ENERGY PRICE MODEL

Progress Report

submitted to

National Energy Administration

Ministry of Science, Technology and Energy

Kingdom of Thailand

by

OSAMU KUMAKURA

Japan International Cooperation Agency

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PREFACE

Since September 1986, I have joined in the Project on Energy Pricing Model. This report contains my works done in this nine months in this project. As the project will be continued and many works are left to be done, this report is only to record the steps of my works and is not an accomplished one. However, I expect that this report will be useful for the further progress of the project.

I would like to express my appreciation to Dr. Itthi Bijayendrayodhin, Director of Energy Economics Division, Ms. Swanee Saratunti, Project Chief, and the staffs, Ms. Netnara Oonchai, Ms. Nuanlaor Wongpinitwarodom, Mr. Pradit Thetsiangwhan and Mr. Siri Rojratanakiat, who accepted me warmly to the project, and Mr. Kitti Limskul, Deputy Director, Chulalongkorn University Social Research Institute, who kindly leaded us. And I would like to express my thanks to my secretary, Ms. Srisamorn Lukitcharoenkul.

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I. Structure of the Model and Senario Setting

1. Structure of the Model

This model is a combination of macro-econometric model and I-O model. Principal features of this model are (1), that it has closed causal relations and keeps consistency between macro-economic variables and I-O table components, (2) that I-O table is used in a way which reflects the actual situation, namely, I-O coefficients for inputs of petroleum products change corresponding to price changes, and (3) that prices are determined in some different ways reflecting the actual situations of price determination.

By this model, we can calculate consistent values for GDP, and value added, components of final demand, intermediate demands and prices by sector.

The figure 1 shows the causal relations among variables. Exogenous variables are devided into two groups, i.e. autonomous variables and policy variables.

World economic growths (GDPWi, GDPWF), world prices (PWi) and import prices (PMi) are autonomous. They affect import and export, and indirectly domestic prices.

Energy prices (PORi, POXi, PNGP, etc.), domestic productions of energy and exportable crops (QLi, QNG, QRi), total public consumption and investment (IGT, CPT), and exchange rate (EXCH) are policy variables. These variables are exogenously determined

as tools of policy.

Purchaser's prices of energy affect intermediate and final demand of energy through substitution, and also indirectly affect domestic prices of non-energy products.

Production of energy and exportable crops determine exports or imports of these products as the differences between domestic demands and productions.

Total public consumption and investment as components of final demand influence productions by sector.

Exchange rate influences import and export through import prices and ratios between domestic price and world prices.

2. Scenario Setting

For the analyses on the effects of various policies, scenarios can be developed by combining various cases of movements of the policy variables.

It should be noticed that values for the exogenous variables are not independent from each other. For example, purchaser's and producer's prices of petroleum products are considered to be decided in the relation to world prices of them. Domestic production (petroleum products, crude oil, natural gas, etc.) will be decided by their relative costs (prices) for domestic supply and import. And government consumption and investment depend on government income which is determined by GDP, tax rate, etc.

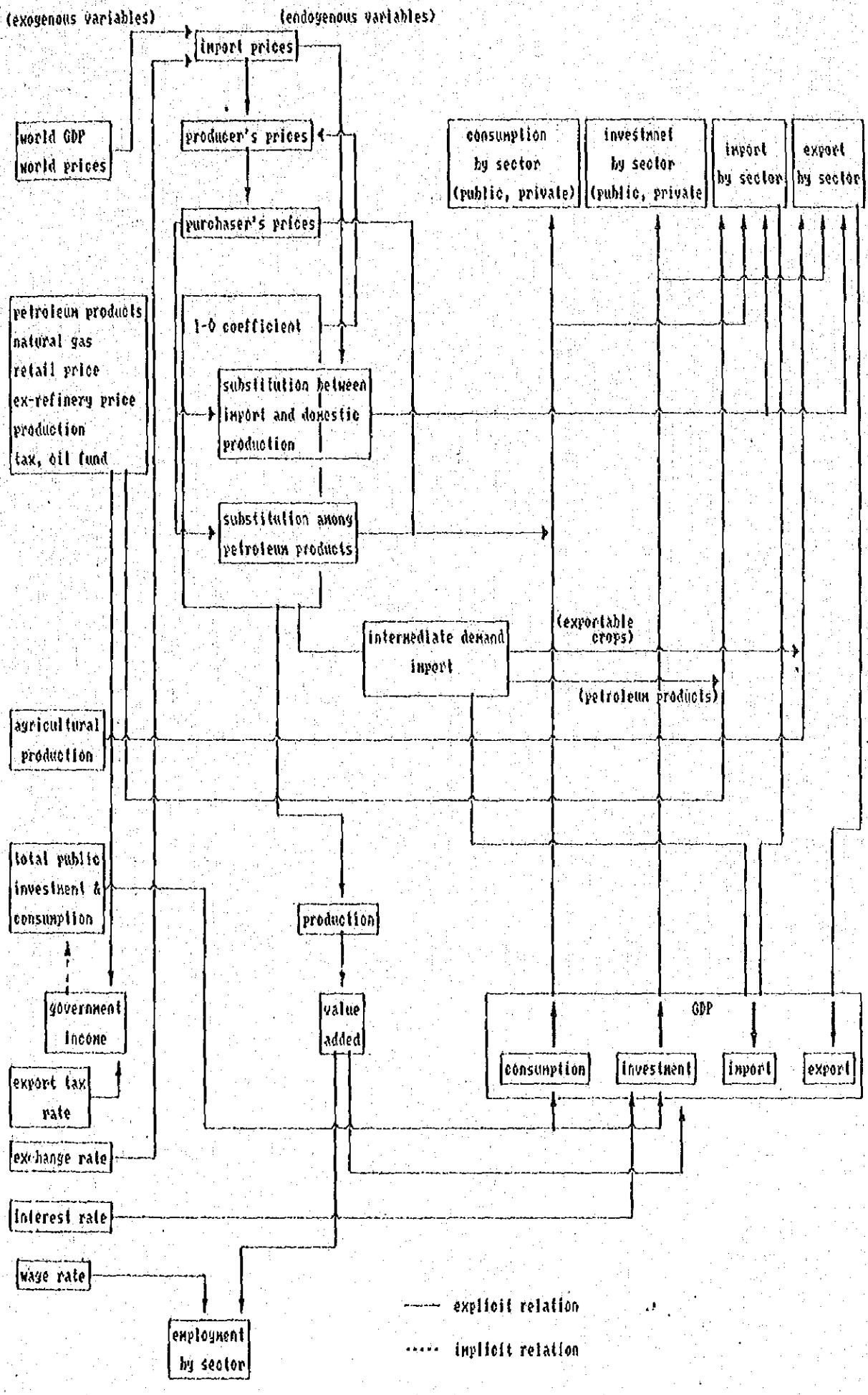
Scenarios must be developed so that the values for exogenous variables keep consistency and drop in plausible ranges.

An example of scenario development for the analyses on the effects by various energy policies is presented below. Among the autonomous variables, world economic growths and world prices perform substantial effects on the economy. And as ex-refinery prices of petroleum products and well-head price of natural gas can be rather said as autonomous variables same as world prices, because the formers are determined in connection with the latter.

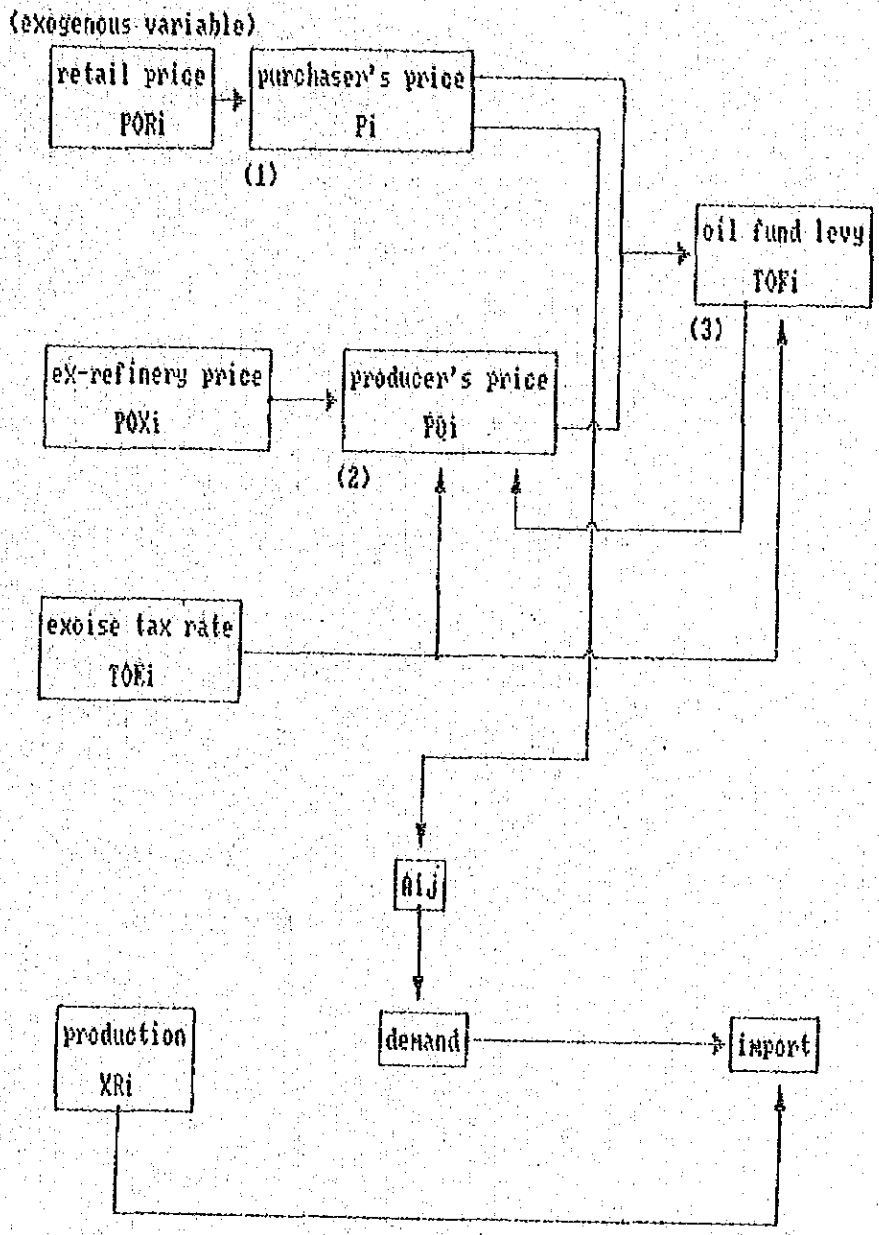
As policy variables, purchaser's prices of petroleum products and natural gas, production of natural gas and refinery capacity will be used for scenario setting. Domestic productions are exogenous for the sectors 1-11, and producter's prices and purchasers's prices for the sector 1-12. For the sector 11 (electricity) production are endogenously determined through I-O coefficients, and fuel inputs are exogenous. For the other types of energy (charcoal, fuel wood, coal, lignite, bagasse, saw mill waste and other energy), prices and productions are determined endogenously, and consequently excluded from the policy variables.

And in the model, excise tax and oil-fund levy, do not affect prices of corresponding products, these variables are also excluded from policy variables.

Structure of Energy Price Model



Flowchart of Petroleum Product Sector



(1) $P_i = PORi/PORio$

(2) $POi = \frac{POXi + TORi + TOFi}{POXio + TOEio + TOFio}$

(3) $TOFi = PORi - THOi - TOEi - POXi$

The macro-economic policy variable, such as interest rate, exchange rate, wage rate should not be used for scenario setting. As these variables are not controlable by government, or their functions in the economy are reflected only partially in the model these variables should be fixed to some most probable values. Scenarios can be developed combining cases for the principal factors as follows :

Autonomous variables

World economic growth

World prices

Ex-refinery prices (or policy variable)

Policy variables

Purchasers prices of petroleum products and natural gas

levels (relation to world prices)

relative prices

Production of natural gas

Capacity of refinery

II. Limitations and Improvement of the Model

1. Electricity Sector

Shares of fuel inputs by type are fixed to the values in 1982 by I-O table. They cannot change reflecting actual generating capacity expansion plans such as by EGAT. And also, price changes do not have any influences on the shares of fuel inputs. Comparing with refinery sector, production by which can be changed as exogenous variables, the rigidity for electricity sector may become one of limitations of the model. To improve the model so that the shares of fuel inputs can be changed reflecting prices, there are some methods as follows :

- Input fuel shares calculated taking into account fuel prices as exogenous variables, for example by EMP model.
- Put the mechanism of fuel substitution in the model. For example, estimating fuel demand function by electricity sector, modify the model so that I-O coefficient can be changed by prices changes, through elasticities of substitution.

In the Phase II Model, this sector was made exogenous, and fuel inputs by type can be inputted exogenously. Now, this sector can be treated in more realistic condition, by setting some scenarios on fuel consumptions reflecting capacity expansion plans in this sector.

2. Household Consumption and Income Distribution

In subroutine EQUAT, private consumptions by good and by

region (rural and urban) are determined with fixed shares of total private consumptions by rural and urban sectors, using consumption functions estimated separately for the two sectors.

In subroutine GINI, using the shares of total consumptions by two regions and total household income calculated by the model (EQUAT), income distributions in two sectors are calculated. However, this calculation does not take into consideration any factors which affect income distribution, consequently by this calculation any implications about effects on income distribution by any factors in the model can be acquired.

This part of the model has some meaning only if we consider it as a preliminary step for the improvement of the model.

To analyse the effects on income distribution by some factors in the model, some variables which actually affect directly income distribution, for example wage rates and employments by sector, must be used for the calculation (or estimation) of income distribution.

3. Labor Block

Labor demands by sector are calculated using values added and wage rates by sector, and labor supplies for each sector are calculated using growth rate of population (or labor force) in each sector. And unemployments are calculated as differences between supplies and demands of labor in each sector. By these calculation, some information about labor markets in each sector can be acquired. However, there are some limitations which must

be improved if some analysis on labor market is to be conductd on this model.

- Labor migrations among sectors are neglected
- Wage rates are given exogenously, and interactions among wage rates, conditions of labor market and macro-economic variables are not considered in the model.

4. Private Investment

In the model, to determine total private investment the following function is used.

$$IPTR = \underset{(1.1)}{1367.7} + \underset{(2.1)}{0.295} \cdot (GDPR - GDPR_{-1}) + \underset{(3.6)}{0.575} \cdot (GDPR_{-1} - GDPR_{-2}) + \underset{(8.8)}{1.15} \cdot (OSC - HIEP)/PIPVT$$

In this equation, the second and the third term explain accelerator effect on investment, and the fourth term may explain the availability of fund for investment. There are some problems about the fourth term as follows.

- The availability of fund may not be explained by operating surplus (excluding interest and dividend) of companies. It should be explained by factors which reflect the condition of capital market.
- At least, the fourth or the fifth term should be removed. Because, in the above equation, if the operating surplus in a year increases, investment will increase in the same year. And, morever, the operating surplus has multiplier effect through IPTR in the iteration process. These are

not reasonable.

Removing the fourth term of the above equation, the function should be estimated with the accelerator effect and some variables which reflect the condition of capital market (such as interest rate).

5. Exchange Rate (EXCHi)

Exchange rate enters the model by the following equations.

$$PW_i = PW_i \cdot EXCH$$

$$PM_i = PM_i \cdot EXCH$$

$$POX_j = POX_i \cdot EXCH$$

$$WROW = WROW \cdot EXCH$$

By these equations, the exchange rate is defined as a index of value of dollar in terms of baht (the value for 1982 = 1.0).

The third equation seems not necessary, because ex-refinary costs are set already reflecting exchange rate.

6. Tax Rate

Tax rates for various types of indirect tax are introduced in the model (as for direct taxes, tax revenues are determined by tax bases not by tax rates).

- Indirect tax rates Ti for domestic good and import tax rates TMRi for imported good (excluding petroleum products) are calculated on I-O coefficients.
- Excise tax rates for petroleum products (TOEi) are exogenous. Oil fund levies (TOFi) are determined endoge-

nously as difference between retail price and ex-refinery price plus excise tax etc.

- Export tax rates (TXRi) are exogenous.

Two problems can be pointed out.

(1) For petroleum products, ex-refinery prices and retail prices are fixed exogenously. So excise tax and oil fund do not have any influences on prices of petroleum products.

(2) Only TOEi, and TXRi are given exogenously, and the other tax rates are fixed throughout the simulation period. It is desirable to make indirect tax rates for domestic goods (and import tax rate for imported goods other than petroleum products) exogenous variables which can be changed.

7. Wage Rate(w) and Interest Rate(IR)

Exactly speaking the variables, w and IR are not wage rate and interest rate respectively.

For example, price determined by cost is defined by the following equation (for products, prices of which are determined by costs).

$$PQ_j = \Sigma P_j A_{ij} + w \cdot L_j + T_j + R_j \cdot IR$$

As L_j and R_j are the share of wage and profit in producer's price and fixed at the values in 1982, w and IR are prices (or inflators) same as P_j. So, actually the meaning of these variables can be understood in the following two ways.

- w and IR are, strictly speaking the prices (or inflators),

and the values for them should be calculated according to this definition (for example, use GDP deflater for both variables). In this case, we can simply assume w = IR = PGDP, and the model will be solved by replacing w and IR by PGDP.

- L_j and R_j are assumed to change throughout the period. And w and IR have functions to adjust L_j and R_j after 1983 reflecting the changes of the shares of $w \cdot L_j$ and $R_j \cdot IR$ in producer's prices. In this case, changes in all prices should be taken into consideration to get the values of w and IR which make the reasonable projected values for $w \cdot L$ and $R_j \cdot IR$ after 1983.

III. Records of Works for the Improvement of Performance of the Model

The purpose of this paper is to record the processes of our works to improve the performance of the model. In each step of work, reasons or purposes of some modifications of the model and their effects on the performance of the model are presented.

The modifications of the model should be conducted basically in the way to improve the model so that it can truck or explain the actual performance of the economy better. Consequently, the improvements of the structure of the model and the modifications of the equations or their parameters are the main ways in our works.

The works are especially practical and not free from trial and error. However, the following viewpoints will be always useful.

1). To compare the performance of the model with the actual performance of the economy, especially to compare the values of variables calculated by the model and the actual values in the period 1982-1986.

2). To investigate the results referring to the knowledges and informations about the actual performance of the economy.

The methods to improve the model are usually 1). to improve (re-estimate) the structural functions, 2). to modify the parameters of them. At least in this step exogenous variables should not be modified to get more resonable results. Because by doing this, the problems in the model which must really be solved

are concealed.

Steps of our works will be chronologically recorded.

1. Return the values of some exogenous variables to the original values (at the end of April).

At the time when the works started, the values of some exogenous variables had been arbitrarily modified from the original values to get more reasonable results of simulation runs. For example, the growth rates of GDPWi (world GDP index for commodity i) in the extra-polation period were set very low compared with ones which are considered realistic, probably for the purpose to suppless the exports which will become very large without such manipulations of exogenous variables.

GDPWi and prices of ex-refinery products which were unreasonably low were modified to more realistic values.

The results up to 1989 are shown in Table 1. According to them, the following problems are presented about the performance of the model.

GDPF

Total GDP is overestimated at 15% in 1982. Looking by sector, GDP by the manufacturing sector is mostly overestimated.

Growth rate of total GDP tends to be overestimated, especially from arround 1988. Those for the exportable sector and the other manufacturing sector become overestimated at the

same year. The traceability of GDP will be an important criterion of improvement of the model.

National Expenditure

IPTR is overestimated at 80% in 1982, and CPTR at 15% in the same year. There seems to be some mistakes in the part of the model which determines IPTR.

Exports and Imports

Traceability of exports and imports by sector are not sufficient. This may be partly because the import and export functions, but partly because of the overestimations of GDP. Because imports by sector are determined by GDP and domestic and world prices. Exports by sector are determined by GDPW, domestic and world prices, and GDP (for exportable crops).

2. Change the consumption function of exportable crops (13 May).

Consumption functions estimated in the form of AIDS function without prices as explanatary variables using cross section data, imply price elasticity of consumption arround 1.0. This value is too large at least for goods such as food. And this large value makes the consumption of exportable crops fluctuant reflecting price changes, consequently their export as the difference between production and consumption fluctuates unrealistically.

To make the consumption function of exportable crops more realistic, another consumption function is estimated using time-

series data.

As the results, the export became stable, however, under-estimated in the extrapolation period.

3. Change GDPWi for other manufacturing and correct input data for exchange rate (May 18).

Growth rates of GDPWi for other manufacturing were obviously too high both in the past and in the future, and consequently the export of other manufacturing products were over-estimated. To correct this, the values for GDPWi for this sector were modified to a lower and more realistic values.

By this (although there were some mistakes in data), the movements of the export were improved.

And by correcting exchange rate, the results were improved (for example, GDP growth rate in 1986).

4. Improve the IPTR function.

Because the estimated values of IPTR is overestimated in a larger degree than any other variables, the IPTR function seems not correct. To correct it, IPTR function is estimated again.

Table 1 : Outputs of the Energy Price Model at the Beginning

GROSS DOMESTIC PRODUCT AT CONSTANT 1982 PRICES(MILLION BAHT)

			1982	1983	1984	1985	1986	1987	1988	1989
1501	VAR1	PET.REFINING	3055.552	3326.137	3684.864	4075.565	4314.695	4025.204	5260.457	5474.551
1509	VAR9	NATURAL GAS	4356.512	5159.552	7455.020	12039.953	11532.512	11565.405	12940.230	15104.723
1510	VAR10	CRUDE OIL	0.0	405.424	1014.032	1075.357	1037.300	1756.294	1092.612	1390[illegible]
1512	VAR12	ELECTRICITY	11322.465	12649.711	13603.254	14625.437	13675.492	15007.250	15657.240	17461.076
1513	VAR13		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1514	VAR14	CHARCOAL	8376.426	9011.512	9179.477	5053.521	9545.157	8912.532	9006.559	9525.029
1515	VAR15	FUEL WOOD	2561.514	2696.314	2740.524	2627.754	2663.724	2716.743	2700.651	2859.514
1516	VAR16	COAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1517	VAR17	LIGNITE	100.457	109.530	139.531	173.514	175.197	173.927	174.251	175.932
1518	VAR18	BAGASSE	5.239	4.516	4.504	4.967	4.875	4.718	5.363	5.836
1519	VAR19	SAW MILL WST	142.350	152.714	169.263	177.825	201.323	190.102	197.172	222.050
1520	VAR20		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1521	VAR21		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1522	VAR22	OTHER ENERGY	21.985	22.749	25.015	27.464	30.152	26.569	29.726	32.627
1523	VAR23	EXP. CROPS	105316.750	91634.487	91400.750	100797.037	95923.500	95741.312	108221.437	116433.500
1524	VAR24	OTHER CROPS	33714.620	36636.113	39120.729	40365.309	42267.090	42790.070	45346.125	47047.256
1525	VAR25	OTHER AGRIC.	50194.289	51142.391	55392.168	56956.601	60662.840	60799.102	65264.801	68460.502
1526	VAR26	MINING	14941.793	16971.238	17617.801	20164.754	23492.166	21421.945	21351.500	24727.371
1527	VAR27	FOOD PRC.	35340.676	37212.473	41913.607	42459.098	46282.035	47024.527	48735.509	52495.090
1528	VAR28	OTHER MNFC.	121261.062	131556.375	150434.937	166087.375	209978.312	180492.187	189505.312	221753.312
1529	VAR29	CONSTRUCTION	40968.023	60149.968	59945.913	60747.567	57875.215	61595.645	58801.848	73679.437
1530	VAR30	MKT.SERVICES	95105.375	106292.750	120633.437	133796.125	147551.812	150113.500	159405.625	183955.125
1531	VAR31	NON-MKT.SER.	115713.250	121253.500	129232.312	126583.312	110915.875	119100.187	120171.375	131800.312
1532	VAR32	TRPT.&COM.	57679.434	66452.062	76374.625	85107.437	94315.375	99314.937	100541.687	121777.625
1533	VAR33	TRADE	150566.937	167936.437	181379.750	192023.937	203179.812	206206.250	210677.187	243759.412
1104	GDPPR		874243.937	933474.437	1014200.75	1024642.75	1085505.00	1102680.00	1157905.00	1321977.00

GROWTH RATE(IN PERCENT)

1501	VAR1	PETROLEFINING	0.0	[illegible]	-3.[illegible]	10.[illegible]	[illegible]	11.[illegible]	[illegible]	[illegible]
1502	VAR9	NATURAL GAS	0.0	17.[illegible]	45.[illegible]	[illegible]	-4.[illegible]	[illegible]	[illegible]	[illegible]
1520	VAR10	CRUDE OIL	0.0	0.0	[illegible]	[illegible]	-[illegible]	[illegible]	[illegible]	-17.[illegible]
1512	VAR12	ELECTRICITY	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1513	VAR13		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1514	VAR14	CHARCOAL	0.0	[illegible]	[illegible]	-[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1515	VAR15	FUEL WOOD	0.0	[illegible]	[illegible]	-[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1516	VAR16	COAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1517	VAR17	LIGNITE	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1518	VAR18	BAGASSE	0.0	-13.[illegible]	-0.[illegible]	[illegible]	-[illegible]	-[illegible]	[illegible]	[illegible]
1519	VAR19	SAW MILL WST	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1520	VAR20		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1521	VAR21		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1522	VAR22	OTHER ENERGY	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1523	VAR23	EXP. CROPS	0.0	-13.[illegible]	-0.[illegible]	[illegible]	-[illegible]	-[illegible]	[illegible]	[illegible]
1524	VAR24	OTHER CROPS	0.0	-0.074	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1525	VAR25	OTHER AGRIC.	0.0	[illegible]	[illegible]	[illegible]	[illegible]	-0.[illegible]	[illegible]	[illegible]
1526	VAR26	MINING	0.0	[illegible]	[illegible]	[illegible]	[illegible]	-[illegible]	[illegible]	[illegible]
1527	VAR27	FOOD PRC.	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1528	VAR28	OTHER MNFC.	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1529	VAR29	CONSTRUCTION	0.0	[illegible]	-0.[illegible]	[illegible]	-[illegible]	[illegible]	[illegible]	[illegible]
1530	VAR30	MKT.SERVICES	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1531	VAR31	NON-MKT.SER.	0.0	-.[illegible]	[illegible]	-[illegible]	-[illegible]	[illegible]	[illegible]	[illegible]
1532	VAR32	TRPT&COM.	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1533	VAR33	TRADE	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1104	COPPER		0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1103	GDPF	874243.937	964812.062	1064901.00	1180930.00	1250533.00	1269188.00	1333466.00	1509205.00
046	TI	91384.812	102360.500	108831.375	97665.687	139839.512	136094.625	145316.562	171554.250
1101	GDP	978609.750	1080153.00	1166713.00	1291570.00	1403203.00	1416606.00	1491765.00	1694390.00
044	NFN	-10404.324	-1672.539	-496.809	6320.016	6867.629	-784.805	-7567.371	-2661.340
1105	GNP	968204.875	1078474.00	1166216.00	1297902.00	1410070.00	1414083.00	1484177.00	1691736.00

NATIONAL EXPENDITURE AT CONSTANT 1982 PRICES (MILLION BAHT)

098	XTR	1735283.00	1830570.00	1927711.00	2140077.00	2357619.00	2279113.00	2403493.00	2713498.00
662	INTDTR	837490.062	890644.750	965965.250	1042628.31	1107689.00	1125512.00	[illegible]	1345000.00
672	CPTR	630228.500	702560.937	772733.625	830640.000	871854.375	904973.437	941493.875	1027743.31
664	CGTR	110875.612	110132.562	125031.125	118929.937	94665.187	105528.062	[illegible]	121653.127
670	ITR	245294.937	309179.687	302634.062	307304.187	289898.687	311836.687	292879.250	376023.875
668	IPTR	179812.000	235279.937	222216.812	237675.125	235127.625	241315.000	220037.250	301595.187
666	IGTR	66482.937	73899.750	80417.250	69629.062	54771.074	70523.637	72642.000	74418.627
674	EXGR	171942.750	142435.000	167500.937	165280.625	179666.500	204020.562	245079.625	259392.625
690	EXSR	41408.234	44621.891	61295.871	70791.812	83046.062	104709.167	130000.500	161321.375
1107	CFTR	25905.230	34798.187	45143.000	55450.883	67316.437	87842.267	111926.562	139061.127
676	MGR	202623.000	248099.187	257303.500	253556.500	197516.375	298699.562	313395.437	362371.375
692	MSR	25347.340	31291.320	37478.172	28240.551	29291.228	36950.241	48034.887	55192.[illegible]

BALANCE OF PAYMENTS (MILLION BAHT)

673	TXG	171942.625	140045.187	173261.937	169977.812	193340.312	224252.062	256519.625	250667.375
675	MG	202628.000	221156.750	241400.000	267961.875	226547.937	[illegible]	[illegible]	[illegible]
695	GT	-30685.375	-74130.562	-54756.062	-96032.062	-55001.625	[illegible]	-59625.500	-71905.[illegible]
689	XS	41406.152	50493.754	62442.277	76014.937	93375.750	112134.750	130731.625	173211.127
691	MS	25347.340	30431.027	35602.523	36976.914	40230.317	[illegible]	50550.035	55050.[illegible]
544	NFN	-10404.324	-1676.539	-496.804	6326.016	6867.629	-4734.005	-7567.371	-2661.340
545	NFL	-23404.224	-10088.[illegible]	-20731.797	-17415.[illegible]	-19534.659	-20511.[illegible]	-[illegible]	-[illegible]
673	NRUW	15080.000	18407.000	20254.[illegible]	25741.652	20222.408	15735.492	15750.000	15750.000
447	TRAN	5164.082	5883.273	6551.043	6812.074	7446.422	9127.414	10077.047	11552.[illegible]
555	CA	-19865.324	-54343.102	-35374.074	-45900.944	33467.759	11995.[illegible]	53045.762	51959.224

SAVING – INVESTMENT (MILLION BAHT)

560	S	214372.627	252067.312	261224.750	259997.187	375726.125	357440.125	357227.437	452220.312
675	SH	131455.687	146502.125	156690.625	172994.167	107319.062	155129.625	153371.187	201825.000
659	SC	75613.200	92367.875	101757.875	104451.125	115190.750	111115.437	110043.750	150150.937
674	SG	7203.500	14194.312	20814.500	12519.875	94222.312	90195.062	100512.500	130247.375
669	IT	245294.687	307096.000	310444.187	321558.250	324717.000	322247.000	302545.687	405900.000
667	IPT	179811.687	235772.000	225490.187	245954.250	250216.000	248770.000	225346.687	325099.000
665	IGT	66483.000	72424.000	81555.000	75619.000	74506.000	73704.000	78199.000	80891.000
546	CA	-19305.324	-54343.102	-35374.074	-45900.944	33467.754	11993.461	53045.762	51523.234

EXPORTS OF GOODS AT CURRENT PRICES (MILLION BAHT)

2461	EX1	PMG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2462	EX2	RMG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2463	EX3	DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2464	EX4	LPG.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2465	EX5	FUEL OIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2466	EX6	KEROSENE	12.000	12.000	12.000	12.000	12.000	12.000	12.353	[illegible]
2467	EX7	JET FUEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2468	EX8	OTHER PET.PR	25.000	25.000	25.000	25.000	25.000	25.000	[illegible]	[illegible]
2469	EX9	NATURAL GAS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2470	EX10	CRUDE OIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2471	EX11	CONDENSATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2472	EX12	ELECTRICITY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2473	EX13		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2474	EX14	CHARCOAL	33.000	33.794	54.273	92.137	92.395	[illegible]	[illegible]	92.156
2475	EX15	FUEL WOOD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2476	EX16	COAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2477	EX17	LIGNITE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2478	EX18	BAGASSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2479	EX19	SAW MILL WST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2480	EX20		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2481	EX21		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2482	EX22	OTHER ENERGY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2483	EX23	EXP. CROPS	73759.000	43374.258	40517.291	14955.176	9427.293	23471.039	[illegible]	[illegible]
2484	EX24	OTHER CROPS	5104.168	2557.382	[illegible]	2470.994	2077.202	1406.767	4090.750	1800.971
2485	EX25	OTHER AGRIC.	565.544	[illegible]	607.434	664.727	623.446	711.441	726.722	750.497
2486	EX26	MINING	10598.076	11813.707	12579.520	9045.353	7324.000	8880.051	8605.227	12255.273
2487	EX27	FOOD PRC.	27854.590	26244.609	37878.273	38060.475	46367.414	40146.572	50002.505	53127.441
2488	EX28	OTHER MNFC.	53940.387	60820.551	84106.250	106521.875	127517.625	130496.427	147753.375	166411.875
673	EXG		171942.025	146045.167	175161.927	169879.612	193340.312	214252.062	236510.625	260867.675
2489	EX29	CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2490	EX30	MKT. SERVICE	6164.996	6650.844	7732.254	7207.945	7493.500	6422.207	9505.500	13951.297
2491	EX31	NON-MKT.SER.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2492	EX32	TRPT.&COM.	5539.988	5570.582	8748.100	9492.312	9772.934	9754.336	9978.395	10339.195
2493	EX33	TRADE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1108	CFT		26903.168	35256.328	46511.563	59317.707	75107.312	93757.750	117447.750	146620.612
689	EXS		41408.152	50493.754	62992.277	76019.937	93375.750	112137.750	136931.625	173211.187

IMPORTS OF GOODS AND SERVICES (MILLION BAHT)

2541	M1	PMG	2.433	413.334	1260.127	1727.253	1703.192	2050.063	1773.493	3041.004
2542	M2	KMG	21.059	174.261	615.003	720.300	767.229	673.271	749.015	1320.055
2543	M3	DIESEL	5810.953	3489.385	7425.480	7333.234	3850.188	1930.240	2821.460	3225.742
2544	M4	LPG.	2206.136	4550.279	6147.003	6909.492	5153.723	7132.980	8109.676	9335.025
2545	M5	FUEL OIL	2298.990	4506.254	3952.730	2404.635	2373.176	1554.745	622.490	4200.025
2546	M6	KEROSENE	502.513	691.409	432.374	414.960	526.171	1133.579	2200.719	1191.757
2547	M7	JET FUEL	900.711	437.056	1704.933	3053.013	3129.926	3535.619	5700.227	10202.640
2548	M8	OTHER PET.PR	4726.258	4574.023	5953.240	3222.255	6700.145	6020.010	5341.027	9555.559
2549	M9	NATURAL GAS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2550	M10	CRUDE OIL	45890.504	39296.551	36225.145	43302.916	27452.340	35595.544	45111.476	53592.441
2551	M11	CONDENSATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2552	M12	ELECTRICITY	475.320	501.767	544.519	661.409	610.324	619.532	633.026	673.502
2553	M13		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2554	M14	CHARCOAL	3.924	7.539	8.771	11.001	10.001	10.069	10.157	10.507
2555	M15	FUEL WOOD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2556	M16	COAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2557	M17	LIGNITE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2558	M18	BAGASSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2559	M19	SAW MILL WST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2560	M20		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2561	M21		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2562	M22	OTHER ENERGY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2563	M23	EXP. CROPS	1149.974	1275.640	1370.554	994.395	1130.309	1530.471	1490.017	1749.043
2564	M24	OTHER CROPS	4775.740	5011.324	5541.934	6139.133	5434.289	6082.520	6427.121	[illegible]
2565	M25	OTHER AGRIC.	663.093	702.537	659.477	1031.254	1219.361	1035.042	1057.007	1175.562
2566	M26	MINING	5209.414	6455.535	7244.137	5566.992	5243.227	5797.140	5527.959	[illegible]
2567	M27	FOOD PRO.	6540.955	5155.410	7560.525	4405.105	10921.555	9207.935	9572.514	10547.944
2568	M28	OTHER-MNFG.	121066.025	140356.675	157856.552	171774.000	149271.500	167644.350	192623.551	226121.167
575	MG		202023.000	225155.750	243900.000	267961.575	225347.937	273656.312	292336.125	352099.500
2569	M29	CONSTRUCTION	2.030	2.478	2.413	3.302	3.775	2.959	1.501	3.551
2570	M30	MKT. SERVICE	25337.936	30353.122	30055.097	37077.101	40349.040	43352.076	50552.135	54472.512
2571	M31	NON-MKT.SER.	399.590	414.198	442.101	512.812	554.025	595.029	617.554	661.121
2572	M32	EXP.T.ACUM.	[illegible]	-235.795	-565.762	-710.501	-757.100	-603.923	-952.554	-1101.747
2573	M33	TRADE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
692	MS		25347.340	29431.027	33532.523	36974.914	40120.237	45383.042	50550.035	58030.492

IV-1 Demand Equations and Input Parameters in the Energy Pricing Model

The purpose of this report is to present concepts of the demand equations and the methodology of estimation and inputting parameters which are practically required in manipulating the model. The reports on this model (especially, Inception Report, Chapter 2) should be referred to in reading this report.

1. Import Demand Function

Each demand component (final and intermediate) is separated into domestic goods and imported goods by import share function called "Armington Model"

$$\frac{M}{M+D} = (1 - qo)P^{-S}(qoP_D^{-S} + (1 - qo)P^{-S})^{-1}$$

where $\frac{M}{M+D}$: share of import in total demand for good i

P_M : import price

P_D : domestic price

S and qo are parameters to be estimated, S is the elasticity of substitution between import and domestic production, which (total 1 (p.48) of Inception Report) is input as SIGMA(I) in the model.

Procedure in the model (example for private consumption)

[Armington Model]

SU(I) = ARM(Qo,P(I),P(1+N),SIGMA(I)) EQU

where SU(I) : $\frac{M}{M+D}$

SIGMA(I) : elasticity of substitution

Qo corresponds to qo in the above equation, but the estimated value for qo is not used for Qo in the model. The value for Qo is calculated as share of domestic production in total consumption for each good, using I-O table.

[Import demand]

CPR(I+N) = (1.0-SU(I)) * CPR(I) EQU

CPR(I+N) : import demand for good i

CPR(I) : composite demand for good i (M+D)

[Production]

CPR(I) = CPR(I) - CPR(1 + N) EQU

CPR(I) (left side) : production of good i

CPR(I) (right side) : composite demand for good i

2. Export Function

Exports of goods (excluding energy and agricultural products) are determined by export function.

$$\log E_i = a_0 + a_1 \cdot \log\left(\frac{PW_i}{PX_i}\right) + a_2 \log GDPW_i$$

where E_i : export of good i

PX_i : export price

PW_i : world price

GDPW : world GDP

Using the estimated parameters, input parameters, a_1 (=ETA(I)), a_2 (=RHO(I)), are calculated (Table 3, P.57). Generally, average of long-run and short-run elasticities are adopted for the model.

Procedure in the Model

[Export of good i in 1982]

ERO(I) = DMP(I,7) COV

[Export function]

ER(I) = ERO(I)*(GDPW(I)**RHO(I)*((PW(I)/PX(I)**ETA(I)[1] EQU

where ER(I) : export of good i

ERO(I) : export of good i in 1982

3. Consumption Function

A simplified form of the linear expenditure system (IES) is used for the allocation of total private consumption to sectors.

$$PA_{it} \cdot CPR_{it} = \alpha_i + \beta_i \cdot CPT_t$$

where PA_{it} : price of composite good i (domestic + import)

CPR_{it} : consumption of composite good i (domestic + import)

CPT_t : total consumption

As the consumption functions are estimated using the Socio-Economic Survey (SES, 1975), it is necessary to convert the estimated parameters to these for the sectors by the classification in the model.

1) Estimation of income elasticities by sector by the model's classification

(1) The estimated parameters of the consumption functions by the SES' classification are converted to the parameters of consumption functions by the model's

---

1) As, $PW_i = PX_i = GDPW_i = 1.0$ in 1982, $\log E_i = a_o$ in 1982.

So, e^{a_o} = ERO (= the value of export of good i in 1982).

classifications, using the conversion matrix of the classifications obtained from NESDB.

(2) Income elasticities by the model's classification are calculated based on the converted parameters. And these income elasticities are input in the model as ELAS(I) [2].

2) Calculation of consumption by sector using the income elasticities

(1) Average budget share by sector by the definition of the I-O table is calculated. Marginal propencities to consume (MPC(I) = CBET(I)) and constant terms of consumption functions (CGAM(I)) are calculated using ELAS(I) and the budget shares [3].

Procedure in the model

[Average budget share of good i]

DELTA(I) = DELTA(I)/DELTA(NT) COVT2

DELTA(I) : share of private consumption of good i in total consumption

---

2) Using parameters of consumption function, $C = a + bY$, income elasticity is calculated as follows :

$$e = \frac{\partial C/C}{\partial Y/Y} = \frac{\partial(\alpha+\beta Y)}{\partial Y} \cdot \frac{Y}{\alpha+\beta Y} = \frac{\beta Y}{\alpha+\beta Y}$$

3) MPC(I) is calculated as follows :

(budget shares) (income elasticities)

$$= \frac{\alpha+\beta Y}{Y} \cdot \frac{\beta Y}{\alpha+\beta Y} = \beta$$

[Average budget share of good i (composite good)]

CBET(I) = DELTA(I) + DELTA(I + NC) COVT2

CBET(I) : share of private consumption of composite good i (domestic + import)

[Marginal propensity to consume]

MPC(I) = ELAS(I)·(DELTA(I) + DELTA(I + N)) PARAM

MPC(I) : marginal propensity to consume

Marginal propensity to consume is calculated using income elasticity and budget share.

[Constant term]

CGAM(I) = (CBET(I) - MPC(I))·DELTA(2·N + 2)[4] PARAM

CGAM(I) : constant term of consumption function

DELTA(2·N + 2) : value of total consumption

[Marginal propensity to consume (re-definition)]

CBET(I) = MPC(I)

(2) Consumption by sector is calculated using the consumption function

[Consumption function]

CPR(I) = (CGAM(I) + CBET(I) PT)/PA(I) EQU

CPR(I) : real consumption of good i (composite of domestic and import)

PA(I) : price of good i

---

4) Constant term of consumption function is calculated using $\alpha = C - \beta Y$. In the program,

C = CBET(I)·DELTA(2·N + 2), $\beta \cdot Y$ = MPC(I)·DELTA(2·N + 2)

CPT : total consumption

4. Substitution between Different Types of Petroleum Products

A simplified version of AIDS is used to determine substitution between different types of petroleum products, both for private consumption and intermediate demand. For intermediate demand,

$$\frac{P_{it} \cdot A_{ijt}}{\sum_{K=1} P_{kt} A_{kjt}} = \frac{A_{ijo} \cdot P_{io}}{\sum_{K=1} (A_{kjo} \cdot P_{ko})} + \sum_{K=1} GS_{ikj} \log(P_{kt}) \quad 5)$$

The parameters GS_{ikj} (or G_{ik} for private consumption) are estimated using the cross price elasticities estimated by the Rural Energy Assessment and the PEIDA report[6].

Procedure in the Model

[Share of demand]

WW(I) = WW(I)/ALF1 EQU

WW(I) (left side) : share of demand for good i in the total demand (real) in 1982

ALF1 : total consumption in 1982

---

5) In this equation, share of good i at current price is determined. The first term of the right side become $A_{ijo}/\Sigma A_{kjo}$, because $P_{io} = P_{ko} = 1.0$

6) The formula to calculate is presented in the note to Table 9 (P. 70).

[Demand share function]

WW(I) = WW(I)+GS(I,K,J) ALOG(P(K)) EQU

WW(I) (left side) : share of demand for good i at current price in year i

[Input coefficient]

A(I,J) = ALF * WW(I)/P(I)

ALF : Demand for good i at current price

5. Some Comments

Table 1 shows the features of methodologies to estimate input parameters. According to this, following problem are pointed out.

(1) For consumption function and substitution between petroleum products, cross section data are used for ostimation (except PEIDA which is not described about data in the report). Usually, estimated results using cross section data are over-estimated when they are used as parameters for time-series function.

(2) For consumption function, R^2s for the estimated results are very low, and for substitution between petroleum products no method to calculate cross price elasticity is shown clearly.

(3) Conversion matrix for consumption function is not available.

(4) For up-dating or improving the parameters, for all of the functions, the availability of data and large man-hours required for the estimation are serious problems.

Table 1 : Methodology to Estimate Input Parameters

	Model	Data	Estimated Results	Input Parameter
Import	Armington	time services (NESDB)	R^2 : 0.19 - 0.99	SIGMA(I) : elasticity of substitution between import and domestic supply
Export	Demand by the world	GDPW : weighted average of GDP of the major markets for each commodity	high R^2	RHO(I) : income elasticity ETA(I) : price elasticity
Consumption	Liner expenditure system	Socio-Economic Survey	R^2 : 0.046 - 0.758	ELAS(I) : income elasticity
Substitution between petroleum products	AIDS	cross price elasticities by previous studies (REA, PEIDA)	no method to estimated is shown	GS(I,J) : coefficient of price

IV-2 Deriving Formulas for Price Elasticities in LES

1. Uncompensated Own Price Elasticity

Linear expenditure system is

$$V_i = P_i q_i = P_i \gamma_i + \beta_i (V - \Sigma P_j \gamma_j) \qquad ---(1)$$

where P_i : price of good i

q_i : quantity of good i

$V = \Sigma V_i$, and β_i , γ_i are parameters to be estimated.

From (1)

$$q_i = \gamma_i + \frac{\beta_i}{P_i} (V - \sum_{j \neq i} P_j \gamma_j - P_i \gamma_i)$$

$$= (1 - \beta_i)\gamma_i + \frac{\beta_i}{P_i} (V - \sum_{j \neq i} P_j \gamma_j) \qquad ---(2)$$

Own price elasticity of demand for good i is

$$\frac{\partial q_i}{\partial P_i} \cdot \frac{P_i}{q_i} = - \frac{\beta_i}{P_i^2} (V - \sum_{j \neq i} P_j \gamma_j) \cdot \frac{P_i}{q_i}$$

$$= - \frac{\beta_i}{V_i} (V - \sum_{j \neq i} P_j \gamma_j)$$

$$= - \frac{\beta_i}{V_i} (V - \Sigma P_j \gamma_j + P_i \gamma_i) \qquad ---(3)$$

Substitute $V = \frac{V_i}{\beta_i} - \frac{P_i \gamma_i}{\beta_i} + \Sigma P_j \gamma_j$ (from (1))

into (3)

$$\frac{\partial q_i}{\partial P_i} \cdot \frac{P_i}{q_i} = -1 + \frac{P_i \gamma_i}{V_i} - \frac{\beta_i \Sigma P_j \gamma_j}{V_i} + \frac{\beta_i \Sigma P_j \gamma_j}{V_i} - \frac{\beta_i P_i \gamma_i}{V_i}$$

$$= -1 + \frac{P_i \gamma_i}{V_i} - \frac{\beta_i P_i \gamma_i}{V_i}$$

$$= (1 - \beta) \cdot \frac{P_i \gamma_i}{V_i} - 1$$

2. Compensated Own Price elasticity

From (2), and $V = \sum V_j = \sum P_j q_j$

$$q_i = (1-\beta_i)\gamma_i + \frac{\beta_i}{P_i}\left(\sum P_j q_j - \sum_{j \neq i} P_j \gamma_j\right)$$

$$= (1-\beta_i)\gamma_i + \beta_i q_i + \frac{\beta_i}{P_i}\left(\sum_{j \neq i} P_j q_j - \sum_{j \neq i} P_j \gamma_j\right)$$

Own price elasticity is

$$\frac{\partial q_i}{\partial P_i} \cdot \frac{P_i}{q_i} = -\frac{\beta_i}{P_i^2}\left(\sum_{j \neq i} P_j q_j - \sum_{j \neq i} P_j \gamma_j\right) \cdot \frac{P_i}{q_i}$$

$$= -\frac{\beta_i}{V_i}\left(\sum P_j q_j - P_i q_i - \sum P_j \gamma_j + P_i \gamma_i\right) \quad \text{---(4)}$$

From (1), $\sum P_j q_j - \sum P_j \gamma_j = V - \sum P_j \gamma_j = \frac{V_i}{\beta_i} - \frac{P_i \gamma_i}{\beta_i}$

Substitute it to (4),

$$\frac{\partial q_i}{\partial P_i} \cdot \frac{P_i}{q_i} = -\frac{\beta_i}{V_i}\left(\frac{V_i}{\beta_i} - \frac{P_i \gamma_i}{\beta_i} - P_i q_i + P_i \gamma_i\right)$$

$$= -1 + \frac{P_i \gamma_i}{V_i} - \beta_i - \frac{\beta_i P_i \gamma_i}{V_i}$$

$$= -(1-\beta)\left(1 - \frac{P_i \gamma_i}{V_i}\right)$$

IV-3 Definitions of Macro-Economic Variables

Definitions of principal macro-economic variables and their norminal values for 1983 (by National Income of Thailand, 1984 edition) are shown in the table.

As for real values and prices (or deflators), the following principles are important.

- Real values of the macro-economic variables are calculated at 1982 prices using prices or deflators.
- Accordingly, prices and deflators are standardized so that values for 1982 are 1.0 except PORi, POXi etc.

		Description by the Model	Definition by National Account	Value for 1983 by National Account
CA	696	current account	surplus of nation on current account	-65,722
CFG	681	current transfer from government to household	current transfer to household from general government	863
CFT	1108	total consumption of foreigners	expenditure of non-residents in the country	25,050
CFW	680	current transfer from abroad to households	current transfer to household from the rest of the world	3,958
CFWG	649	current transfer from abroad to government		3,243
CPT	671	total private consumption	private consumption expenditure	618,636
CTG	653	current transfer to government	other current transfer from households to general government	2,171
CTW	685	current transfer from households to the rest of the world	"	440
CTWG	648	current transfer from government to the rest of the world	"	4
D	657	depreciation	Provision of the consumption of fixed capital	73,386
GDP	1101	GDP at market prices (real)	gross domestic product at 1982 prices	924,254
HI	682	household income	income of households and private non-profit institutions	719,465
HIEP	679	household income from property and entrepreneurship	income from farm, professions and other unincorporated enterprises received by households + income from property received by households and private non-profit institutions	451,905
IGT	665	total public investment	"	72,924 (+ change in inventories)
INCD	683	interest on consumers debt	"	9,730
INPDG		interest on public debt	"	21,158
IPEG	651	government income from property and entrepreneurship	"	12,680
IPT	667	total private investment	"	
NFI	693	net investment income from abroad	net factor income payment from the rest of the world	133,068 (+change in inventories) -25,370
OSC	655	operating surplus of companies	total value added-wages and salaries -farm income-depreciation-net indirect tax-subsidies	372,975
SG		government saving	"	4,807
TDC	658	corporate income tax	direct tax on corporations	13,199
TOC	656	total income of companies	OSC + INCD + INPDG + NFI	360,305
TOG	650	total government income	current revenue less interest on public debt of general government	151,088
TOS		total operating surplus of companies	OSC + IPEG	367,467

V-1 Note on Progress and Proposed Future Plan of Work on the Energy Price Model

December 1986

The purpose of this note is, (1) to review our works on the Energy Price Model in the past four months, (2) to describe the present stage of our works, (3) and to propose some orientations and work schedule for the next six months.

1. Works in the Past four Months

The following works were conducted on the Energy Price Model (the former model).

1). Investigate the structure of the model and problems to be improved and their methodologies.

2). Study the whole program, and correct some mistakes.

3). Review the theory and methodology for estimating equations and inputting the estimated results in the model, as for final demand petroleum product consumption, import and export functions.

4). Check and compile data for macro-economic variables and exogenous variables, and re-estimate some equations.

2. Present Stage of Work

By these works, we have now complete conception of the model. As the next step, works for improving the model and performing simulations should be planned. And, the Draft Final Report by CURSI was submitted recently, our work should be conducted taking the attainments in the report. According to the report, the main results which were accomplished in the phase II

are as follows :

1). Improve the model so that it treat rural and urban household consumption, and formal and informal employment by sector separately, from the former model in which both variables were not separated into two types.

2). Re-estimate final demand, petroleum product consumption, import and export functions.

At this stage, we should shift from the old model to the new model. To do so, works which should be done at first are,

1). Get all informations about the new model, and transfer the new model to NEA, at least we need to get a copy of all printout of the model.

2). Investigate the sturcture of the new model, especially the parts of household and employment, and the four types of equations revised.

3). After finishing 1) and 2), if necessary, we should ask CUSRI some more informations or works which he has properly or can conduct easily based on his accomplished works.

3. Orientation of the Work

After finishing the urgent works mentioned above, I think, we should concentrate our work to attain our final objective that we will conduct analyses using the model. To make substantial progress in this orientation, the following policies are proposed.

1). Make the model operational for us as soon as possible.

2). Improve some parts of the model improvement of which

are essential to correct it or to improve its performance.

3). Do not stick to works which are not essential to the model or take too much man-hours, even if they are important in the theoretical point of view. Re-estimation of the equations, for example, need not to be conducted, if it is not essential.

4). Improve the model, in parallel with performing simulations by the model. By doing this, we can improve or correct the model more efficiently, and in some cases can find out mistakes which otherwise can not be found out.

My work schedule for the next six month was proposed based on these orientations (it was proposed before we get the Draft Final Report, but it may need no change after we got it).

Finally, I like to conclude this note by presenting a few problems which will necessitate your help.

1). We need some person (a specialist of programming) who can correct errors concerning program or relating problems now we are confronting and will confront.

2). To transfer the new model from CUSRI, it may possibly become necessary to require CUSRI something more than the results until now, through your agency.

V-2 On the Work Schedule for the Next Six Months for the Energy Price Model

December, 1986

For the purpose of promoting our work for the energy price model in the next six months, the following plan will be proposed about my work.

For each main field, the following works will be conducted :

1. Improve and Up-date the Model

Some improvements, especially, which are essential to the model's performance, and up-dating exogenous variables will be done, along with performing test runs of the model. Re-estimation of functions (petroleum product demand, import, etc.) will be conducted if the circumstances (time, technological ---) allow.

2. Simulation Aanalysis

Setting alternative scenarios, conducting simulations by the model, some analyses on the effects on energy supply-demand structure and macro-economic variables by energy policy will be performed.

3. Accomplish a Final Report Arranging my all Works on the Model

4. Work Schedule

	1987	
	Jan.- Mar.	Apr.- Jun.
1. Up-dating and improvement of the model	----------	- - - - - -
2. Simulation analysis	----------	
3. Writing a final report	----------	----------