^{*}(@TREND) + 0.0269^{*}(D94Q4) - 0.0095^{*}(D95Q4) \\ & (-1.13)\qquad\quad (6.46)\qquad\quad (-3.26) \\ & + 0.0067^{*}(@SEAS(1)) + 0.0115^{*}(@SEAS(2)) + 0.0091^{*}(@SEAS(3)) \\ & (3.12)\qquad\quad (4.46)\qquad\quad (5.30)\end{aligned}$$

$R^2 = 0.9305$, $RA^2 = 0.8609$, $SE = 0.0024$, $SD = 0.0063$, $DW = 2.51$, $F = 13.4$

(2) Investment of Machinery and equipment (INVM)

$$\begin{aligned}INVM/KR(-1) = {} & -0.0138 + 0.0035^{*}(Y23(-1)/Y23(-2)) + 0.00014^{*}((NUCI(-3) + NUCI(-4))/2) \\ & (-2.44)\quad (1.89)\qquad\qquad (1.97) \\ & - 0.0011^{*}(SELIC(-2)/SELIC(-3)) + 0.0040^{*}(SFDIR(-2)/SFDIR(-3)) \\ & (-2.47)\qquad\qquad (5.06) \\ & + 0.0005^{*}(IM(-2)/GDE(-2)) + 0.6534^{*}(INVM(-1)/KR(-2)) \\ & (2.15)\qquad\qquad (6.82) \\ & - 0.0030^{*}(DESA(-3)/DESA(-4)) + 0.0006^{*}(D95Q1) - 0.0023^{*}(@SEAS(1)) \\ & (-2.52)\qquad\qquad (0.81)\qquad\quad (-4.07) \\ & - 0.0011^{*}(@SEAS(2)) - 0.0016^{*}(@SEAS(3)) \\ & (-1.80)\qquad\quad (-1.90)\end{aligned}$$

$R^2 = 0.9421$, $RA^2 = 0.8841$, $SE = 0.0004$, $SD = 0.0010$, $DW = 1.71$, $F = 16.3$

(3) Investment of Construction (INVC)

$$\begin{aligned}INVC/KR(-1) = {} & -0.0106 + 0.0071^{*}(GDP(-1)/GDP(-2)) \\ & (-1.34)\quad (1.21) \\ & + 7.98E\text{-}05^{*}((NUCI(-1) + NUCI(-2) + NUCI(-3))/3) \\ & (1.68) \\ & - 0.00060^{*}(SELIC(-1)/SELIC(-2)) + 0.7584^{*}(INVC(-1)/KR(-2)) \\ & (-2.00)\qquad\qquad (7.18) \\ & - 0.0009^{*}(D95Q2) - 0.0008^{*}(D95Q3) + 0.00030^{*}(@SEAS(1)) \\ & (-3.32)\qquad\quad (-2.66)\qquad\quad (1.21) \\ & + 0.0012^{*}(@SEAS(2)) + 0.0008^{*}(@SEAS(3)) \\ & (4.38)\qquad\quad (3.70)\end{aligned}$$

$R^2 = 0.9233$, $RA^2 = 0.8703$, $SE = 0.0002$, $SD = 0.0006$, $DW = 2.00$, $F = 17.4$

(4) Investment (INV)

INV=(INVM+INVC)/(1−0.026)

(5) Exports of Goods (X)

X/GDP(−1)=−14.390+12.110*(GDPUS(-1)/GDPUS(-2))
(−2.30) (1.97)

+2.8653*(NUCI(-3)/NUCI(-4))+1.5081*(Y1/GDP(-1))
(1.65) (2.40)

+23337.2*(RATE(-2)/IGPDI(-2))+6.0812*((X(-1)+X(-2))/(KR(-1)+KR(-2)))
(1.70) (3.21)

+0.3308*(D97Q2)− 0.4355* (@SEAS(1))+0.4911*(@SEAS(2))+0.4361*(@SEAS(3))
(1.85) (−3.15) (3.58) (3.35)

$R^2$=0.9118, $RA^2$=0.8507, $SE$=0.1465, $SD$=0.3791, $DW$=1.75, $F$=14.9

(6) Imports of Goods (IM)

IM/GDP(-1)=−2.3921+5.2846*(GDE(-1)/GDE(-4))− 290.75* (SELIC(-1)/IGPDI(-1))
(−1.50) (3.89) (−1.74)

+2.3209*(IM(-1)/(KR(-1))+0.4383*(RES$(-2)/KR(-2))
(1.97) (2.51)

−27775.04*(RATE(-1)/IGPDI(-1))− 0.6401* (D97Q1)− 0.5192* (@SEAS(1))
(−1.18) (−3.32) (−5.09)

+0.4848*(@SEAS(2))+0.2780*(@SEAS(3))
(3.53) (2.35)

$R^2$=0.9180, $RA^2$=0.8612, $SE$=0.1655, $SD$=0.4442, $DW$=1.27, $F$=16.2

(7) Net Exports (XMGSNF)

XMGSNF=(X−IM+SERNF$)*RATE*1000/IGPDI

(8) GDE

GDE=CP+CG+INV+XMGSNF

B : Supply and Capital Stock Sector

(9) GDP for Non−primary Sector (Y23)

Y23/EMP(-1)=0.0559+0.0505*((NUCI(-1)/100)*(KR(-1)/EMP(-1)))
(1.28) (2.18)

+0.0021*(M2(-1)/KR(-1))+0.0413*(SFDIR(-2)/SFDIR(-3))
(2.86) (6.42)

+0.0515*(D95Q1)− 0.0299* (D95Q3)− 0.0196* (D95Q4)
(11.8) (−6.42) (−4.30)

$$-\underset{(-3.40)}{0.0088^{*}}\,(@\mathrm{SEAS}(1))+\underset{(2.30)}{0.0057^{*}}\,(@\mathrm{SEAS}(2))+\underset{(3.62)}{0.0100^{*}}\,(@\mathrm{SEAS}(3))$$

$R^2=0.9616$, $RA^2=0.9350$, $SE=0.0037$, $SD=0.0145$, $DW=2.57$, $F=36.2$

(10) GDP for primary sector

$$\mathrm{Y1}=\mathrm{GDP}-\mathrm{Y23}$$

(11) Nominal GDP

$$\mathrm{GDPV}=\mathrm{GDP}^{*}\mathrm{IGPDI}$$

(12) Capital Stock

$$\mathrm{KR}=\mathrm{KR}(-1)+\mathrm{INV}-\mathrm{DEPR}$$

(13) Rate of Capacity Utilization (NUCI)

$$\mathrm{NUCI}=\underset{(0.26)}{2.8631}+\underset{(5.79)}{41.574^{*}}\,(\mathrm{GDE}(-1)/\mathrm{GDE}(-4))+\underset{(1.27)}{19.660^{*}}\,(\mathrm{Y23}(-1)/\mathrm{EMP}(-1))$$

$$+\underset{(3.56)}{0.3934^{*}}\,(\mathrm{NUCI}(-1))-\underset{(-1.74)}{1.6222^{*}}\,(\mathrm{SELIC}(-1)/\mathrm{IPCA}(-1))+\underset{(3.05)}{0.8126^{*}}\,(\mathrm{FDIR}/\mathrm{FDIR}(-1))$$

$$+\underset{(2.28)}{2.0554^{*}}\,(\mathrm{D96Q1})-\underset{(-2.55)}{2.3134^{*}}\,(\mathrm{D99Q3})-\underset{(-7.38)}{3.4553^{*}}\,(@\mathrm{SEAS}(1))+\underset{(3.48)}{2.3790^{*}}\,(@\mathrm{SEAS}(2))$$

$$+\underset{(1.70)}{0.9808^{*}}\,(@\mathrm{SEAS}(3))$$

$R^2=0.9288$, $RA^2=0.8694$, $SE=0.6928$, $SD=1.9171$, $DW=1.89$, $F=15.6$

C : Income Sector

(14) Disposable Income

$$\mathrm{YD}=(\mathrm{GDPV}-\mathrm{TAX})/\mathrm{IGPDI}$$

D : Labor Sector

(15) Rate of Unemployment (DESA)

$$\mathrm{DESA}=\underset{(-2.02)}{-11.954}+\underset{(2.17)}{0.0262^{*}}\,(\mathrm{AWR}(-2))+\underset{(1.49)}{57.206^{*}}\,(\mathrm{GDE}(-2)/\mathrm{EMP}(-2))$$

$$+\underset{(2.30)}{5.8494^{*}}\,(\mathrm{KR}(-2)/\mathrm{EMP}(-2))-\underset{(-2.21)}{12.551^{*}}\,(\mathrm{NUCI}(-1)/\mathrm{NUCI}(-2))$$

$$+\underset{(7.51)}{2.1985^{*}}\,(@\mathrm{SEAS}(1))+\underset{(4.35)}{1.5985^{*}}\,(@\mathrm{SEAS}(2))+\underset{(3.90)}{1.8633^{*}}\,(@\mathrm{SEAS}(3))$$

$R^2=0.9381$, $RA^2=0.9092$, $SE=0.4470$, $SD=1.4838$, $DW=1.98$, $F=32.5$

⑯ Employment

EMP＝PTO*(1－DESA/100)

⑰ Wage Rate (AWR)

log(AWR/AWR(-1))＝0.4977－ 0.7851* log(EMP(-2)/EMP(-3))
(2.31) (－1.16)

＋0.7276* log(NUCI(-1)/NUCI(-2))－ 0.0416* log((DESA(-3)＋DESA(-4))/2)
(2.71) (－1.17)

＋0.0601* log(IGPDI(-2)/IGPDI(-3))＋0.0738* log(RATE(-2)/IPCA(-2))
(2.14) (2.01)

＋0.4318* log(AWR(-2)/AWR(-3))－ 0.0421* (D95Q3)＋0.0601*(D96Q1)
(3.18) (－1.68) (1.94)

－ 0.2039* (@SEAS(1))－ 0.0544* (@SEAS(2))－ 0.0715* (@SEAS(3))
(－12.1) (－3.35) (－2.22)

$R^2$＝0.9639, $RA^2$＝0.9278, $SE$＝0.0195, $SD$＝0.0725, $DW$＝2.44, $F$＝26.7

E：Price Sector

⑱ General Price Index (IGPDI)

IGPDI/IGPDI(-1)＝0.8087＋0.1085*(RATE/RATE(-1))＋6487.7*(RATE(-1)/IGPDI(-1))
(8.62) (10.3) (16.1)

＋0.0180*(M1/M1(-1))＋0.0237*(AWR(-3)/AWR(-4))＋0.2199*(GDE(-3)/GDE(-4))
(1.75) (1.41) (3.42)

－ 0.0588* (KR(-1)/EMP(-1))－ 0.0020* (@TREND)－ 0.0360* (D95Q4)
(－1.57) (－4.21) (－7.18)

－ 0.0230* (D96Q4)－ 0.0156* (@SEAS(1))－ 0.0152* (@SEAS(2))－ 0.0073* (@SEAS(3))
(－4.13) (－2.26) (－2.67) (－1.45)

$R^2$＝0.9812, $RA^2$＝0.9586, $SE$＝0.0039, $SD$＝0.0192, $DW$＝1.85, $F$＝43.4

⑲ Consumer Price Index(IPCA)

IPCA/IPCA(-1)＝1.0209＋0.0337*(RATE/RATE(-1))＋3233.7*(RATE(-1)/IGPDI(-1))
(23.4) (3.63) (6.05)

＋0.0392*(M2/M2(-1))＋0.0003*((PIM(-3)＋PIM(-4))/2)－6.73E-07*(SELIC(-2))
(2.31) (1.11) (－1.39)

＋0.0006*(NFSNO(-2))－ 0.0026* (@TREND)－ 0.0130* (D96Q4)
(6.20) (－8.21) (－3.01)

＋0.0063*(@SEAS(1))＋0.0040*(@SEAS(2))－ 0.0008* (@SEAS(3))
(2.37) (1.59) (－0.32)

$R^2$＝0.9848, $RA^2$＝0.9695, $SE$＝0.0038, $SD$＝0.0218, $DW$＝1.92, $F$＝64.6

F : Balance of Payment Sector

⑳ Trade Balance (TB$)

TB$ = X − IM

㉑ Current Account Balance (CA$)

CA$ = TB$ + SER$ + TUN$

㉒ Foreign Direct Investment (FDI$)

FDI$ = 79844.3 + 16.9507*(GDE(-1)) − 143128.0*(GDPUS(-1)/GDPUS(-2))
(1.39) (3.85) (−2.53)

+ 7653.5*(RATE/RATE(-1)) + 0.2996*(FDI$(-1)) − 3709.5* (D95Q2)
(2.54) (1.81) (−2.30)

+ 66.988*(@SEAS(1)) + 3752.6*(@SEAS(2)) − 821.49*(@SEAS(3))
(0.08) (3.61) (1.05)

$R^2 = 0.8857$, $RA^2 = 0.8203$, $SE = 1266.0$, $SD = 2986.8$, $DW = 2.15$, $F = 13.6$

㉓ Foreign Portfolio Investment (FPF$)

FPF$ − FPF$(-1) = −4513.2 + 1435.8*(RATE) + 53.724*(SELIC − INTRUS)
(−1.85) (1.09) (1.51)

+ 7764.8*(D98Q1) − 11949.5*(D98Q3) − 8395.1*(D98Q4)
(3.81) (−5.74) (4.14)

+ 1268.6*(@SEAS(1)) + 1975.2*(@SEAS(2)) − 1547.4*(@SEAS(3))
(1.08) (1.74) (1.24)

$R^2 = 0.8526$, $RA^2 = 0.7683$, $SE = 1849.1$, $SD = 3841.5$, $DW = 1.95$, $F = 18.6$

㉔ Capital Account Balance (CAP$)

CAP$ = FDI$ + FPF$ + CAPOTH$

㉕ Real Foreign Direct Investment (FDIR)

FDIR = FDI$*RATE*1000/IGPDI

㉖ Accumulation of Real Foreign Direct Investment (SFDIR)

SFDIR = SFDIR(-1) + FDIR

㉗ Balance of Payment (BP$)

BP$ = CA$ + CAP$

(28) Foreign Reserve (RES$)

RES$ = RES$(-1) + BP$ + RESE$

G : Reaction Function Sector

(29) Nominal Interest rate (SELIC)

SELIC = −24.434 − 0.2733* (BP$(-2)/BP$(-3)) − 822486.9*(RATE(-1)/IGPDI(-2))
(−0.34) (−1.31) (−3.70)

− 34.279* (M2(-1)/M2(-2)) + 0.0235*(GDE(-2)) + 0.3638*(NFSNO(-2))
(−1.55) (1.56) (2.60)

+ 34.618*(FDIR(-1)/SFDIR(-1)) + 0.6280*(SELIC(-1))
(1.68) (5.45)

− 7.0579* (@SEAS(1)) − 4.9176* (@SEAS(2)) − 2.5570* (@SEAS(3))
(−2.48) (−1.84) (−0.84)

$R^2$ = 0.9533, $RA^2$ = 0.9143, $SE$ = 3.9730, $SD$ = 13.574, $DW$ = 2.52, $F$ = 24.5

(30) Money Supply (M2)

(M2/IGPDI(-1))/GDE(-1) = 0.0028 − 0.0002* (IPCA(-2)/IPCA(-3))
(3.80) (−6.24)

−2.92E-05*(SELIC/SELIC(-2)) − 0.0024* (GDE(-1)/GDE(-2)) + 3.96E-09*(CA$(-1))
(−0.67) (−3.37) (0.64)

−1.60E-09*(CAP$(-1)) −8.23E-05*(RATE(-1)/RATE(-2))
(−1.31) (−1.02)

+1.0108*(M2(-1)/IGPDI(-2)/GDE(-2)) −7.24E-05*(@SEAS(1))
(31.9) (−1.81)

−9.21E-05*(@SEAS(2)) + 1.87E-05*(@SEAS(3))
(−2.51) (0.59)

$R^2$ = 0.9928, $RA^2$ = 0.9867, $SE$ = 3.41$e$−05, $SD$ = 0.0003, $DW$ = 2.27, $F$ = 164.8

(31) Necessity of Financial Sector (NFSNO)

NFSNO = 8.8478 − 0.0003* (BP$(-2)) − 0.0007* (IGPDI(-2))
(0.18) (−4.61) (−6.48)

+ 9.0740* (SELIC(-3)/SELIC(-4)) − 1.0489* (NUCI(-2))
(−5.43) (−2.92)

+429.52*(GDE(-2)/EMP(-2)) + 20.020*(Y23(-1)/Y23(-2))
(2.87) (2.48)

− 0.0928* (@SEAS(1)) + 3.8260*(@SEAS(2)) − 2.8568* (@SEAS(3))
(−0.06) (1.91) (−1.39)

## Appendix B : Variables List of Quarterly Econometric Model

| | | |
|---|---|---|
| AWR | Wage Rate | Index |
| BP$ | Balance of Payment | Millions of US Dollars |
| CA$ | Current Account | Millions of US Dollars |
| CAP$ | Capital Account | Millions of US Dollars |
| CAPOTH$* | Other Foreign Investment except FDI$ and FPF$ in CAP$ | Millions of US Dollars |
| CG* | Government Final consumption | Millions of Reais, 1990 prices |
| CP | Private Final consumption | Millions of Reais, 1990 prices |
| DESA | Rate of Unemployment | Percent |
| DEPR* | Depreciation for Capital stock | Millions of Reais, 1990 prices |
| DiQj* | Dummy | 1 (when i year j quarterly), 0 (other) |
| EMP | Employment | Million of Person |
| FDI$ | Foreign Direct Investment | Millions of US Dollars |
| FDIR | Real Foreign Direct Investment | FDI$*RATE*1000/IGPDI |
| FPF$ | Foreign Portfolio Investment | Millions of US Dollars |
| GDE | GDE | Millions of Reais, 1990 prices |
| GDP | GDP | Millions of Reais, 1990 prices |
| GDPV | Nominal GDP | Thousands of Reais |
| GDPUS* | U. S. GDP | Millions of US Dollars, 1990 prices |
| IPCA | CPI | Index |
| IPCAUS* | U. S. CPI | Index |
| IGPDI | General Price Index | Index |
| IM | Imports of Goods | Millions of Reais, 1990 prices |
| INTRUS* | Nominal Interest Rate in U. S. | Percent |
| INV | Investment | Millions of Reais, 1990 prices |
| INVC | Investment of Construction | Millions of Reais, 1990 prices |
| INVM | Investment of Machinery and equipment | Millions of Reais, 1990 prices |
| KR | Capital Stock | Millions of Reais, 1990 prices |
| M1* | Narrow Money Supply | Millions of Reais |
| M2 | Wide Money Supply | Millions of Reais |
| NFSNO | Necessity of Financial Sector | Index |
| NUCI | Rate of Capacity Utilization | Index |
| PIM* | Prices for Import of Goods | Index |
| PTO* | Economic Active Population | Millions of Person |
| RATE* | Nominal Exchange Rate | Real per US Dollars |

| | | |
|---|---|---|
| RES$ | Foreign Currency Reserve | Millions of US Dollars |
| RESE$* | Error of Foreign Currency Reserve | Millions of US Dollars |
| SELIC | Nominal Interest Rate | Percent |
| SER$* | Service balance | Millions of US Dollars |
| SERNF$* | Net Non-Factor Services | Millions of US Dollars |
| SFDIR | Accumulation of real Foreign Direct Investment | FDIR (94Q1)＋....＋FDIR (2000Q2) |
| TAX* | Tax Revenue | Thousands of Reais |
| TB$ | Trade Balance | Millions of US Dollars |
| TUN$* | Transfers | Millions of US Dollars |
| X | Exports of Goods | Millions of US Dollars |
| XMGSNF | Net Exports (Exports minus Imports of Goods plus SERNF$) | Millions of US Dollars |
| Y1 | GDP for Primary Sector | Millions of Reais, 1990 prices |
| Y23 | GDP for Primary Sector | Millions of Reais, 1990 prices |
| YD | Disposable Income | Thousands of Reais, 1990 prices |

＊: exogenous variable