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A Study of Energy-Economy Interaction in the Philippines

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FOREWORD

The Philippine Institute for Development Studies is pleased to launch its Monograph Series with the publication of this issue entitled "A Study of Energy – Economy Interaction in the Philippines." Through the Series, the Institute hopes to disseminate policy-oriented research on specific topics of interest.

The subject of energy has been a high priority research area in the research programs of many national and international research institutions. And rightly so. The two oil shocks of the 1970s have demonstrated the need for countries to adopt appropriate adjustment measures in order to enable them to ride out the effects of the drastic increases in oil prices without any major economic dislocation. In deciding on particular responses to the energy crisis, policymakers can certainly benefit from studies providing some idea of the impact of alternative actions, as well as from suggestions which can expand their range of alternatives.

This monograph, researched and written by Leander Alejo, is an effort to provide policymakers and planners with a tool that would allow an analysis of interactions between energy and the rest of the domestic economy. Given a change in the world energy situation (a price change or quantitative change, for example), what can be expected to happen in the domestic economy? How can fiscal, monetary and other policy instruments respond to these changes, considering such objectives as internal and external stability?

Through simulation experiments, Alejo's model can directly assist in the estimation of the effects of alternative policy packages for varying energy scenarios. Used with care, this model can be of valuable help in more explicitly taking into account the energy factor in plan and policy formulation.

FILOLOGO PANTE, JR.
President

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A STUDY OF ENERGY-ECONOMY INTERACTION IN THE PHILIPPINES*

Leander J. Alejo

INTRODUCTION

Current planning and policy-making have not been very successful in terms of target-setting and policy prescriptions because of the seemingly implicit treatment of the energy factor in the formulation of models for policy and planning. Inflation and GNP growth targets, for example, were recently revised significantly because of unrealistic assumptions and the deficient framework used in the formulation of the NEDA Five-Year Development Plan.

What is necessary, therefore, is a model that will explicitly include energy disturbance variables (price and availability of energy), capture cost-push phenomena in price determination and analyze trade-offs among different target variables implied by alternative policy regimes.

This paper reports the results of an econometric modelling project aimed at studying energy-economy interactions in the Philippines. Specifically, it seeks to quantify the impact of the energy crisis on macro-economic variables of policy importance. Relatedly, it may be used to evaluate the effectiveness of government policy reactions (fiscal, monetary and balance of payments policies) to the energy crisis of the 1970s. Furthermore, the model can serve as a planning and policy tool when utilized to make *ex ante* forecasts of the economy through alternative policy simulation experiments. The model will then be useful in answering the following questions:

1. What is the direction and magnitude of the effects of the energy crisis on the level and growth of gross domestic product and its components: consumption, investment, exports and imports?
2. By how much are domestic prices affected by increases in crude oil prices and at what speed do these adjustments occur?
3. What will be the impact on employment if the relative price of energy increases and/or an energy supply shortage occurs? How do wages respond to resulting price increases and with how long a lag?
4. How will increases in relative prices of energy products affect the

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demand for these products? Accordingly, what would happen to the GDP-energy ratio (or efficiency of energy use)?

5. What is the effect of the energy crisis on the balance of payments, government budget deficit, and the monetary system in general?
6. To what extent have past economic policies counteracted, or perhaps even exacerbated, the inflationary effect of the energy crisis? In general, what mix of economic policies is most effective in minimizing the impact of energy disturbances on the economy? Impacts of fiscal, monetary, and balance of payments policies have to be analyzed as to their differential effectiveness in combatting the present and future energy-related economic crises.

We shall later attempt to answer these questions through *ex post* simulation experiments with the model under alternative policy assumptions.

We first present the estimated model in its structural form and the underlying theoretical underpinnings for the specifications. The estimated parameters, taken as they are, already convey a lot of useful information for analyzing recent structural changes in the economy as compared perhaps with estimates of earlier models.[1/]

The model is then validated through historical simulations (base run) using, first, a static solution algorithm. It is later subjeeted to a more stringent test through dynamic simulation. In both cases, various measures of goodness of fit are computed. We then perform multiplier analysis and use the model for alternative policy simulations. We conclude the paper with a summary of findings and possible areas for improvement.

THE MACROECONOMETRIC ENERGY POLICY SIMULATION (MEPS) MODEL

The model consists of 80 structural equations, 18 of which are statistically estimated, using ordinary least squares with autocorrelation correction[2/] applied on most equations. There are 110 variables – 80 endogenous and 30 exogenous. The data used consist of semestral observations from the first semester of 1970 to the second semester of 1979 (20 observations). The period of estimation, therefore, covers a relatively unstable decade for the Philippine economy characterized by devaluation of the peso, high inflation rates, externally generated economic disturbances led by spiralling imported crude oil prices, and a changed political environment under a martial law administration.

[1/]These include the macromodel by Encarnación, et al. (2), Narasimhan and Sabater (6) and Bautista (1) all of which used annual data up to 1969 only. A more recent macromodel by Villanueva (8) utilized semestral data from 1967-76 and focused on the monetary sector.

[2/]Correction for autocorrelation follows the procedure suggested by Kelijian and Oates (4), pp. 195-199.

For discussion purposes, we have divided the model into two parts: an energy sub-model (42 equations) and a macroeconomic sub-model (38 equations). The division is not a rigid one as there exists a high degree of simultaneity between the sub-models because of the presence of strong linkage equations in both sub-models accounting for two-way interactions. (In the following discussions, please refer to the list of symbols for definitions of variables).

Energy Sub-Model

The energy sub-model contains the determinants of energy flows and prices within a consistent energy accounting framework designed for this purpose.[3/] Consumption, production, trade and inventory change for broad energy products are linked within the sub-model. Demand equations are specified for crude petroleum, refined petroleum products, coal and hydro-geothermal electricity. Furthermore, total system energy consumption is decomposed into demand by the consuming sector and losses in the transformation sector. Demand by the consuming sector is in turn decomposed into electricity and non-electricity demand. Energy prices, on the other hand, are consumption- and time-weighted averages of individual energy products and include energy tariffs and taxes.

DEFINITION OF VARIABLES

Endogenous Variables:

C	:	total consumption expenditures at 1972 prices; in million pesos
C*	:	total consumption expenditures at current prices; in million pesos
Ce	:	value of total system energy consumption at 1972 prices; in million pesos
CE	:	total system energy consumption net of refinery fuel and loss; in 10^{10} kilocalories
CE′	:	total system energy consumption; in 10^{10} kilocalories
CE*	:	value of total system energy consumption net of refinery fuel and loss at current prices; in million pesos
CE_C	:	energy consumption of consuming sector (industries and household); in 10^{10} kilocalories
CE_{Cel}	:	electrical energy consumption of consuming sector; in 10^{10} kilocalories

[3/]The accounting framework, data base, and methodology for deriving energy flows in the Philippine economy (Philippine National Energy Accounts) as well as theoretical discussions on energy prices and actual data computations are contained in separate papers available from the author upon request.

CE_{Cnel} : non-electrical energy consumption of consuming sector; in 10^{10} kilocalories

CE_{co} : consumption of coal; in 10^{10} kilocalories

CE_{cp} : consumption of crude petroleum; in 10^{10} kilocalories

CE_{hg} : consumption of hydro-geothermal energy; in 10^{10} kilocalories

C_g : government consumption expenditures at 1972 prices; in million pesos

CE_{rp} : consumption of refined petroleum products; in 10^{10} kilocalories

CGS : claims on the government sector of the monetary system; in million pesos

C_p : private consumption expenditures at 1972 prices, in million pesos

CPE : total consumption of primary energy; in 10^{10} kilocalories

EE : macroeconomic energy efficiency ratio; in million pesos of real GDP per 10^{10} kilocalories

EE_{rp} : petroleum refining efficiency ratio; in 10^{10} kilocalories of refined petroleum products per 10^{10} kilocalories of crude petroleum

ER : peso to dollar exchange rate index; 1972 = 100

ES : energy self-sufficiency ratio; in 10^{10} kilocalories of primary energy production per 10^{10} kilocalories of system energy consumption

ES_{cp} : crude petroleum self-sufficiency ratio; in 10^{10} kilocalories of crude petroleum production per 10^{10} kilocalories of crude petroleum consumption

GE_{rp} : consumption-production gap in refined petroleum products; in 10^{10} kilocalories

I : total investment expenditures at 1972 prices; in million pesos

I_g : government investment expenditures at 1972 prices; in million pesos

I_p : private investment expenditures at 1972 prices; in million pesos

K : capital stock at 1972 prices; in million pesos

LE_{rp} : refinery fuel and loss including production of non-energy petroleum by-products; in 10^{10} kilocalories

LE_T : total system energy losses in transformation sector; in 10^{10} kilocalories

M : total imports of goods and services at 1972 prices; in million pesos

M* : total imports of goods and services at current prices; in million pesos

Me : energy imports at 1972 prices; in million pesos

ME : energy imports; in 10^{10} kilocalories

ME* : energy imports at current prices; in million pesos

ME_{co} : imports of coal; in 10^{10} kilocalories

ME_{cp} : imports of crude petroleum; in 10^{10} kilocalories
Mne : non-energy imports at 1972 prices; in million pesos
Mne* : non-energy imports at current prices; in million pesos
N : total employment index; 1972 = 100
NFA : net foreign assets of the monetary system; in million pesos
P : price index for gross domestic product; 1972 = 100
p : semestral inflation rate in percent
P_{Cg} : price index for government consumption expenditures; 1972 = 100
P_{Cp} : price index for private consumption expenditures; 1972 = 100
P_I : price index for investment expenditures; 1972 = 100
Pe : price index for total system energy consumption net of refinery fuel and loss; 1972 = 100
Pe_C : price index for energy consumption of consuming sector; 1972 = 100
Pe_{co} : price index for coal consumption; 1972 = 100
Pe_{el} : price index for electrical energy consumption; 1972 = 100
Pe_{nel} : price index for non-electrical energy consumption; 1972 = 100
Pe_{rp} : price index for refined petroleum products consumption; 1972 = 100
Pme : peso price index for energy imports; 1972 = 100
$Pme : dollar price index for energy imports; 1972 = 100
Pmne : peso price index for non-energy imports; 1972 = 100
Px : peso price index for exports; 1972 = 100
PE : total system energy production; in 10^{10} kilocalories
pe : weighted average price of total system energy consumption net of refinery fuel and loss; in million pesos per 10^{10} kilocalories
pe_C : weighted average price of energy consumption of consuming sector; in million pesos per 10^{10} kilocalories
pe_{co} : weighted average price of coal; in million pesos per 10^{10} kilocalories
pe_{el} : marginal price of electricity; in million pesos per 10^{10} kilocalories
pe_{nel} : weighted average price of non-electrical energy; in million pesos per 10^{10} kilocalories
PE_{rp} : production of refined energy petroleum products; in 10^{10} kilocalories
pe_{rp} : weighted average price of refined energy petroleum products; in million pesos per 10^{10} kilocalories
PPE : total production of primary energy; in 10^{10} kilocalories
pp_{rp} : weighted average posted price (pre-tax) of refined energy petroleum products; in pesos per 10^{10} kilocalories
$pdcp : duty paid landed cost of crude petroleum imports; in million dollars per 10^{10} kilocalories

$pme : weighted average price of refined energy petroleum products imports; in million dollars per 10^{10} kilocalories
R : weighted average interest rate on deposit substitutes; in percent per annum
T : total tax revenues at 1972 prices; in million pesos
T* : total tax revenues at current prices; in million pesos
Te* : energy tax revenues at current prices; in million pesos
Tne* : non-energy tax revenues at current prices; in million pesos
TIne* : non-energy indirect tax revenues at current prices; in million pesos
W : money wage index for unskilled labor; 1972 = 100
X : total exports of goods and services at 1972 prices; in million pesos
Y : gross domestic product at 1972 prices; in million pesos
Y* : gross domestic product at current prices; in million pesos
Y′ : gross output defined as gross domestic product plus the real value of intermediate energy inputs; in million pesos
Z : total liquidity at the end of the semester; in million pesos
Z′ : average of beginning and end of the semester total liquidity; in million pesos

Exogenous Variables:

BE_{rp} : refined energy petroleum products used for bunkering purposes; in 10^{10} kilocalories
Cg* : government consumption expenditures at current prices; in million pesos
CPS : claims on the private sector of the monetary system; in million pesos
Ds : semestral dummy variable; Ds = 1 for first semester
= 0 for second semester
De : dummy variable for energy crisis period; De = 1 after 1973
= 0 1973 and before
ed : equalization difference for refined energy petroleum products; in million pesos per 10^{10} kilocalories
er : peso to dollar exchange rate; in pesos per dollar
F* : net other sources of financing the fiscal deficit including errors and omissions; in million pesos
I_g* : government investment expenditures at current prices; in million pesos
ΔInv_{cp} : increase in crude petroleum inventory; in 10^{10} kilocalories
ΔInv_{rp} : increase in refined energy petroleum products inventory; in 10^{10} kilocalories
K_f* : net foreign capital inflows including errors and omissions; in million pesos

ME_{rp} : imports of refined energy petroleum products; in 10^{10} kilocalories
NOL : net other liabilities of the monetary system; in million pesos
$\$Pm_{ne}$: dollar price index of non-energy imports; 1972 = 100
$\$Px$: dollar price index of exports; 1972 = 100
PE_{co} : production of coal; in 10^{10} kilocalories
PE_{cp} : production of crude petroleum; in 10^{10} kilocalories
PE_{hg} : production of hydro-geothermal energy; in 10^{10} kilocalories
$\$pc_{co}$: C.I.F. dollar price of coal imports; in million dollars per 10^{10} kilocalories
pd_{co} : price of domestically produced coal; in million pesos per 10^{10} kilocalories
$\$pc_{cp}$: C.I.F. dollar price of crude petroleum imports; in million dollars per 10^{10} kilocalories
$\$pc_{rp}$: C.I.F. dollar price of refined energy petroleum products imports; in million dollars per 10^{10} kilocalories
TD* : total direct tax revenues at current prices; in million pesos
t : time; 1970 first semester = 1
tm_{cp} : import duty on crude petroluem; in percent
t_s : weighted average specific tax on refined energy petroleum products; in million pesos per 10^{10} kilocalories
t_{sf} : weighted average special fund tax on refined energy petroleum products; in million pesos per 10^{10} kilocalories
X* : total exports of goods and services at current prices; in million pesos
XE_{rp} : exports of refined energy petroleum products; in 10^{10} kilocalories

A MACROECONOMETRIC ENERGY POLICY SIMULATION MODEL FOR THE PHILIPPINES: STRUCTURAL EQUATIONS

(Estimation Methods: OLS and OLS with Autocorrelation Correction)

Part I. Energy Sub-Model

Crude Petroleum and Refined Petroleum Products

(1) $ME_{cp} = CE_{cp} - PE_{cp} + \Delta Inv_{cp}$

(2) $CE_{cp} = 281.91584 + \underset{(22.24327)}{1.01140}\ PE_{rp}$

$\bar{R}^2 = 0.96483$ S.E.E. = 58.85175
D.W. = 1.80725 ρ = 0.66397

$$(3)\quad PE_{rp} = CE_{rp} - GE_{rp}$$

$$(4)\quad GE_{rp} = ME_{rp} - XE_{rp} - BE_{rp} - \Delta Inv_{rp}$$

$$(5)\quad CE_{rp} = \underset{}{774.25944} - \underset{(-1.77527)}{231.37450\left(\frac{Pe_{rp}}{P}\right)} + \underset{(9.67260)}{0.12351\,Y} + \underset{(2.03061)}{83.22202\,Ds}$$

$\bar{R}^2 = 0.92540$ S.E.E. = 121.40701

D.W. = 2.01513 ρ = 0.330745

Coal and Hydro-geothermal Power

$$(6)\quad ME_{co} = CE_{co} - PE_{co}$$

$$(7)\quad CE_{co} = -189.02496 + \underset{(2.25612)}{33.40527\left(\frac{P}{Pe_{co}}\right)} + \underset{(7.69469)}{0.00603\,Y}$$

$\bar{R}^2 = 0.82767$ S.E.E. = 12.7074

D.W. = 1.50569

$$(8)\quad CE_{hg} = PE_{hg}$$

Total System Energy Consumption

$$(9)\quad CPE = CE_{op} + CE_{co} + CE_{hg}$$

$$(10)\quad CE' = CPE + GE_{rp}$$

$$(11)\quad CE = CE' - LE_{rp}$$

$$(12)\quad CE^* = pe_{rp} \cdot CE_{rp} + pe_{co} \cdot CE_{co} + pe_{el} \cdot CE_{hg}$$

Energy Consumption in Consuming Sector

$$(13)\quad CE_C \quad 1385.8334 - \underset{(-3.23654)}{354.11914\left(\frac{Pe_C}{P}\right)} + \underset{(9.10279)}{0.09308\,Y}$$

$\bar{R}^2 = 0.86973$ S.E.E. = 106.59091

D.W. = 2.07567 ρ = 0.37417

$$(14)\quad CE_{Cnel} = 1206.7609 - \underset{(-3.63138)}{315.95435\left(\frac{Pe_{nel}}{P}\right)} + \underset{(9.77277)}{0.08825\,Y}$$

$\bar{R}^2$ = 0.91060 S.E.E. = 99.88461

D.W. = 2.05846 ρ = 0.158945

(15) $CE_{Cel} = CE_C - CE_{Cnel}$

Energy Losses in Transformation Sector

(16) $LE_T = CE' - CE_C$

(17) $LE_{rp} = CE_{cp} - PE_{rp}$

Total System Energy Production and Imports

(18) $PE = PE_{rp} + PE_{co} + PE_{hg}$

(19) $PPE = PE_{cp} + PE_{co} + PE_{hg}$

(20) $ME = ME_{cp} + ME_{rp} + ME_{co}$

(21) $ME^* = (\$pme \cdot er) \cdot ME$

Energy Prices

(22) $pe_{rp} = pp_{rp} + t_s + t_{sf} + ed$

(23) $pp_{rp} = 0.07711 + 0.71426\ (\$pd_{cp} \cdot er) + 0.28568\ pp_{rp} - 1$

(17.24408) (6.27231)

$\bar{R}^2$ = 0.99678 S.E.E. = 0.01954

D.W. = 2.04613

(24) $\$pd_{cp} = \$pc_{cp}\ (1 + tm_{cp})$

(25) $pe = (CE^*/CE)$

(26) $pe_C = (pe_{nel} \cdot CE_{cnel} + pe_{el} \cdot CE_{cel})/CE_C$

(27) $pe_{nel} = -0.01413 + 1.09956\ pe_{rp}$

(174.49739)

$\bar{R}^2$ = 0.99941 S.E.E. = 0.1116

D.W. = 1.98380 ρ = 0.072895

(28) pe_{el} = $-0.46436 + 6.58941\ pe_{rp} - 6.00206\ (De \cdot pe_{rp}) + 3.87504\ De$

(2.10690) (−1.91251) (4.45855)

$\bar{R}^2$ = 0.97779 S.E.E. = 0.21202

D.W. = 1.58376

(29) \$pme = $(\$pc_{cp} \cdot ME_{cp} + \$pc_{rp} \cdot ME_{rp} + \$pc_{co} \cdot ME_{co})/ME$

(30) pe_{co} = $(\$pc_{co} \cdot er \cdot ME_{co} + pd_{co} \cdot PE_{co})/CE_{co}$

(31) Pe_{rp} = $(pe_{rp}/0.25926) \cdot 100$

(32) Pe_{co} = $(pe_{co}/0.08728) \cdot 100$

(33) Pe_{el} = $(pe_{el}/1.43299) \cdot 100$

(34) Pe = $(pe/0.29558) \cdot 100$

(35) Pe_C = $(pe_C/0.34930) \cdot 100$

(36) Pe_{nel} = $(pe_{nel}/0.26434) \cdot 100$

(37) \$Pme = $(\$pme/0.01695) \cdot 100$

(38) Pme = $(\$Pme \cdot ER)/100$

Energy Efficiency

(39) EE = Y/CE

(40) EE_{rp} = PE_{rp}/CE_{cp}

Energy Self-Sufficiency

(41) ES = PPE/CE′

(42) ES_{cp} = PE_{cp}/CE_{cp}

Part II. Macroeconomic Sub-Model

Aggregate Production

(43) $\left(\frac{Y'}{N}\right) = 7.43677 + 0.05339 \left(\frac{K}{N}\right) + 3.31591 \left(\frac{CE}{N}\right) + 1.65788\ t$

(2.28992) (3.07811) (3.82845)

$\bar{R}^2 = 0.88048$ S.E.E. = 7.22310

D.W. = 1.95568 $\rho = 0.059715$

(44) $Y = Y' - Ce$

(45) $Ce = (CE^*/Pe) \cdot 100$

(46) $K = K_{-1} + I_{-1}$

(47) $Y^* = (P.Y_{ii})/100$

Aggregate Expenditures

(48) $C_p = 439.46484 + 0.10627\ (Y-T)$

(2.45688)

$+\ 0.85911\ C_{p-1} + 233.65666\ Ds$

(11.53529) (2.60759)

$\bar{R}^2 = 0.99603$ S.E.E. = 194.84009

D.W. = 2.47377

(49) $C_g = (C_g^*/P_{Cg}) \cdot 100$

(50) $C = C_p + C_g$

(51) $C^* = (C_p \cdot P_{Cp})/100 + C_g^*$

(52) $I = Y - C - X + M$

(53) $I_g = (I_g^*/P_I) \cdot 100$

(54) $I_p = I - I_g$

Employment and Wages

(55) $N = 98.686886 + 0.00204\ Y - 0.88565\ W + 0.32205\ P$

(2.93331) (−2.40759) (3.86443)

$\bar{R}^2 = 0.93755$ S.E.E. = 3.07703

D.W. = 1.81929 $\rho = 0.12115$

$$(56)\quad W = 25.20401 + 0.13295\,P + 0.62206\,W_{-1}$$
$$\qquad (3.27490) \quad (5.40166)$$

$\bar{R}^2 = 0.98639$ S.E.E. = 2.25219
D.W. = 2.62790

Prices

$$(57)\quad P = -313.69409 + 0.11832\,Pe_C + 84.51352\,\ln W + 0.00134\,Z'$$
$$\qquad (2.80687) \quad (1.78468) \quad (2.91641)$$

$\bar{R}^2 = 0.97930$ S.E.E. = 7.88799
D.W. = 1.16420

$$(58)\quad p = \left(\frac{P - P_{-1}}{P_{-1}}\right) \cdot 100$$

$$(59)\quad P_{Cp} = -18.02322 + 0.11231\,Pe_C + 0.90659\,W + 0.00133\,Z$$
$$\qquad (3.67021) \quad (2.22420) \quad (3.14005)$$

$\bar{R}^2 = 0.99010$ S.E.E. = 5.7155
D.W. = 1.28629

$$(60)\quad P_{Cg} = -49.77615 + 0.07409\,Pe_C + 1.02817\,W + 0.41690\,P_{Cg-1}$$
$$\qquad (2.41376) \quad (2.32565) \quad (2.73154)$$

$\bar{R}^2 = 0.98813$ S.E.E. = 5.74524
D.W. = 2.82276

$$(61)\quad P_I = \left(\frac{Y^* - C^* - X^* + M^*}{I}\right) \cdot 100$$

Money and Interest

$$(62)\quad \frac{Z'}{P} = 11.63232 - 4.61409\,R + 0.00567\,Y + 22.99557\,De - 4.96257\,Ds$$
$$\qquad (-2.96679) \quad (8.65170) \quad (2.66970) \quad (-1.54060)$$

$\bar{R}^2 = 0.97370$ S.E.E. = 6.89085
D.W. = 2.12518 ρ = 0.0542

$$(63)\quad Z = Z_{-1} + (CPS - CPS_{-1}) + (CGS - CGS_{-1}) + (NFA - NFA_{-1}) - (NOL - NOL_{-1})$$

$$(64)\quad Z' = (Z + Z_{-1})/2$$

Government Revenues and Expenditures

(65) $CGS - CGS_{-1} = Cg^* + Ig^* - T^* - F^*$

(66) $T^* = Te^* + Tne^*$

(67) $Te^* = (t_s + t_{sf}) \cdot CE_{rp} + t_{mcp} (\$pc_{cp} \cdot er \cdot ME_{cp})$

(68) $Tne^* = TD^* + TIne^*$

(69) $TIne^* = -56.042906 + 0.04548\ Y^*\ 0.49099\ TIne^*_{-1}$

$$(2.51586) \quad (2.09170)$$

$\bar{R}^2 = 0.93991$ S.E.E. = 473.56201

D.W. = 1.87082 = 0.210605

(70) $T = (T^*/P) \cdot 100$

Balance of Payments

(71) $NFA - NFA_{-1} = X^* - M^* + K_f^*$

(72) $M^* = ME^* + Mne^*$

(73) $Mne^* = (Pmne \cdot Mne)/100$

(74) $M = Me + Mne$

(75) $Me = (ME^*/Pme) \cdot 100$

(76) $Mne = 2352.5435 + 0.09610\ Y - 1664.18237\ (\frac{Pmne}{P}) + 11.37831\ Px$

$$(4.11101) \quad (-2.32911) \quad (4.86780)$$

$\bar{R}^2 = 0.92149$ S.E.E. = 279.57129

D.W. = 2.17761 = 0.19946

(77) $X = (X^*/Px) \cdot 100$

(78) $ER = (er/6.67105) \cdot 100$

(79) $Px = (\$Px \cdot ER)/100$

(80) $Pmne = (\$Pmne \cdot ER)/100$

Crude Petroleum and Refined Petroleum Products. Equation (1) is an accounting identity defining crude petroleum imports (ME_{cp}) in terms of the domestic crude petroleum consumption-production gap ($CE_{cp}-PE_{cp}$) and demand for inventory accumulation (ΔInv_{cp}). Domestic production and change in inventory are treated as exogenously determined variables subject to influence by energy policy as exemplified by a vigorous oil exploration program or a contingency plan of stockpiling crude petroleum. Total imports of crude petroleum can therefore be divided into consumption demand by oil refineries and a policy-determined demand for inventory accumulation net of domestic production.

The domestic demand for crude petroleum (CE_{cp}) is actually a *derived* demand from oil refineries' crude oil input requirements needed to satisfy a given output of refined petroleum products (PE_{rp}). An estimate of this raw material-intensive technical input-output relation is given in equation (2) (all units in 10^{10} kilocalories). The marginal crude input requirement of petroleum refineries is $\frac{\partial CE_{cp}}{\partial PE_{rp}} = 1.0114$ while the computed elasticity for 1979 (second semester) is

$$e(CE_{cp}, PE_{rp}) = \frac{\partial CE_{cp}}{\partial PE_{rp}} \cdot \frac{PE_{rp}}{CE_{cp}} = 0.938 \cdot$$

Production of refined petroleum products is less than the consumption of crude petroleum because of transformation losses, energy consumed by refineries, and production of non-energy by-products (eqn. [17]). The energy conversion efficiency (EErp) of petroleum refineries (as defined in eqn. [40]) may also be derived from eqn. (2) as follows:

$$EE_{rp} = \frac{PE_{rp}}{CE_{cp}} = 0.98873 - \frac{278.73822}{CE_{cp}}$$

From this we can infer that, over time, EE_{rp} improves as CE_{cp} increases:

$$\frac{EE_{rp}}{CE_{cp}} = \frac{278.73822}{CE_{cp}^{\ 2}} > 0$$

Production of refined petroleum products (PE_{rp}) is determined in eqn. (3) as the difference between total consumption of refined petroleum products (CE_{rp}) and net supply from other sources of refined petroleum products (GE_{rp}). GE_{rp} is defined in equation (4) as equal to net imports ($ME_{rp} - XE_{rp}$) less bunker sales (BE_{rp}) and inventory change (Inv_{rp}) in refined petroleum products. Again, inventory accumulation of refined petroleum products can be considered a policy instrument.

Eqn. (5) gives the demand for refined petroleum products (CE_{rp}) as a function of its real price (Pe_{rp}/P), an activity variable (Y) and a seasonal dummy (Ds). Price elasticity estimates show that demand for refined petroleum products has become more price elastic over time although in absolute terms, it is still very price inelastic. Its price elasticity in the first semester of 1973 (pre-energy crisis) was –0.048 as compared to –0.100 in the first semester of 1979 indicating the increasing importance of prices as an energy conservation tool.

Income (GDP) elasticity of demand for refined petroleum products, on the other hand, is almost unitary (0.973 in the second semester of 1979). This estimate is substantially lower than the Ministry of Energy's official estimate of about 1.5 (for petroleum consumption) as well as an earlier estimate by Gonzalo.[4/] The disparity could be attributed to the difference in the time period used in the estimation. While the Ministry of Energy and Gonzalo used annual data which extends even to the 1960s (an era of cheap energy), we utilized semestral data for the more recent period (1970s) of high cost energy and conservation that could have significantly changed this parameter.

A semestral intercept dummy (Ds) is also found to shift first semester consumption of refined petroleum products by 83.22×10^{10} kilocalories, or about two percent of total consumption.

Coal and Hydro-geothermal Power. Coal imports (ME_{co}) (eqn. [6]) fill the domestic coal consumption-production gap. For lack of coal inventory data or *actual* consumption figures, our coal consumption data are really *apparent* consumption derived implicitly from production and trade figures.[5/]

Domestic demand for coal (CE_{co}) was found to be significantly related to the reciprocal of its real price (P/Pe_{co}) and gross domestic product (Y) (eqn. [7]). In this particular specification, demand for coal becomes more price inelastic over time. Its price elasticity estimate for second semester of 1979 is –0.248 compared to its elasticity at mean values of –0.663, implying the growing importance of coal as an alternative energy source.

Income elasticity for coal, on the other hand, is very high (3.495 in the second semester of 1979 and 5.506 at the means). Although coal is becoming less income elastic, its current income elasticity is still substantially high indicating its potential as another energy source.

An alternative commercial energy source is hydro-geothermal electricity whose consumption (CE_{hg}) we just equate to an exogenously determined

[4/]See Ministry of Energy (6) and Gonzalo (3).

[5/]A similar concept of apparent consumption applied to energy data is used by the U.N. See (8).

production level (PE_{hg}) as in eqn. (8). For obvious reasons, there is no inventory change nor trade in hydro-geothermal power. Production of hydro-geothermal electricity can be treated as partly policy-influenced considering the government's hydro-geothermal power development program.

Total System Energy Consumption. Eqns. (9)-(11) define three alternative concepts of the economy's total energy consumption. The most common way is to define it in terms of consumption of primary energy inputs (CPE) of crude petroleum, coal and hydro-geothermal electricity as given in eqn. (9). However, a better alternative would be to adjust this for consumption from net energy trade and inventory change of refined petroleum products (GE_{rp} in eqn. [4]). In eqn. (10), CE′ provides a more comprehensive definition incorporating these refinements. CE′ in effect defines energy consumption by all consuming sectors including all losses in energy transformation in both petroleum refining and electricity generation and transmission. Still, a third definition (CE) which is a variant of CE′ is given in eqn. (11) and is really a post-petroleum refinery definition of total energy consumption since it excludes refinery losses and production of energy by-products (LE_{rp} in eqn. [17]). As can be seen later, among these three definitions, CE proved to be the most significant variable in the economy's aggregate production function. CE* in eqn. (12) values CE in terms of individual energy products consumption and their respective prices.

Energy Consumption in Consuming Sector. The consuming sector consists of households and the non-energy producing industries. It, therefore, excludes petroleum refineries and electrical utilities which are classified under the energy transformation sector. We have broadly divided energy consumption by the consuming sector into two forms: electrical and non-electrical energy. Non-electrical energy consumption consists mainly of refined petroleum products and a relatively small share of coal.

Total energy demand function for the consuming sector (CE_C) is given in eqn. (13). The implied price elasticity in 1973 (second semester) is −0.084 becoming more elastic in 1979 (second semester) with an estimate of −0.176. Income elasticity, on the other hand, is close to unity with a value of 0.912 in 1979 (second semester).

Consumption of non-electrical energy by the consuming sector (CE_{Cnel}) as given in eqn. (14) implies a mean price elasticity of −0.157 and mean income elasticity of 0.824. These compare with 1979 (second semester) values of −0.204 and 0.958, respectively.

Consumption of electrical energy by the consuming sector (CE_{Cel}) is the difference between its consumption of total energy (CE_C) and non-electrical energy (CE_{Cnel}) as given by eqn. (15). It can be shown from eqns. (13), (14), (15), (26), (33) and (35) that the price elasticity of demand for electrical energy by the consuming sector can be expressed as

$$e(CE_{Cel}, (\frac{Pe_{el}}{P})) = -1452.76034 (\frac{Pe_{el}/P}{CE_C})$$

while the income elasticity is given by

$$e\ (CE_{Cel}, Y) = 0.00483\ (\frac{Y}{CE_{Cel}})$$

The computed price and income elasticity for electricity consumption for second semester of 1979 is –0.356 and 0.487, respectively, compared with their respective second semester 1973 estimates of –0.358 and 0.538. Demand for electrical energy is, therefore, more price elastic compared to non-electrical energy (mainly refined petroleum products). This could be explained by the fact that the absolute price of electricity is several times higher than the other secondary energy products and, therefore, solicits very strong substitution and conservation responses. Consumption of electrical energy is, however, seen to be quite income inelastic as compared to the almost unitary elasticity for non-electrical energy.

Energy Losses in Transformation Sector. Total system energy losses in conversion, transformation and production of non-energy by-products (LE_T) is derived in eqn. (16) as the difference between total system energy consumption (CE′) and productive energy consumption of the consuming (non-energy producing) sector (CE_C). LE_T would thus consist of energy losses in both petroleum refineries and electrical utilities. Eqn. (17), on the other hand, focuses on oil refinery losses in transforming crude petroleum into refined petroleum products (LE_{rp}).

Total System Energy Production and Imports. Eqn. (18) defines total post-refinery energy production (PE) as the sum of the production of refined petroleum products (PE_{rp}), coal (PE_{co}) and hydro-geothermal power (PE_{hg}). This definition, however, would include a substantial input of imported crude oil used in producing PE_{rp}. Thus we can redefine total system energy production to include only primary indigenous energy sources (PPE) as given in eqn. (19). Total energy imports (ME) is simply the sum of crude petroleum (ME_{cp}), refined petroleum products (ME_{rp}) and coal imports (ME_{co}) (eqn. 20). This can also be expressed in peso terms (ME*) as in eqn. (21).

Energy Prices. The pricing mechanism in the petroleum industry is summarized in eqns. (22) – (24). Because of data constraints, we decided to measure prices of refined petroleum products at the wholesale level (ex-Pandacan), instead of retail or pump prices. As such, the price data used do not include the dealer's mark-up and freight charges which varies according to distance. In eqn. (22), the price of refined petroleum products (pe_{rp}) (in million pesos/10^{10} kilocalories) is decomposed into pp_{rp}, the wholesale posted price (re-tax), and the tax components consisting of specific taxes

(t_s), the special fund contribution (t_{sf}), and the equalization difference (ed).

The pre-tax wholesale price, on the other hand, is postulated in eqn. (23) to be behaviorally related to the so-called duty-paid landed cost of crude petroleum ($\$pd_{cp}$) and the exchange rate (er). This is a very important relation that captures the resultant price behavior (including lags) of both oil firms and government's institutional price-setting. Implied elasticity of pp_{rp} with respect to ($\$pd_{cp} \cdot er$) in 1979 (second semester) is 0.728 in the short run and 1.019 in the long run, higher than the pre-energy crisis (second semester 1973) values of 0.532 and 0.744, respectively, and implying an increasing response of domestic prices of petroleum products to the duty-paid landed cost. The equation also indicates a rapid domestic posted price adjustment with a mean lag of only 0.40 semester or 2.4 months, with approximately 71.4 per cent of total response of pp_{rp} felt during the current period.

The duty-paid landed cost of crude petroleum, for our purpose, is defined as the dollar C.I.F. price ($\$pc_{cp}$) plus the *ad valorem* tariff on crude petroleum ($tm_{cp} \cdot \$pc_{cp}$) as seen in eqn. (24).

Eqn. (25) defines the average price of energy (net of oil refinery losses) consumed by the entire economy (pe) while eqn. (26) gives the effective energy price charged to the consuming sector (pe_C) as a weighted price of electrical (pe_{el}) and non-electrical (pe_{nel}) energy. In first semester 1979, pe and pe_C were about ₱1.68 and ₱2.04 million (both per 10^{10} kilocalories), respectively, compared to only ₱0.24 million and ₱0.29 million, respectively, in first semester 1970.

Non-electrical energy price (pe_{nel}) is related to the price of refined petroleum products (pe_{rp}), its main component (eqn. [27]). Computed elasticity at the means of pe_{nel} with respect to pe_{rp} is 1.016.

Likewise, electricity price (pe_{el}) is determined by the price of refined petroleum products, these being the major input to electricity production (eqn. [28]). A slope and intercept dummy variable for the energy crisis period (DE = 1 after 1973, 0 otherwise) came out significant. The slope dummy variable drastically reduced the coefficient of pe_{rp} from 6.589 to 0.587 while the intercept shifted by 3.875. The resulting elasticity estimates of pe_{el} with respect to pe_{rp} were 1.376 in second semester 1973 (pre-energy crisis) and 0.233 in second semester 1979 (during energy crisis). This drop in the elasticity values reflects perhaps a change in the institutional price-setting behavior of government authorities in reluctantly granting rate increases in electricity despite spiralling oil prices because of the strong pressure from electricity consumers.

Eqn. (29) defines the effective dollar import price of energy imports ($\$pme$) while eqn. (30) gives the effective domestic price of coal (pe_{co}) as a weighted average of domestically produced (pd_{co}) and imported ($\$pc_{co}$) coal. Eqns. (31) – (38) transforms actual energy prices into indices (1972 = 100).

Energy Efficiency and Self-Sufficiency Ratios. Macroeconomic energy efficiency (EE) is defined as gross domestic product (Y) per unit of energy input (CE) (eqn. [39]). *A priori,* we would expect this to be increasing from the onset of the energy crisis as conservation measures are adopted. Eqn. (40) focuses on the efficiency of energy conversion in the petroleum refineries (EE_{rp}). Here we define energy efficiency as refined petroleum products output (PE_{rp}) per unit of crude petroleum input (CE_{cp}). Historically, this ratio has also been improving as was shown previously.

Energy self-sufficiency (ES) can be measured by the ratio between indigenous production of primary energy (PPE) and total energy consumption (inclusive of losses) of the economy (CE′) as in eqn. (41). Self-sufficiency in crude petroleum (ES_{cp}) alone can also be measured as the ratio of domestic production of crude petroleum (PE_{cp}) to total crude petroleum consumption (CE_{cp}) (eqn. [42]).

Marcoeconomic Sub-Model

The macroeconomic sub-model provides an integrating framework that links the energy variables with economic variables. It is general in nature and contains equation blocks for aggregate production and expenditures, wage rates and prices, money supply and demand, government revenues and expenditures, and the balance of payments.

In view of the constraint imposed by energy inputs on the economy, the model is constructed with a basically supply-determined framework.

Aggregate Production. Eqn. (43) is a modified aggregate production function which is really a linearized version of a constant returns to scale production function with three inputs, namely, labor (N), capital (K) and energy (CE), and a shift parameter (t). The inclusion of an intermediate input, energy, necessitates a redefinition of output from a value-added concept (returns to primary factors) such as GDP (Y) to gross output (Y′) defined to include the r 1 value of intermediate energy input (Ce) as given in eqn. (45). Aggregate supply, however, is not Y′ but Y or GDP (eqn. [44]) in conformity with national income accounting.

We could rewrite eqn. (43) in the following form:

$$Y' = (7.43677 + 1.65788\ t)\ N + 0.05339\ K + 3.31591\ CE$$

from which we could readily infer the marginal product of each factor input:

$$\frac{\partial Y'}{\partial N} = 7.43677 + 1.65788\ t$$

$$\frac{\partial Y'}{\partial K} = 0.05339$$

$$\frac{\partial Y'}{\partial CE} = 3.31591$$

The marginal productivity of labor is seen to be increasing over time. This seems plausible considering the more rapid growth of capital stock relative to labor as evidence by the increase in the capital-output ratio from about 6.0 (semestral basis) in the 1950s to around 9.0 at present. In the absence of actual employment data by semester (call this N', in thousands), we have used the Central Bank employment index for N. However, to compute for the marginal productivity per unit of employment (instead of per index point), it is necessary to have an auxilliary equation linking N' and N. After adjusting available NCSO employment data (mostly May and October figures) to approximate semestral average, we came out with rough transformation equations linking N' and N.

$$\text{OLS:} \quad N' = -671.56250 + \underset{(9.31185)}{124.97484}\, N$$

$$R^2 = 0.83449 \qquad D.W. = 1.12114$$

$$\text{OLSAC:} \quad N' = 1160.80240 + \underset{(5.64291)}{109.58311}\, N$$

$$R^2 = 0.64467 \qquad D.W. = 1.46381 \qquad \rho = 0.43943$$

Using the second equation (with autocorrelation correction) the marginal productivity per unit of labor can be computed as follows:

$$\left(\frac{\partial Y'}{\partial N'}\right) = \left(\frac{\partial Y'}{\partial N}\right)\left(\frac{\partial N}{\partial N'}\right) = \frac{7.43677 + 1.65788\, t}{109.58311}$$

The computed marginal productivity of labor for second semester 1979 is ₱741 per year at constant 1972 prices or about ₱1,918 in current prices. This is also increasing at the rate of ₱30 per year in real terms or ₱78 in current prices. The value of marginal product of labor is substantially lower (less than one-half) than the actual basic wage rate of common laborers in 1979. This finding supports our contention in a later section that wages are set not by labor supply and demand considerations but by some institutional mechanism responding to price movements with some lag.

The computed marginal productivity of capital of 5.3 percent per semester or about 11.0 percent per annum (compounded) seems a reasonable estimate when compared to actually prevailing rates of return. However, the marginal productivity of energy input of about ₱3.31 million per 10^{10} kilocalories is almost twice the observed actual price of energy (₱1.68 million per 10^{10} kilocalories in second semester 1979) indicating that energy is still relatively underpriced when compared to its contribution to output.

Eqn. (46) is our definition of capital stock (K) while eqn. (47) transforms real GDP into current terms (Y*).

Aggregate Expenditures. The consumption function (C_p) in eqn (48) follows a Koyck lag formulation. Aside from disposable income, we also introduce a semestral dummy (Ds) to account for seasonality. The marginal propensity to consume is seen to be 0.11 in the short run and increases to its long run value of 0.75.

Real government consumption (C_g) is determined in eqn. (49) from the exogenously given current value of government consumption (C_g*) and its price index (P_{Cg}). Fiscal planners estimate revenues and expenditures in nominal terms, hence C_g* instead of C_g is treated as a policy variable. Total real and current consumption are defined in eqns. (50) and (51), respectively.

Total real investment (I) is determined from the national income accounting identity in eqn. (52). As in government consumption, current government investment (I_g*) is taken as policy-determined and real government investment (I_g) is found by deflating I_g* with the investment index (P_I) (eqn. [53]). Private investment (I_p) is then the difference between total investment and government investment (eqn. [54]).

Employment and Wages. In our employment equation (eqn. [55]), labor demand (N) is a function of an activity variable, GDP (or Y), wage rate index (W) and the GDP deflator (P). N is seen to have an inelastic response to Y, its elasticity being 0.650 in second semester 1979. Nominal wage is also seen to have a stronger impact than price, their elasticity estimates for second semester 1979 being –0.938 for wage and 0.600 for price. *Ceteris paribus,* price would have to grow by about one and one-half times the growth in wages if employment level is to be maintained.

For wage behavior, we postulate an institutionally set wage rate either through minimum wage legislations or collective bargaining agreements aimed at regaining labor's purchasing power. The net effect is seen to be an incomplete lagged indexation pattern of wages to prices. In eqn. (56), a simple Koyck lag is introduced in order to estimate wage reaction (W) to price (P) increases. In terms of elasticities (computed for second semester 1979), a short run (first period) elasticity of wages with respect to prices of 0.232 is estimated, or only 37.8 percent of the long run elasticity of 0.615. The computed mean lag of 1.646 semesters implies that it takes about 10 months before even one-half the full wage response to a price increase is felt. Wages, therefore, are not only inelastically adjusted to prices, but also lag significantly behind prices.

Prices. The price level (P) equation (eqn. [57]) is a mixed explanation for inflation. Cost push factors are embodied in the energy price index variable (Pe_C) and the wage rate (W). We also include a monetary variable, domestic liquidity (Z'), considering the rapid growth of money supply in recent years and its high correlation with prices. Pe_C, the effective energy price index for the consuming sector, came out more significantly in the price equation than Pe, the effective energy price index for the economy (inclusive of transformation losses), and was therefore used. Pe_C represents not only price movements in imported crude oil prices but also changes in policy-controlled taxes in energy consumption and tariffs on energy imports as well as movements in the exchange rate.

Eqns. (56) and (57) jointly exhibit a feedback mechanism between wages and prices. Computed elasticities of prices with respect to energy price, wages and domestic liquidity for second semester 1979 are 0.267, 0.326 and 0.285, respectively. The relatively high elasticity of prices with respect to wages can probably be attributed to the relatively higher share of the wage bill compared, for example, to energy expense in the cost of production. However, the particular form of the wage variable (1n W) in eqn. (57) shows a declining importance of wage increases and an increasing significance for energy price and monetary expansion over time as primary determinants of inflation. The elasticity estimates for 1979 are higher than the mean elasticities with respect to energy price (0.214) and money supply (0.228) but elasticity with respect to wages exhibited a decline from its mean value of 0.542. Eqn. (58) computes for the semestral inflation rates (p) in terms of the GDP deflator (P).

Consumer prices, as represented by the deflator for personal consumption expenditures (P_{CP}) is similarly linked to energy price in the consuming sector (Pe_C), wages (W) and domestic liquidity (Z). Elasticity estimates of P_{Cp} with respect to Pe_C, W and Z in second semester 1979 are 0.247, 0.505 and 0.287, respectively.

The Koyck lag formulation is done for the deflator for government consumption (P_{Cg}) in eqn. (60). We do not include a monetary variable in the specification. A slow reaction of P_{Cg} to changes in energy prices and wages is seen with a mean lag of 0.71 semesters or 4.3 months. This can probably be explained by the fact that most of Cg are government purchases of labor services whose wages, in particular, have been shown to be slow in responding to price increases. Computed short run elasticity for first semester 1979 is 0.437 while long run elasticity is 1.086.

In order not to overdetermine the system, the deflator for investment (P_I) is derived residually from the ratio between current investment expenditures and real investment expenditures (eqn. [61]).

Money and Interest Rate. In this model, we adopt the broad definition of money supply (commonly referred to as M_3) or domestic liquidity (our Z). Eqn. (63) presents a simplified accounting of period to period changes in money supply and its components, as found in the monetary survey of the Central Bank. Domestic credits to the private sector (CPS) is assumed to be policy-controlled through the traditional Central Bank monetary tools. Credits to the government sector (CGS) and net foreign assets (NFA), however, are endogenous to the model and are determined in the fiscal and balance of payments equations, respectively.

In the demand for money equation (eqn. [62]), on the other hand, we have redefined Z (beginning of period balance) to Z′ (semestral average balance) as given in eqn. (64). Money demand (in real terms) is specified as a function of the effective interest rate (R), gross domestic product (Y), a seasonal dummy variable (Ds) and another dummy variable that captures a structural shift implied by the energy crisis period (De = 1 from first semester 1974 to second semester 1979). This particular specification constrains the elasticity of Z′ with respect to P to unity. Money demand is seen to be inelastic with respect to the interest rate (–0.306 at the means, –0.284 in second semester 1979). However, it is elastic with respect to GDP with a value of 1.276 at the means and 1.239 in second semester 1979.

Eqns. (62) and (64) (together with [63]) jointly solve for domestic liquidity (Z′ and Z) and the interest rate (R).

Government Revenues and Expenditures. Eqn. (65) defines the fiscal deficit as the difference between current government expenditures (Cg* + Ig*) and revenue from taxes (T*) and other sources (F*). Any fiscal deficit (surplus) will register an increase (decrease) in money supply (eqn. [63]) through ($CGS - CGS_{-1}$), the change in claims to the government sector of the monetary system.

In order to analyze the impact of energy taxes, we have divided total taxes (T*) into total energy taxes (Te*) and non-energy taxes (Tne*) in eqn. (66). In eqn. (67), an institutional relation for total energy taxes (Te*) is specified to include specific tax (t_s) and special fund (t_{sf}) applied on energy consumption of refined petroleum products (CE_{rp}) and an *ad valorem* tax (t_{mcp}) applied on the value of crude petroleum imports ($ME_{cp} \cdot \$pc_{cp} \cdot er$).

The impact of energy taxes is double-edged. While it has a direct effect on increasing energy prices and thus, overall prices, it also has an anti-inflationary impact through reduction of the fiscal deficit, and hence, money supply. Its net effect, however, can only be known through simulation of the model.

Non-energy taxes is further decomposed in eqn. (68) into direct taxes (TD*), a fiscal policy tool, and non-energy indirect taxes (TIne*). A behavioral equation is formulated for non-energy indirect taxes to be a function of current GDP and lagged TIne* (eqn. 69). Short and long-run elasticities of TIne* with respect to Y* of 0.543 and 1.067 for second semester 1979 are exhibited. A relatively slow response of TIne* to Y* is seen from its mean lag value of 0.965 semesters or almost six months. This may well explain why persistent fiscal deficits have existed in the past. Government expenditures have been outstripping revenues because of a longer lag of revenue collections compared to expenditures in response to inflation or income growth.

Eqn. (70) transforms current tax revenues (T*) into real value (T).

Balance of Payments. The balance of payments surplus is defined in eqn. (71) as the sum of the surplus on current account ($X^* - M^*$) and capital account (K_f^*). This is reflected in a change in net foreign assets ($NFA - NFA_{-1}$) component of domestic liquidity. X^* and K_f^* are treated exogenously while current imports is decomposed into current energy imports (ME^*) and current non-energy imports (M_{ne}^*) in eqn. (72). Current non-energy imports is given in eqns. (73). In real value terms, eqn. (74) also decomposes imports (M) into energy (Me) and non-energy (Mne) components. Eqn. (75) defines real energy imports (Me). Real non-energy imports (Mne), on the other hand, is related to an activity variable Y, relative price of non-energy imports (Pmne/P) and a foreign exchange constraint variable proxied by the export price index, (Px), as in eqn. (76). The mean elasticities of non-energy imports with respect to relative prices, GDP and export price index are –0.308, 0.554 and 0.347, respectively.

Real exports are determined from exogenously given current exports and export price index as seen in eqn. (77).

In eqn. (78) we transform the peso to dollar exchange rate (er) (a policy variable) into its index form (ER). Finally, eqns. (79) and (80) are definitional equations linking the dollar export ($Px) and non-energy import price indices ($Pmne), respectively, with their peso equivalents through the exchange rate index.

A summary of the various elasticities implied by the structural equation of the energy and macro submodels is found in Table 1.

Table 1: ELASTICITY ESTIMATES FOR 1979 II IMPLIED BY THE MEPS MODEL

Elasticity of	With Respect to	Estimate
I. Energy Sub-Model		
1. Crude Petroleum Consumption	Product on of Refined Petroleum Products	0.938
2. Demand for Refined Petroleum Products	Real Price of Refined Petroleum Products	–0.100
3. Demand for Refined Petroleum Products	Gross Domestic Product	0.973
4. De and for Coal	Real Price of Coal	–0.248
5. Demand for Coal	Gross Domestic Product	3.495
6. Energy Demand by Consuming Sector	Real Price of Energy to Consuming Sector	–0.084
7. Energy Demand by Consuming Sector	Gross Domestic Product	0.912
8. Non-Electrical Energy	Real Price of Non-Electrical	–0.204

Demand for Consuming Sector	Energy to Consuming Sector	
9. Non-Electrical Energy Demand by Consuming Sector	Gross Domestic Product	0.958
10. Electrical Energy Demand by Consuming Sector	Real Price of Electrical Energy to Consuming Sector	–0.356
11. Electrical Energy Demand by Consuming Sector	Gross Domestic Product	0.457
12. Wholesale Posted Price (Pre Tax) of Refined Petroleum Products	Duty Paid Landed Cost Cost of Crude Petroleum	0.728 (short run) 1.019 (long run)
13. Price of Non-Electrical Energy	Price of Refined Petroleum Products	0.994
14. Price of Electrical Energy	Price of Refined Petroleum Products	0.233
Macroeconomic Sub-Model		
1. Employment	Gross Domestic Product	0.650
2. Employment	Nominal Wage	–0.938
3. Employment	Deflator for Gross Domestic Product	0.600
4. Nominal Wage	Deflator for Gross Domestic Product	0.232 (short run) 0.615 (long run)
5. Deflator for Gross Domestic Product	Energy Price Index for Consuming Sector	0.267
6. Deflator for Gross Domestic Product	Nominal Wage	0.326
7. Deflator for Gross Domestic Product	Domestic Liquidity	0.285
8. Deflator for Personal Consumption Expenditures	Energy Price Index for Consuming Sector	0.247
9. Deflator for Personal Consumption Expenditures	Nominal Wage	0.505
10. Deflators for Personal Consumption Expenditures	Domestic Liquidity	0.287

11. Deflator for Government Consumption	Energy Price Index for Consuming Sector	0.179 (short run) 0.307 (long run)
12. Deflator for Government Consumption	Nominal Wages	0.437 (short run) 1.086 (long run)
13. Domestic Liquidity	Weighted Interest Rate	–0.284
14. Domestic Liquidity	Gross Domestic Product	1.239
15. Domestic Liquidity	Deflator for Gross Domestic Product	1.000
16. Non-Energy Indirect Taxes	Current Gross Domestic Product	0.543 (short run) 1.067 (long run)
17. Non-Energy Imports	Relative Price of Non-Energy Imports	–0.215
18. Non-Energy Imports	Export Price Index	0.381
19. Non-Energy Imports	Gross Domestic Product	0.522

MEPS MODEL SOLUTION AND VALIDATION

The complete model can be described as a dynamic non-linear simultaneous system of equations whose solution would require an iterative computer algorithm. In the absence of a readily available computer software package that can be used for solving the model, a computer simulation program was constructed specifically for the MEPS Model.[6/] The mathematical technique utilized in the main program is the Gauss-Seidel method of successive approximations.[7/] While other numerical methods such as the Newton-Raphson or Jacobi Methods, are available to solve non-linear systems, the Gauss-Seidel technique was chosen on the basis of its simplicity in implementation and speed of convergence.

As a first step, however, in simplifying the model, it was decided to classify the 80 equations into three blocks:

(1) Pre-recursive block (15 equations)
(2) Simultaneous block (53 equations)
(3) Post-recursive block (12 equations)

Equations under the pre-recursive block are solved first and depend only on exogenous variables, lagged variables, constants and recursively with

[6/] Documentation of the MEPS Computer Software Package is presently underway. Main features of the package include options for static and dynamic simulations, historical and forecast simulations, and control for convergence criterion, maximum number of iterations and choice of initial period of simulations.

[7/] For a computer-oriented approach to applications of the Gauss-Seidel Method for econometric model simulations, see Johnson and Van Peeterssen (4).

other pre-recursive equations. Solutions from the pre-recursive block, exogenous and lagged variables, and constants are then used as inputs to solve the simultaneous block. Finally in the post recursive block, the remaining equations are solved recursively.

The model is then validated by solving the entire equation system for each period, using historical values of exogenous variables (ex post simulation and comparing the solution of endogenous variables with the corresponding actual values. In testing how well the model is able to track the actual data, several standard measures of goodness of fit are computed. These include the mean absolute error (MAE), mean absolute percent error (MAPE), root mean square error (RMSE) and the root mean square percent error (RMSPE).

Two sets of historical simulations (or base runs) were done: (1) static simulation and (2) dynamic simulation. The dynamic simulation option is clearly the more stringent test of the tracking performance of the model considering that it uses internally generated solution values for the lagged endogenous variables compared to the actual values used in the static simulation. Both results are, however, reported for comparative purposes.

Table 2 contains a summary of the various measures of goodness of fit for selected endogenous variables. A more detailed (period by period) computation is found in the Appendix for the most important variables. The historical simulations were run, using first semester 1972 as the initial period up to second semester of 1979 for both st tic and dynamic solutions.

In general, the results of both simulations are quite satisfactory with most variables exhibiting percent errors of less than 10 percent by both MAPE and RMSPE measures. Expectedly, the dynamic simulation showed a higher percent error than the static results, but majority of the cases are still within reasonable limits considering that the simulation is done for a lengthy 16 periods. The few cases where the RMS percent error exceeded 10 percent can be explained by a few extreme errors that are heavily penalized in the RMS computations. This is verified by a much lower MAPEs compared to RMSPEs for the same variables.

Among all the simulations presented in Table 2, energy price variables seem to exhibit the best tracking ability. Domestic price of refined petroleum products (pe_{rp}) and effective price for consuming sector (pe_C), for example, have dynamic simulation (RMSPEs of 3.23 and 3.12 percent, respectively. The same simulations were also able to predict the sudden breaks in prices such as the large price increases in oil products that occured in 1974 and later in 1979 (Appendix Tables A-1 and A-2).

Table 2. RESULTS OF EX POST SIMULATION (BASE RUN VALUES)

	STATIC				DYNAMIC			
	Mean Absolute Error	Mean Absolute Percent Error	Root Mean Square Error	Root Mean Square Percent Error	Mean Absolute Error	Mean Absolute Percent Error	Root Mean Square Error	Root Mean Square Percent Error
ENERGY PRICES								
pe_{rp}	0.01553	2.28	0.01896	3.04	0.01554	2.40	0.01892	3.23
pp_{rp}	0.01553	2.69	0.01896	3.53	0.01554	2.82	0.01892	3.72
pe_C	0.01863	2.12	0.02343	2.87	0.01795	2.14	0.02380	3.12
pe_{nel}	0.01691	2.70	0.02101	4.49	0.01663	2.72	0.02051	4.55
pe_{el}	0.1475	5.34	0.19955	7.60	0.14726	5.28	0.20061	7.61
Pme	13.03	2.50	26.81	4.40	11.02	2.52	26.38	4.93
ENERGY QUANTITIES								
CE_{cp}	357.55	7.60	484.29	10.32	363.07	7.64	483.51	10.11
CE_{rp}	296.51	6.24	403.90	8.47	400.85	8.53	522.57	11.34
CPE	374.85	6.51	509.13	9.33	381.81	7.85	497.51	10.24
CE	598.82	12.47	830.37	17.53	559.61	11.45	768.18	15.91
CE_c	227.18	5.65	285.64	7.15	286.22	7.18	364.85	9.41
CE_{Cnel}	219.23	5.96	274.40	7.49	274.86	7.52	346.36	9.74
CE_{Cel}	20.58	6.35	23.90	7.64	25.22	7.79	28.72	9.12
PE_{rp}	2441.05	7.60	8566.12	10.43	366.71	8.57	463.22	11.21
PE	325.44	7.37	434.98	10.12	352.49	8.00	441.88	10.13
ME_{cp}	159.00	3.28	213.79	4.43	240.95	5.51	319.27	6.88
ME	149.60	2.88	207.49	4.03	242.51	4.75	311.43	6.23

Table 2 (cont'd.)

ENERGY EFFICIENCY AND SELF-SUFFICIENCY

EE	0.67	9.81	1.03	15.07	0.56	8.21	0.84	12.35
ES	0.00217	8.48	0.00297	12.13	0.00224	8.84	0.00297	12.46
ES_{cp}	0.00102	1.44	0.00102	1.67	0.00113	1.76	0.00117	2.15

MACROECONOMIC VARIABLES

Y	1809.88	5.33	2575.97	7.79	1790.13	5.20	2475.92	7.39
Cp	244.00	1.06	340.00	1.52	556.00	2.36	636.00	2.73
Cg	95.00	2.72	120.00	3.44	95.00	2.66	118.00	3.33
C	242.56	0.91	356.40	1.37	623.56	2.30	713.37	2.66
I	1437.00	17.84	2047.00	27.71	1471.00	17.55	2026.00	26.72
Me	16.91	2.88	23.45	4.03	25.17	4.37	29.99	5.31
Mne	214.45	3.51	308.03	4.97	210.02	3.44	289.62	4.67
M	261.00	4.23	341.00	5.41	286.00	4.03	382.00	5.72

EMPLOYMENT, WAGES AND PRICES

N	4.82	4.16	6.33	5.55	4.56	3.86	6.12	5.25
W	0.97	0.85	1.26	1.17	2.16	1.70	2.58	1.99
P	6.01	3.63	7.61	4.89	9.43	5.42	11.60	6.74
PC_p	5.06	3.13	5.67	3.69	9.23	5.35	11.99	6.95

MONETARY AND FISCAL VARIABLES

Z	1067.00	2.77	2163.00	4.19	4203.00	11.82	5104.00	14.83
R	2.77	21.01	3.93	29.51	3.93	28.13	5.07	36.57
Te*	65.06	4.81	95.71	6.58	93.19	7.11	126.10	9.28
Tne*	428.92	6.40	544.33	7.91	731.49	10.89	855.01	12.82

Energy quantity variables, on the other hand, had higher dynamic simulation RMS percent errors (about 10 percent for most cases). Mean absolute percent error were all below 10 percent with the exception of CE. These summary measures, however, hide the good predictions on energy consumption towards the end of the simulation period in spite of the sudden increase in crude oil prices that occured. (Appendix Tables A-4 to A-9).

Energy efficiency (EE) and self sufficiency (ES) simulations (Appendix Tables A-10 and A-11) were less satisfactory but they nevertheless were able to track the general pattern of conservation and substitution responses for the period under study.

Simulated values of macroeconomic variables, especially consumption (Cp, Cg and C), non-energy imports (Mne) showed very good results (less than 5 percent RMSPE in the dynamic simulations). As expected, however, the investment variable, being the most volatile component of GDP, exhibited a relatively large error (MAPE of about 20 percent).

With the exception of two periods, the gross domestic product (Y) showed very good results for most years with dynamic simulation errors of less than 10 percent. The dynamic simulation of Y also has the characteristic that the solution values improve towards the end of the period. The prediction error for second semester 1979 is practically nil.

Simulation results for employment (N), wages (W) and prices (P) all showed small RMSPEs (less than 7 percent) for both static and dynamic options.

For monetary and fiscal variables, the model exhibited fairly good results when simulation is static. However, the dynamic simulation shows a significant increase in the different measures of goodness of fit. In all cases, however, the interest rate variable (R) exhibited large errors (21-37 percent) for all the measures. This result is expected considering the highly fluctuating nature of the interest rate especially when measured on a semestral basis.

On an overall evaluation, however, the MEPS Model is well validated with very good tracking performance (dynamic and static) particularly in energy prices, energy quantities, and the most important macroeconomic variables.

APPLICATIONS OF THE MEPS MODEL FOR POLICY SIMULATIONS

Given the encouraging model validation results of the previous section, we can be in a more confident position to utilize the model for various policy simulation experiments. The model is first applied in determining dynamic multipliers and elasticities for selected exogenous and policy-controlled variables. These include multipliers for government expenditures and energy taxes as well as elasticities for imported crude oil price increases. We then perform simulation experiments to determine the incremental effects of different economic scenarios and policy regimes.

Dynamic Elasticities and Multipliers

In this section, we present several examples of the uses of the model for multiplier and elasticity analysis. Dynamic multipliers and elasticities are derived by increasing (throughout the simulation period) the value of an exogenous variable by one unit or one percent, respectively, and comparing the simulation result with the base run values. *Impact* multipliers and elasticities are the first-period effects while *long run* multipliers and elasticities are derived as the cumulated effects up to the end of the simulation period. All simulations done in this and the next section are *dynamic*.

As a first example, consider the effect of a sustained one percent change in dollar import price of crude petroleum ($\$pc_{cp}$). Table 3 shows the impact and long run elasticities of $\$pc_{cp}$ on selected macroeconomic and energy variables. The immediate impact is to decrease gross domestic product (Y) by 0.07 percent. In the long run, however, its total effect is to lower Y by 0.25 percent. Impact and long run elasticities for domestic price level (P) are 0.05 and 0.13, respectively. Wages (W) likewise increased by 0.01 percent in the short run and 0.10 in the long run. Money supply (Z), on the other hand, is decreased (impact and long run elasticities of –0.07 and –0.19 respectively) because of, first, increased value of imports which lowers net foreign assets, and, second, of increased tax collections (elasticity of 0.13 and 0.25 in the short and long runs, respectively). Meanwhile, consumption of refined petroleum products (CE_{rp}) is decreased by 0.07 percent in the short run and 0.12 in the long run. We can also observe from Table 3 that a one percent change in $\$pc_{cp}$ has the effect of increasing domestic price index of refined petroleum products by 0.35 percent on the first period until reaching 0.69 percent in the long run. Such a result reflects the fact that the domestic price of refined petroleum products is not solely determined by movements in imported oil prices but to a considerable extent also by domestic taxes and tariffs.

A summary of energy tax multipliers is shown in Table 4. Here we assume a sustained increase of one percentage point in either the specific tax rate (t_s) or the special fund rate (t_{sf}), both taxes having the same effect on the model system. The initial impact of the energy tax increase is to decrease gross domestic product by ₱192 million which is about the same as its long run value. The full effect of the energy tax on Y is therefore felt immediately.

Table 3

Dynamic Elasticities
Dollar Import Price of Crude Petroleum ($\$pc_{cp}$)
Elasticity*

	Impact	Long Run
Y	–0.07	–0.25
P	0.05	0.13
N	–0.03	–0.05
W	0.01	0.10
Z	–0.07	–0.19
T*	0.13	0.25
CErp	–0.07	–.012
PErp	0.35	0.69

* $\$pc_{cp}$ increased by one percent

Table 4

Dynamic Multipliers
Domestic Energy Taxes (t_s, t_{sf})
Multiplier *

	Impact	Long Run
Y	–192.40	–191.30
P	0.53	0.15
N	–0.22	–0.29
W	0.07	0.09
Z	–44.60	–266.10
T*	66.20	110.70
CE	–61.18	–65.52
Pe	7.88	10.51

* t_s or t_{sf} increased by 0.01

Domestic prices, on the other hand, exhibited a decline in the value of the multiplier from 0.53 (impact) to 0.15 (long run). This case of the short run multiplier "overshooting" the long run multiplier may well be explained by the double-edged effect of energy taxes. Being a component of domestic energy prices, it has a direct positive effect on domestic prices. However, because of its contractionary effect on the money supply (through lower fiscal deficits), it has a strong indirect and negative effect on the general price level. The strong initial impact on prices due to the increase in domestic energy prices is dampened over time by the indirect effect on the price level caused by the subsequent increase in tax revenues and decline in money supply. This is evidenced by the much larger long run multipliers for money (negative) and total taxes (positive) compared to their respective short-run values (Table 4).

The effect of taxes on energy prices is shown by the impact multiplier of 7.88 index points and corresponding long run value of 10.51. This price increase solicits a consumption response as seen from the multipliers for energy consumption (CE) – -61.18×10^{10} kilocalories in the short run and -65.52×10^{10} kilocalories in the long run – quite a rapid adjustment to taxes.

Table 5 presents a similar analysis for energy import tariff assuming a one percentage point increase in the tariff rate. Compared to domestic energy taxes, the impact and long run multipliers are seen to be less pronounced for gross domestic product, wages, taxes, energy consumption and domestic energy prices. However, its long run multiplier for domestic prices is higher because of a reduced long-run multiplier for money. It should also be noticed that in the long run, employment is marginally increased inspite of the negative short-run effect. This is presumably the effect of substitution of labor for energy and relatively mild decline of gross domestic product.

Table 5

Dynamic Multipliers
Energy Import Tariff (tm_{cp})
Multiplier *

	Impact	Long Run
Y	–16.43	–57.10
P	0.04	0.30
N	– 0.02	0.02
W	0.01	0.09
Z	– 6.22	– 0.52
T*	8.31	52.43
CE	– 5.19	– 12.78
PeC	0.33	2.17

* tm_{cp} increased by 0.01

As a final exercise in multiplier analysis, Table 6 presents the impact and long run GDP multipliers of traditional fiscal policy variables. Current government consumption and investment have the same impact multipliers (0.24). However, their long run values differ with a slightly higher value for government consumption (5.48) compared to investment (4.81). Both these multipliers are within a reasonable range of estimates.

Table 6

Dynamic Multipliers on Current GDP (Y*)
Current Government Consumption (C_g*) and Investment (I_g*)

	C_g*	I_g*
Impact	0.24	0.24
Long Run	5.48	4.81

Policy Simulation Experiments

In this section, we present several simulation experiments to answer the questions posed at the beginning of this paper. The approach we take is to do simple "with" and "without" simulations in order to isolate the effects of a particular variable or combination of variables. For example, in order to assess the incremental effects of high priced energy, we simulate the model with the energy crisis (base run) and compare the results in an alternative scenario by assuming a lower price energy in the simulation. Each of the simulation experiments and corresponding results are summarized in the succeeding discussions.

Economic Cost of High Energy Prices. In this experiment, we assume a growth rate of 5.3 percent per semester for $\$pc_{cp}$, the dollar import price of crude petroleum, after first semester 1973. This growth rate is considered "normal" and merely sustains the average growth of $\$pc_{cp}$ before second semester 1973 when the energy crisis period is considered to have begun. All the other exogenous variables in the model remain the same.

The economic cost of higher priced energy is quantified through its effects on economic variables. Results of the simulation with (base run) and without the energy crisis are shown in Table 7. A clear economic cost of the energy crisis is the loss in output. The simulation results show that on an annual basis, gross domestic product (Y) could have grown by almost one percent more, from base run growth rate of about 7 percent to a full 8 percent. Furthermore, consumption expenditures (C) could have expanded by almost an additional one percent and investment expenditures (I) by 0.2 percent more. Total imports, however, would also have risen faster by more than one percent. Table 7 also indicates a perceptible lowering of the domestic price level and wages and a higher level of employment. However, it should be noted that the effect on prices is not as much as what is normally thought to be attributable to oil price increases. Higher imported energy costs contract domestic liquidity, first, through increased import bill and, second, through increased energy tax collections which finances the fiscal deficit. Such strong secondary effects were also verified previously in the dynamic elasticity analysis of the effects of $\$pc_{cp}$. These results strongly suggest that inflation in the Philippines, while significantly affected by imported oil prices, also has a strong linkage with other factors, particularly monetary and fiscal variables, and wage costs.

Energy Conservation Effects of High Energy Prices. Higher priced energy will normally reduce energy consumption in various forms. Table 8 presents the incremental effect on consumption of total energy, crude petroleum and refined petroleum products. We can observe that energy consumption would have grown by almost an additional 2 percent per year had there been no drastic oil price increases in the 1970s. Furthermore, crude petroleum imports would have grown by about 2 percent compared to the no growth results of the energy crisis simulation. Relatedly, we can look at the energy efficiency ratio and observe that the low-priced energy scenario has a significantly lower efficiency in energy. All these results point out that prices do matter insofar as it is an effective instrument for energy conservation.

Economic Impacts of Energy Taxes and Tariff. In this simulation experiment, we take an extreme position and assume the non-existence of all domestic taxes and import tariff on energy. Our purpose is to evaluate the economic merits of taxing energy products heavily as was done in the past. The main reasons for such high energy taxes is that these act as conservation as well as revenue generating policy tools. The results in Table 9 indicate that this policy has a high economic cost in lowering growth of gross domestic product by one percent annually. Correspondingly, we observe lower growth rates for consumption, investment and imports. However, we can see a slight decline in the inflation rate and wages and marginal increase in employment due to substitution effects. From here, we can conclude that heavy tax rate on energy, while having the merit of generating large tax revenues which are anti-inflationary, imposes a large economic cost in terms of lowering gross domestic product and its components.

Energy Conservation Effects of Energy Taxes and Tariff. While energy taxes and tariff may have negative effects on gross domestic product, it did succeed in its energy conservation goal. As evident in Table 10, consumption of total energy, crude petroleum and refined petroleum products significantly declined, with annual growth rates dropping by more than two percentage points. This is brought about by the annual growth rate in domestic energy prices (pe) of about 25 percent with taxes, compared to about 18 percent

Table 7 SIMULATION EXPERIMENT – Economic Cost of High Energy Prices

		Gross Domestic Product (Y)		Consumption (C)		Investment (I)		Imports (M)		GDP Price Index (P)		Wages (W)		Employment (N)	
		Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated
1972	I	26772.95	26772.95	22246.15	22246.15	5489.44	5489.44	4919.50	4919.50	98.35	98.35	96.87	96.87	96.28	96.28
	II	28505.91	28505.91	22980.40	22980.40	5143.08	5143.08	5192.81	5192.81	102.43	102.43	99.07	99.07	101.40	101.40
1973	I	25043.51	25043.51	23003.61	23003.61	1074.71	1074.71	5431.18	5431.18	107.28	107.28	101.14	101.14	95.25	95.25
	II	26940.15	26855.75	23173.68	26855.75	5129.64	4958.16	5594.01	5660.53	115.44	113.86	103.56	103.35	98.33	97.63
1974	I	31007.44	34695.87	23820.38	24381.99	8025.96	10704.10	6193.39	6212.65	142.08	131.76	108.50	106.89	111.75	115.69
	II	31911.66	34453.43	25031.64	25979.47	9642.82	9445.71	5934.76	5841.35	157.32	145.11	113.68	110.71	114.26	114.69
1975	I	31443.61	36366.45	25347.03	26798.98	8385.98	11136.71	6583.18	6813.52	169.67	153.22	118.52	114.83	112.38	116.74
	II	29066.30	34250.02	25255.94	27112.97	5864.71	8268.89	6058.05	6565.13	180.27	164.48	123.06	118.15	108.90	113.92
1976	I	377015.58	41415.35	26691.14	28816.20	11692.49	12718.46	6644.21	6948.43	194.06	178.48	127.49	122.18	127.78	129.86
	II	38263.54	39619.41	27424.28	29455.20	11676.41	10976.79	6911.77	7531.24	200.81	188.12	131.15	126.03	127.82	121.19
1977	I	36276.42	38931.12	28031.28	30098.92	8401.77	8808.27	6711.66	6951.53	207.52	195.84	134.49	129.70	123.69	125.22
	II	38351.17	41496.39	28586.89	30723.98	10605.45	11187.04	7447.93	7972.82	216.04	207.61	137.62	133.86	127.37	138.86
1978	I	40082.10	43431.88	29587.07	31820.13	11672.88	12389.38	7428.93	7942.25	221.37	215.45	140.32	136.68	129.95	134.38
	II	41124.26	46607.66	30317.52	32833.44	11337.76	13883.35	7822.53	8257.48	229.33	224.69	142.97	139.98	133.27	142.69
1979	I	44830.62	45216.25	31621.12	33921.25	14563.61	12190.92	8069.36	8672.35	240.52	239.41	146.19	144.12	140.75	141.03
	II	44534.37	49516.63	32302.00	34896.40	12917.17	14663.97	8696.40	9319.65	264.19	255.85	152.64	148.50	146.79	150.02
Semestral Growth Rate (percent)		3.45	4.18	2.52	3.05	5.87	6.77	3.87	4.35	6.81	6.58	3.08	2.89	2.85	3.0
Annual Growth Rate (percent)		7.10	8.00	5.07	6.18	14.53	14.33	7.49	8.58	14.07	13.77	6.22	5.90	5.50	5.1

Table 8 SIMULATION EXPERIMENT – Energy Conservation Effects of High Energy Prices

		Energy Consumption (CE)		Crude Petroleum	Consumption (CEcp)	Ref. Petroleum Prod. Consumption (CErp)		Crude Petroleum Imports (MEcp)		Energy Efficiency (EE)	
		Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated
1972	I	3700.27	3700.27	4384.64	4384.64	3790.59	3790.59	5325.28	5325.28	7.24	7.24
	II	4163.57	4163.57	4687.94	4687.94	4218.72	4218.72	4188.53	4188.53	6.85	6.85
1973	I	3009.52	3009.52	4328.06	4328.06	4551.48	4551.48	4989.41	4989.41	8.32	8.32
	II	3322.25	3321.81	3519.13	3582.92	3823.76	3964.19	4401.89	4535.36	8.11	8.08
1974	I	4426.43	5592.73	4113.56	4806.31	4309.47	4723.89	4353.29	4569.58	7.01	6.20
	II	4324.92	5088.74	3724.83	5163.06	2996.82	3579.62	3767.33	5155.72	7.38	6.77
1975	I	4184.88	5750.84	4246.96	5267.06	4081.55	4911.27	4649.02	5186.93	7.51	6.32
	II	3223.73	4892.72	3666.65	4853.04	3744.02	4947.97	4192.59	4932.87	9.02	7.00
1976	I	5725.19	6843.57	4893.85	5811.60	4614.34	5479.71	4809.95	5417.86	6.58	6.05
	II	5616.05	6057.47	5044.93	5652.30	4594.72	5639.64	4856.51	5666.54	6.81	6.54
1977	I	4710.89	5 69.97	4377.24	5026.48	4586.35	5256.21	4310.88	4851.55	7.70	7.12
	II	5152.09	6118.61	4717.62	5558.81	4830.40	5836.76	5028.12	5747.01	7.44	6.78
1978	I	5440.66	6452.91	4975.59	5825.54	5066.31	6040.54	4831.44	5525.14	7.37	6.73
	II	5565.54	7180.81	5228.95	6287.54	5433.17	6278.54	5427.66	5950.10	7.39	6.49
1979	I	6273.06	6351.04	5399.88	5812.44	5224.85	6263.02	4704.19	5478.55	7.15	7.12
	II	5927.81	7466.37	5487.59	6712.77	5684.63	6987.66	4642.07	5577.28	7.51	6.63
Semestral Growth Rate (percent)		3.19	4.79	1.51	2.88	2.74	4.16	–0.09	0.31	–	–
Annual Growth Rate								–0.25		–	–
(percent)		6.48	8.39	2.63	4.71	4.51	7.46	–0.25	2.17		

Table 9 SIMULATION EXPERIMENT – Economic Impacts of Energy Taxes and Tariffs

		Gross Domestic Product (Y)		Consumption (C)		Investment (I)	
		Base Run	Simulated	Base Run	Simulated	Base Run	Simulated
1972	I	26773	27673	22246	22398	5489	6121
	II	28506	29516	22980	23277	5143	5741
1973	I	25044	26099	23004	23407	1075	1605
	II	26940	26343	23174	23514	5130	4127
1974	I	31007	33572	23820	24533	8026	9527
	II	31912	39940	25032	26694	9643	7288
1975	I	31444	32590	25347	26939	8386	7667
	II	29066	31482	25256	26943	5865	6337
1976	I	37702	38276	26691	28358	11692	10338
	II	38264	38154	27424	28968	11676	9924
1977	I	36276	36718	28031	29521	8402	7205
	II	38351	40506	28587	30233	10605	10788
1978	I	40082	42503	29587	31399	11673	11964
	II	41124	45010	30318	32408	11338	12764
1979	I	44831	47386	31621	33850	14564	14639
	II	44534	47996	32302	34738	12917	13483
Semestral Growth (percent)		3.45	3.97	2.52	3.02	5.87	6.17
Annual Growth (percent)		7.10	8.10	5.07	6.13	14.53	14.91

Table 9 (Cont'd)
SIMULATION EXPERIMENT – Economic Impacts of Energy Taxes and Tariffs

		Imports (M)		GDP Price Index (P)		Wages (W)		Employment (N)	
		Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated
1972	I	4919	4919	98.35	96.06	96.87	96.55	96.28	97.34
	II	5193	5219	102.43	99.97	99.07	98.52	101.40	102.63
1973	I	5431	5467	107.28	104.95	101.14	100.47	95.25	96.60
	II	5594	5741	115.44	112.48	103.56	102.75	98.33	96.15
1974	I	6193	6269	142.08	134.55	108.50	106.92	111.75	114.39
	II	5935	4388	157.32	149.90	113.68	111.57	114.26	127.92
1975	I	6583	7109	169.67	167.08	118.52	116.82	112.38	113.75
	II	6058	6447	180.27	176.87	123.06	121.48	108.90	112.58
1976	I	6644	7156	194.06	189.06	127.49	125.78	127.78	127.17
	II	6712	7353	200.81	195.48	131.15	129.36	127.82	125.84
1977	I	6712	7022	207.52	201.68	134.49	132.58	123.69	122.65
	II	7448	7835	216.04	210.03	137.62	132.54	127.37	129.61
1978	I	7429	7798	221.37	216.52	140.32	138.24	129.95	133.00
	II	7823	8145	229.33	225.08	142.97	141.06	133.27	139.06
1979	I	8069	8465	240.52	237.53	146.19	144.46	140.75	144.66
	II	8696	9202	264.19	256.57	152.64	148.95	146.79	147.50
Semestral Growth (percent)		3.87	4.26	6.81	6.60	3.08	2.91	2.85	2.88
Annual Growth (percent)		7.49	8.30	14.07	13.73	6.22	5.94	5.50	5.74

Table 10 SIMULATION EXPERIMENT – Energy Conservation Effects of Energy Taxes and Tariff

		Energy Consumption (CE)		Crude Petroleum Consumption (CEcp)		Refined Petroleum Products Consumption (CErp)	
		Base Run	Simulated	Base Run	Simulated	Base Run	Simulated
1972	I	3700.27	3983.28	4384.64	4552.74	3790.59	3888.69
	II	4163.57	4475.07	4687.94	4880.50	4218.72	4351.26
1973	I	3009.52	3328.18	4328.06	4528.48	4551.48	4703.39
	II	3322.25	3164.51	3519.13	4117.83	3823.76	4119.85
1974	I	4426.43	5240.13	4113.56	5250.92	4309.47	4698.48
	II	4324.92	6273.48	3724.83	4367.73	2996.82	967.57
1975	I	4184.88	4511.50	4246.96	4739.99	4081.55	4959.27
	II	3223.73	3907.46	3666.65	4658.42	3744.02	4439.34
1976	I	5725.19	5882.28	4893.85	5962.50	4614.34	5489.45
	II	5616.05	5570.32	5044.93	5803.16	4594.72	5354.93
1977	I	4710.89	4833.46	4377.24	5473.48	4586.65	5224.74
	II	5152.09	5826.77	4717.62	6055.45	4830.40	5566.83
1978	I	5440.66	6187.42	4975.59	6379.55	5066.31	5778.25
	II	5565.54	6732.35	5228.95	6733.39	5433.17	6074.79
1979	I	6273.06	7031.37	5399.88	6905.55	5224.85	5951.40
	II	5927.81	7013.88	5478.59	7167.09	5684.63	6698.00
		3.19	4.36	1.51	3.33	2.74	3.87
		6.48	8.64	2.64	6.47	4.51	6.75

Table 10 (cont'd.)

SIMULATION EXPERIMENT – Energy Conservation Effects of Energy Taxes and Tariff

		Crude Petroleum Imports (MEcp)		Energy Efficiency (EE)		Energy Price Index (Pe)		Consuming Sector Energy Price Index (Pe_c)	
		Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated
1972	I	5325.28	5374.74	7.24	6.94	101.50	110.33	101.02	81.69
	II	4188.53	4260.81	6.85	6.60	106.60	83.14	107.29	85.19
1973	I	4989.41	5074.33	8.32	7.84	157.77	117.85	109.79	86.64
	II	4401.83	4690.00	8.11	8.32	148.60	130.03	132.25	101.51
1974	I	4353.29	4581.58	7.01	6.41	248.69	163.14	262.46	197.15
	II	3767.33	2298.70	7.38	6.37	225.21	51.54	330.83	271.81
1975	I	4694.02	5386.62	7.51	7.22	319.57	245.67	341.90	252.90
	II	4192.59	4696.28	9.02	8.06	419.59	292.71	368.11	273.89
1976	I	4809.95	5498.67	6.58	6.51	308.42	259.25	388.46	281.05
	II	4856.51	5507.50	6.81	6.85	316.15	274.80	392.94	284.59
1977	I	4310.88	4843.24	7.70	7.60	389.18	294.33	412.79	295.81
	II	5028.12	5550.89	7.44	6.95	390.39	268.98	426.51	297.65
1978	I	4831.44	5331.14	7.37	6.87	396.95	269.53	430.58	300.14
	II	5427.66	5835.61	7.39	6.69	375.33	130.29	429.57	300.45
1979	I	4704.19	5233.74	7.15	6.74	393.83	268.56	472.90	323.91
	II	4642.07	5373.79	7.51	6.84.	574.54	406.49	586.25	390.56
		– 0.91	0.06			12.25	9.69	12.44	9.43
		– 0.25	1.57			24.56	18.31	26.15	19.25

without taxes. Such high energy costs also decreased energy imports very significantly. The net effect is a high energy efficiency ratio in first semester 1979 of 7.51 with taxes, compared to 6.84 without taxes.

Credit Restraint Under Inflation. In the preceding discussions, we have pointed out that the total effect of energy prices is much smaller than expected because of large indirect effects caused by monetary contraction. Furthermore, it was hinted that monetary factors play a significant role in price determination. In this experiment (Table 11), we attempt to quantify the impact of money supply growth on controlling inflation. Particularly, we assume a growth rate of private domestic credits to be equal to 3.4 percent per semester – which is the average growth rate of gross domestic product during the period. Such a policy would limit expansion of liquidity and would expectedly put a brake on growth of prices. The simulation results show that inflation has indeed dropped with the growth of GDP price index declining from 14 percent to 11 percent per year. This was surprisingly accompanied by a higher GDP, consumption, and investment. Apparently, a credit restraint policy would successfully lower domestic prices without sacrificing output. Energy consumption, however, is seen to increase with its annual growth rate increasing from 6.5 percent to about 8.0 percent.

CONCLUDING REMARKS

In this paper, we have tried to show that it is possible to construct a macroeconometric model with an explicit energy sector and the advantage of such an approach to planning and policy evaluation. We have tried to incorporate in the model quite a number of fiscal, monetary, balance of payments and energy policy instruments that can be manipulated in practice.

The estimates of the structural equations confirm our hypothesis that significant changes in parameter values of the behavioral equations have occurred, therefore, justifying the construction of a new model.

We have shown that with the use of recent semestral data, significant lagged variables as well as seasonal, slope and intercept dummy variables are appropriately introduced. Hence, short-run and long-run elasticities, seasonal and structural shifts may be estimated.

In the policy simulation experiments, we were able to quantify the economic effects of the energy crisis that occurred in the 1970s. The cost to economy is shown to be a substantial decrease in gross domestic product and its components.

We have also demonstrated the impact of energy taxes and tariff and shown the economic trade offs involved in such a policy of highly-taxing energy products. Our results tend to show a high economic cost relative to the benefit to be derived from such policy.

However, high energy costs and taxes were shown to be quite effective

Table 11 SIMULATION EXPERIMENT — Credit Restraint Under Inflation

	Gross Domestic Product(M)		Consumption (C)		Investment (I)		Imports (M)		GDP Price Index (P)		Wage (W)	
	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated
1972 I	26773	26773	22246	22246	5489	5489	4919	4919	98.35	98.35	96.87	96.87
II	28506	28533	229.80	22984	5143	5153	5193	5174	102.43	101.57	99.07	98.95
1973 I	25044	25147	23004	23019	1075	1121	5431	5370	107.23	104.83	101.14	100.74
II	26940	26810	23174	23183	5130	4905	5594	5536	115.44	110.63	103.56	102.67
1974 I	31007	31435	23820	23883	8026	8249	6193	5970	142.08	132.78	108.50	106.71
II	31912	34160	25032	25343	9643	11177	5935	5679	157.32	142.73	113.68	110.57
1975 I	31444	32849	25347	25777	8386	9140	6583	6212	169.67	151.52	118.52	114.16
II	29066	29979	25256	25738	5865	6078	6058	5745	180.27	160.99	123.06	117.74
1976 I	37702	32669	26691	26627	11692	6340	6644	6836	194.06	171.81	127.49	121.28
II	38264	37929	27424	27385	11676	11393	6712	6245	200.81	173.94	131.15	123.75
1977 I	36276	37151	28031	28107	8402	8782	6712	6291	207.52	181.89	134.49	126.45
II	38351	40141	28587	28856	10605	11836	7448	7010	216.04	189.09	137.62	128.99
1978 I	40082	41777	29587	30016	11673	12621	7429	6944	221.37	192.22	140.32	131.03
II	41124	43942	30318	31000	11338	13115	7823	7267	229.33	196.59	142.97	132.88
1979 I	44831	46979	31621	32455	14564	15486	8069	7465	240.52	201.28	146.19	134.63
II	44534	47282	32302	33261	12917	14185	8696	8104	264.19	218.32	152.64	137.88
Semestral Growth Rate (percent)	3.45	3.86	2.52	2.51	5.87	6.53	3.87	3.38	6.81	5.46	3.08	2.38
Annual Growth Rate (percent)	7.10	7.92	5.07	5.48	14.53	15.79	7.49	6.36	14.07	11.10	6.22	4.83

Table 11 (cont'd.)

		Employment (N)		Energy Consumption (CE)		Energy Price Index(Pe)		Consuming Sector Energy Price Index (Pe_c)	
		Base Run	Simulated	Base Run	Simulated	Base Run	Simulated	Base Run	Simulated
1972	I	96.28	96.28	3700.27	3700.27	101.50	101.50	101.02	101.02
	II	101.40	101.18	4163.57	4170.44	106.60	106.18	107.29	107.30
1973	I	95.25	94.67	3009.52	3035.65	157.77	155.74	109.79	109.83
	II	98.33	96.50	3322.25	3287.24	148.60	150.85	132.25	132.20
1974	I	111.75	109.63	4426.43	4536.40	248.69	235.51	262.46	268.52
	II	114.26	114.02	4324.92	4987.65	225.21	190.18	330.83	330.38
1975	I	112.38	109.35	4184.88	4540.11	319.57	279.37	341.90	343.29
	II	108.90	104.47	3223.73	3432.13	419.59	378.96	368.11	370.00
1976	I	127.78	110.46	5725.19	4286.11	308.42	504.78	388.46	386.39
	II	127.82	118.58	5616.05	5448.02	316.15	287.63	392.94	397.95
1977	I	123.69	117.15	4710.89	4992.71	389.18	349.24	412.79	414.61
	II	127.37	122.23	5152.09	5677.62	390.39	330.48	426.51	429.00
1978	I	129.95	123.91	5440.66	5917.95	396.95	342.09	430.58	433.21
	II	133.27	128.56	5565.54	6350.22	375.33	334.44	429.51	432.03
1979	I	140.75	132.34	6273.06	6830.14	393.83	337.32	472.90	476.65
	II	146.79	134.05	5927.81	6675.91	574.54	483.80	586.25	590.44
Semestral Growth Rate (percent)		2.85	2.23	3.19	4.01	12.25	10.97	12.44	12.49
Annual Growth Rate (percent)		5.50	4.35	6.48	8.03	24.56	21.66	26.15	26.29

in reducing energy consumption. These resulted in higher energy efficiency ratios for the economy.

The effect on inflation of high cost imported energy seems to be overstated if only direct effects are considered. As shown in the simulation experiments, the economy has built in anti-inflationary factors that counteract such cost-push increases. Moreover, a stronger anti-inflationary factor is the domestic liquidity. Controlling the growth of liquidity is an effective tool for combatting high prices.

The model can be utilized for economic forecasting and planning in future applications. Alternative simulation experiments similar to the ones done here can also be performed.

To be more useful for energy planning, the model can be extended by further disaggregating energy demand for specific refined petroleum products. Sectoral demand by households and industries can also be modeled. Future work in this regard can be done using the accounting framework of the Philippine National Energy Accounts.

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Appendix

EX POST SIMULATION OF SELECTED VARIABLES

Table A-1 EX POST SIMULATION: Price of Refined Petroleum Products (pe_{rp})

			STATIC			DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	0.25946	0.26123	0.00177	0.68	0.26123	0.00177	0.68
II	0.25907	0.27792	0.01885	7.28	0.27843	0.01936	7.47
1973 I	0.27481	0.27893	0.00412	1.50	0.28446	0.00965	3.51
II	0.31220	0.33065	0.01845	5.90	0.33340	0.02120	6.79
1974 I	0.68487	0.65779	–0.02708	–3.95	0.66385	–0.02102	–3.06
II	0.84708	0.82440	–0.02268	–2.68	0.81839	–0.02869	–3.38
1975 I	0.86150	0.88285	0.02135	2.48	0.87466	0.01316	1.53
II	0.91327	0.94008	0.02681	2.94	0.94384	0.03057	3.35
1976 I	1.05731	1.02021	–0.03710	–3.51	1.02894	–0.02837	–2.68
II	1.07073	1.05078	–0.01995	–1.86	1.04267	–0.02806	–2.62
1977 I	1.09762	1.10556	0.00794	0.72	1.09754	–0.00008	0.01
II	1.15866	1.14704	–0.01162	–1.00	1.14701	–0.01165	–0.01
1978 I	1.16694	1.16467	–0.00227	–0.19	1.16135	–0.00559	–0.48
II	1.16698	1.16755	0.00057	0.05	1.16595	–0.00103	–0.09
1979 I	1.29335	1.29631	0.00296	0.23	1.29602	0.00267	0.21
II	1.63890	1.66392	0.02502	1.53	1.66468	0.02578	1.57
Mean Absolute			0.01553	2.28		0.01554	2.40
R M S			0.01896	3.04		0.01892	3.23

Table A-2 EX POST SIMULATION – Energy Price for Consuming Sector (pe_c)

			STATIC			DYNAMIC		
		Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972	I	0.34077	0.35286	0.01209	3.55	0.35286	0.01209	3.55
	II	0.35784	0.37410	0.01626	4.54	37476	0.01692	4.73
1973	I	0.37898	0.37518	–0.0038	–1.00	38351	0.00453	1.20
	II	0.42477	0.45579	0.03102	7.30	46196	0.03719	8.76
1974	I	0.93463	0.92907	–0.00556	–0.59	93771	0.00380	0.33
	II	1.17795	1.14841	–0.02954	–2.51	1.15558	–0.02237	–1.90
1975	I	1.19107	1.20067	0.00960	0.81	1.19425	0.00318	0.27
	II	1.22432	1.28185	0.05753	4.70	1.28580	0.06148	5.02
1976	I	1.38072	1.34509	–0.03563	–2.58	1.35690	–0.02382	–1.73
	II	1.40437	1.38408	–0.02029	–1.44	1.37252	–0.03185	–2.27
1977	I	1.43368	1.45216	0.01848	1.29	1.44187	0.00819	0.57
	II	1.49199	1.48947	–0.00252	–0.17	1.48979	–0.00220	–0.15
1978	I	1.53512	1.50696	–0.02816	–1.83	1.50402	–0.03110	–2.03
	II	1.51348	1.50308	–0.01040	–0.69	1.50050	–0.01298	–0.86
1979	I	1.64570	1.65189	0.00619	0.38	1.65185	0.00615	0.37
	II	2.03769	2.04876	0.01107	0.54	2.04776	0.01007	0.49
Mean Absolute				0.01863	2.12		0.01795	2.14
R M S				0.02343	2.87		0.02380	3.12

Table A-3 EX POST SIMULATION – Price Index for Energy Imports (Pm_e)

			STATIC			DYNAMIC		
		Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972	I	92.26	92.41	0.15	0.16	92.41	0.15	0.16
	II	110.05	100.32	–9.73	–8.84	100.21	–9.84	–8.94
1973	I	110.68	110.95	0.27	0.24	111.25	0.57	0.51
	II	150.24	158.44	8.20	5.46	155.15	4.91	3.26
1974	I	359.99	355.92	–4.07	–1.13	354.70	5.29	–1.46
	II	467.12	469.05	1.93	0.41	472.26	5.14	1.10
1975	I	456.92	456.25	–0.67	–0.15	458.87	1.65	0.36
	II	550.54	564.72	14.18	2.58	564.21	13.67	2.48
1976	I	511.15	510.95	–0.20	–0.04	508.73	–2.42	–0.47
	II	570.29	572.46	2.17	0.38	564.91	–5.38	–0.94
1977	I	513.40	507.08	–6.32	–1.23	506.78	–6.62	–1.28
	II	625.87	628.45	2.58	0.41	629.38	3.51	0.56
1978	I	562.88	562.18	–0.70	–0.12	561.59	–1.29	–0.22
	II	609.99	529.57	–80.42	–13.18	507.25	–102.74	–16.84
1979	I	689.65	699.89	10.24	1.48	700.54	10.89	1.57
	II	901.55	903.82	2.27	0.25	903.72	2.17	0.24
Mean Absolute				13.03	2.50		11.02	2.52
R M S				26.81	4.40		26.38	4.93

Table A-4 EX POST SIMULATION — Consumption of Crude Petroleum (CE_{cp})

		STATIC				DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	4673.24	4384.64	−288.60	− 6.18	4384.64	−288.60	− 6.18
II	4612.00	4692.97	80.97	1.76	4687.94	75.94	1.65
1973 I	5225.42	4350.12	−875.30	−16.75	4328.06	−897.36	−17.17
II	4307.99	3454.60	−853.39	−19.81	3519.13	−788.86	−18.31
1974 I	4276.13	4117.17	−158.96	− 3.72	4113.56	−162.57	− 3.80
II	3989.80	3470.52	−159.28	−13.02	3724.83	−264.97	− 6.64
1975 I	4559.09	4416.41	−142.68	− 3.13	4246.96	−312.13	− 6.85
II	4757.86	3612.94	−1144.92	−24.06	3666.65	−1091.21	−22.93
1976 I	4613.60	4796.36	182.76	3.96	4893.85	280.25	6.07
II	4876.40	4733.41	−142.99	− 2.93	5044.93	168.53	3.46
1977 I	4909.72	4421.94	−487.78	− 9.93	4377.24	−532.48	−10.85
II	5051.78	4670.56	−381.22	− 7.55	4717.62	−334.16	− 6.61
1978 I	5232.58	4934.36	−298.22	− 5.70	4975.59	−256.99	4.91
II	5267.58	5275.52	7.94	0.15	5228.95	− 38.63	− 0.73
1979 I	5237.99	5360.77	122.78	2.34	5399.88	161.89	3.09
II	5515.93	5482.98	− 32.95	− 0.60	5487.59	− 28.34	− 0.51
Mean Absolute			357.55	7.60		355.18	7.48
R M S			484.29	10.32		467.58	9.83

Table A-5 EX POST SIMULATION — Consumption of Refined Petroleum Products (CE_{rp})

			STATIC			DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	4019.15	3790.59	–228.56	– 5.69	3790.59	–228.56	– 5.69
II	3972.75	4211.06	238.31	6.00	4218.72	245.97	6.19
1973 I	4600.69	4559.25	– 41.44	– 0.90	4551.48	– 49.21	– 1.07
II	4323.53	4095.19	–228.34	– 5.28	3823.76	–499.77	–11.56
1974 I	4434.44	4470.96	36.52	0.82	4309.47	–124.97	– 2.82
II	4192.20	3593.57	–598.63	–14.28	2996.82	–1195.38	28.51
1975 I	4579.21	4153.79	–425.42	– 9.29	4081.55	–497.66	–10.87
II	4836.38	3787.72	–1048.66	–21.68	3744.02	–1092.36	–22.59
1976 I	4827.28	4804.06	– 23.22	– 0.48	4614.34	–212.94	4.41
II	4910.61	4656.99	–253.62	– 5.16	4594.72	–315.89	– 6.43
1977 I	5250.34	4588.73	–661.61	–12.60	4586.65	–663.69	–12.64
II	5362.85	4931.06	–431.79	– 8.05	4830.40	–532.45	– 9.93
1978 I	5446.86	5187.27	–259.59	– 4.77	5066.31	–380.55	– 6.99
II	5415.38	5436.55	– 21.17	– 0.39	5433.17	17.79	0.33
1979 I	5546.28	5323.86	–222.42	– 4.01	5224.85	–321.43	– 5.80
II	5649.67	5674.59	24.92	0.44	5684.63	34.96	0.62
Mean Absolute			296.51	6.24		400.85	8.53
R M S			403.90	8.47		522.57	11.34

Table A-6 EX POST SIMULATION — Consumption of Primary Energy (CPE)

			STATIC			DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	4789.74	4464.96	–324.78	– 6.78	4464.96	–324.78	– 6.78
II	4735.39	4793.42	58.03	1.23	4789.01	53.62	1.13
1973 I	5319.40	4431.91	–887.49	–16.68	4409.64	–909.76	–17.10
II	4398.27	3518.31	–879.96	–20.01	3570.84	–824.43	–18.81
1974 I	4392.68	4228.50	–164.18	– 3.74	4217.80	–174.88	– 3.98
II	4109.58	3535.95	–573.63	–13.96	3758.04	–351.54	– 8.55
1975 I	4668.62	4502.47	–166.15	– 3.56	4327.23	–341.39	– 7.31
II	4901.85	3694.95	–1206.90	–24.62	3745.40	–1156.45	–23.59
1976 I	4766.63	4949.69	183.06	3.84	5136.45	369.82	7.76
II	5034.94	4898.16	–136.78	– 2.72	5188.01	153.07	3.04
1977 I	5080.74	4521.45	–559.29	–11.01	4491.67	–589.07	–11.59
II	5242.17	4840.69	–401.48	– 7.66	4882.32	–359.85	– 6.86
1978 I	5439.34	5131.57	–307.77	– 5.66	5166.17	–273.17	– 5.02
II	5463.72	5458.25	– 5.47	– 0.10	5410.88	– 52.84	– 0.97
1979 I	5428.13	5550.43	–122.30	2.25	5583.64	155.51	2.86
II	5717.02	5696.68	– 20.34	– 0.36	5701.30	– 15.72	– 0.27
Mean Absolute			374.85	6.51		381.81	7.85
R M S			509.13	9.33		497.51	10.24

Table A-7 EX POST SIMULATION – Energy Consumption of Consuming Sector (CE_c)

			STATIC			DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	3593.59	3417.67	–175.92	– 4.90	3417.67	–175.92	– 4.90
II	3592.38	3789.37	196.99	5.48	3791.21	198.83	5.53
1973 I	3993.64	3998.28	4.64	0.12	3987.48	– 6.16	0.15
II	3799.75	3589.43	–110.32	– 2.90	3482.28	–317.47	8.36
1974 I	3640.40	3753.30	112.90	3.10	3629.93	– 10.47	– 0.29
II	3552.03	3141.38	–410.65	–11.56	2696.69	855.34	24.08
1975 I	3842.17	3493.75	–348.42	– 9.07	3458.91	–383.26	– 9.98
II	3976.40	3294.93	681.47	17.14	3278.20	–698.20	–17.56
1976 I	4036.40	3979.64	– 56.76	– 1.41	3859.45	–176.95	– 4.38
II	4174.82	3944.09	–230.73	– 5.53	3918.46	–256.36	– 6.14
1977 I	4243.84	3839.50	–404.34	– 9.53	3858.99	–384.85	– 9.07
II	4477.10	4164.60	–312.50	– 6.98	4105.11	–371.99	– 8.31
1978 I	4385.67	4305.97	– 79.70	– 1.82	4227.95	–157.72	– 3.60
II	4585.12	4566.74	– 18.38	– 0.40	4575.26	– 9.86	– 0.22
1979 I	4732.93	4411.66	–321.27	– 6.79	4350.14	–382.79	– 8.09
II	4544.17	4714.03	169.86	3.74	4737.56	193.39	4.26
Mean Absolute			227.18	5.65		286.22	7.18
R M S			285.64	7.15		364.85	9.41

Table A-8 EX POST SIMULATION – Production of Refined Petroleum Products (PE_{rp})

		Actual	STATIC Simulated	STATIC Error	STATIC Percent Error	DYNAMIC Simulated	DYNAMIC Error	DYNAMIC Percent Error
1972	I	4274.47	4905.93	631.46	14.77	4905.93	631.46	14.77
	II	4217.82	4149.04	– 68.78	– 1.63	4134.92	– 82.90	– 1.97
1973	I	4808.49	4741.87	– 66.62	– 1.38	4747.31	– 61.18	– 1.27
	II	3848.16	4475.67	627.51	16.30	4482.95	634.79	16.50
1974	I	3925.96	3654.55	–271.41	6.91	3624.82	–301.14	– 7.67
	II	3757.87	4688.62	930.75	24.76	4822.89	1065.02	28.34
1975	I	4331.85	4338.11	6.26	0.14	4551.10	219.25	5.06
	II	4533.54	5222.80	689.26	15.20	5191.78	658.24	14.52
1976	I	4391.07	4002.58	–388.49	– 8.84	3961.64	–429.43	– 9.78
	II	4616.87	4550.68	– 66.19	– 1.43	4256.88	–359.99	– 7.80
1977	I	4603.96	4946.18	342.22	7.43	4973.16	369.20	8.02
	II	4795.02	4764.21	– 30.81	– 0.64	4725.83	– 69.19	– 1.44
1978	I	4864.63	5195.02	330.39	6.79	5148.08	283.45	5.83
	II	4896.91	4941.94	45.03	0.91	4886.64	– 10.27	– 0.21
1979	I	4880.56	5530.24	649.68	13.31	5490.56	610.00	12.50
	II	5112.79	5174.93	62.14	1.21	5184.64	71.85	1.41
Mean Absolute				2441.05	7.60		366.71	8.57
R M S				8566.12	10.43		463.22	11.21

Table A-9 EX POST SIMULATION – Total Energy Imports (ME)

			STATIC			DYNAMIC		
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972	I	5437.88	5331.02	–106.86	– 1.97	5331.02	–106.86	– 1.97
	II	4090.95	4172.57	81.62	2.00	4176.65	85.70	2.09
1973	I	5030.98	5003.35	– 27.73	– 0.55	5002.08	– 28.90	– 0.57
	II	4799.67	4717.15	– 85.52	– 1.72	4441.32	–358.35	– 7.47
1974	I	4957.77	4904.17	– 53.60	– 1.08	4747.24	–210.53	– 4.25
	II	4677.72	4553.38	–124.34	– 2.66	3997.04	–680.68	–14.55
1975	I	5157.09	4904.56	–252.53	– 4.90	4917.57	–239.52	– 4.64
	II	4804.37	4298.65	–505.72	–10.53	4241.26	–563.11	–11.72
1976	I	5429.82	5414.55	– 15.27	– 0.28	5194.53	–235.29	– 4.33
	II	5621.29	5486.79	–134.50	– 2.39	5616.05	– 5.24	– 0.09
1977	I	5415.77	4970.85	–444.92	– 8.22	4962.64	–453.13	– 8.37
	II	5927.51	5648.58	–279.93	– 4.71	5540.69	–386.82	– 6.53
1978	I	5442.68	5287.04	–155.64	– 2.86	5158.47	–284.21	– 5.22
	II	5813.64	5794.83	– 18.81	– 0.32	5785.50	– 28.14	– 0.48
1979	I	5815.83	5755.60	– 60.23	– 1.04	5650.05	–165.78	– 2.85
	II	5645.92	5596.48	– 49.44	– 0.88	5598.09	– 47.83	– 0.85
Mean Absolute				149.60	2.88		242.51	4.75
R M S				207.49	4.03		311.43	6.23

Table A-10 EX POST SIMULATION – Macroeconomic Energy Efficiency Ratio (EE)

		Actual	STATIC Simulated	STATIC Error	STATIC Percent Error	DYNAMIC Simulated	DYNAMIC Error	DYNAMIC Percent Error
1972	I	6.50	7.24	0.74	11.38	7.24	0.74	11.38
	II	6.92	6.83	–0.09	– 1.30	6.85	–0.07	– 1.01
1973	I	6.62	8.25	1.63	24.62	8.32	1.70	25.68
	II	6.62	8.74	2.12	32.02	8.11	1.49	22.51
1974	I	7.07	7.17	0.10	1.41	7.01	–0.06	– 0.85
	II	7.11	8.62	1.51	21.24	7.38	0.27	3.80
1975	I	7.07	7.22	0.15	2.12	7.51	0.44	6.22
	II	6.92	9.37	2.45	35.40	9.02	2.10	30.35
1976	I	7.35	6.94	–0.41	– 5.91	6.59	–0.35	– 5.04
	II	7.37	7.42	0.05	0.68	6.81	–0.56	– 7.60
1977	I	7.12	7.69	0.57	8.01	7.70	0.58	8.15
	II	7.27	7.66	0.39	5.36	7.44	0.17	2.34
1978	I	7.18	7.58	0.40	5.57	7.37	0.19	2.65
	II	7.44	7.38	–0.06	– 0.81	7.39	–0.05	– 0.67
1979	I	7.28	7.30	0.02	0.27	7.15	–0.13	– 1.79
	II	7.61	7.54	–0.07	– 0.92	7.51	–0.10	– 1.31
Mean Absolute				0.67	9.81		0.56	8.21
R M S				1.03	15.07		0.84	12.35

Table A-11 EX POST SIMULATION – Energy Self-Sufficiency Ratio (ES)

		Actual	STATIC Simulated	STATIC Error	STATIC Percent Error	DYNAMIC Simulated	DYNAMIC Error	DYNAMIC Percent Error
1972	I	0.02566	0.02764	0.00198	7.72	0.02764	0.00198	7.72
	II	0.02747	0.02712	–0.00035	– 1.27	0.02715	–0.00032	– 1.16
1973	I	0.01831	0.02215	0.00384	20.97	0.02346	0.00515	28.13
	II	0.01842	0.02248	0.00406	22.04	0.02219	0.00377	20.47
1974	I	0.02372	0.02454	0.00082	3.46	0.02460	0.00088	3.71
	II	0.02565	0.02935	0.00370	14.42	0.02780	0.00215	8.38
1975	I	0.02222	0.02299	0.00077	3.47	0.02388	0.00166	7.47
	II	0.02765	0.03600	0.00835	30.20	0.03555	0.00790	28.57
1976	I	0.02884	0.02786	–0.00098	– 3.40	0.02693	–0.00191	– 6.62
	II	0.02965	0.03043	0.00078	2.63	0.02882	–0.00083	– 2.80
1977	I	0.02935	0.03253	0.00318	10.83	0.03272	0.00337	11.48
	II	0.03039	0.03265	0.00226	7.44	0.03240	0.00201	6.61
1978	I	0.03089	0.03256	0.00167	5.41	0.03236	0.00147	4.76
	II	0.03281	0.03284	0.00003	0.09	0.03310	0.00029	0.88
1979	I	0.07219	0.07077	–0.00142	– 1.97	0.07039	–0.00180	– 2.49
	II	0.17239	0.17295	0.00056	0.32	0.17282	0.00043	0.25
Mean Absolute				0.00217	8.48		0.00224	8.84
R M S				0.00297	12.13		0.00297	12.46

Table A-12 EX POST SIMULATION – Real Gross Domestic Product (Y)

			STATIC			DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	26,867	26,773	– 94	0.34	26,773	– 94	0.34
II	28,348	28,543	195	0.69	28,506	158	0.56
1973 I	31,077	25,170	–5,907	–19.02	25,044	–6,033	19.41
II	29,200	25,780	–3,420	–11.71	26,940	–2,260	7.74
1974 I	32,167	30,735	–1,432	– 4.45	31,007	–1,160	– 3.61
II	30,662	28,389	–2,273	– 7.41	31,912	1,250	4.08
1975 I	33,160	32,725	– 435	– 1.31	31,444	–1,716	– 5.17
II	34,427	28,720	–5,752	–16.69	29,066	–5,406	–15.68
1976 I	36,605	36,424	– 181	– 0.49	37,702	1,097	3.00
II	37,343	36,044	–1,299	– 3.48	38,264	921	2.47
1977 I	38,587	36,769	–1,818	– 4.71	36,276	–2,311	– 5.99
II	40,399	37,972	–2,427	– 6.01	38,351	–2,048	– 5.07
1978 I	40,592	39,694	– 898	– 2.21	40,082	– 510	– 1.26
II	41,744	41,739	– 5	– 0.01	41,124	– 620	– 1.49
1979 I	41,792	44,495	2,703	– 6.47	44,831	3,039	7.27
II	44,515	44,634	119	0.27	44,534	19	0.04
Mean Absolute			1,809.88	5.33		1,790.13	5.20
R M S			2,575.97	7.79		2,475.92	7.39

Table A-13 EX POST SIMULATION – Total Real Consumption Expenditures (C)

			STATIC			DYNAMIC		
		Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972	I	22,210	22,246	36	0.16	22,246	36	0.16
	II	22,972	22,908	– 64	–0.27	22,980	8	0.03
1973	I	23,873	22,999	–874	–3.66	23,004	– 869	–3.64
	II	24,279	23,787	–492	–2.03	23,174	–1,105	–4.55
1974	I	24,662	24,692	30	0.12	23,820	– 842	–3.41
	II	25,419	25,269	–150	–0.59	25,032	– 387	–1.52
1975	I	25,935	25,830	–105	–0.40	25,347	– 588	–2.27
	II	26,267	25,667	–600	–2.28	25,256	–1,011	–3.85
1976	I	27,461	27,375	– 86	–0.31	26,691	– 770	–2.80
	II	28,010	27,941	– 69	–0.25	27,424	– 586	–2.09
1977	I	28,479	28,556	77	0.27	28,031	– 448	–1.57
	II	29,610	28,981	–629	–2.12	28,587	–1,023	–3.45
1978	I	30,518	30,414	–104	0.34	29,587	– 931	–3.05
	II	31,188	31,192	4	0.01	30,318	870	–2.79
1979	I	31,920	32,350	430	1.35	31,621	– 299	–0.94
	II	32,506	32,637	131	0.40	32,302	– 204	–0.63
Mean Absolute				242.56	0.91		623.56	2.30
R M S				356.40	1.37		713.37	2.66

Table A-14 EX POST SIMULATION – Total Real Investment Expenditures (I)

			STATIC			DYNAMIC		
		Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972	I	5188	5489	301	5.80	5489	301	5.80
	II	5302	5290	– 12	– 0.23	5143	– 159	– 3.00
1973	I	5764	1208	–4556	–79.04	1075	–4689	–81.35
	II	5849	3352	–2497	–42.69	5130	– 719	–12.29
1974	I	8350	6899	–1451	–17.38	8026	– 324	– 3.88
	II	7301	5752	–1549	–21.22	9643	2342	32.08
1975	I	9042	8982	– 60	– 0.66	8386	– 656	– 7.26
	II	9942	5051	–4891	–49.20	5865	–4077	41.01
1976	I	10145	9650	– 495	– 4.88	11692	1547	15.25
	II	10080	9054	–1026	–10.18	11676	1596	15.83
1977	I	9783	8281	–1502	–15.35	8402	–1381	–14.12
	II	11045	9806	–1239	–11.22	10605	– 440	– 3.98
1978	I	10868	10440	– 428	– 3.94	11673	805	7.41
	II	11340	11077	– 263	– 2.32	11338	– 2	0.02
1979	I	10995	13472	2477	22.53	14564	3569	32.46
	II	12853	12616	– 237	– 1.84	12917	64	0.50
Mean Absolute				1437	17.84		1417	17.55
R M S				2047	27.71		2026	26.72

Table A-15 EX POST SIMULATION – Total Real Imports (M)

			STATIC			DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	5060	4919	–141	– 2.79	4919	–141	– 2.79
II	5274	5214	– 60	– 1.14	5193	– 81	– 1.54
1973 I	4892	5441	549	11.22	5431	539	11.02
II	5908	5802	–106	– 1.79	5594	–314	– 5.31
1974 I	6081	6310	–229	3.77	6193	112	1.84
II	6802	6351	–451	– 6.63	5935	–867	–12.75
1975 I	6597	6564	– 33	– 0.50	6583	– 14	– 0.21
II	6908	6017	–891	–12.90	6058	–850	–12.30
1976 I	6857	6695	162	– 2.36	6644	–213	– 3.11
II	6822	6897	75	1.10	6712	–110	– 1.61
1977 I	6916	6624	–292	– 4.22	6712	–204	– 2.95
II	7183	7474	291	4.05	7448	265	3.69
1978 I	7502	7474	– 28	– 0.37	7429	– 73	– 0.97
II	8050	7786	–270	– 3.35	7823	–233	– 2.89
1979 I	8490	8092	–407	– 4.79	8069	–430	– 5.06
II	8827	8634	–193	– 2.19	8696	–131	– 1.48
Mean Absolute			261	4.23		286	4.03
R M S			341	5.41		382	5.72

Table A-16 EX POST SIMULATION – Total Employment Index (N)

			STATIC			DYNAMIC		
		Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972	I	99.40	96.28	– 3.12	– 3.14	96.28	– 3.12	– 3.14
	II	100.70	102.09	1.39	1.38	101.40	0.70	0.70
1973	I	104.60	95.65	– 8.95	– 8.56	95.25	– 9.35	– 8.94
	II	112.30	96.04	–16.26	–14.48	98.33	–13.97	–12.44
1974	I	122.30	111.03	–11.27	– 9.22	111.75	–10.55	– 8.63
	II	114.20	106.35	– 7.85	– 6.87	114.26	0.06	– 0.05
1975	I	111.20	112.87	1.67	1.50	112.38	1.18	1.06
	II	110.70	105.36	– 5.34	– 4.82	108.90	– 1.80	– 1.63
1976	I	119.70	121.02	1.32	1.10	127.78	8.08	6.75
	II	121.80	119.39	– 2.41	1.98	127.82	6.02	4.94
1977	I	124.70	121.23	– 3.47	– 2.78	123.69	– 1.01	– 0.81
	II	127.70	123.38	– 4.32	– 3.38	127.37	– 0.33	– 0.26
1978	I	128.90	126.55	– 2.35	– 1.82	129.95	1.05	0.81
	II	129.13	132.14	3.01	2.33	133.27	4.14	3.21
1979	I	136.20	137.12	0.92	0.68	140.75	4.55	3.34
	II	139.80	143.28	3.48	2.49	146.79	6.99	5.00
Mean Absolute				4.82	4.16		4.56	3.86
R M S				6.33	5.55		6.12	5.25

Table A-17 EX POST SIMULATION – Money Wage Index for Unskilled Labor (W)

			STATIC			DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	100.30	96.87	–3.43	–3.42	96.87	–3.43	–3.42
II	99.80	101.45	1.65	6.65	99.07	–0.73	–0.73
1973 I	100.70	101.65	0.95	0.94	101.14	0.44	0.44
II	104.70	103.32	–1.38	–1.32	103.56	–1.14	–1.09
1974 I	108.30	109.14	0.84	0.78	108.50	0.20	0.18
II	113.30	113.25	–0.05	–0.04	113.68	0.38	0.34
1975 I	118.80	117.41	–1.39	–1.17	118.52	–0.28	–0.24
II	121.40	122.06	0.66	0.54	123.06	1.66	1.37
1976 I	124.40	124.75	0.35	0.28	127.49	3.09	2.48
II	128.10	127.61	–0.49	–0.38	131.15	3.05	2.38
1977 I	181.10	131.16	0.06	0.05	134.49	3.39	2.59
II	134.60	134.18	–0.42	–0.31	137.62	3.02	2.24
1978 I	137.73	137.36	–0.37	–0.27	140.32	2.50	1.82
II	139.05	140.38	1.33	0.96	142.97	3.92	2.82
1979 I	143.42	142.53	–0.89	–0.62	146.19	2.77	1.93
II	148.10	149.39	1.29	0.87	152.64	4.54	3.07
Mean Absolute			0.97	0.85		2.16	1.70
R M S			1.26	1.17		2.58	1.99

Table A-18 EX POST SIMULATION – GDP Price Index (P)

			STATIC			DYNAMIC		
		Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972	I	100.00	98.35	– 1.65	– 1.65	98.35	– 1.65	– 1.65
	II	100.00	104.34	4.34	4.34	102.43	2.43	2.43
1973	I	105.96	107.76	1.80	1.70	107.28	1.32	1.25
	II	135.36	115.70	–19.66	–14.52	115.44	–19.92	–14.72
1974	I	144.64	141.56	– 3.08	– 2.13	142.08	– 2.56	– 1.77
	II	168.93	154.80	–14.13	– 8.36	157.32	–11.61	– 6.87
1975	I	167.25	163.32	– 3.93	– 2.33	169.67	2.42	1.45
	II	166.25	171.45	5.20	3.13	180.27	14.02	8.43
1976	I	179.32	181.05	1.73	0.96	194.06	14.74	8.22
	II	181.20	188.14	6.94	3.83	200.81	19.61	10.82
1977	I	193.77	196.73	2.96	1.53	207.52	14.04	7.25
	II	201.06	205.95	4.89	2.43	216.04	14.98	7.45
1978	I	206.50	213.17	6.67	3.23	221.37	14.87	7.20
	II	218.01	221.96	3.95	1.81	229.33	11.32	5.19
1979	I	240.24	231.27	– 8.97	– 3.73	240.52	– 0.05	– 0.02
	II	258.93	252.65	– 6.28	– 2.43	264.19	5.26	2.03
Mean Absolute				6.01	3.63		9.43	5.42
R M S				7.61	4.89		11.60	6.74

Table A-19 EX POST SIMULATION – Total Domestic Liquidity (Z)

			STATIC			DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	10391	10431	40	0.38	10431	40	0.38
II	11871	11631	– 240	– 2.02	11700	– 171	– 1.44
1973 I	15179	14855	– 324	– 2.13	14549	– 630	– 4.15
II	18063	18380	317	1.75	18415	352	1.95
1974 I	21602	21984	382	1.77	22974	1372	6.35
II	24242	25586	1344	5.54	28627	4385	18.09
1975 I	25590	26704	1114	4.35	31374	–4216	–16.48
II	28886	30697	1811	6.27	36945	8059	27.90
1976 I	32311	32094	– 217	– 0.67	40413	8102	25.08
II	35898	35436	– 462	– 1.29	43082	7184	20.01
1977 I	39592	39672	80	0.20	45996	6404	16.17
II	43931	43496	– 435	– 0.99	49118	5187	11.81
1978 I	46705	46612	– 93	– 0.20	51395	4690	10.04
II	51837	53158	1321	2.55	57340	5503	10.62
1979 I	62800	54724	–8076	–12.86	60077	–2723	– 4.34
II	57360	58177	817	1.42	65583	8223	14.36
Mean Absolute			1067	2.77		4203	11.82
R M S			2163	4.19		5104	14.83

Table A-20 EX POST SIMULATION – Interest Rate (R)

			STATIC			DYNAMIC	
	Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972 I	12.23	13.47	1.24	10.14	13.47	1.24	10.14
II	13.76	14.76	1.00	7.27	14.17	0.41	2.98
1973 I	11.90	7.68	–4.22	–35.46	7.89	– 4.01	–33.70
II	12.05	2.80	–9.25	–76.76	4.72	– 7.33	–60.83
1974 I	15.00	15.72	0.72	4.8	15.15	0.15	1.00
II	16.40	9.39	–7.01	–42.74	11.21	– 5.19	–31.65
1975 I	14.54	15.03	0.49	3.37	8.94	– 5.60	38.51
II	15.03	7.25	–7.78	–51.76	2.18	–12.85	–85.50
1976 I	12.37	16.88	4.51	36.46	11.75	– 0.62	– 5.01
II	13.16	12.81	–0.33	– 2.66	9.50	– 3.66	–27.81
1977 I	13.60	12.18	–1.42	–10.44	6.68	– 6.92	–50.88
II	11.58	10.49	–1.09	– 9.41	6.96	– 4.62	–39.90
1978 I	9.97	11.37	1.4	14.04	8.68	– 1.29	12.94
II	11.48	10.08	–1.4	–12.20	6.70	– 4.78	–41.64
1979 I	12.73	13.38	0.65	5.11	10.82	– 1.91	–15.00
II	13.04	14.80	1.76	13.50	10.74	– 2.30	–17.64
Mean Absolute				21.01		3.93	28.13
R M S				29.51		5.07	36.57

Table A-21 EX POST SIMULATION – Energy Tax Revenues (Te*)

			STATIC			DYNAMIC		
		Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972	I	234.98	226.24	– 8.74	– 3.72	226.24	– 8.74	– 3.72
	II	217.69	227.44	9.75	4.48	227.77	10.08	4.63
1973	I	261.86	259.91	– 1.95	– 0.74	259.62	– 2.84	– 1.08
	II	331.80	318.96	– 12.84	– 3.87	299.79	– 32.01	– 9.65
1974	I	999.40	1000.98	1.58	0.16	965.61	– 33.79	– 3.38
	II	1120.55	1013.93	–106.62	– 9.51	863.33	–257.22	–22.95
1975	I	1230.53	1140.38	– 90.15	– 7.33	1130.53	–100.00	– 8.13
	II	1317.24	1096.94	–220.30	16.72	1083.55	–233.69	–17.14
1976	I	1575.15	1569.19	– 5.96	– 0.38	1507.70	– 67.45	– 4.28
	II	1624.68	1557.46	– 67.22	– 4.14	1524.29	–100.39	– 6.18
1977	I	1774.37	1574.93	–199.44	–11.24	1157.94	–200.43	–11.30
	II	2087.06	1944.22	–142.84	– 6.84	1904.08	–182.98	– 8.77
1978	I	2100.44	2013.08	– 87.36	– 4.16	1964.37	–136.07	– 6.48
	II	2136.39	2140.73	4.34	0.20	2139.02	2.63	0.12
1979	I	2316.54	2240.60	– 75.94	– 3.28	2196.15	–120.39	5.20
	II	2861.36	2855.40	– 5.96	–21.00	2859.05	– 2.31	– 0.08
Mean Absolute				65.06	4.81		93.19	7.11
R M S				95.71	6.58		126.10	9.28

Table A-22 EX POST SIMULATION — Non-Energy Tax Revenue (Tne*)

			STATIC			DYNAMIC		
		Actual	Simulated	Error	Percent Error	Simulated	Error	Percent Error
1972	I	3084.02	3062.15	− 21.87	− 0.71	3062.15	− 21.87	− 0.71
	II	2785.31	3160.72	375.41	13.48	3154.35	369.04	13.25
1973	I	5579.13	5147.52	− 431.61	− 7.74	5290.26	− 288.87	− 5.18
	II	4403.19	4150.00	− 253.19	− 5.75	3734.04	− 689.15	−15.20
1974	I	6152.60	5474.31	− 678.29	−11.02	5077.35	−1075.25	−17.48
	II	6242.45	5539.86	− 702.59	−11.26	4680.53	−1561.92	−25.02
1975	I	7369.47	6373.72	− 995.75	−13.51	5994.61	−1374.86	−18.66
	II	6364.76	6409. 4	44.38	0.70	5866.14	− 498.62	− 7.83
1976	I	6757.85	7394.60	636.75	9.42	7258.59	500.74	7.41
	II	6725.32	7089.63	364.31	5.42	7612.38	887.06	13.19
1977	I	7214.63	7868.62	653.99	9.06	8606.00	1391.37	19.29
	II	7966.94	8018.85	51.91	0.65	8883.08	916.14	11.50
1978	I	9630.56	9751.47	120.91	1.26	10314.03	683.47	7.10
	II	10076.61	9918.36	− 158.25	− 1.57	10488.83	412.22	4.09
1979	I	12430.46	11269.29	−1161;17	− 9.34	11523.21	− 907.25	− 7.30
	II	13433.64	13221.28	− 212.36	− 1.58	13287.65	− 145.99	− 1.09
Mean Absolute				428.92	6.40		731.49	10.89
R M S				544.33	7.91		855.01	12.82