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Macroeconometric model of the Thai economy

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MACROECONOMETRIC MODEL OF THE THAI ECONOMY

Iowa State University

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Macroeconometric model of the Thai economy

by

Kajonwan P. Itharattana

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
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DOCTOR OF PHILOSOPHY

Major: Economics

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CHAPTER I. INTRODUCTION

Thailand is an agricultural country in Southeast Asia. About 80 per cent of her economically active population is employed in the agricultural sector. Rice is a major crop for both consumption and export. Rice exports produce a substantial volume of income to the country. Like other developing countries, Thailand faces problems of low income per capita, surplus labor, unequal income distribution, and small internal markets. It is thus necessary for the Thai government to have some policy to solve such problems. Development planning has served as a means of accelerating economic progress. Since the first national development plan was adopted in 1960, lack of adequate statistical data and trained manpower have slowed progress. The real effects of the plan were not achieved because the planning techniques used were not based upon sound theory. The Ministry of Agriculture and Cooperatives and some government agencies are in charge of agricultural planning in order to solve the problem in the agricultural sector. In July 1973, the Thailand Agricultural Sector Analysis Program, a cooperative project between the Ministry of Agriculture and Cooperatives (through its Division of Agricultural Economics), Iowa State University, and United States Overseas Mission/Thailand was started. The purpose of the project was to apply agricultural economic research in supporting development of Thailand's Fourth Five-Year Development Plan for the period B.E. 2520-2524 (1977-1981). A national linear programming model of Thai Agriculture, demand analysis, transportation, and marketing analysis were to be constructed. At the outset, the nonagricultural sector of the economy was not included in the project. As the agricultural modeling

proceeded, it was felt that an incomplete picture of Thai economy would result if the nonagricultural sector was not included. Therefore, the macroeconometric model of the Thai economy was initiated.

During September 1974 through August 1976, the macroeconometric model was constructed at the Division of Agricultural Economics, the Ministry of Agriculture and Cooperatives, Thailand. The ultimate purpose of the construction was to link an econometric model of the nonagricultural sector with a linear programming model of Thai agriculture. The preliminary results of a macroeconometric model were published in March 1977. When the model was constructed, there were some difficult problems in terms of econometrics and computer programming. Therefore, the equations in the model are estimated by Ordinary Least Squares. Two Stage Least Squares could not be used directly because of the small amount of time series data. These problems led to further study in this dissertation.

The objective of this research is to construct a model which can describe the Thai economy in a more extensive and disaggregate manner and to investigate the effect of alternative policy proposals with particular emphasis on increasing agricultural production and income. This means that the macro-modeling of the nonagricultural sector must be aimed at the interaction between the nonagricultural sector and the agricultural sector and at the effects of the international and financial sectors. There are also expansion and disaggregation in some sectors of the economy, such as in the international sector, monetary and price sector, and the income distribution sector. Foreign trade is regarded as one of the most influential sectors in a developing economy like Thailand. External economic and noneconomic factors have a substantial influence on internal economic

activities. The import and export sector, thus, will be developed in more detail. Sub-models for import and export commodities such as rice, rubber, sugar, etc., will be constructed. The monetary and price sector will be expanded greatly because it is one of the important ones for both the agricultural and nonagricultural sectors. A Balance of Payments sector is included. The income distribution sector is expanded considerably. This hopefully provides an explanation of the political and social effects of income distribution.

This dissertation will be presented in the following sequence.

Chapter II presents a description of the structure of the Thai economy. Chapter III presents the specification of the macroeconomic model. Chapter IV discusses the empirical results of the estimation of the model and the data used in the model. It also presents the estimated model. Chapter V presents the model simulation which is a test of the model. In Chapter VI, the conclusions and recommendations of the study will be presented.

CHAPTER II. OVERVIEW OF THE STRUCTURE OF THE THAI ECONOMY

Thailand covers an area of about 514,000 square kilometers and has a population of about 44 million in 1979. The population density is approximately 85 persons per square kilometer. But of the total land area, only about 20 percent can be cultivated (Thailand, Ministry of National Development, 1966, p. 13). Thailand is normally divided into four parts: the Central Plain, North, Northeast, and South.

The Thai economy presents many challenges to economic analysis. Many characteristics of developing countries are visible in Thailand. Per capita income is very low. Gross domestic product (GDP) per capita in 1979 was 12,869 baht in current price or 6,492 baht in 1972 prices. The problem of inequality of income distribution is substantial. The ratio of income of the agricultural to the nonagricultural sector is less than unity. This indicates the inequality of income between the two sectors. GDP has fluctuated considerably from year to year. Table 2.1 shows the growth rate of GDP from 1960 to 1979. The average rate of growth of GDP accelerated noticeably from year to year. An average annual growth rate during 1961-1966 was 7.96 percent, and it rose to 8.59 percent during the 1977-1979 period. The average growth rate during 1967-1971 decreased due to the construction decrease sharply in both the private and public sectors. The average growth rate during 1972-1976 also fell due to bad weather in 1972, which caused a decrease in agricultural production.

The structure of the Thai economy can be described by major sectors which the Office of National Economic and Social Development Board (NESDB) has described as the main sources of GDP.

Table 2.1. Sectoral growth rates

Industrial origin	1961	1962	1963	1964	1965	1966	Average
Agriculture	3.04	7.53	8.94	0.91	3.45	14.29	6.36
Manufacturing	9.52	12.19	9.06	8.57	16.06	11.58	11.16
Construction	5.01	14.16	10.53	14.98	11.02	21.54	12.87
Transportation and communication	0.56	9.02	3.49	11.56	4.81	7.27	6.12
Wholesale and retail trade	7.14	4.46	9.88	11.14	6.16	10.05	8.14
Services	5.94	5.58	6.55	7.51	10.36	9.90	7.64
Other	7.94	8.09	3.59	7.95	11.62	11.52	8.45
GDP	5.12	8.00	8.40	6.27	7.51	12.44	7.96

Industrial origin	1967	1968	1969	1970	1971	Average
Agriculture	-3.79	9.55	7.50	2.68	5.26	4.24
Manufacturing	12.19	7.24	13.39	6.81	17.18	11.36
Construction	18.41	4.61	1.50	-0.45	-11.50	2.57
Transportation and communication	10.31	2.79	6.81	9.26	0.32	5.90
Wholesale and retail trade	18.14	6.26	5.81	11.22	9.45	10.18
Services	8.59	10.40	6.91	7.41	8.46	8.35
Other	11.86	14.17	9.50	10.78	13.60	11.98
GDP	7.08	8.45	7.75	6.41	7.82	7.50

Industrial origin	1972	1973	1974	1975	1976	Average
Agriculture	-1.12	12.66	1.29	8.99	6.15	5.59
Manufacturing	9.68	13.13	9.14	6.93	15.61	10.90
Construction	-6.76	0.74	3.30	14.14	17.71	5.83
Transportation and communication	11.42	7.67	6.97	11.03	8.96	9.21
Wholesale and retail trade	3.28	5.07	9.09	4.45	8.52	6.08
Services	7.40	9.94	1.52	4.80	7.98	6.33
Other	6.05	6.66	8.51	4.78	7.73	6.75
GDP	3.86	9.43	5.44	7.14	9.93	7.16

Table 2.1. (continued)

Industrial origin	1977	1978	1979	Average
Agriculture	-0.55	14.53	-1.93	4.02
Manufacturing	13.03	9.75	10.01	10.93
Construction	19.70	17.88	8.67	15.42
Transportation and communication	10.18	14.20	13.00	12.46
Wholesale and retail trade	6.16	5.43	8.19	6.59
Services	9.33	13.14	10.54	11.00
Other	11.29	12.44	11.23	11.65
GDP	7.34	11.72	6.71	8.59

Agriculture

Thailand has an unusually large agricultural sector both in terms of production and population. The economy of the nation is based primarily on agriculture. About 38.88 percent of the GDP originated in this agricultural sector during 1960-1966, and it gradually declined to 27.10 percent during 1977-1979. This indicates a declining position of the agricultural sector. However, agricultural output still constitutes the highest share of total GDP (see Table 2.2). Despite the decline, it is still greater than the other sectors. The percentage share of the nonagricultural sector increased considerably, indicating a relatively rapid advance of industrialization in the country. Agriculture remains large in terms of population as can be shown by the 1970 census. About 79.3 percent of the economically active population was engaged in agriculture. The large number of people leads to many problems in the sector, such as low productivity of labor and low income per capita. In 1979, GDP originating from agriculture per farm labor was 9,615 baht (approximately \$480) in current prices while the

Table 2.2. Gross domestic product originating by industry at 1972 prices (million baht)^a

Industrial origin	1960	1961	1962	1963	1964	1965	1966	Total	Average	% share of GDP
Agriculture	28,624	29,495	31,717	34,554	34,869	36,072	41,225	236,556	33,794	38.88
Manufacturing	7,813	8,557	9,600	10,470	11,367	13,192	14,720	75,719	10,817	12.45
Construction	3,376	3,545	4,047	4,473	5,143	5,710	6,940	33,234	4,748	5.46
Transportation and communication	4,995	5,023	5,476	5,667	6,322	6,626	7,108	41,217	5,888	6.77
Wholesale and retail trade	11,206	12,006	12,541	13,780	15,315	16,259	17,893	99,000	14,143	16.27
Services	6,671	7,067	7,561	8,056	8,661	9,558	10,504	58,078	8,297	9.55
Other	7,153	7,721	8,346	8,946	9,657	10,779	12,021	64,623	9,232	10.62
GDP	69,838	73,414	79,288	85,946	91,334	98,196	110,411	608,427	86,918	100.00

Industrial origin	1967	1968	1969	1970	1971	Total	Average	% share of GDP
Agriculture	39,663	43,450	46,710	47,962	50,484	228,269	45,654	33.08
Manufacturing	16,514	17,709	20,081	21,449	25,134	100,887	20,177	14.62
Construction	8,218	8,597	8,726	8,687	7,688	41,916	8,383	6.07
Transportation and communication	7,841	8,060	8,609	9,406	9,436	43,352	8,670	6.28
Wholesale and retail trade	21,138	22,461	23,765	26,432	28,931	122,727	24,545	17.78
Services	11,406	12,592	13,462	14,460	15,684	67,604	13,521	9.80
Other	13,447	15,353	16,812	18,624	21,157	85,393	17,079	12.37
GDP	118,227	128,222	138,165	147,020	158,514	690,148	138,030	100.00

^aSource: Thailand, Office of the National Economic (1968-1980).

Table 2.2. (continued)

Industrial origin	1972	1973	1974	1975	1976	Total	Average	% share of GDP
Agriculture	49,919	56,237	56,962	62,081	65,898	291,097	58,219	30.30
Manufacturing	27,864	31,523	34,403	36,787	42,529	173,106	34,621	18.02
Construction	7,168	7,221	7,459	8,514	10,022	40,384	8,077	4.20
Transportation and communication	10,514	11,320	12,109	13,445	14,650	62,038	12,408	6.46
Wholesale and retail trade	29,881	31,396	34,249	35,774	38,821	170,121	34,024	17.71
Services	16,844	18,519	18,801	19,704	21,276	95,144	19,029	9.90
Other	22,436	23,930	25,967	27,209	29,313	128,855	25,771	13.41
GDP	164,626	180,146	189,950	203,514	222,509	960,745	192,149	100.00

Industrial origin	1977	1978	1979	Total	Average	% share of GDP
Agriculture	65,537	75,059	73,612	214,208	71,403	27.10
Manufacturing	48,071	52,756	58,036	158,863	52,954	20.10
Construction	11,996	14,141	15,367	41,504	13,835	5.25
Transportation and communication	16,142	18,434	20,831	55,407	18,469	7.01
Wholesale and retail trade	41,213	43,452	47,009	131,674	43,891	16.66
Services	23,260	26,317	29,090	78,667	26,222	9.95
Other	32,622	36,681	40,802	110,105	36,702	13.93
GDP	238,841	266,840	284,747	790,428	263,476	100.00

nonfarm income was 83,465 (approximately \$4,174) baht per capita. These figures show the inequality of income.

Agricultural production can be classified into crops, livestock, fisheries, and forestry. Rice is the most important crop. It is not only a major crop for domestic consumption, it also is the leading export commodity. Rice earns foreign exchange for the nation. It is grown in scattered locations over the country, but the main area of cultivation is the Central Plain. Rice farming follows a seasonal pattern. The method of production is traditional and relatively inefficient because modern technology has not been much adopted. For the last decade, the production of rice has been steady (see Table 2.3), but the percentage share of total GDP originating from agriculture fell from 42.96 percent in 1960 to 29.77 percent in 1979, indicating a decline in its importance. Farmers switched from rice to other crops or moved to the nonagricultural sector.

Rubber is another important crop in the Thai economy and is the second most important foreign exchange earner for Thailand. Thailand produces about 10 percent of the world's supply of natural rubber. Rubber is grown mostly in the south. About half of the GDP originating from agriculture in the south comes from rubber production (Sakarindr, 1979, p. 4). Its production increased from 172,000 tons in 1960 to 540,000 tons in 1979. Export price of rubber fluctuated with world demand. Today, because natural rubber has strong competition from synthetic rubber, the future of natural rubber production is in doubt. However, new high yield varieties are being introduced to replace the old varieties, a change that may make natural rubber successfully competitive.

Table 2.3. The value of important crops in 1972 prices and percentage of total value of GDP originating in agriculture

Year	AGOUT	RICE	% share of AGOUT	RUB	% share of AGOUT	MZE	% share of AGOUT	SG	% share of AGOUT
1960	28,624	12,298	42.96	853	2.98	573	2.00	786	2.75
1961	29,495	12,843	43.54	796	2.70	520	1.76	574	1.95
1962	31,717	14,599	46.03	837	2.64	638	2.01	452	1.43
1963	34,554	15,771	45.64	848	2.45	822	2.38	680	1.97
1964	34,869	15,068	43.21	903	2.59	914	2.62	728	2.09
1965	36,072	14,479	40.14	933	2.59	1,049	2.91	645	1.79
1966	41,225	17,633	42.77	922	2.24	1,182	2.87	548	1.33
1967	39,663	14,765	37.23	1,013	2.55	1,311	3.31	756	1.91
1968	43,450	16,198	37.28	1,189	2.74	1,510	3.48	1,001	2.30
1969	46,710	17,230	36.89	1,255	2.69	1,682	3.60	1,046	2.24
1970	47,962	17,641	36.78	1,323	2.76	1,950	4.07	1,136	2.37
1971	50,484	17,717	35.09	1,434	2.84	2,358	4.67	952	1.89
1972	49,919	15,409	30.87	1,529	3.06	1,333	2.67	1,554	3.11
1973	56,237	18,282	32.51	1,738	3.09	2,363	4.20	2,095	3.73
1974	56,962	17,639	30.97	1,721	3.02	2,690	4.72	2,268	3.98
1975	62,081	19,760	31.83	1,583	2.55	2,880	4.64	2,983	4.81
1976	65,898	19,508	29.60	1,779	2.70	2,690	4.08	4,104	6.23
1977	65,537	18,181	27.74	1,940	2.96	1,719	2.62	2,768	4.22
1978	75,059	21,551	28.71	2,128	2.84	2,871	3.82	3,102	4.13
1979	73,612	21,915	29.77	2,344	3.18	3,348	4.55	2,425	3.29

Maize, the other important crop of Thailand, is not only produced for domestic consumption but is also an important export commodity. Since 1950, maize production rose remarkably, and through the 1960s, maize became an important crop. As rice declines in importance, maize is rising. Cultivated land which is not suitable for rice farming is being used and also newly cultivated land is being expanded. Production of maize has increased steadily from 1960 to 1979. Its GDP value in 1960 was only 573 million baht in 1972 prices, but it increased to 3,348 million baht in 1979. Its percentage share of GDP originating from agriculture also increased from 2.00 percent in 1960 to 4.55 percent in 1979 (see Table 2.3).

Sugar has been a problem commodity since the 1800s. There are three kinds of sugar produced in Thailand: coconut, palmyrs, and cane sugar, with cane sugar being the most important. Thai sugar is produced at cost above world prices. The government tries to help the infant sugar industry by imposing an import tax and subsidizing exports. Therefore, the sugar industry has been capable of supplying both domestic requirements and export quantities. In mid-1980, when the production of sugar cane decreased due to bad weather, the amount and the quality of cane sugar fell. There was a shortage of sugar for domestic consumption, and its prices started to rise greatly. During this crisis period, the government was pushed into action. Price controls were imposed to ensure a low domestic price, and in response to this, dealers began to hoard in anticipation of the price controls being removed. The crisis was alleviated when sugar was imported from England under a contract agreement that raw sugar would be shipped to England the following year.

Manufacturing

Manufacturing, an important sector, has had an average growth rate of about 10 percent per year. The percentage share of total GDP ranked second during 1972-1979. Thai manufacturing is mostly in the medium and small scale range. Most producers are private entrepreneurs. Government enterprises account for only 28 factories producing only 22 commodities. The manufacturing sector includes 160 industries, which are broken down into 20 groups. The most important activities are the agricultural product processing industries, viz., rice milling, slaughtering, saw milling, weaving, tobacco curing, and animal hide processing. The government

attempts to promote this sector by low taxes, relaxation of import and export restriction, etc. The sector has expanded rapidly, especially after the first national plan period.

Construction

The construction sector represents about 9 percent of GDP. The value added originating from this sector includes private, public, and military construction expenditures. During the first national plan period (1960-1966), production in the construction sector increased from 5.01 percent in 1961 to 21.54 percent in 1966. The average growth rate was 12.87 percent per annum. Since 1970, construction decreased in both the private and public sectors due to a shortage of building material and sharply rising prices of other materials and wages. At that time, the cost of iron rods used for construction doubled. The price of cement also increased due to changes in labor, fuel, and transportation costs. The withdrawal of U.S. forces was another factor. Since 1975, however, this sector has expanded considerably because the government allocated a greater budget for rural development. Until 1979, output fell a little due once again to a shortage of building materials.

Transportation and Communication

Transportation and communication are divided into two parts, government and private. Of the value added from this sector in 1979, about 77 percent originates in the private sector while the rest comes from government. The output constituted about 6 to 7 percent of GDP. Most of the output originates from transportation. Highway transport has played an important role in this sector because modern highways have been expanded

and improved throughout the country. Communication, comprised of postal, telegraph and telephone service, has improved greatly. However, there is a problem concerning the expansion of telephone lines. Because the expansion is not coordinated with road construction and water supply, it causes traffic difficulties and budget waste. If this problem can be solved, this sector may have good prospects.

Wholesale and Retail Trade

During 1960 to 1971, the output originating in the wholesale and retail trade sector ranked second in GDP, but during 1972 to 1979, its importance decreased, ranking third to manufacturing sector. The highest growth rate occurred during the second national plan period (1967-1971), when the average annual growth rate was 10.18 percent. It was the result of increases in the number of commodities and the opening of new urban and rural markets. During 1972 to 1979, the average growth rate was increased at a decreasing rate. This might be the result of tight money and inflation.

Services

The service sector consists of many sub-sectors such as hotels and restaurants, entertainment and recreation, medical and health services, and education. This sector ranks fourth in GDP contribution. The percentage average share of GDP was about 9 percent in 1961-1966. The average growth rate was 7.64 percent in 1961-1966, 8.35 percent in 1967-1971, 6.33 percent in 1972-1976, and 11.00 percent in 1977-1979. The most important part in this sector is hotel and restaurant, largely because of the promotion of tourism, a growing business that is expected to be a big source of foreign

exchange earnings. The next most important activity in this sector is education. The value added in this sub-sector in GDP contribution has increased due to the revision of civil servant salaries and the improvement in education under the national plan.

Foreign Trade

Thailand is an open economy. She started international trade in 1855 and often experiences deficit trade balances due to imports of goods and services increasing more than exports (see Table 2.4). A rise in imports has resulted from the development of the country. The balance of payments was favorable from 1963 to 1968 and from 1972 to 1974 because the deficit trade balance was exceeded by unrequited transfer and net foreign capital inflow. From 1969 to 1971 and from 1975 to 1978, the balance of payment was in deficit because foreign aid to the central government and private transfers decreased. During 1972 to 1974, even though foreign aids to the government decreased, private transfers and net capital inflow rose to offset the deficit. After 1975, private transfers decreased again which caused the unfavorable balance of payments.

Thailand's main exports are agricultural commodities. Rice has been an export commodity since the 1800s. In the 1900s, rubber became a major export. In recent years, many agricultural products, maize, cassava, and others, have become important exports. Table 2.5 shows the value of principal export commodities and their percentage share of total exports. The percentage share of rice and rubber has declined gradually. Rice share decreased from 29.32 percent in 1962 to 9.99 percent in 1978, while rubber fell from 19.10 percent in 1962 to 7.69 percent in 1978. Maize, tapioca,

Table 2.4. Thailand's balance of payments 1963-1978^a (millions of baht)

Year	Total exports	Total imports	Unrequited transfers	Net foreign capital inflows	Errors and omissions	Balance of payments
1963	11426	13709	1138	1644	450	949
1964	14427	15545	775	1644	129	1430
1965	15913	16896	796	1675	497	1985
1966	20016	20265	964	1340	1249	3304
1967	22242	24334	1198	2250	-43	1313
1968	22438	26707	1548	2440	730	449
1969	23639	28854	1187	2897	217	-914
1970	24365	30466	1012	2479	42	-2652
1971	26592	31102	904	1733	1538	-335
1972	33073	35385	1239	3643	1421	3991
1973	43975	47942	2969	2938	-1076	864
1974	64636	71339	4917	9055	743	8012
1975	60916	74917	1632	7754	1757	-2858
1976	74354	83797	465	9263	-368	-83
1977	85235	108371	802	13967	829	-7538
1978	104375	127801	816	14858	-5546	-13,298

^aSource: Bank of Thailand (1971-1980).

and sugar are gradually becoming more important exports, though their shares have not increased steadily. Export of services is also an important foreign exchange earner. During 1965-1972, the percentage share in total exports increased considerably due to the U.S. military bases in Thailand. After the Vietnam War, exports of services have fallen somewhat.

Thailand's total import trend has increased. The value of imports rose from 12,351 million baht in 1962 to 127,801 million baht in 1978. Table 2.6 presents the value of import commodities and the percentage share in total imports. The percentage share of consumer goods and of capital goods has declined considerably from 29.50 percent and 26.30 percent in

Table 2.5. Value of principal export commodities in current prices and percentage of total exports^a (value in million baht)

Year	Rice	%	Rubber	%	Maize	%	Tapioca	%
1962	3240	29.32	2111	19.10	516	4.67	423	3.83
1963	3424	29.97	1903	16.65	857	7.50	439	3.84
1964	4389	30.42	2060	14.28	1388	9.62	653	4.53
1965	4334	27.24	1999	12.56	1004	6.31	676	4.25
1966	4001	19.99	1861	11.69	1577	9.91	644	4.05
1967	4653	20.92	1574	7.08	1431	6.43	726	3.26
1968	3775	16.82	1816	8.09	1647	7.34	772	3.44
1969	2945	12.46	2664	11.27	1767	7.47	876	3.71
1970	2516	10.33	2232	9.16	1969	8.08	1223	5.02
1971	2909	10.94	1905	7.16	2286	8.60	1240	4.66
1972	4437	13.42	1862	5.63	2085	6.30	1547	4.68
1973	3594	8.17	4573	10.40	2969	6.75	2537	5.77
1974	9778	15.13	5035	7.79	6078	9.40	3836	5.93
1975	5852	9.61	3474	5.70	5705	9.37	4597	7.55
1976	8603	11.57	5297	7.12	5676	7.63	7527	10.12
1977	13382	15.70	6164	7.23	3345	3.92	7720	9.06
1978	10425	9.99	8030	7.69	4275	4.10	10842	10.44

^aSource: Bank of Thailand (1971-1980).

Sugar	%	Service	%	Other	%	Total exports
46	0.42	1618	14.64	3098	28.03	11052
122	1.07	1848	16.17	2833	24.79	11426
211	1.46	2262	15.68	3464	24.01	11427
100	0.63	3249	20.42	4551	28.60	15913
82	0.52	6199	38.96	5652	35.52	20016
37	0.17	8434	37.90	5387	24.22	22242
0	-	9210	41.05	5218	23.26	22438
47	0.20	9385	39.70	5955	25.19	23639
94	0.39	10095	41.43	6236	25.59	24365
382	1.44	9900	37.23	7970	29.97	26592
1264	3.82	11323	34.24	10555	31.91	33073
1161	2.64	12723	28.93	16418	37.33	43975
3757	5.81	15634	24.19	20518	31.74	64636
5696	9.35	16552	27.17	19040	31.26	60916
6843	9.20	13993	18.82	26415	35.53	74354
7445	8.73	14772	17.33	32407	38.02	85235
3969	3.80	21124	20.24	45660	43.75	104375

Table 2.6. Value of import commodities in current prices and percentage of total imports^a (value in million baht)

Year	Imports of consumer goods		Imports of intermediate goods and raw materials		Imports of fuel and lubricants		Imports of capital goods		Imports of other		Imports of services		Total imports
	Value	%	Value	%	Value	%	Value	%	Value	%	Value	%	
1962	3644	29.50	1968	15.93	1224	9.91	3248	26.30	1158	9.38	1109	8.98	12351
1963	3619	26.40	2197	16.03	1221	8.91	4056	29.59	1454	10.61	1162	8.48	13709
1964	3914	25.18	2786	17.92	1458	9.38	4242	27.29	1615	10.39	1530	9.84	15545
1965	4113	24.34	3210	19.00	1353	8.01	4775	28.26	1640	9.71	1805	10.68	16896
1966	4644	22.92	3941	19.45	1873	9.24	5701	28.13	2013	9.93	2093	10.33	20265
1967	5276	21.68	4737	19.47	1588	6.53	7543	31.00	2669	10.97	2521	10.36	24334
1968	5248	19.65	5086	19.04	1995	7.47	8339	31.22	2978	11.15	3061	11.46	26707
1969	5628	19.51	5866	20.33	1829	6.34	9172	31.79	2928	10.15	3431	11.89	28854
1970	5229	17.16	6725	22.07	2329	7.64	9371	30.76	2753	9.04	4059	13.32	30466
1971	4390	14.11	7764	24.96	2721	8.75	8628	27.74	3103	9.98	4496	14.46	31102
1972	4950	13.99	9131	25.80	3115	8.80	9783	27.65	3666	10.36	4740	13.40	35385
1973	6311	13.16	13621	28.41	4661	9.72	12826	26.75	4636	9.67	5887	12.28	47942
1974	7995	11.21	18370	25.75	12571	17.62	19808	27.77	4561	6.39	8034	11.26	71339
1975	8455	11.29	16105	21.50	14233	19.00	22239	29.68	3494	4.66	10391	13.87	74917
1976	9418	11.24	20216	24.12	16695	19.92	19405	23.16	5712	6.82	12351	14.74	83797
1977	11114	10.26	26921	24.84	20889	19.28	24393	22.51	12688	11.71	12366	11.41	108371
1978	12942	10.13	29598	23.16	22851	17.88	31317	24.50	21491	16.82	17845	13.96	127801

^aSource: Bank of Thailand (1971-1980).

1962 to 10.13 percent and 24.50 percent in 1978, respectively, while that of intermediate goods and raw materials and fuel and lubricants have increased due to the expansion of the manufacturing sector. Imports of capital goods increased during the early 1960s to meet the objective of the national economic development plan. Construction, communication, and transportation of public facilities were accelerated. These stimulated imports of intermediate goods and raw materials and fuels and lubricants in later years.

Money and Banking

The Thai monetary system consists of the Bank of Thailand, commercial banks, and the government saving bank. Notes are issued by the Bank of Thailand, coins are issued by the Treasury Department, and demand and time deposits are liabilities of commercial and government saving banks. These financial assets are held by the government, the banks, and the public. The money supply is that part held by the public.

Bank of Thailand

The Bank of Thailand has been in existence since 1942. It is an independent agency. Its duties can be summarized as follows:

1. Note issuance
2. Banks' banker
3. Government's banker
4. Government's fiscal agent
5. Credit controller

In order to picture how the Bank of Thailand works, its balance sheet should be studied. Table 2.7 presents the summary of the major assets and

Table 2.7. Assets and liabilities of the Bank of Thailand^a (millions of baht)

Year	Assets				Total assets or liabilities	Liabilities				
	Foreign assets	Claims on central government	Claims on commercial banks	Other assets		Notes in circulation	Deposits of private sector	Deposits of commercial bank	Deposits of others	Capital accounts and others
1960	5802	5466	227	23	11518	6661	98	481	1553	2725
1961	7489	5014	224	21	12748	7268	156	594	1848	2882
1962	8875	5051	287	20	14233	7414	248	702	2789	3080
1963	10631	3973	217	26	14847	7741	160	920	2298	3728
1964	11923	4178	317	54	16472	8474	109	940	3180	3769
1965	13481	4231	389	45	18146	9379	144	942	3653	4028
1966	17234	4322	450	41	22047	10573	116	1071	5853	4434
1967	19099	3720	357	48	23224	11087	273	1247	5843	4774
1968	19095	4082	413	90	23680	12093	338	1344	4486	5419
1969	18209	8066	294	124	26693	12607	455	1713	5785	6133
1970	16530	11011	793	131	28465	13626	662	1814	4974	7389
1971	15707	12652	1277	137	29773	14877	710	2307	3289	8590
1972	19333	15052	1256	151	35792	17179	694	2542	5314	10063
1973	22954	16420	2886	180	42440	20725	709	2611	6616	11779
1974	32490	13476	3914	153	50033	23148	437	3670	8757	14021
1975	32826	13194	7199	157	53376	25397	286	4721	5253	17719
1976	33247	18910	5410	233	57800	28654	360	4362	4234	20190
1977	32550	24749	5864	329	63492	31127	323	4347	4095	23600
1978	35594	34655	8038	463	78750	37075	238	5484	4255	31698

^aSource: Bank of Thailand (1971-1980).

liabilities of the Bank of Thailand from 1960-1978. Total assets increased from 11,518 million baht in 1960 to 78,750 million baht in 1978. Foreign assets have been the major assets of the Bank of Thailand. In 1978, they accounted for 45 percent of total assets. Foreign assets are comprised of gold, foreign exchange, holdings of SDR, and the gold contribution of IMF. Foreign exchange is the important item in foreign assets, with a percentage share of about 90 percent in 1978. Claims on the central government, also important, are second to foreign assets. Treasury bill and government bonds are the major part of this item. Claims on commercial banks are the smallest component of total assets. Notes in circulation are the most important item of the Bank liabilities, being 37,075 million baht in 1978. The bank issues notes under the Currency Act B.E. 2501 (1958), which was revised in 2516 (1973).

Commercial banks

Commercial banks are one of the important institutions of the Thai financial system. They are places where people deposit, lend, and exchange money. In 1955, there were only 115 bank offices in Thailand increasing to 731 bank offices in 1972. Their role in the Thai economy depends on the efficiency of their operation. The components of assets and liabilities from the balance sheets show their situation or their behavior. Table 2.8 presents the principal assets and liabilities of commercial banks from 1960-1978, Total assets increased about thirtyfold during this period, rising from 8,048 million baht in 1960 to 218,241 million baht in 1978. The increase in total assets was caused by an increase in demand, savings, and time deposits. As a result, it expanded credit on accelerated

Table 2.8. Assets and liabilities of commercial banks 1960-1978^a (million baht)

Year	Assets						Total assets or liabilities
	Cash on hand	Foreign currency on hand	Deposits at the Bank of Thailand	Government securities	Bill, loans and overdrafts	Other assets	
1960	258	5	481	418	5397	1489	8048
1961	282	5	594	598	6333	1686	9498
1962	303	6	702	1141	7536	1713	11401
1963	364	5	920	1685	8807	2285	14066
1964	356	14	940	2172	10596	2633	16711
1965	351	10	942	2540	12779	2298	18920
1966	386	18	1071	4119	15073	2716	23383
1967	445	22	1247	4858	17259	3099	26930
1968	609	21	1344	5554	20093	3609	31230
1969	626	12	1713	5446	23347	4499	35643
1970	628	23	1814	5906	28197	4773	41341
1971	656	23	2307	8221	31564	6052	48823
1972	873	41	2542	13792	35653	7169	60070
1973	1011	59	2611	14897	51184	8600	78362
1974	1562	82	3670	15772	67679	9987	98752
1975	1763	68	4721	17581	81302	12442	117877
1976	1911	99	4362	20911	95145	17203	139631
1977	2486	259	4347	22263	121805	22116	173276
1978	2941	170	5484	24439	158600	26607	218241

^aSource: Bank of Thailand (1971-1980).

Liabilities							
Private demand deposits	Other demand deposits	Private saving and time deposits	Other saving and time deposits	Other demand liabilities	Borrowing from abroad	Borrowing from other banks	Other liabilities
3639	394	1026	340	385	976	31	1256
3990	499	1497	317	280	1268	41	1605
4024	480	3201	271	226	1670	53	1476
4696	599	4299	359	243	2153	69	1649
5201	796	5398	403	233	2626	84	1969
4454	669	7790	524	285	2481	109	2608
5157	586	10769	701	316	2630	92	3132
5449	726	13089	975	352	2564	13	3763
6142	800	15611	1184	404	2538	46	4504
6330	773	18834	1243	486	2942	58	4978
6802	796	22494	1371	421	3208	8	6241
7532	742	27492	1476	516	3284	63	7781
8661	1105	35698	1649	633	3486	160	8677
10296	1429	43949	1848	850	6899	260	12830
11518	2100	56449	2222	1310	7574	643	16936
12146	1874	69286	2284	968	8052	425	22843
14116	2664	85046	3416	1176	9205	660	23348
15260	3837	107156	3237	1590	14703	350	27143
18299	5222	128749	3982	2272	24805	204	34708

investment. It can be seen that government securities holdings, bills, loans, and overdrafts increased significantly, rising from 418 to 5,397 million baht in 1960 to 24,439 and 158,600 million baht in 1978, respectively. The other source of expansion of commercial banks has been a borrowing from abroad. It increased from 976 million baht in 1960 to 24,805 million baht in 1978 and accounted for about 10 percent of the liabilities. The rapid growth of commercial banks led to good monetary prospects.

Government saving bank

The Government saving bank (GSB) is a government owned bank set up by the Government Saving Act 1946 and is a self-governing body under the general guidance of the Ministry of Finance (Soonthornsima, 1963). The GSB is a bank for low income savers and issues saving bonds and premium saving bonds.

Table 2.9 shows the assets and liabilities of the GSB. Among the assets, claims on government takes the highest share of total assets, increasing from 52.14 percent in 1963 to 88.89 percent in 1978. The GSB is an important source of loans for the government. Bank cash holdings have increased gradually since 1963 and reached a peak in 1978, accounting for 122 million baht. Loan and overdrafts have fluctuated because of the business and economic situation. On the liabilities side, savings and time deposits are the most important. Saving bonds and premium saving bonds take second rank. All deposits including saving bonds and premium saving bonds grow very rapidly at an annual average growth rate of about 12 percent.

Table 2.9. Assets and liabilities of the Government saving bank^a (million baht)

Year	Assets				Liabilities				
	Cash on hand	Loans and over- drafts	Claim on government	Other assets	Total assets or liabilities	Private demand deposits	Savings and time deposits	Savings	Other
								bonds and premium saving bonds	
1963	36	768	1328	415	2547	178	1543	431	395
1964	36	689	1756	452	2933	184	1698	591	459
1965	40	579	2410	481	3510	176	2060	712	562
1966	46	374	3463	429	4312	183	2598	846	686
1967	50	290	4295	406	5041	193	3195	978	674
1968	43	307	4865	565	5780	224	3640	1077	839
1969	54	327	5466	538	6385	164	4077	1174	970
1970	51	419	5914	440	6824	195	4403	1231	995
1971	50	401	6777	465	7693	225	4958	1308	1203
1972	67	373	8444	521	9405	150	6396	1406	1453
1973	71	324	10773	498	11666	139	8294	1551	1682
1974	67	327	11854	1041	13289	301	9457	1529	2002
1975	84	329	12712	1027	14152	194	10180	1515	2264
1976	80	458	14334	725	15597	184	11375	1538	2500
1977	94	667	16538	906	18205	104	13919	1584	2598
1978	122	658	17603	1420	19803	131	15231	1683	2758

^aSource: Bank of Thailand (1971-1980).

CHAPTER III. THE SPECIFICATION OF THE MACROECONOMETRIC MODEL

The specification of the Thai macroeconomic model is based generally on the Keynesian macroeconomic model. It begins with a set of national income accounting identities which represent income flow through the various parts of the circular flow such as the following:

Gross Domestic Product = Private Consumption of Goods and Services + Government Consumption Expenditures + Gross Private Fixed Capital Formation + Gross Government Fixed Capital Formation + Total Exports - Total Imports.

The model will include a real sector, a monetary sector, and a foreign sector.

The Consumption Function

The concept of the consumption function was first proposed by Keynes in 1936. Keynes specified the consumption expenditure as a function of the absolute level of measured income.

$$C_w = f(Y_w)$$

where C_w = consumption expenditure in terms of wage units

Y_w = level of income in terms of wage units

Thus, both consumption expenditure and income were measured in real terms.

The Keynesian consumption may be written in general form as:

$$C = f(Y)$$

It may appear unrealistic since the consumer must pay taxes with some portion of Y . Then taxes should be deducted from real income which is called real disposable income (PDY).

The function $C = f(Y)$ may be expressed as a linear form:

$$C = a_1 + a_2 Y$$

Keynes made the following assumptions about the consumption function.

1. "Men are disposed as a rule and on the average, to increase their consumption as their income increase, but not by as much as the increase in their income" (Keynes, 1936, p. 96).

That is, the marginal propensity to consume (MPC) is positive and less than unity ($0 < a_2 < 1$).

2. MPC is smaller than the average propensity to consume (APC).

3. APC would decline as income increased because it might take time for people to change their habits. Therefore, a rising income will often be accompanied by increased saving. At low levels of income, people dissave when consumption exceeds their income ($a_1 > 0$).

The Keynesian consumption function in various forms was used in business cycle theory. On the basis of research done in the late 1930s and 1940s, there were three observed phenomena which a theory of consumption must account for.

1. Cross-sectional budget studies showed APC declining as Y rises, so that in cross-section data, $MPC < APC$.

2. Business cycle or short-run data showed that APC is smaller than average during a slump, so that in the short run, as income fluctuates, $MPC < APC$.

3. Long-run trend data showed no tendency for APC to change over the long run, so that as income grows along the trend, $MPC = APC$ (Branson, 1979, p. 186).

Theories of consumption function were developed by Duesenberry (1949), Modigliani and Brumberg (1954), and Friedman (1957). All explained consumption behavior on the basis of microeconomic theory. Both Friedman's and Modigliani's hypotheses are similar in the sense that consumers attempt to maximize their utility by allocating a lifetime stream of income to an optimum lifetime pattern of consumption. Here only the Friedman permanent income hypothesis will be discussed.

The discussion will be started with the Fisherian model of saving. The utility function is expressed as a function of real consumption during an entire lifetime period.

$$U = U(C_0, C_1, \dots, C_T)$$

where U = lifetime utility

C_t = real consumption in all time periods up to T

The consumer is assumed to maximize his utility subject to the constraint that the present value of total the consumption stream does not exceed the present value of his total income stream, i.e.,

$$\sum_{t=0}^T \frac{Y_t}{(1+r)^t} = \sum_{t=0}^T \frac{C_t}{(1+r)^t}$$

where T = individual's expected lifetime

r = interest rate

Y_t = real income received in year t

The relation between the present value of income stream and current consumption can be written as

$$C_t = f(PV_t) \quad f' > 0$$

where PV_t = the present value of current and future income at

$$\text{time } t \left(\sum_{t=0}^T \frac{Y_t}{(1+r)^t} \right)$$

The individual's consumption at time t is an increasing function of the present value of his income at time t .

Friedman bases his theory of consumption behavior on the theory of rational consumer behavior over time. The relation between an individual's consumption and present value of income stream is obtained from the assumption of individual consumer utility maximization.

$$C_i = f_i(PV_i)$$

Friedman assumes that consumption is proportional to the present value of the income stream.

$$C_i = h_i PV_i$$

Then the aggregate consumption can be written as

$$C_t = h_t PV_t$$

Friedman also introduces the permanent income, which is the perpetual income stream supported by wealth. It is equal to the rate of return on wealth.

$$Y_t = r.PV_t$$

So that the consumption function becomes

$$C_t = h \left(\frac{Y_t}{r} \right)$$

which can be rewritten as

$$C_t = k(r, w, u)Y_t$$

where k depends on interest rate (r), the ratio of nonhuman wealth to permanent income (w) and the variable which will vary with the age and family composition of the individuals (u).

The permanent income hypothesis is reconciled with long run time series data because Kuznets used decade average data that could be a good proxy of permanent income. In short run data, Friedman argued that measured income is not a good proxy for permanent income. Therefore, he assumes that permanent income is a weighted average of all past measure income with the weights decreasing geometrically.

$$Y_p = (1-\lambda)(Y_t + \lambda Y_{t-1} + \lambda^2 Y_{t-2} + \dots)$$

where $0 < \lambda < 1$

Y_p = permanent income

Y_t = measured income in t period

Let C_t be a linear function of Y_p

$$C_t = \gamma_0 + \gamma_1(1-\lambda)(Y_t + \lambda Y_{t-1} + \lambda^2 Y_{t-2} + \dots)$$

Applying the Koyck transformation

$$\lambda C_{t-1} = \lambda \gamma_0 + \gamma_1(1-\lambda)(\lambda Y_{t-1} + \lambda^2 Y_{t-2} + \dots)$$

$$C_t - \lambda C_{t-1} = \gamma_0(1-\lambda) + \gamma_1(1-\lambda)Y_t$$

$$C_t = \gamma_0(1-\lambda) + \gamma_1(1-\lambda)Y_t + \lambda C_{t-1}$$

This is the basic form of consumption function which will be used for estimation. Prices of commodities will be added in the function when consumption expenditure is disaggregated into various commodities.

The Investment Function

A theory of investment behavior based on neoclassical theory of optimal capital accumulation requires maximization of the utility of a stream of consumption which may be combined with a set of technological possibilities of production and economic possibilities of transformation of the results into a stream of consumption. The technological possibilities may be described by a production function relating the flow of output to flows of labor services and capital services. The firm supplies capital services to itself through the acquisition of investment goods; the rate of change of capital services is proportional to the rate of acquisition of investment goods less the rate of replacement of previously acquired investment goods. The results of the productive process may be transformed into a stream of consumption under fixed prices for output, labor services, investment goods, and consumption goods.

The problem of maximizing utility may be carried out in two stages. First, a production plan is chosen so as to maximize the present value of the productive enterprises. Second, a consumption stream is chosen so as to maximize utility subject to the present value determined by production (Jorgenson and Stephenson, 1967, p. 170).

To develop the theory of investment behavior, consider the neoclassical theory of optimal accumulation of capital which maximizes the present value of the firm subject to the production function and net investment.

Assuming that output, Q , depends on two inputs, labor (L) and capital (K), the production function which represents the relationship among them is:

$$Q(t) = F(L(t), K(t))$$

Net investment (\dot{K}) is equal to total investment (I) less replacement, where replacement is proportional to capital.

The net return of the firm is the difference between revenue and outlay of production

$$R(t) = P(t) Q(t) - W(t) L(t) - q(t) I(t)$$

where $R(t)$ = a flow of net return of the firm

$Q(t)$ = a flow of output

$L(t)$ = a flow of labor services

$I(t)$ = the amount of capital acquired at time t

$P(t)$ = price of output

$W(t)$ = price of labor services

$q(t)$ = price of investment goods

The present value of the firm (PV) is defined as the integral of discounted revenue less discounted outlays, and r is the rate of discount.

$$PV = \int_0^{\infty} e^{-rt} [P(t)Q(t) - W(t)L(t) - q(t)I(t)] dt$$

To maximize the present value subject to two constraints, the Lagrangean expression is formed as

$$\mathcal{L} = \int_0^{\infty} \{ e^{-rt} R(t) + \lambda_0(t) [Q(t) - F(L(t)K(t))] + \lambda_1(t) [K^\circ(t) - I(t) + \delta K(t)] \} dt$$

where $K^\circ(t) = \frac{dK(t)}{dt}$

After manipulating the maximization problem, the marginal productivity condition for labor and capital are obtained

$$\frac{\partial Q(t)}{\partial L(t)} = \frac{W(t)}{P(t)}$$

$$\frac{\partial Q(t)}{\partial K(t)} = \frac{q(t)(\delta+r - \frac{\dot{q}(t)}{q(t)})}{P(t)} = \frac{C(t)}{P(t)}$$

where $C(t) = q(t)(\delta+r - \frac{\dot{q}(t)}{q(t)})$ = user cost of capital

If the production function is assumed to have the Cobb-Douglas form, the marginal productivity condition for capital services is

$$\frac{\alpha Q}{K^*} = \frac{C}{P}$$

where α is the elasticity of output with respect to input of capital services and K^* is desired capital. Solving for desired capital yields:

$$K^* = \frac{\alpha PQ}{C} = \beta Q$$

where $\beta = \frac{\alpha P}{C}$

Investment can occur only when there is a discrepancy between the desired capital stock and the actual capital stock. Thus, we add an adjustment cost to the model. In order to move the actual capital stock to desired capital stock, there is a cost which is called the adjustment cost. Therefore, the adjustment of capital stock occurs slowly due to the adjustment cost.

When embodying a distributed lag response of actual net investment to changes in the desired stock of capital, the net investment function becomes:

$$I(t) = \mu(S)(K_t^* - K_{t-1}^*)$$

where $\mu(S)$ = a power series in the lag operator, S

If $\mu(S)$ is a rational function, it may be written as

$$\mu(S) = \frac{u(S)}{v(S)}$$

$$\text{Then } I(t) = \frac{u(S)}{v(S)}(K_t^* - K_{t-1}^*)$$

Jorgensen and Stephenson suggest that the flexible accelerator of Chenery (1952) and Koyck (1954) is a special case of this theory of investment behavior, corresponding to a geometric distribution of completions of new investment projects. In this case, a rational distributed lag function can be represented by

$$u(S) = 1-\lambda$$

$$v(S) = 1-\lambda S$$

$$I(t) = \frac{1-\lambda}{1-\lambda S}(K_t^* - K_{t-1}^*)$$

Thus, the flexible accelerator becomes

$$I_t - \lambda I_{t-1} = (1-\lambda)(K_t^* - K_{t-1}^*)$$

$$I_t = (1-\lambda)(K_t^* - K_{t-1}^*) + \lambda I_{t-1}$$

$$\text{Substituting } K_t^* = \beta Q_t$$

$$I_t = \lambda I_{t-1} + (1-\lambda)\beta(Q_t - Q_{t-1})$$

The limitation of accelerator principle occurs when output is falling. The capital goods industry may experience idle capacity. Thus, a modification is to assume that the firm bases its capital requirement on the previous period's output rather than current output. K_t^* then is proportional to Q_{t-1} rather than Q_t .

$$K_t^* = \beta Q_{t-1}$$

$$I_t = \lambda I_{t-1} + (1-\lambda)\beta(Q_{t-1} - Q_{t-2})$$

Another variant of the accelerator hypothesis by Goodwin and Chenery is in the form as follows:

$$\begin{aligned}
I_t &= \lambda I_{t-1} + (1-\lambda)(K_t^* - K_{t-1}) \\
&= \lambda I_{t-1} + (1-\lambda)(\beta Q_t - K_{t-1}) \\
&= \lambda I_{t-1} + (1-\lambda)\beta Q_t - (1-\lambda)\beta K_{t-1}
\end{aligned}$$

In order to obtain a gross investment function, depreciation must be added. Assuming depreciation (D) is proportional to past capital stock,

$$D = \delta K_{t-1}$$

$$\begin{aligned}
I_t + \delta K_{t-1} &= \lambda I_{t-1} + \delta K_{t-2} + (1-\lambda)\beta(Q_t - Q_{t-1}) \\
I_t &= \lambda I_{t-1} + (1-\lambda)\beta(Q_t - Q_{t-1}) - \delta(K_{t-1} - K_{t-2})
\end{aligned}$$

The basic form of gross fixed capital formation will be used as follows:

$$I_t = f(I_{t-1}, Q_t - Q_{t-1}, K_{t-1} - K_{t-2})$$

$$\text{or } I_t = f(I_{t-1}, Q_t, K_{t-1})$$

$$\text{or } I_t = f(I_{t-1}, Q_{t-1} - Q_{t-2})$$

$$\text{or } I_t = f(I_{t-1}, Q_t - Q_{t-1})$$

The Import Function

The import function is based on the theory of demand. Assuming that the consumer has a well-defined utility function (U) and he attempts to allocate his income among consumable commodities, both domestic and import commodities, in an effort to achieve maximum satisfaction,

$$U = U(D, \text{IMP})$$

where D = domestic commodity

IMP = import commodity

The consumer maximizes his utility subject to budget constraint

$$P_D D + P_{IMP} IMP = Y$$

where P_D = price of domestic commodity

P_{IMP} = price of import commodity

Y = domestic money income

Applying the Lagrangean and differentiating, an import demand function can be derived as

$$IMP = f(P_{IMP}, P_D, Y)$$

$$\text{or } IMP = f\left(\frac{P_{IMP}}{P_D}, \frac{Y}{P_D}\right)$$

Prachowny (1969) suggests that the relationship between imports and income is a special case of the consumption function. However, in general the total merchandise imports in each country are subdivided into different categories, namely, a) imports of consumer goods, b) imports of investment goods, and c) imports of raw materials. Therefore, each category must be specified differently. Imports of consumer goods can be treated by some form of a consumption function, which is related to disposable income (PDY).

Prachowny also suggests that the other two categories of imports are more correctly treated as an investment function. More specifically, imports of investment goods are defined as a special case of the theory of fixed investment while imports of raw materials are a special case of inventory investment. However, in his study, he makes an assumption about the relationship between imports of investment goods and total domestic investment. He assumes that imports of investment goods are a constant fraction of total domestic investment. He also adds prices of imported

investment goods and domestically produced investment goods in the function in order to reflect the substitutability between those two.

In the imports of raw materials, he assumes that imports of these goods are directly related to industrial production in the industries which use them and to changes in inventory holdings.

Finally, Prachowny specifies the functional form of the import demands as follows:

- (1) Imports of consumer goods (M_C)

$$M_C = f_1 \left(PDY, \frac{P_{M_C}}{P_D} \right)$$

- (2) Imports of raw materials (M_R)

$$M_R = f_2 \left(IP, DINV, \frac{P_{M_R}}{P_D} \right)$$

- (3) Imports of investment goods (M_I)

$$M_I = f_3 \left(TINV, \frac{P_{M_I}}{P_D} \right)$$

where IP = index of industrial production

PDY = personal disposable income

M_i = import of i th goods $i = C, R, I$

P_{M_i} = price index of import of i th goods

P_D = domestic price index

DINV = changes in inventories

TINV = total domestic investment

The Export Function

The export demand function can be derived analogously to the import function. The rest of the world importers are regarded as a consumer who tries to maximize his satisfaction by allocation of the commodity exported from exporter and his domestic commodity.

$$U_{ROW} = U(X, ROW)$$

where U_{ROW} = the rest of the world utility

X = commodity exported from exporter

ROW = domestic commodities

The rest of the world budget constraint is

$$P_X X + P_{ROW} ROW = Y_{ROW}$$

where P_X = exported price

P_{ROW} = domestic price

Y_{ROW} = the rest of the world income

Finally, the export demand function can be written as

$$X = X \left(\frac{Y_{ROW}}{P_{ROW}}, \frac{P_X}{P_{ROW}} \right)$$

Prachowny suggests that world total exports is a good proxy for world income (Y_{ROW}). Rhomberg and Boissonneault used GNP prices of the other countries while Balassa used the prices of the competitive country, P_{ROW} (as cited in Prachowny, 1969).

Therefore, the export demand function can be written as

$$X = f \left(\frac{Wx}{Pf}, \frac{Px}{Pf} \right)$$

X = commodity exported

Wx = world total export

Pf = GDP price deflator of foreign country

Px = export price deflator

The Output Functions

The general form of output equations in each industry is represented by a production function. It represents the relationship between output and factor of production.

$$Y = f(L, K)$$

where

Y = output

L = labor

K = capital

In cases where data on capital stock are lacking but investment data are available, an approximation of capital stock can be shown by

$$K_T = \sum_{t=-\infty}^{1959} I_t + \sum_{t=1960}^T I_t$$

where K_T = capital stock at time T

I_t = net investment at time t

Assuming that $\sum_{t=-\infty}^{1959} I_t$, which is the value of capital stock at the end of year 1959, is constant, this term will appear in the output function as the intercept.

Finally, the output function can be written as

$$Y_T = f(L_t, \sum_{t=1960}^T I_t)$$

Net Private Capital Movements

The theory of international capital movements is based on the hypothesis of interest arbitrage. National capital movements, especially short-run capital, depend on the difference between domestic and foreign interest rates. A high foreign interest rate results in a flow of funds abroad.

Trade credit is also considered as a crucial factor in private capital movements because of its role in the financing of international trade. Thus, the relationship between trade credit and quantity of exports will be discussed.

Suppose the relationship can be specified as

$$TC = TC(X)$$

where TC = trade credit

X = exports

Now let us simplify it as a linear and homogeneous relationship

$$TC_t = gX_t$$

Net capital flows for trade credit in any period can be represented as follows:

$$NTC_t = TC_t - RTC_t$$

where NTC_t = net trade credit extended in period t

RTC_t = repayment of previous trade credit at time t

It is assumed that the repayments are a constant fraction of trade credit extended in the past. That is, trade credit is repaid in equal payment for n period.

$$RTC_t = \frac{1}{n} \sum_{i=1}^n TC_{t-i}$$

$$\begin{aligned} NTC_t &= TC_t - \frac{1}{n} \sum_{i=1}^n TC_{t-i} \\ &= gX_t - \frac{1}{n} \sum_{i=1}^n gX_{t-i} \end{aligned}$$

Since $TC_t = gX_t$

then $TC_{t-i} = gX_{t-i}$

Therefore,

$$NTC_t = g(X_t - \frac{1}{n} \sum_{i=1}^n X_{t-i})$$

It is assumed that $\frac{1}{n} \sum_{i=1}^n X_{t-i}$ is constant so that X_t is the variable which will be used as independent variable.

There is one problem left, that is, the problem of stocks and flows. Capital movements are a flow phenomenon. It is necessary to relate flows to stocks. Leamer and Stern (1970) have discussed how to relate the flow of capital to an explanatory stock variable. It is similar to the case of investment and capital. Suppose that the actual stock K is related to explanatory variable (X) as follows:

$$K_t = k + \sum_{i=0}^{\infty} \alpha_i X_{t-i}$$

Then the flow $K_t - K_{t-1}$ is given by

$$K_t - K_{t-1} = \alpha_0 X_t + \sum_{i=0}^{\infty} (\alpha_{i+1} - \alpha_i) X_{t-i-1}$$

If the value of the α s are such that $\alpha_{i+1} \approx \alpha_i$ for all i then the flow equation becomes

$$K_t - K_{t-1} \approx \alpha_0 X_t$$

The flow is related to the level of explanatory variable.

Monetary Sector

Keynes' theory of the demand for money

Keynes formulated the theory of the demand for money in terms of three motives that individuals and firms have for holding cash balances: the transactions demand, the precautionary demand, and the speculative demand.

The transactions demand for money is based on the theory that people hold money as a medium of exchange. People hold money because it is convenient to purchase goods and services. Keynes argued that the transactions demand is determined by the level of income.

The precautionary demand was the result of providing for contingencies and unplanned expenditures. The basic argument for the precautionary demand that Keynes used is the same as the transaction demand. He hypothesized that the precautionary demand is determined by the level of income.

The demand for money for speculative purposes depends on the interest rate. If the interest rate increases, people will hold more bonds because they yield an interest return. If it decreases, people hold more money.

According to Keynes, the demand for real money is the sum of the transactions, precautionary, and speculative demands which can be written as:

$$\frac{M^d}{P} = k(Y) + l(r)$$

Friedman's modern quantity theory

Friedman develops the demand for money within the context of the traditional microeconomic theories of consumer behavior and of the producer's demand for inputs. Consumers hold money because it yields utility in the form of convenience, security, pride of possession, and so on. Business firms hold money as a durable producer's good which can be treated as an intermediate product, and these services may be entered into the production function.

Friedman's demand for money function can be written as:

$$\frac{M^d}{P} = f(Y_p, \Omega, i, \frac{\Delta P}{P}, u)$$

where

$$\frac{M^d}{P} = \text{real money balance}$$

$$Y_p = \text{real permanent income}$$

$$\Omega = \text{ratio of nonhuman wealth to total wealth}$$

$$i = \text{nominal interest rate}$$

$$\frac{\Delta P}{P} = \text{rate of price change}$$

$$u = \text{other factors which influence the utility of money}$$

CHAPTER IV. THE MODEL

Statistical Data and Sources

Time series data are used in this study. Most of them were obtained from the National Income Accounts of Thailand of the Office of the Prime Minister, the Monthly Bulletin of the Bank of Thailand, Agricultural Statistics of Thailand of the Office of Agricultural Economics, Ministry of Agriculture and Cooperatives, FAO's Trade Yearbook, and the International Financial Statistics of the International Monetary Fund. Problems in the construction of an econometric model are always encountered in studies of developing countries, i.e., the limitation of time series data. Researchers attempt to avoid the problems by using estimated or adjusted data.

The National Income Accounts of Thailand, at current prices, are available from 1960 to 1979, but data in constant prices are divided into two series. The first series goes from 1960 to 1976 at 1962 prices, and the second extends from 1972 to 1979 in 1972 prices. Therefore, in order to make these data suitable for analysis, data at 1962 prices need to be converted into 1972 prices. This adjustment can be done in three steps.

1. First, the value of 1962 and 1972 price deflators is computed by dividing the current price series by the constant one.

2. Starting from a benchmark year, 1972, going back to 1960, the adjusted 1972 deflators are computed by dividing 1962 price deflator in year t by 1962 price deflator in year 1972 and multiplying by 100. The computation may be written as follows:

$$\text{Adjusted 1972 price deflator}_t = \frac{\text{1962 price deflator}_t}{\text{1962 price deflator}_{1972}} \times 100$$

where t goes from 1972 back to 1960.

Whenever the true value of 1972 price deflators from 1972 to 1979 are available, they are then used directly.

3. When the 1972 price deflator is obtained, the value of current price variables is adjusted to 1972 prices as follows:

$${}^Y_{1972 \text{ prices}_t} = \frac{{}^Y_{\text{current prices}_t}}{1972 \text{ price deflator}_t} \times 100$$

Table 4.1 illustrates an example of the adjustment of the variable in different series of prices to the same series.

The gross fixed capital formation data from 1962 to 1978 are disaggregated into two main groups, agricultural investment and nonagricultural investment at current prices. Investment for sub-industries in the nonagricultural group is available only from 1970 to 1978. Thus, it is necessary to derive data during 1962 to 1969 for sub-industries. The derivation can be done as follows:

1. The proportion of gross fixed capital formation for each sub-industry group to gross fixed capital formation in nonagriculture for 1970 to 1978 investment data are computed.

2. A regression is run with these proportions regressed on time and then are extrapolated to 1962.

3. The extrapolated proportions are then multiplied by the actual gross fixed capital formation in nonagriculture for the 1962 to 1969 period to get sub-industry investment data.

Depreciation data for each industry including agriculture are obtained by multiplying the proportion of gross fixed capital formation for each industry to total gross fixed capital formation by capital consumption allowance, or

Table 4.1. Example of the adjustment of current price variable to 1972 price variable

Year	Variable at current prices (1)	Variable at 1962 prices (2)	1962 price deflator (1)/(2)x100	Variable at 1972 prices (3)	1972 price deflator (1)/(3)x100	Adjusted 1972 price deflator (4)	Variable at 1972 prices after adjustment (1)/(4)x100
1960	18,520	20,610	89.86			70.91	26118
1961	20,334	21,561	94.31			74.42	27323
1962	22,678	22,678	100.00			78.91	28740
1963	23,642	23,848	99.14			78.24	30217
1964	25,054	24,993	100.24			79.10	31674
1965	27,439	26,376	104.03			82.09	33426
1966	31,787	28,137	112.97			89.15	35656
1967	36,095	29,586	122.00			96.28	37490
1968	38,311	31,144	123.01			97.07	39467
1969	41,163	32,491	126.69			99.98	41171
1970	42,866	34,646	123.73			97.64	43902
1971	43,796	36,781	119.07			93.96	46611
1972	49,379	38,967	126.72	49,379	100.00	100.00	49379
1973	63,799	40,221	158.62	51,882	122.97	122.97	51882
1974	83,563	41,900	199.43	53,180	157.13	157.13	53180
1975	93,091	43,633	213.35	56,090	165.97	165.97	56090
1976	103,994	45,370	229.21	59,658	174.32	174.32	56958
1977	117,837			63,515	185.53	185.53	63515
1978	139,144			66,062	210.63	210.63	66062
1979	159,358			68,427	232.29	232.29	68427

$$\text{CCA industry } i = \frac{\text{gross fixed capital formation industry } i}{\text{total gross fixed capital formation}} \times \text{CCA}$$

In order to obtain net fixed capital formation (NINV), the capital consumption allowance in each industry (CCA_i) is subtracted from gross fixed capital formation in each industry (GINV_i), or

$$\text{NINV}_i = \text{GINV}_i - \text{CCA}_i$$

Since the data of net fixed capital formation for each crop are not available, they can be derived by multiplying the proportion of planted

area of each crop to total planted area by net fixed capital formation in agriculture (AGNINV), or

$$\text{net fixed capital formation for crop } i = \frac{\text{planted area for crop } i}{\text{total planted area}} \times \text{AGNINV}$$

Actual data on population are available only from census as of 1960 and 1970. The data from 1961 to 1969 and 1971 to 1978 can be derived by using the exponential equation,

$$Y = b e^{mt}$$

$$\ln Y = \ln b + mt$$

Y = number of population in year t

b = constant term

m = growth rate of population

t = year

Fitting two points of available population on time (t) and interpolated for 1961 to 1969 and 1971 to 1978.

The Estimated Model

The model consists of 91 equations which are constructed specifically as linear in parameters and nonlinear in the variables in some equations. It contains 68 behavioral equations and 23 identities. The behavioral equations consist of 11 groups of equations.

The behavioral equations are as following:

1. Private personal consumption equations : 7
2. Government expenditure equations : 3
3. Investment equations : 7
4. Import equations : 5

5. Export equations : 8
6. Net private capital movement equation: 1
7. Output equations : 11
8. Income distribution equations : 10
9. Tax equations : 5
10. Monetary sector : 8
11. Price equations : 3

The results of estimating the model as hypothesized are now presented. The symbols and discussion of the equations follow the equations. The figures in parentheses are t-statistics. D. W. denotes the Durbin-Watson statistic. The equations in the model are estimated by the two stage principal components method. The principal components are used to estimate the first stage regressions. The second stage is to regress the endogenous variables on the estimated value of the explanatory endogenous variable are obtained from the first stage and the other predetermined variables in the equation. The model contains 89 endogenous variables and 107 predetermined variables.

Equations of the Model

Private personal consumption equations (1963-1978)

$$\frac{FBT_t}{N_t} = 43.451 + 0.054 \frac{PDY_t}{N_t} + 0.883 \frac{FBT_{t-1}}{N_{t-1}} \quad (IV-1)$$

(0.930) (1.422) (7.740)

$$R^2 = 0.997 \quad D.W. = 1.946 \quad F(2, 13) = 2,458.18$$

$$\frac{\text{RFLHHO}_t}{N_t} = 22.226 + 0.012 \frac{\text{PDY}_t}{N_t} + 0.133 \frac{\text{RFLHHO}_{t-1}}{N_{t-1}} \quad (\text{IV-2})$$

(1.473) (1.770) (5.978)

$$R^2 = 0.984 \quad \text{D.W.} = 1.401 \quad F(2, 13) = 410.80$$

$$\frac{\text{COPE}_t}{N_t} = -21.757 + 0.031 \frac{\text{GDP}_t}{N_t} + 0.598 \frac{\text{COPE}_{t-1}}{N_{t-1}} \quad (\text{IV-3})$$

(-1.714) (2.547) (3.387)

$$R^2 = 0.990 \quad \text{D.W.} = 1.819 \quad F(2, 13) = 664.01$$

$$\frac{\text{FFHHE}_t}{N_t} = 160.807 + 0.016 \frac{\text{PDY}_t}{N_t} - 122.523 \frac{\text{PFFHHE}_t}{P_t} \quad (\text{IV-4})$$

(2.289) (2.822) (-2.041)

$$R^2 = 0.620 \quad \text{D.W.} = 1.680 \quad F(2, 13) = 10.62$$

$$\frac{\text{SERV}_t}{N_t} = -26.366 + 0.031 \frac{\text{PDY}_t}{N_t} + 0.636 \frac{\text{SERV}_{t-1}}{N_{t-1}} \quad (\text{IV-5})$$

(-1.092) (1.999) (3.095)

$$R^2 = 0.922 \quad \text{D.W.} = 1.395 \quad F(2, 13) = 77.14$$

$$\frac{\text{TC}_t}{N_t} = 102.859 + 0.068 \frac{\text{PDY}_t}{N_t} - 116.085 \frac{\text{PTC}_t}{P_t} \quad (\text{IV-6})$$

(0.372) (16.600) (-0.801)

$$R^2 = 0.957 \quad \text{D.W.} = 1.870 \quad F(2, 13) = 144.20$$

$$\frac{\text{RE}_t}{N_t} = 21.652 + 0.050 \frac{\text{GDP}_t}{N_t} + 0.237 \frac{\text{RE}_{t-1}}{N_{t-1}} - 51.161 \frac{\text{PRE}_t}{P_t} \quad (\text{IV-7})$$

(0.649) (3.004) (1.023) (-3.094)

$$R^2 = 0.996 \quad \text{D.W.} = 2.109 \quad F(3, 12) = 1,153.73$$

Government consumption equations (1963-1978)

$$\text{GADJP}_t = -1,417.86 + 0.330 \text{ GREV}_t + 0.570 \text{ GADJP}_{t-1} \quad (\text{IV-8})$$

(-2.114) (2.422) (2.418)

$$R^2 = 0.980 \quad \text{D.W.} = 1.412 \quad F(2, 13) = 324.10$$

$$\text{GSERV}_t = -1,134.63 + 0.151 \text{ GREV}_t + 0.590 \text{ GSERV}_{t-1} \quad (\text{IV-9})$$

(-2.729) (2.679) (2.928)

$$R^2 = 0.982 \quad \text{D.W.} = 2.759 \quad F(2, 13) = 360.76$$

$$\text{GTC}_t = -56.398 + 0.031 \text{ GREV}_{t-1} + 0.303 \text{ GTC}_{t-1} \quad (\text{IV-10})$$

(-0.250) (1.800) (1.114)

$$R^2 = 0.629 \quad \text{D.W.} = 1.520 \quad F(2, 13) = 11.03$$

Investment equations (1963-1978)

$$\text{AGINV}_t = -589.443 + 0.293 \text{ AGINV}_{t-1} + 0.045 \text{ AGOUT}_t \quad (\text{IV-11})$$

(-0.628) (0.876) (1.202)

$$R^2 = 0.684 \quad \text{D.W.} = 2.160 \quad F(2, 13) = 14.06$$

$$\text{MANINV}_t = 1,143.993 + 0.498 \text{ MANINV}_{t-1} + 0.259 (\text{MGDP}_t - \text{MGDP}_{t-1}) \quad (\text{IV-12})$$

(2.070) (2.926) (1.093)

$$+ 0.673 (\text{MGDP}_{t-1} - \text{MGDP}_{t-2})$$

(2.919)

$$R^2 = 0.914 \quad \text{D.W.} = 2.114 \quad F(3, 12) = 42.79$$

$$\text{CONSINV}_t = 354.958 + 0.392 \text{ CONSINV}_{t-1} + 0.093 \text{ CONSOUT}_t \quad (\text{IV-13})$$

(1.784) (1.983) (2.463)

$$R^2 = 0.809 \quad \text{D.W.} = 2.485 \quad F(2, 13) = 27.51$$

$$\text{TCINV}_t = -59.682 + 0.544 \text{TCINV}_{t-1} + 0.318 \text{TCOUT}_t \quad (\text{IV-14})$$

(-0.133) (2.559) (2.276)

$$R^2 = 0.958 \quad \text{D.W.} = 2.065 \quad F(2, 13) = 150.26$$

$$\text{WRTINV}_t = 717.124 + 0.405 \text{WRTINV}_{t-1} + 0.062 \text{WRTOUT}_t \quad (\text{IV-15})$$

(1.754) (1.661) (2.186)

$$R^2 = 0.849 \quad \text{D.W.} = 2.096 \quad F(2, 13) = 36.43$$

$$\text{SERVINV}_t = 1,478.97 + 0.289 \text{SERVINV}_{t-1} + 0.024 (\text{GDP}_t - \text{GDP}_{t-1}) \quad (\text{IV-16})$$

(2.258) (1.259) (0.579)

$$+ 0.129 (\text{GDP}_{t-1} - \text{GDP}_{t-2})$$

(2.302)

$$R^2 = 0.678 \quad \text{D.W.} = 2.853 \quad F(3, 12) = 8.44$$

$$\text{OTHINV}_t = -1,095.71 + 0.898 \text{OTHINV}_{t-1} + 1.807 (\text{OUTHOUT}_t - \text{OUTHOUT}_{t-1}) \quad (\text{IV-17})$$

(-1.407) (6.044) (3.024)

$$R^2 = 0.943 \quad \text{D.W.} = 1.949 \quad F(2, 13) = 108.30$$

Import equations (1963-1978)

$$\text{IMP1}_t = 12,974.85 + 0.018 \text{PDY}_t - 10,069.5 \frac{\text{M1P}_t}{\text{PGDP}_t} \quad (\text{IV-18})$$

(11.821) (6.239) (-7.473)

$$R^2 = 0.837 \quad \text{D.W.} = 1.691 \quad F(2, 13) = 35.45$$

$$\text{IMP2}_t = 9,109.127 + 7,888.982 \text{IP}_t - 8,202.2 \frac{\text{M2P}_t}{\text{PGDP}_t} \quad (\text{IV-19})$$

(3.182) (6.593) (-5.942)

$$u_t = 0.354 u_{t-1}$$

(1.513)

$$R^2 = 0.917 \quad F(2, 13) = 71.81.$$

$$\text{IMP3}_t = -373.916 + 0.028 \text{PDY}_t - 304.630 \frac{\text{M3P}_t}{\text{PGDP}_t} \quad (\text{IV-20})$$

(-1.844) (11.318) (-2.597)

$$R^2 = 0.952 \quad \text{D.W.} = 1.677 \quad F(2, 13) = 128.09$$

$$\text{IMP4}_t = 13,818.32 + 0.299 \text{TINV}_t - 15,828.2 \frac{\text{M4P}_t}{\text{PGDP}_t} \quad (\text{IV-21})$$

(8.616) (9.409) (-6.541)

$$R^2 = 0.872 \quad \text{D.W.} = 1.563 \quad F(2, 13) = 44.43$$

$$\text{IMPSEV}_t = 1,520.732 + 0.366 \text{SERGDP}_t - 2,799.31 \frac{\text{MTP}_t}{\text{PGDP}_t} \quad (\text{IV-22})$$

(2.819) (19.482) (-4.803)

$$R^2 = 0.972 \quad \text{D.W.} = 2.285 \quad F(2, 13) = 222.49$$

Export equations

$$\text{XRICE} = -4,348.85 + 0.326 \text{RICE}_{t-1} + 0.267 \text{XRICE}_{t-1} \quad (\text{IV-23})$$

(-1.772) (2.454) (1.353)

$$+ 1,481.694 D_2$$

(2.611)

$$R^2 = 0.546 \quad \text{D.W.} = 1.595 \quad F(2, 13) = 4.80$$

$$\text{XRUB}_t = 291.209 + 0.011 \frac{\text{WIMPRUB}_t}{\text{ER}_t} + 0.528 \text{XRUB}_{t-1} \quad (\text{IV-24})$$

(1.631) (2.299) (2.306)

$$R^2 = 0.914 \quad \text{D.W.} = 1.621 \quad F(2, 13) = 69.00$$

$$\text{XMZE}_t = 565.830 + 165.145 \text{PXMZE}_t + 0.575 \text{MZE}_{t-1} \quad (\text{IV-25})$$

(2.554) (0.851) (3.998)

$$R^2 = 0.758 \quad \text{D.W.} = 2.852 \quad F(2, 13) = 20.39$$

$$\text{XTAP}_t = 9.753 + 1.129 \text{TAP}_t \quad (\text{IV-26})$$

(0.093) (26.932)

$$R^2 = 0.981 \quad \text{D.W.} = 2.360 \quad \text{F}(1, 14) = 725.35$$

$$\text{XSG}_t = -758.981 + 1.180 \text{SG}_{t-1} + 0.185 \text{XSG}_{t-1} \quad (\text{IV-27})$$

(-3.950) (6.974) (1.487)

$$R^2 = 0.943 \quad \text{D.W.} = 1.764 \quad \text{F}(2, 13) = 107.02$$

$$\ln \text{XKN}_t = -10.958 + 1.441 \ln \frac{\text{WIMPKN}_t}{\text{ER}_t} + 0.672 \ln \text{PXKN}_t \quad (\text{IV-28})$$

(-3.672) (4.125) (1.599)

$$+ 0.199 \ln \text{XKN}_{t-1} + 0.618 \ln \text{KN}_{t-1}$$

(1.072) (3.701)

$$R^2 = 0.887 \quad \text{D.W.} = 1.922 \quad \text{F}(4, 11) = 21.65$$

$$\text{XSERV}_t = -1.168.08 + 0.337 \text{SERGDP}_t + 0.275 \text{XSERV}_{t-1} \quad (\text{IV-29})$$

(1.686) (5.739) (2.681)

$$+ 3,513.341 \text{D1}$$

(6.707)

$$R^2 = 0.949 \quad \text{D.W.} = 2,629 \quad \text{F}(3, 12) = 74.08$$

$$\text{XOTH}_t = -2,352.65 + 0.023 \text{GDP}_t + 0.977 \text{XOTH}_{t-1} \quad (\text{IV-30})$$

(-1.571) (0.988) (2.889)

$$R^2 = 0.940 \quad \text{D.W.} = 1.697 \quad \text{F}(2, 13) = 101.70$$

Net private capital movement equation (1963-1978)

$$\text{PFK}_t = -867.664 + 114.430 (\text{CBINT}_t - \text{UINT}_t) + 0.117 \text{TX}_t \cdot \text{XTP}_t \quad (\text{IV-31})$$

(-0.846) (0.446) (7.769)

$$R^2 = 0.823 \quad \text{D.W.} = 2.732 \quad \text{F}(2, 13) = 30.27$$

Output equations (1963-1978)

$$\text{RICE}_t = -67,101.4 + 0.404 \text{RICE}_{t-1} + 8,673.53 \text{RICELAB}_t \quad (\text{IV-32})$$

(-4.589) (2.564) (5.132)

$$+ 1.559 \text{RRICE}_t$$

(1.566)

$$R^2 = 0.787 \quad \text{D.W.} = 1.471 \quad F(3, 12) = 14.76$$

$$\text{RUB}_t = 78.188 + 0.294 \text{ATRUB}_t - 0.089 \text{RRUB}_t \quad (\text{IV-33})$$

(0.380) (14.083) (-1.286)

$$R^2 = 0.942 \quad \text{D.W.} = 1.227 \quad F(2, 13) = 105.34$$

$$\text{MZE}_t = -129.361 + 0.338 \text{AMZE}_t \quad (\text{IV-34})$$

(-0.508) (8.103)

$$R^2 = 0.824 \quad \text{D.W.} = 2.108 \quad F(1, 14) = 31.59$$

$$\text{TAP}_t = 294.451 + 3.689 \Sigma \text{TAPNINV}_t \quad (\text{IV-35})$$

(2.904) (22.370)

$$R^2 = 0.973 \quad \text{D.W.} = 2.172 \quad F(1, 14) = 500.41$$

$$\text{OTHAG}_t = 15,884.03 + 5.595 \Sigma \text{OTHAGNINV}_t \quad (\text{IV-36})$$

(45.397) (41.063)

$$R^2 = 0.992 \quad \text{D.W.} = 1.897 \quad F(1, 14) = 1,686.18$$

$$\text{MGDP}_t = 7,424.978 + 0.589 \Sigma \text{MANNINV}_t \quad (\text{IV-37})$$

(9.174) (30.544)

$$u_t = 0.534 u_{t-1}$$

(2.526)

$$R^2 = 0.985 \quad F(1, 14) = 919.33$$

$$\text{CONSOUT}_t = 205.519 + 0.888 \text{CONSOUT}_{t-1} + 6,038.053 \text{CONSLAB}_t \quad (\text{IV-38})$$

(0.246) (5.289) (1.675)

$$R^2 = 0.903 \quad \text{D.W.} = 0.419 \quad F(2, 13) = 60.55$$

$$\text{TCOUT}_t = 4,803.256 + 0.171 \Sigma \text{TCNINV}_t \quad (\text{IV-39})$$

(14.764) (22.006)

$$u_t = 0.521 u_{t-1}$$

(2.443)

$$R^2 = 0.972 \quad F(1, 14) = 486.00$$

$$\text{WRTOUT}_t = 12,301.38 + 0.692 \Sigma \text{WRTNINV}_t \quad (\text{IV-40})$$

(46.734) (67.553)

$$R^2 = 0.997 \quad \text{D.W.} = 2.016 \quad F(1, 14) = 4,563.41$$

$$\text{SERGDP}_t = -3,992.330 + 15,473.537 \text{SERLAB}_t \quad (\text{IV-41})$$

(-6.762) (34.598)

$$u_t = 0.302 u_{t-1}$$

(1.268)

$$R^2 = 0.988 \quad F(1, 14) = 1,152.67$$

$$\text{OTHOUT}_t = 118.301 + 1.089 \text{OTHOUT}_{t-1} \quad (\text{IV-42})$$

(0.294) (54.284)

$$R^2 = 0.995 \quad \text{D.W.} = 1.191 \quad F(1, 14) = 2,946.71$$

Compensation of employee equations (1967-1978)

$$\text{COMPAG}_t = -8,979.43 + 0.192 \text{AGOUT}_t + 374.092 \text{AGLAB}_t \quad (\text{IV-43})$$

(-0.681) (2.012) (0.281)

$$R^2 = 0.945 \quad \text{D.W.} = 1.219 \quad F(2, 9) = 76.71$$

$$\text{COMPMC}_t = 3,386.599 + 17,219.51 \text{ CONSLAB}_t + 0.340 \text{ CONSOUT}_{t-1} \quad (\text{IV-44})$$

(2.834) (5.880) (1.955)

$$R^2 = 0.902 \quad \text{D.W.} = 1.326 \quad F(2, 9) = 0.902$$

$$\text{COMPTC}_t = 716.825 + 0.189 \text{ TCOUT}_t \quad (\text{IV-45})$$

(4.111) (13.102)

$$R^2 = 0.945 \quad \text{D.W.} = 2.038 \quad F(1, 10) = 171.67$$

$$\text{COMPWRT}_t = -3,386.45 + 0.235 \text{ WRTOUT}_t \quad (\text{IV-46})$$

(-4.164) (9.329)

$$R^2 = 0.897 \quad \text{D.W.} = 1.182 \quad F(1, 10) = 87.50$$

$$\text{COMPSERV}_t = 1,582.909 + 0.438 \text{ SERGDP}_t \quad (\text{IV-47})$$

(1.998) (10.058)

$$R^2 = 0.910 \quad \text{D.W.} = 1.281 \quad F(1, 10) = 101.16$$

$$\text{COMPOTH}_t = 1,912.851 + 0.361 \text{ OTHOUT}_t \quad (\text{IV-48})$$

(3.203) (14.878)

$$R^2 = 0.957 \quad \text{D.W.} = 1.742 \quad F(1, 10) = 221.35$$

Income from unincorporated enterprises equations (1967-1978)

$$\text{FY}_t = -7,857.05 + 1.352 \text{ OTHAG}_t \quad (\text{IV-49})$$

(-2,032) (11.110)

$$R^2 = 0.925 \quad \text{D.W.} = 1.588 \quad F(1, 10) = 123.43$$

$$\text{YUE}_t = 4,354.486 + 0.265 \text{ GDP}_t - 11,008.7 \text{ RNAGLAB}_t \quad (\text{IV-50})$$

(0.085) (2.509) (-0.034)

$$R^2 = 0.981 \quad \text{D.W.} = 1.622 \quad F(2, 9) = 232.02$$

$$FR_t = -1,530.692 + 0.143 AGOUT_t \quad (IV-51)$$

(-1.505) (7.963)

$$u_t = 0.493 u_{t-1}$$

(1.965)

$$R^2 = 0.864 \quad F(1, 10) = 63.53$$

$$INTDIV_t = 549.749 + 111.646 INTTB_t + 0.063 STDPCB_t \quad (IV-52)$$

(0.813) (0.942) (19.141)

$$R^2 = 0.981 \quad D.W. = 1.394 \quad F(2, 9) = 230.90$$

Tax equations (1963-1978)

$$DTAX_t = -2.022.349 + 0.038 PI_t \quad (IV-53)$$

(-5.448) (14.098)

$$u_t = 0.402 u_{t-1}$$

(1.757)

$$R^2 = 0.934 \quad F(1, 14) = 198.12$$

$$IMPTAX_t = 1,625.824 + 0.114 TIMP_t \quad (IV-54)$$

(3.846) (9.669)

$$u_t = 0.342 u_{t-1}$$

(1.454)

$$R^2 = 0.870 \quad F(1, 14) = 93.62$$

$$XTAX_t = 622.510 + 0.047 XRICE_t + 0.997 PR_t \quad (IV-55)$$

(3.102) (0.966) (14.382)

$$u_t = 0.553 u_{t-1}$$

(2.656)

$$R^2 = 0.942 \quad F(2, 13) = 105.57$$

$$\text{BUSTAX}_t = -629.544 + 0.031 \text{ GDP}_t \quad (\text{IV-56})$$

$$(-4.845) \quad (39.785)$$

$$R^2 = 0.992 \quad \text{D.W.} = 1.803 \quad F(1, 14) = 1,582.82$$

$$\text{OIDTAX}_t = -1,153.63 + 0.043 \text{ GDP}_t \quad (\text{IV-57})$$

$$(-5.841) \quad (36.338)$$

$$R^2 = 0.990 \quad \text{D.W.} = 2.338 \quad F(1, 14) = 1,320.48$$

Monetary sector (1963-1978)

$$\text{CHP}_t = 3,138.676 + 0.064 \text{ GDP}_t \cdot \text{PGDP}_t \quad (\text{IV-58})$$

$$(5.402) \quad (26.569)$$

$$u_t = 0.359 u_{t-1}$$

$$(1.538)$$

$$R^2 = 0.981 \quad F(1, 14) = 722.84$$

$$\text{DDPCB}_t = 3,929.994 + 0.035 \text{ GDP}_t \cdot \text{PGDP}_t - 197.017 \text{ CBINT}_t \quad (\text{IV-59})$$

$$(3.777) \quad (22.435) \quad (-1.630)$$

$$u_t = 0.346 u_{t-1}$$

$$(1.476)$$

$$R^2 = 0.979 \quad F(2, 13) = 303.02$$

$$\text{STDPCB}_t = -18.926.197 + 0.307 \text{ GDP}_t \cdot \text{PGDP}_t \quad (\text{IV-60})$$

$$(-8.537) \quad (33.412)$$

$$u_t = 0.388 u_{t-1}$$

$$(1.683)$$

$$R^2 = 0.988 \quad F(1, 14) = 1,152.67$$

$$\text{STDPGB}_t = -265.168 + 0.034 \text{ GDP}_t \cdot \text{PGDP}_t \quad (\text{IV-61})$$

(-0.628) (19.794)

$$u_t = 0.459 u_{t-1}$$

(2.064)

$$R^2 = 0.965 \quad F(1, 14) = 386.00$$

$$\text{GSCB}_t = -11,337.0 - 0.143 \text{ LDCB}_t + 3.264 \text{ DDPCB}_t \quad (\text{IV-62})$$

(-4.899) (-2.806) (6.126)

$$R^2 = 0.971 \quad \text{D.W.} = 2.340 \quad F(2, 13) = 217.99$$

$$\text{GSGB}_t = -135.638 + 1.155 \text{ STDPGB}_t + 119.850 \text{ INTTB}_t \quad (\text{IV-63})$$

(0.148) (21.293) (0.678)

$$u_t = 0.325 u_{t-1}$$

(1.375)

$$R^2 = 0.980 \quad F(2, 13) = 318.50$$

$$\text{LDCB}_t = -53,561.583 + 2.704 \text{ TINV}_t \quad (\text{IV-64})$$

(-3.568) (7.746)

$$u_t = 0.489 u_{t-1}$$

(2.240)

$$R^2 = 0.811 \quad F(1, 14) = 60.07$$

$$\text{BFCB}_t = -10,523.928 + 2,734.399 \text{ CBINT}_t - 1,138.835 \text{ JINT}_t \quad (\text{IV-65})$$

(-1.724) (4.097) (-2.785)

$$u_t = 0.550 u_{t-1}$$

(2.634)

$$R^2 = 0.589 \quad F(2, 13) = 9.32$$

Price equations (1967-1978)

$$P_t = 0.029 + 0.984 \text{ PGDP}_t \quad (\text{IV-66})$$

(1.562) (62.144)

$$R^2 = 0.996 \quad \text{D.W.} = 1.949 \quad F(1, 14) = 3,861.84$$

$$\text{PGDP}_t = 0.705 + 0.000004 M_t + 0.074 \text{ M3P}_t \quad (\text{IV-67})$$

(26.600) (4.587) (2.996)

$$R^2 = 0.969 \quad \text{D.W.} = 1.591 \quad F(2, 13) = 203.54$$

$$\text{IP}_t = 0.092 + 0.931 \text{ PGDP}_t \quad (\text{IV-68})$$

(2.189) (25.895)

$$R^2 = 0.980 \quad \text{D.W.} = 2.426 \quad F(1, 14) = 670.56$$

Identities

$$\frac{\text{TPCE}_t}{N_t} = \frac{\text{FBT}_t}{N_t} + \frac{\text{COPE}_t}{N_t} + \frac{\text{RFLHHO}_t}{N_t} + \frac{\text{FFHHE}_t}{N_t} + \frac{\text{SERV}_t}{N_t} + \frac{\text{TC}_t}{N_t} + \frac{\text{RE}_t}{N_t} \quad (\text{IV-69})$$

$$\text{TGCE}_t = \text{GADJP}_t + \text{GTC}_t + \text{GSERV}_t \quad (\text{IV-70})$$

$$\text{TINV}_t = \text{AGINV}_t + \text{NAGINV}_t + \text{DINV}_t \quad (\text{IV-71})$$

$$\text{NAGINV}_t = \text{MANINV}_t + \text{CONSINV}_t + \text{TCINV}_t + \text{SERVINV}_t + \text{WRTINV}_t + \text{OTHINV}_t \quad (\text{IV-72})$$

$$\text{TIMP}_t = \text{IMP1}_t + \text{IMP2}_t + \text{IMP3}_t + \text{IMP4}_t + \text{IMP5}_t + \text{IMP5ERV}_t \quad (\text{IV-73})$$

$$\text{TX}_t = \text{XRICE}_t + \text{XRUB}_t + \text{XMZE}_t + \text{XTAP}_t + \text{XSG}_t + \text{XKN}_t + \text{XSERV}_t + \text{XOTH}_t \quad (\text{IV-74})$$

$$\text{AGOUT}_t = \text{RICE}_t + \text{RUB}_t + \text{MZE}_t + \text{TAP}_t + \text{OTHAG}_t \quad (\text{IV-75})$$

$$\begin{aligned} \text{NAGOUT}_t = & \text{MGDP}_t + \text{CONSOUT}_t + \text{TCOUT}_t + \text{WRTOUT}_t + \text{SERGDP}_t \\ & + \text{OTHOUT}_t \end{aligned} \quad (\text{IV-76})$$

$$\text{GDP}_t = \text{AGOUT}_t + \text{NAGOUT}_t \quad (\text{IV-77})$$

$$\text{GDP}_t = \text{TPCE}_t + \text{TGCE}_t + \text{TX}_t - \text{TIMP}_t + \text{TINV}_t + \text{SD}_t \quad (\text{IV-78})$$

$$\begin{aligned} \text{COMP}_t = & \text{COMPAG}_t + \text{COMPMC}_t + \text{COMPTC}_t + \text{COMPWRT}_t + \text{COMPSEV}_t \\ & + \text{COMPOTH}_t \end{aligned} \quad (\text{IV-79})$$

$$\text{TYUE}_t = \text{FY}_t + \text{YUE}_t \quad (\text{IV-80})$$

$$\text{YPROP}_t = \text{INTDIV}_t + \text{FR}_t + \text{OTHR}_t \quad (\text{IV-81})$$

$$\text{PI}_t = \text{COMP}_t + \text{TYUE}_t + \text{YPROP}_t + \text{TRANIN}_t \quad (\text{IV-82})$$

$$\text{TAX}_t = \text{DTAX}_t + \text{IDTAX}_t \quad (\text{IV-83})$$

$$\text{IDTAX}_t = \text{IMPTAX}_t + \text{XTAX}_t + \text{BUSTAX}_t + \text{OIDTAX}_t \quad (\text{IV-84})$$

$$\begin{aligned} \text{NY}_t = & \text{COMP}_t + \text{TYUE}_t + \text{YPROP}_t + \text{CORPSAV}_t + \text{DTCORP}_t + \text{GGY}_t \\ & - \text{INTPD}_t - \text{INTCD}_t \end{aligned} \quad (\text{IV-85})$$

$$\text{PDY}_t = \text{NY}_t - \text{DTHH}_t - \text{TRANOUT}_t + \text{TRANIN}_t - \text{DTCORP}_t \quad (\text{IV-86})$$

$$\text{TFK}_t = \text{PFK}_t + \text{PORTINV}_t + \text{GFK}_t \quad (\text{IV-87})$$

$$BOP_t = TX_t \cdot XTP_t - TIMP_t \cdot MTP_t + UT_t + TFK_t + ERR_t \quad (IV-88)$$

$$M_t = CHP_t + DDPBOT_t + DDPCB_t + DDPGB_t + STDPGB_t + STDPGB_t + SB_t \quad (IV-89)$$

$$M_t = FABOT_t + FADCB_t - BFCB_t + GSCB_t + LDCB_t + LDGB_t + GSCB_t \quad (IV-90)$$

$$+ CCBBOT_t + FIACB_t - DDOCB_t - STDOCB_t - ODCB_t - BOCB_t$$

$$- CACB_t + OAGB_t - CAGB_t + GSBOT_t + OABOT_t + COINS_t$$

$$- DDOBOT_t - CABOT_t - CHG_t$$

$$GREV_t = TAX + MREV \quad (IV-91)$$

List of variables

1. AGINV = Gross Fixed Capital Formation in Agriculture
2. AGLAB* = Number of Workers in Agriculture (100,000s of workers)
3. AGOUT = Total Output in Agriculture
4. AMZE* = Planted Area for Maize (1,000 rai)
5. ATRUB* = Tapping Area for Rubber (1,000 rai)
6. BFCB = Commerical Bank Borrowing from Abroad (mb.)
7. BOCB* = Commercial Bank Borrowing from Banks in Thailand (mb.)
8. BOP = Balance of Payment (mb.)
9. BUSTAX = Business Taxes
10. CABOT* = Capital Accounts and Other Liabilities of the BOT (mb.)
11. CACB* = Capital Accounts and Other Liabilities of CB (mb.)
12. CAGB* = Capital Accounts and Other Liabilities of GSB (mb.)
13. CBINT* = Commercial Banks "Call Money" Interest Rate (% per annum)

14. CCBBOT* = Claim on Commercial Bank at BOT (mb.)
15. CHG* = Currency in Hand of Government (mb.)
16. CHP = Currency in Hand of Public (mb.)
17. COINS* = Total Coins (mb.)
18. COMP = Compensations of Employees
19. COMPAG = Compensations of Agricultural Workers
20. COMPMC = Compensations of Manufacturing and Construction Workers
21. COMPOTH = Compensations of Other Employees
22. COMPSERV = Compensations of Service Workers
23. COMPTC = Compensations of Transportation and Communication Workers
24. COMPWRT = Compensation of Wholesale and Retail Trade Workers
25. CONSINV = Gross Fixed Capital Formation in Construction
26. CONSLAB* = Number of Workers in Construction (100,000s of workers)
27. CONSOUT = Total Output in Construction
28. COPE = Consumption of Clothing and Other Personal Effects
29. CORPSAV* = Saving of Corporations and Government Enterprises
30. D₁* = Dummy Variable, 1966-1972 = 1; Otherwise = 0
31. D₂* = Dummy Variable, 1973-1975 = 0; Otherwise = 1
32. DDOBOT* = Other Demand Deposits at BOT (mb.)
33. DDOCB* = Other Demand Deposits at CB (mb.)
34. DDPBOT* = Private Demand Deposits at BOT (mb.)
35. DDPCB = Private Demand Deposits at CB (mb.)
36. DDPGB* = Private Demand Deposits at GSB (mb.)
37. DINV* = Change in Inventories
38. DTAX = Direct Taxes
39. DTCORP* = Direct Taxes on Corporations

40. DTHH* = Direct Taxes on Households
41. ER* = Exchange Rates (\$/Baht)
42. ERR* = Error in BOP (mb.)
43. FABOT* = Foreign Assets at BOT (mb.)
44. FADCB* = Foreign Currency on Hand and Balances at Banks in CB (mb.)
45. FBT = Consumption of Food, Beverages, and Tobacco
46. FIACB* = Commercial Bank Fixed and Other Assets (mb.)
47. FFHHE = Consumption on Furniture, Furnishings, and Household
Equipment
48. FR = Farm Rent
49. FY = Farm Income
50. GADJP = Government Expenditures on Administration, Defense,
Justice, and Police
51. GDP = Gross Domestic Product
52. GFK* = Government International Capital Movement (mb.)
53. GGY* = General Government Income from Property and Entrepreneurship
54. GREV = Government Revenue
55. GSBOT = Claims on Central Government at BOT
56. GSCB = Commercial Bank Investment on Government Securities
57. GSERV = Government Expenditures on Services
58. GSGB* = Claims on Government at Government Saving Bank
59. GTC = Government Expenditures on Transportation and Communication
60. IDTAX = Indirect Taxes
61. IMP1 = Imports of Consumer Goods
62. IMP2 = Imports of Intermediate Products and Raw Materials
63. IMP3 = Imports of Fuel and Lubricants

64. IMP4 = Imports of Capital Goods
65. IMP5* = Total Merchandise Imports in BOP - (IMP1 + IMP2 + IMP3
+ IMP4)
66. IMPSERV = Imports of Services
67. IMPTAX = Import Taxes
68. INTCD* = Interest on Consumer Debt
69. INTDIV = Interest Income and Dividends
70. INTPD* = Interest on Public Debt
71. INTTB* = Interest Rate on Treasury Bills (percent per annum)
72. IP = Index of Industrial Production or GDP Price Deflator for
Nonagricultural Sector
73. JINT* = "Call Money" Interest Rate in Japan (percent per annum)
74. KN* = Output of Kenaf
75. LDCB = Commercial Bank Loans, Overdrafts, and Discounts (mb.)
76. LDGB* = Loans and Overdrafts of GSB (mb.)
77. M = Money Supply (mb.)
78. MANINV = Gross Fixed Capital Formation in Manufacturing
79. MANNINV = Net Fixed Capital Formation in Manufacturing
80. MGDP = Manufacturing Output
81. M1P* = Price Deflator for IMP1
82. M2P* = Price Deflator for IMP2
83. M3P* = Price Deflator for IMP3
84. M4P* = Price Deflator for IMP4
85. MREV = The Government Revenue from Miscellaneous
86. MTP* = Total Import Price Deflator
87. MZE = Output of Maize

- 88. N* = Number of Population (100,000s of workers)
- 89. NAGINV = Gross Fixed Capital Formation on Nonagriculture
- 90. NAGOUT = Total Output in Nonagriculture
- 91. NY = National Income
- 92. OABOT* = Other Assets of BOT (mb.)
- 93. OAGB* = Other Assets of GSB (mb.)
- 94. ODCB* = Other Demand Liabilities of CB (mb.)
- 95. OIDTAX = Other Indirect Taxes
- 96. OTHAG = Output of Agricultural Products, Other Than Crops
- 97. OTHAGNINV = Net Fixed Capital Formation in Agriculture, Other Than
Crops
- 98. OTHINV = Gross Fixed Capital Formation in Other
- 99. OTHOUT = Output of Other Products
- 100. OTHR* = Other Rent
- 101. P = Price Deflator for All Consumption
- 102. PDY = Personal Disposable Income
- 103. PFFHHE* = Price Deflator for FFFHHE
- 104. PFK = Net Private Capital Movement (mb.)
- 105. PGDP = GDP Price Deflator
- 106. PI = Personal Income
- 107. PORTINV* = Portfolio Investment (mb.)
- 108. PR* = Rice Premium Per Unit
- 109. PRE* = Price Deflator for RE
- 110. PTC* = Price Deflator for TC
- 111. PXKN* = Export Price Deflator for Kenaf
- 112. PXMZ* = Export Price Deflator for Maize

- 113. RE = Consumption Expenditures on Recreation and Entertainment
- 114. RFLHHO = Consumption Expenditures on Rent, Light, and Household
Operation
- 115. RICE = Output of Rice
- 116. RICELAB* = Number of Workers in Rice Production (100,000s of
Workers)
- 117. RNAGLAB* = Ratio of Nonagricultural Labor to Total Labor Force
- 118. RRICE = Rain Fall in Rice Production Area (mm.)
- 119. RRUB* = Rain Fall in Rubber Production Area (mm.)
- 120. RUB = Output of Rubber
- 121. SB* = Saving Bonds and Premium Saving Bonds at GSB (mb.)
- 122. SD* = Statistical Discrepancy
- 123. SERGDP = Output of Services
- 124. SERLAB* = Number of Workers in Services (100,00s of workers)
- 125. SERV = Consumption Expenditures on Services
- 126. SERVINV = Gross Fixed Capital Formation on Services
- 127. SG = Output of Sugar
- 128. STDOCB* = Other Saving and Time Deposits at CB (mb.)
- 129. STDPCB = Private Saving and Time Deposits at CB (mb.)
- 130. STDPGB = Private Saving and Demand Deposits at GSB (mb.)
- 131. TAP = Output of Tapioca
- 132. TAPNINV = Net Fixed Capital Formation on Tapioca
- 133. TAX = Total Taxes
- 134. TC = Consumption Expenditures of Transportation and Communication
- 135. TCINV = Gross Fixed Capital Formation on Transportation and Commu-
nication

136. TCNINV = Net Fixed Capital Formation on Transportation and Communication
137. TCOUT = Output of Transportation and Communication
138. TFK = Total Net Foreign Capital Movement (mb.)
139. TGCE = Total Government Consumption Expenditures
140. TIMP = Total Imports
141. TINV = Total Gross Fixed Capital Formation
142. TPCE = Total Personal Consumption Expenditures
143. TRANIN* = Net Transfers to Household from Government and the Rest of the World
144. TRANOUT* = Net Transfers from Household to Government and the Rest of the World
145. TX = Total Exports
146. TYUE = Total Income for Unincorporated Enterprises
147. UINT = Eurodollar Interest Rate in London (percent per annum)
148. UT = Unrequited Transfers
149. WIMPKN* = World Imports of Kenaf (millions of U.S. dollars)
150. WIMPRUM* = World Imports of Rubber (millions of U.S. dollars)
151. WRTINV = Gross Fixed Capital Formation in Wholesale and Retail Trade
152. WRTNINV = Net Fixed Capital Formation in Wholesale and Retail Trade
153. WRTOUT = Output of Wholesale and Retail Trade
154. XKN = Exports of Kenaf
155. XMZE = Exports of Maize
156. XOTH = Exports of Other Goods

- 157. XRICE = Exports of Rice
- 158. XRUB = Exports of Rubber
- 159. XSERV = Exports of Services
- 160. XSG = Exports of Sugar
- 161. XTAP = Exports of Tapioca
- 162. XTAX = Export Taxes
- 163. XTP = Total Export Price Deflator
- 164. YPROP = Income from Property
- 165. YUE = Income from Unincorporated

Notes: (1) All variables are in millions of baht, 1972 prices, unless otherwise noted.

(2) Exogenous variables are indicated by an asterisk (*)

(3) mb. denotes million baht in current prices

(4) BOT denotes the Bank of Thailand

(5) CB denotes the commercial banks

(6) GSB denotes the government saving bank

Discussion of the Empirical Results of the Model

Private consumption expenditure equations (TPCE)

The specification of the private consumption equations follows the Friedman "permanent income" consumption hypothesis. Consumption for a particular commodity group is a function of income and the lagged value of consumption which reflects the permanent income effect. However, a relative price variable was also included with an anticipated negative sign. The ratio of the price deflator of each category in private consumption expenditure to the price deflator for all consumption was used as the

relative price variable. The equations in this sector are specified on a per capita basis to introduce the effect of population into the model and also to obtain a better explanation of the welfare of the people in the economy. If consumption increases but the population increases faster, per capita consumption tends to decrease.

The private consumption expenditure sector is disaggregated into seven categories as follows:

1. Food, beverage, and tobacco (FBT)
2. Clothing and other personal effects (COPE)
3. Rent, fuel, light, and household operation (RFLHHO)
4. Furniture, furnishings, and household equipment (FFHHE)
5. Services (SERV)
6. Transportation and communication (TC)
7. Recreation and entertainment (RE)

As mentioned before, the specification of each equation has per capita consumption as a function of income, the lagged value of consumption, and relative prices. However, the results of some equations were not satisfactory. Some coefficients were statistically insignificant or did not have proper signs. These variables have been left out when the ordinary least square (OLS) is applied.

The final estimated equation is shown in equations IV-1 through IV-7. The results of the estimation of the coefficients in each commodity group are reasonable and have good fits except for some coefficients in equations IV-6 and IV-7, which are insignificant. Those coefficients correspond to the variables $\frac{PTC_t}{P_t}$ and $\frac{RE_{t-1}}{N_{t-1}}$, respectively. These variables were not

dropped from the equations because when the OLS was applied with sample period 1960 to 1979, they were significant in terms of t-statistics. As 2SPC are applied, the number of observations in the sample period is reduced in order to make the available data consistent for all variables in the model. The sample period then runs from 1963 to 1978. As the number of observations is decreased, low t-ratios for those coefficients may result. In equation IV-4, the R^2 is fairly low, only 0.620, but the t-statistic of each coefficient is satisfactory. However, all estimated coefficients in this sector have the expected sign.

Government consumption expenditure equations (TGCE)

Many macroeconometric models have treated government consumption expenditure as an exogenous variable. Here it is specified to be determined endogenously. Government consumption expenditure is observed to be closely related to the government revenue. Its trend responds to the growth of the population and the growth of the economy. Government consumption expenditure is hypothesized to be a function of government revenues and lagged value of government consumption, and it is disaggregated into three categories, as follows:

1. General administration, Defense and justice, and Police (GADJP)
2. Transport and communication (GTC)
3. Education and research, Health services, Special welfare services, and Other services (GSERV)

The results of the estimation of coefficients are statistically satisfactory and have good fit with high R^2 , except for equation IV-10. The R^2

of this equation is only 0.629. However, the t-ratio of each coefficient is statistically significant.

Gross fixed capital formation equations (TINV)

The specification of the investment equations, made to be simple as possible, follows the accelerator principle, where gross fixed capital formation is hypothesized to be a function of output, or the past change of output, and the lagged value of the endogenous variable. The gross fixed capital formation equation is disaggregated into two main categories with the second main category further divided into six groups. They are shown as follows:

1. Gross fixed capital formation in agriculture (AGINV)
2. Gross fixed capital formation in nonagriculture (NAGINV)
 - a. Gross fixed capital formation in manufacturing (MANINV)
 - b. Gross fixed capital formation in construction (CONSINV)
 - c. Gross fixed capital formation in transportation and communication (TCINV)
 - d. Gross fixed capital formation in wholesale and retail (WRTINV)
 - e. Gross fixed capital formation in services (SERINV)
 - f. Gross fixed capital formation in other (OTHINV)

The results of the estimated equations are statistically satisfactory with generally good R^2 s, except for equations IV-11 and IV-16. The R^2 s of these equations are only 0.684 and 0.678, respectively. However, the estimated coefficients have the expected signs.

The import equations

The specification of the import equation is based on the theory of demand. Import goods are hypothesized to be a function of relative prices and income, but some have their own characteristics, such as imports of intermediate products and raw materials (IMP2) and imports of capital goods (IMP4). Therefore, an alternative specification is considered. IMP2 is hypothesized to be a function of income, the change in inventories, the industrial production index, and relative prices. The price deflator of nonagricultural output is used as a proxy for the industrial production index. Changes in inventories and income have been dropped from the equation because they do not yield the proper sign. The final specification has IMP2 as a function of the industrial production index and relative price. For the import of capital goods (IMP4) equation, it is considered as an investment function and follows the Prachowny specification, discussed above. It is hypothesized to be a function of total investment and the price ratio.

Imports are classified into six categories:

1. Imports of consumer goods (IMP1)
2. Imports of intermediate product and raw material (IMP2)
3. Imports of fuel and lubricants (IMP3)
4. Imports of capital goods (IMP4)
5. Imports of services (IMP5SERV)
6. Other imports (IMP5)

The results of the estimation of the coefficients are satisfactory both in terms of t-ratios and R^2 s. For IMP2 equation, the low Durbin-Watson statistic shows autocorrelation. Generalized least squares is used

to correct autocorrelation. The autocorrelation coefficient ($\hat{\rho}$) for this equation is 0.354, with a t-ratio of 1.513.

The export equations (TX)

The first attempt at export specification is based on the theory of demand. However, it was found that the theory of demand is not a good approach for Thai exports.

For Thailand, Ammar Siamwalla (1975) suggests that many Thai export commodities take only small shares in the total world market. Therefore, the major problem concerning exports is not lack of foreign demand but deficiency of supply. Thus, the specification of Thai export is based on supply rather than demand.

Stephenson and Itharattana (1977) suggest that a single equation of exports of an economy is a reduced form equation which reflects a series of equilibrium positions over time. It is difficult to specify the export equation as demand or supply. However, it is not impossible. The single equation approach will show a negative or a positive price effect which indicates demand or supply relationship. The 1977 report also shows the relationship between export and output and lagged value of exports which indicates a trend of export. Therefore, the specification of Thai export of various commodities will follow Stephenson and Itharattana and include Siamwalla's suggestion, i.e., a supply relationship will be observed.

$$X_t = f(Px_t, Y_t, X_{t-1})$$

where Y_t = output

X_{t-1} = export in period t-1

Exports are disaggregated into

1. Export of rice (XRICE)
2. Export of rubber (XRUB)
3. Export of maize (XMZE)
4. Export of tapioca (XTAP)
5. Export of sugar (XSG)
6. Export of kenaf (XKN)
7. Export of services (XSERV)
8. Export of other (XOTH)

In specifying that rice export equation, a dummy variable is added due to a shortage in rice supply from 1973 to 1975. The results of the estimation of coefficients in this equation are not particularly satisfactory. The R^2 is quite low, but as OLS is applied, the R^2 is equal to 0.775 for the sample period 1960 to 1978. When using 2SPC, R^2 is only 0.546. At the same time, the t-statistic of each coefficient is lower. This might be due to a reduction in the sample period. The export of maize equation is similar. When using 2SPC, the R^2 is fairly low, only 0.758. When OLS is applied to the sample period from 1960 to 1978, R^2 is 0.805. This pattern is the same as that for the export of rice equation and might be explained in the same way. In the specification of service export equation, a dummy variable is added due to the effect of the Vietnam War during 1966 to 1972. The results of coefficient estimation in the other equations besides rice export and maize export are statistically satisfactory. All coefficients have the expected signs.

The net private capital movement equation (PFK)

The specification of the net private capital movement equation follows the hypothesis of interest arbitrage. An attempt was also made to relate trade credit to the total value of exports. Therefore, the specification is hypothesized as a function of total exports in current prices and the difference between the domestic and the international interest rate. In specifying this equation, dummy variable is also added due to an increase in oil price since 1974. It caused direct investment, loans, and credits to both government and private enterprises to increase. When applying OLS, it was found that the coefficient estimation did not yield statistical significance. Thus, it was dropped from the equation.

The result of estimation is statistically satisfactory. R^2 is 0.823, which is fairly high, but the t-ratio for the difference of domestic and foreign interest is nonsignificant. It shows that the Thai net private capital movement probably depends upon the exports rather than the interest rate.

The output equations

The specification of output equations, in general, is based on the production function, i.e., output is a function of capital and labor. In Thailand, it is difficult to collect data on capital stock. Therefore, the sum of net investment is used for capital stock (as shown in Chapter III). For agricultural output, weather conditions such as the amount of rainfall in the cultivation areas and planted areas are considered as factors which determine the output of production. Output is disaggregated into:

I. Agricultural output (AGOUT)

- (1) Rice (RICE)
- (2) Rubber (RUB)
- (3) Maize (MZE)
- (4) Tapioca (TAP)
- (5) Other agricultural output (OTHAG)

II. Nonagricultural output (NAGOUT)

- (1) Manufacturing (MGDP)
- (2) Construction (CONSOUT)
- (3) Transportation and Communication (TCOUT)
- (4) Wholesale and Retail Trade (WRTOUT)
- (5) Services (SERGDP)
- (6) Other nonagricultural output (OTHNAG)

The results of the estimation of the coefficients in this sector yield satisfactory. Even the R^2 for RICE equation is fairly low, only 0.787, but it is not very bad. Some equations in this sector have difficulties with low Durbin-Watson statistics such as RICE, MGDP, CONSOUT, TCOUT, SERGDP, and OTHOUT. In the RICE, CONSOUT, and OTHOUT_t, there are lagged endogenous variables. Therefore, Durbin-Watson statistics are not good for showing autocorrelation. For MGDP, TCOUT, and SERGDP equations, the low D-W statistics show autocorrelation. Generalized least squares is thus used to correct the autocorrelation. The autocorrelation coefficient ($\hat{\rho}$) for the MGDP equation is 0.534, with a t-ratio of 2.526, while $\hat{\rho}$ for TCOUT and SERGDP are 0.521 and 0.302 with t-ratio of 2.443 and 1.268, respectively. After generalized least squares is applied, the results of the estimation of coefficient remain satisfactory.

Income distribution equations (1967-1978)

Distribution of the national income, which appears in the national income accounts, is disaggregated into wages and salaries among various industries, incomes of unincorporated businesses, rental income, interest, and dividend income. The specification of wages and salaries among industries is based on the assumption of profit maximization by producers. Any change in output will affect employment and also wages and salaries. Some industries such as manufacturing, construction, transportation and communication may be affected by credit availability.

In the final specifications for compensation of employees in manufacturing and construction (COMPMC), loans and overdrafts from commercial banks (LDCB) are dropped from the equation because they yield insignificant results. Therefore, the COMPMC is specified as a function of labor employed in construction and construction output in the last year. The results of the estimation of the coefficient are statistically satisfactory with good R^2 . The t-ratio of each coefficient is also statistically significant.

In the transportation and communication equation, LDCB and labor employed are also dropped due to improper signs and statistical insignificance. The results of the estimation of the coefficients yield a high R^2 , 0.945. The t-ratio of the coefficient is highly significant.

The final result of the estimation of the coefficients is statistically satisfactory.

Income from unincorporated enterprises equations (1967-1978)

Income from unincorporated enterprise consists of farm income and the income of other unincorporated groups such as doctor, lawyers, taxi drivers, barbers, and others. Factors that affect farm income would include output and the number of laborers in the agricultural sector. In final specification, the number of laborers employed in agriculture was dropped because it does not yield a proper sign. This may be caused by correlation between labor employed and output. An attempt was made to specify income of other unincorporated business as a function of gross output and labor employed. It was found that GDP and RNAGLAB yield the best explanation of other unincorporated business income.

Rental income includes earnings received from housing rental, land for agriculture, and rent from various industries. The major source of rental income comes from agriculture. Therefore, farm rent (FR) is treated as an endogenous variable. Other rent is treated as exogenous. Farm rent is specified to be determined by cultivated area and agricultural output. Cultivated area was dropped from the equation because it yielded a nonsignificant coefficient perhaps due to the correlation between output and cultivated area. The estimation of this equation also gives a low Durbin-Watson statistic. The D-W statistic is equal to 0.861. Therefore, generalized least squares was applied to correct for autocorrelation. The correlation coefficient ($\hat{\rho}$) was 0.493 with a t-ratio of 1.965.

Interest income is determined in the financial sector. Interest paid by banks to households is a major source of income in this group. Therefore, interest income is specified to be explained by interest rates in the financial sector and the amount of money deposited in banks.

The estimation of coefficients in the income distribution equations uses time series data available from 1967 to 1978. It is different from the other sectors of the model, which used samples from 1963 to 1978. Data for the earlier years, 1963 to 1966, were not available for the income distribution equations.

Tax functions

Taxation is the major source of government revenue. It is divided into direct taxes (DTAX) and indirect taxes (IDTAX). Direct taxes are assumed to depend on income before taxes, i.e., personal income (PI). Indirect taxes are disaggregated into import duties (IMPTAX), export duties (XTAX), business taxes (BUSTAX), and other indirect taxes (OIDTAX).

The import duties function is specified as a function of the value of import goods. Government revenue from export duties mainly comes from the rice premium. Therefore, export duties are specified to be a function of the value of rice exports (XRICE) and the rice premium rate (PR). Business taxes and other indirect taxes are assumed to depend on the level of income.

$$DTAX = f(PI)$$

$$IMPTAX = f(TIMP)$$

$$XTAX = f(XRICE PR)$$

$$BUSTAX = f(GDP)$$

$$OIDTAX = f(GDP)$$

The results of the direct tax, import tax, and export tax equations show that there is autocorrelation. They yield low Durbin-Watson

statistics, 0.860, 1.071, and 0.664, respectively. Generalized least squares was then applied. The other equations are statistically satisfactory.

Monetary sector equations

The money supply usually is treated as an exogenous variable which is controlled by the financial authorities. Here, money supply is treated as an endogenous variable. Any change in commercial bank investment on government securities (GSCB), government saving investment on government securities (GSGB), loans, overdrafts, and discounts of commercial bank to private sector (LDCB), and borrowing from abroad of commercial banks (BFCB) will change the money supply.

The specification of the function starts with the balance sheet identity of the Bank of Thailand, commercial banks, and government saving bank.

Bank of Thailand balance sheet identity

$$(1) \text{ FABOT} + \text{GSBOT} + \text{CCBBOT} + \text{OABOT} = \text{NCBOT} + \text{DDPBOT} + \text{DDOBOT} + \text{CABOT}$$

Assets

FABOUT = Foreign assets at BOT

GSBOT = Claims on the central government at BOT

CCBBOT = Claim on commercial banks at BOT

OABOT = Other assets of BOT

Liabilities

NCBOT = Notes in circulation

DDPBOT = Private demand deposits at BOT

DDOBOT = Other demand deposits at BOT

CABOT = Capital accounts and other liabilities

Commercial bank balance sheet identity

(2) FADCB + CHCB + GSCB + LDCB + FIACB = DDPCB + DDOCB + STDP
STDOCB + ODCB + BOCB + BFCB + CACB

Assets

FADCB = Foreign currency on hand and in balances at banks

CHCB = Cash in hands of commercial banks

GSCB = Commercial bank investments in government securities

LDCB = Commercial bank loans, overdrafts, and discounts

FIACB = Commercial bank fixed and other assets

Liabilities

DDPCB = Private demand deposits at commercial bank

DDOCB = Other demand deposits at commercial bank

STDP = Private saving and time deposits at commercial bank

STDOCB = Other saving and time deposits at commercial bank

ODCB = Other demand liabilities

BOCB = Commercial bank borrowing from banks in Thailand

BFCB = Commercial bank borrowing from abroad

CACB = Capital accounts and other liabilities

Government saving bank balance sheet identity

(3) CHGB + LDGB + GSGB + OAGB = DDPGB + STDPGB + SB + CAGB

Assets

CHGB = Notes and coins in the hands of the government saving bank

LDGB = Loans, overdrafts of the government saving bank

GSGB = Claims on government at government saving bank

OAGB = Other assets of government saving bank

Liabilities

DDPGB = Private demand deposits at the government saving bank

STDPGB = Private saving and demand deposits at the government saving
bank

SB = Saving bonds and premium saving bonds

CAGB = Capital accounts and other liabilities of government saving
bank

$$(4) \text{ NCBOT} = \text{CHP} + \text{CHCB} + \text{CHGB} + \text{CHG} - \text{COINP} - \text{COINCB} - \text{COING}$$

$$= \text{CHP} + \text{CHCB} + \text{CHGB} + \text{CHG} - \text{COINS}$$

$$\text{COINS} = \text{COINP} + \text{COINCB} + \text{COING}$$

where

CHP = Currency in the hands of the public

CHCB = Currency in the hands of commercial banks

CHGB = Currency and coins in the hand of the government saving
bank

CHG = Currency in the hands of government

COINP = Coins in the hands of the public

COINCB = Coins in the hands of commercial banks

COING = Coins in the hands of government

COINS = Total coins

Substitute (4) in (1)

$$\text{FABOT} + \text{GSBOT} + \text{CCBBOT} + \text{OABOT} = \text{CHP} + \text{CHCB} + \text{CHGB} + \text{CHG} - \text{COINS}$$

$$+ \text{DDPBOT} + \text{DDOBOT} + \text{CABOT}$$

$$(5) \quad \text{CHP} + \text{DDPBOT} = \text{FABOT} + \text{GSBOT} + \text{CCBBOT} + \text{OABOT} - \text{CHCB} - \text{CHGB} - \text{CHG} \\ + \text{COINS} - \text{DDOBOT} - \text{CABOT}$$

From (2)

$$(6) \quad \text{DDPCB} + \text{STDPCB} = \text{FADCB} + \text{CHCB} + \text{GSCB} + \text{LDCB} + \text{FIACB} - \text{DDOCB} \\ - \text{STDOC} - \text{ODCB} - \text{BOCB} - \text{BFCB} - \text{CACB}$$

From (3)

$$(7) \quad \text{DDPGB} + \text{STDPGB} + \text{SB} = \text{CHGB} + \text{LDGB} + \text{GSGB} + \text{OAGB} - \text{CAGB}$$

$$(5) + (6) + (7)$$

Left hand side = $\text{CHP} + \text{DDPBOT} + \text{DDPCB} + \text{DDPGB} + \text{STDPCB} + \text{STDPGB} + \text{SB}$

Right hand side = $\text{FABOT} + \text{GSBOT} + \text{CCBBOT} + \text{OABOT} - \text{CHG} + \text{COINS} - \text{DDOBOT} \\ - \text{CABOT} + \text{FADCB} + \text{GSCB} + \text{LDCB} + \text{FIACB} - \text{DDOCB} - \text{STDOC} \\ - \text{ODCB} - \text{BOCB} - \text{BFCB} - \text{CACB} + \text{LDGB} + \text{GSGB} + \text{OAGB} - \text{CAGB}$

The first specification will be

$$(1) \quad \text{CHP} = f_1\left(Y, r, \frac{\Delta P}{P}\right)$$

$$(2) \quad \text{DDPCB} = f_2\left(Y, r, \frac{\Delta P}{P}, \frac{Y_{na}}{Y}, \frac{Y_a}{Y}\right)$$

$$(3) \quad \text{STDPCB} = f_3\left(Y, r, \frac{\Delta P}{P}, \frac{Y_{na}}{Y}, \frac{Y_a}{Y}\right)$$

$$(4) \quad \text{STDPGB} = f_4\left(Y, r, \frac{\Delta P}{P}, \frac{Y_{na}}{Y}, \frac{Y_a}{Y}\right)$$

$$(5) \quad \text{GSCB} = f_5(\text{LDCB}, \text{DDPCB}, r)$$

$$(6) \quad \text{LDCB} = f_6(\text{TINV}, r, \frac{\Delta P}{P})$$

$$(7) \quad \text{GSGB} = f_7(\text{LDGB}, \text{STDPGB}, r)$$

$$(8) \quad \text{BFCB} = f_8(r, r_f)$$

where Y = income

Y_a = income from agriculture

Y_{na} = income from nonagriculture

r = domestic interest rate

r_f = foreign interest rate

The demand for currency (CHP) is hypothesized to be a function of current income, the interest rate, and the rate of inflation. The interest rate represents the rate of return in holding other financial assets, and the inflation rate represents the opportunity costs of holding cash rather than goods. Statistical tests show insignificance of the two effects. Thus, the interest rate and the rate of inflation have been left out of the demand for currency equation. The result of coefficient estimation shows high significance in the relationship between demand for currency and current income.

The demand for demand deposits and time and saving deposits is specified as the demand for currency. Here changes in income in nonagricultural and agricultural sectors were added to be investigated. They represent a proxy for income distribution. Because statistical tests do not show significant relationship among the variables, they were dropped from the equations. The final specification of demand deposits of commercial is as a function of current income and the interest rate. The interest rate shows a statistically insignificant relationship, but as a whole it improves R^2 in the equation. The demand for time and saving deposits in both commercial banks and government saving banks shows a highly significant relationship with current income.

Claims on government at commercial banks (GSCB) and at the government saving banks (GSCB) are specified to be functions of the amount of bank deposits, the rate of returns, and the amount of other investments, i.e.,

loans and overdrafts. Because the interest rate shows an insignificant relationship to GSCB, it was dropped out. Therefore, GSCB is specified to be a function of LDCB and DDPCB. LDGB is insignificant in GSCB and was left out of the equation. The specification of LDGB then is a function of STDPGB and the interest rate.

LDCB is hypothesized to be a function of total investment, the interest rate, and the rate of inflation. Because only total investment shows statistical significance, the others were dropped.

Commercial bank borrowing from abroad (BFCB) is specified to be a function of the domestic interest rate and the foreign interest rate. The results of coefficients are statistically satisfactory and have the expected signs.

Price determination

An approach to specify a general price level equation may follow the quantity theory of money. The equation for the quantity of money can be defined as

$$PY = MV$$

where P = implicit national income price index

Y = real national income

M = nominal quantity of money

V = income velocity of circulation

Rewritten the quantity of money equation

$$P = \frac{MV}{Y}$$

Assuming that V is fixed, and taking logarithm both sides of the equation,

$$\ln P = \ln M - \ln Y + \ln V$$

Therefore, the specification of a general price equation will be

$$P = f(M, Y)$$

The estimated coefficients have the expected signs, but the estimated coefficient corresponding to GDP does not yield a statistically significant result. This may be due to the correlation between M and GDP. It has been found that M3P (the import price index of fuel and lubricants) has a strong effect on the domestic price level. Thus, M3P was considered and showed a significant effect.

The specification of the price deflator for all consumption (P) equations and the GDP price deflator for the nonagricultural sector (IP) equation follow the Evans and Klein standard hypothesis. It is assumed that the change in prices in any given period is proportional to the difference between the equilibrium sectoral price, which depends on the general price level, and last period actual price.

$$\text{Symbolically, } \Delta P = \delta(P^e - P_{t-1})$$

$$\text{and } P^e = f(\text{PGDP})$$

where P = sectoral price

P^e = equilibrium sectoral price

PGDP = general price level

δ = speed of adjustment

The equation can be rewritten as

$$P_t - P_{t-1} = \delta(P^e - P_{t-1})$$

$$P_t = \delta P^e + (1-\delta)P_{t-1}$$

Substitute for P^e by $f(\text{PGDP})$

$$P_t = \delta \cdot f(\text{PGDP}) + (1-\delta) P_{t-1}$$

The P_t and IP_t equations are specified as functions of PGDP and the last period price in each sector. In the P_t equation, P_{t-1} has been dropped due to having an incorrect sign. The final specification of the P_t equation will be as a function of PGDP alone. In the IP_t equation, IP_{t-1} has also been dropped because it gives an incorrect sign and statistical insignificant. The final specification of the IP_t equation will be as a function of PGDP alone.

The result of the coefficient estimation is statistically satisfactory. It is shown that the price index for all consumption responds to general price level more than the GDP price index for the nonagricultural sector.

CHAPTER V. SIMULATION OF THE MACROECONOMETRIC MODEL

Model Simulation Method

After a model is constructed, it is necessary for researchers to test the model's performance. The model illustrates the relationship among economic variables which are hypothesized from economic theory. Testing the model is done by testing its predictive performance. Simulation is a testing technique of the predictive ability of a model. The method of simulation depends upon the structural model constructed. If the structural equations are linear in both parameters and variables, reduced form simulation can be used. If the structural equations are nonlinear in either the variables, parameters or both, the Gauss-Seidel simulation algorithm can be used. The Thai macroeconomic model described in Chapter IV is linear in parameters, but some equations are nonlinear in variables. Therefore, only the Gauss-Seidel algorithm will be discussed.

The Gauss-Seidel method is an iterative technique. It does not require the inversion of matrices and derivatives. When the equations of the model are written in the following form,

$$\begin{aligned}
 Y_1 &= f_1(Y_2, Y_3, \dots, Y_G, X_1, X_2, \dots, X_K) \\
 Y_2 &= f_2(Y_1, Y_3, \dots, Y_G, X_1, X_2, \dots, X_K) \\
 &\quad \vdots \\
 &\quad \vdots \\
 &\quad \vdots \\
 Y_G &= f_G(Y_1, Y_2, Y_3, \dots, Y_{G-1}, X_1, X_2, \dots, X_K) \\
 Y^0 &= (Y_1^0, Y_2^0, \dots, Y_G^0)
 \end{aligned}$$

The first round of Y_s (Y^1) can be computed as

$$\begin{aligned}
 Y_1^1 &= f_1(Y_2^0, Y_3^0, \dots, Y_G^0, X_1, X_2, \dots, X_K) \\
 Y_2^1 &= f_2(Y_1^1, Y_3^0, \dots, Y_G^0, X_1, X_2, \dots, X_K) \\
 &\vdots \\
 Y_G^1 &= f_G(Y_1^1, Y_2^1, \dots, Y_{G-1}^1, X_1, X_2, \dots, X_K)
 \end{aligned}$$

The first round can then be used to generate a second round (Y^2) as

$$\begin{aligned}
 Y_1^2 &= f_1(Y_2^1, Y_3^1, \dots, Y_G^1, X_1, X_2, \dots, X_K) \\
 Y_2^2 &= f_2(Y_1^2, Y_3^1, \dots, Y_G^1, X_1, X_2, \dots, X_K) \\
 &\vdots \\
 Y_G^2 &= f_G(Y_1^2, Y_2^2, Y_3^2, \dots, Y_{G-1}^2, X_1, X_2, \dots, X_K)
 \end{aligned}$$

The iteration is repeated and stops when

$$\frac{Y_i^K - Y_i^{K-1}}{Y_i^{K-1}} \leq \delta \text{ for all } i$$

where δ is a small positive number.

The Gauss-Seidel method will sometimes not converge, depending on the order of the equations. The procedure suggested is to arrange the equations so that the matrix of endogenous variables is as triangular as possible.

Error Measures

A model should be tested for the accuracy of its predictive performance. The success of the prediction can be checked by comparing the actual values of each variable in the sample period with the predicted values of that variable. This method, called *ex post* prediction, uses the historical value of observed variables.

The statistics which can be used to measure the accuracy of the predictions of the model are as follows:

1. Mean Absolute Error (MAE)

$$\text{MAE} = \frac{1}{T} \sum_{t=1}^T \left| \hat{Y}_t - Y_t \right|$$

2. Mean Absolute Percentage Error (MAPE)

$$\text{MAPE} = \frac{1}{T} \sum_{t=1}^T \left| \frac{\hat{Y}_t - Y_t}{Y_t} \right| \quad (100)$$

3. Root Mean Square Error (RMSE)

$$\text{RMSE} = \frac{1}{T} \sqrt{\sum_{t=1}^T (\hat{Y}_t - Y_t)^2}$$

4. Root Mean Squared Percentage Error (RMSPE)

$$\text{RMSPE} = \sqrt{\frac{1}{T} \sum_{t=1}^T \left(\frac{\hat{Y}_t - Y_t}{Y_t} \right)^2} \quad (100)$$

5. Correlation coefficient (CC)

$$\text{CC} = \frac{\sum_{t=1}^T (\hat{Y}_t - \bar{\hat{Y}}_t)(Y_t - \bar{Y}_t)}{\sqrt{\sum_{t=1}^T (\hat{Y}_t - \bar{\hat{Y}}_t)^2 \sum_{t=1}^T (Y_t - \bar{Y}_t)^2}}$$

6. Theil U-statistic (U)

$$U = \frac{\sqrt{\sum_{t=1}^T (\hat{Y}_t - Y_t)^2}}{\sqrt{\sum_{t=1}^T \hat{Y}_t^2} \sqrt{\sum_{t=1}^T Y_t^2}}$$

where \hat{Y}_t = predicted value of Y at time t

Y_t = actual value of Y at time t

T = the numbers of sample periods

Results of Simulations

The model performance test used in this study is the ex post test, meaning that it is an examination over the sample period. Because of the limitation of data available in some variables, the sample period will be reduced to the 1967 to 1978 period. The simulation is fully dynamic in the sense that the model generates its own lagged endogenous variables. It is assumed that all exogenous variables are known and constant. The results of the simulations are summarized in the Appendix, which are illustrated by both figures and graphs. The only statistic presented is RMSPE because the SAS (ETS) computer package is used for the simulation. It provides this statistic.

The overall results of simulation are fairly satisfactory over the sample period. However, there is some variation in the results. Some equations perform better than others, as will be discussed in more detail.

In the private consumption sector, the difference between the predicted and actual values of the total private consumption is RMSPE 0.070. It shows reasonably good performance of the equation. The worst performance in this sector is consumption expenditures on rent, light, and household operation (RFLHHO), with an 0.736 RMSPE. It can be said that the majority of the equations in this sector predict reasonably well.

The equations in the government expenditure sector perform well. The equations can predict the total government expenditure quite accurately. The total government expenditure has an 0.072 RMSPE. The poorest fit in this sector is the government expenditures on transportation and communication, with an 0.224 RMSPE.

In the investment or gross fixed capital formation sector, the equations have fair predictive performance. The error measurements are comparatively high. RMSPE range from 0.090 to 0.319. It is not surprising considering that data were lacking in this sector initially. The equation for investment of other has a large error, at 0.319 RMSPE. During the period 1971 to 1978, the equation gives overprediction, but underprediction in 1969 and 1970. The investment of construction also has a large error, at 0.165 RMSPE. The reason for the large error in this equation may be the effect of a big prediction error in the construction output which is a variable in this variable. As the construction output equation performs poor, the error is transferred to this equation as well. However, the prediction error of the total investment equation has a 0.097 RMSPE which is not very high.

In the import sector, most equations show results similar to what was found in the investment sector. RMSPEs range from 0.072 to 0.208. The best performance in this sector is the import of fuel and lubricants equation, worth only an 0.072 RMSPE. The worst predictive performance was in the import of intermediate products and raw materials. It shows low predictive power with high RMSPE. However, total imports show reasonably good prediction performance, at 0.090 RMSPE.

The equations in the export sector show variation in predictive power. RMSPEs range from 0.086 in exports of rubber to 2.469 in exports of sugar. Prediction of maize exports was also poor. It might be due to low predictive power in the maize equation which is transmitted to this equation. Lagged maize output is a variable in this equation, thus, as the maize equation does not perform well, it contributes to the poor prediction in

the maize export equation as well. However, the total export prediction is reasonably good, showing a 0.088 RMSPE.

The net private capital movement equation shows relatively low predictive power. The estimated equation has large error, 0.504 RMSPE. This equation performs badly in the 1971 and 1973 years. In 1971, there was a decrease in net private capital movements followed by an increase in 1972. In 1973, it dropped again and then increased tremendously in 1974. The fluctuation of data can be explained by the fact that direct investment, loans, and credits to both government and private enterprises decreased in 1971. In 1973, private enterprise repayments were greater than drawings, which caused PFK to decrease. In 1974, direct investment and loans and credits to private enterprises doubled, and also loans and credits to government enterprises increased by threefold. They caused PFK to increase in 1974.

The equations in the output sector do reasonably well in performance. The equations of agricultural and nonagricultural output have satisfactory predictive power, with 0.027 and 0.032 RMSPE, respectively. The worst predictive performance in this sector falls into the output of construction, where the error measure is very high (0.304 RMSPE). However, the majority of the equations perform well.

In the compensation of employee sector, the results of simulation show good predictive performance, but there are variations in the power of prediction. The aggregate compensation of employee has a relative low error, only 0.044 RMSPE. In the disaggregated equations, RMSPEs range from 0.046 to 0.149, which is satisfactory, except COMPWRT equation. It has a large error, at 0.149 RMSPE. However, the performance is not very bad.

Income from unincorporated enterprises equations perform well. They have good fit, with error measurements of only 0.051 and 0.030 RMSPE in the income from property (YPROP) and total income for unincorporated enterprises (TYUE), respectively. The disaggregated equations also perform fairly well, with error measurements ranging from 0.035 to 0.112 RMSPE. The farm rent equation predicts poorly (0.112 RMSPE). However, this performance is not bad.

The majority of the tax equations shows relatively good predictive power. The exception is in the export taxes equation, which has a very poor predictive performance. The actual data fluctuate considerably, possibly because of political situations and weather conditions. However, as a whole, the total tax equation has a relatively low error of prediction, only 0.088 RMSPE.

In the monetary sector, the money supply equation has a fair performance. The error measurement shows 0.112 RMSPE, which is a little high. The other equations perform reasonably well except for the commercial bank loans, overdrafts and discounts (LDCB) and commercial bank borrowing from abroad (BFCB) equations. The LDCB equation is high during 1969 to 1976 and low from 1977 to 1978. It has a high error of 0.333 RMSPE. The BFCB equation also has a high error (0.676 RMSPE). It has very poor fit during 1969 to 1971 and 1976 to 1978.

All price equations have good fit and show relatively high predictive power. The PGDP equation has 0.068 RMSPE, while P and IP equations have 0.054 and 0.058 RMSPE, respectively.

The last group of variables in simulations is income defined in various ways, i.e., GDP, PDY, NY, and PI. The incomes are all predicted

with small errors, 0.020 RMSPE, 0.020 RMSPE, 0.016 RMSPE, and 0.016 RMSPE, respectively.

CHAPTER VI. SUMMARY AND CONCLUSION

Thailand is experiencing many problems which generally occur in most developing countries, i.e., low capacity income, a high population growth rate, unequal income distribution, and low productivity of labor. Development planning has been used as a means to accelerate economic progress. Agricultural planning has also been used to solve problems in the agricultural sector. A linear programming technique for planning in the agricultural sector was developed initially. Later it was felt that macroeconomic model should be linked to the linear programming model in order to obtain a complete view of Thai agriculture and economy. Thus, the Thai macroeconomic model was constructed in 1974 at the Office of Agricultural Economics, the Ministry of Agriculture and Cooperatives, Thailand. The model was built by using only OLS because there were some difficulties with available computer programs and available data, which led to estimators which did not have the property of consistency. Therefore, an attempt was made in this study to reconstruct and expand the earlier Thai macroeconomic model. The objective of modeling is to investigate the interaction between the nonagricultural sector and agricultural sector and attempts to disaggregate in more detail where possible. Rather than using OLS, a more sophisticated estimation procedure was applied, i.e., two-stage principal component.

The estimated model consists of 91 equations which contain 68 behavioral equations and 23 identities. The model contains 89 endogenous variables and 107 predetermined variables. The estimation of the model was done by the method of two-stage principal component (2SPC). The

disaggregation of the model was attempted as the data permitted. Short-time series data from 1963 to 1978 were used in the estimation of parameters in all sectors except in the compensation of employee equation where the data used ranges from 1967 to 1978. The model simulation uses the Gauss-Seidel algorithm procedure because the estimated model is linear in parameters but nonlinear in variables in some equations. The simulation is fully dynamic. The model generates its own lagged endogenous variables, and it is assumed that all exogenous variables are known and constant. The results of the estimated model and dynamic simulation were discussed in Chapters IV and V.

There were some difficulties in construction, both in terms of theoretical and empirical attempts. Sometimes it is difficult to apply model construction techniques formulated in developed countries such as the U.S. to developing countries like Thailand, because the countries have quite different economic structures. Most developing countries also have problems of availability of disaggregated time series data. Thus, a researcher who builds the models should be aware of these weaknesses.

The model is constructed to provide useful information to policymakers. It is hoped that this objective has been achieved. However, there remain weaknesses in the model. The model is estimated by using short time series data. Therefore, the parameters estimated are subject to these data weaknesses. There also may be specification errors. To be more effective, the model should be revised. Time series data could be expanded and improved in quality.

Despite its limitations, the model may be used to make ex ante forecasts. In order to make such forecasts useful, the policymaker should be

aware of what policy will be used. The model can show the effect of different policies, and the policymaker may select the best one for his purpose.

The weakest parts of the model are the investment sector, income distribution sector, and the balance of payment equation. The investment and income distribution sectors have limited disaggregated time series. It is expected that hopefully reliable disaggregated data will become available in these sectors. The balance of payment equation has low prediction power. It is hoped that this weakness can be reduced in the future, perhaps by using another form of specification.

BIBLIOGRAPHY

- Ball, R. J. 1973. *The International Linkage of National Economic Models*. North-Holland Publishing Co., American Elsevier Publishing Co., New York, New York.
- Bank of Thailand. 1971 through 1980. *Monthly report*. Vol. 11, No. 12 to Vol. 20, No. 1. Bank of Thailand, Bangkok, Thailand.
- Branson, W. H. 1979. *Macroeconomic Theory and Policy*. Harper and Row, Publishers, New York, New York.
- Bridge, J. I. 1971. *Applied Econometrics*. North Holland Publishing Co., American Elsevier Publishing Co., New York, New York.
- Chenery, H. B. 1952. *Overcapacity and the Acceleration Principle*. *Econometrics* 20, 1:1-28.
- Christ, C. F. 1966. *Econometric Models and Methods*. John Wiley & Sons, Inc., New York, New York.
- Duesenberry, J. S. 1949. *Income, Saving and the Theory of Consumer Behavior*. Harvard University Press, Cambridge, Massachusetts.
- Evans, M. K. 1969. *Macroeconomic Activity: Theory, Forecasting and Control*. Harper and Row, Publishers, New York, New York.
- Evans, M. K. and L. R. Klein. 1968. *The Wharton Econometric Forecasting Model*. 2nd enlarged edition. Economics Research Unit, University of Pennsylvania, Philadelphia, Pennsylvania.
- Friedman, M. E. 1957. *A Theory of the Consumption Function*. National Bureau of Economic Research, New York, New York.
- Friedman, M. E. 1970. *The Quantity Theory of Money: A Restatement*. In Clower, R. W., ed. *Reading in Monetary Theory*. Penguin Education, New York.
- Fullerton, H. H. 1977. *Singapore Symposium: Agricultural Sector Analysis in Thailand*. DAE-CARD Sector Analysis Series: No. 7, 173-202.
- Ingram, J. C. 1955. *Economic Change in Thailand Since 1850*. Stanford University Press, Stanford, California.
- Intriligator, M. D. 1978. *Econometric Models, Techniques, and Applications*. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
- Johnston, J. 1972. *Econometric Methods*. McGraw-Hill, New York, New York.

- Jorgenson, D. W. and J. A. Stephenson. 1967. Investment Behavior in U.S. Manufacturing 1947-60. *Econometrica* 35, 2:169-220.
- Keynes, J. M. 1936. *The General Theory of Employment, Interest and Money*. Harcourt and Brace, New York.
- Kloek, T. and L. B. M. Mennes. 1960. Simultaneous Equations Estimation Based on Principal Components of Predetermined Variables. *Econometrica* 28, 1:45-61.
- Koyck, L. M. 1954. *Distributed Lags and Investment Analysis*. North-Holland, Amsterdam, Holland.
- Leamer, E. E. and R. M. Stern. 1970. *Quantitative International Economics*. Aldine Publishing Company, Chicago, Illinois.
- Mitchell, M. B. 1971. Estimation of Large Econometric Models by Principal Component and Instrumental Variable Methods. *The Review of Economics and Statistics* 53, 2:140-146.
- Modigliani, F. and R. Brumberg. 1954. Utility Analysis and the Consumption Function: An Interpretation of Cross Section Data. Pp. 338-436 in K. K. Kurihara, editor. *Post-Keynesian Economics*. Rutgers University Press, New Brunswick, New Jersey.
- Prachowny, Martin F. J. 1969. *A Structural Model of the U.S. Balance of Payments*. North-Holland, Amsterdam, Holland.
- Ramangkura, V. 1972. *A Policy Simulation Model of the Development of the Economy of Thailand*. Unpublished Ph.D. dissertation. University of Pennsylvania, Philadelphia, Pennsylvania.
- Sakarindr, P. 1979. *An Econometric Study of Thai Rubber Industry and the World Rubber Market*. Unpublished Ph.D. dissertation. Iowa State University, Ames, Iowa.
- Seosakul, S. *A Monetary Model of the Thai Economy*. Unpublished M.S. thesis. Chulalongkorn University, Bangkok, Thailand.
- Siamwalla, Ammar. 1975. *A History of Rice Price Policies in Thailand*. Pp. 141-165 in *Finance, Trade and Economic Development in Thailand*. Bank of Thailand, Bangkok, Thailand.
- Silcock, T. H. 1967. *Thailand: Social and Economic Studies in Development*. Duke University Press, Durham, North Carolina.
- Soonthornsima, C. 1963. *A Macroeconomic Model for Economic Development of Thailand*. Unpublished Ph.D. dissertation. University of Michigan, Ann Arbor, Michigan.

- Stavron, Jarilaos. 1978. A Macroeconometric Model for the Paramanian Economy 1950-1972. Unpublished Ph.D. dissertation. Iowa State University, Ames, Iowa.
- Stephenson, J. A. and K. Itharattana. 1977. Macroeconomic Analysis of Economic Activity in Thailand, 1962-1974. DAE-CARD Sector Analysis Series: No. 3.
- Stronge, W. B. 1971. Macroeconometric Simulation of Irish Dependence on the United Kingdom. Unpublished Ph.D. dissertation. Iowa State University, Ames, Iowa.
- Sutabutra, Satri. 1970. The National Planning and the Economy of Thailand. Unpublished M.S. thesis. Iowa State University, Ames, Iowa.
- Thailand, Ministry of Agriculture and Cooperatives. 1970. Agricultural Statistics of Thailand. Ministry of Agriculture and Cooperatives, Bangkok.
- Thailand, Ministry of National Development of Technical and Economic Cooperation. 1966. Thailand Facts and Figures 1966. Bulletin of the Department of Technical and Economic Cooperation Ministry of National Development, Bangkok, Thailand.
- Thailand, Office of the National Economic and Social Development Board. 1968 through 1980. National Income of Thailand, Bangkok, Thailand.
- Thailand, Office of the Prime Minister. National Development Board. 1964. The National Economic Development Plan 1961-1966: Bulletin of the National Economic Development Board. The National Economic Development Board, Office of the Prime Minister, Bangkok, Thailand.
- Theil, Henry. 1971. Principles of Econometrics. John Wiley and Sons, Inc., New York, New York.
- Trescott, P. B. 1971. Thailand's Monetary Experience. Praeger Publishers, New York.

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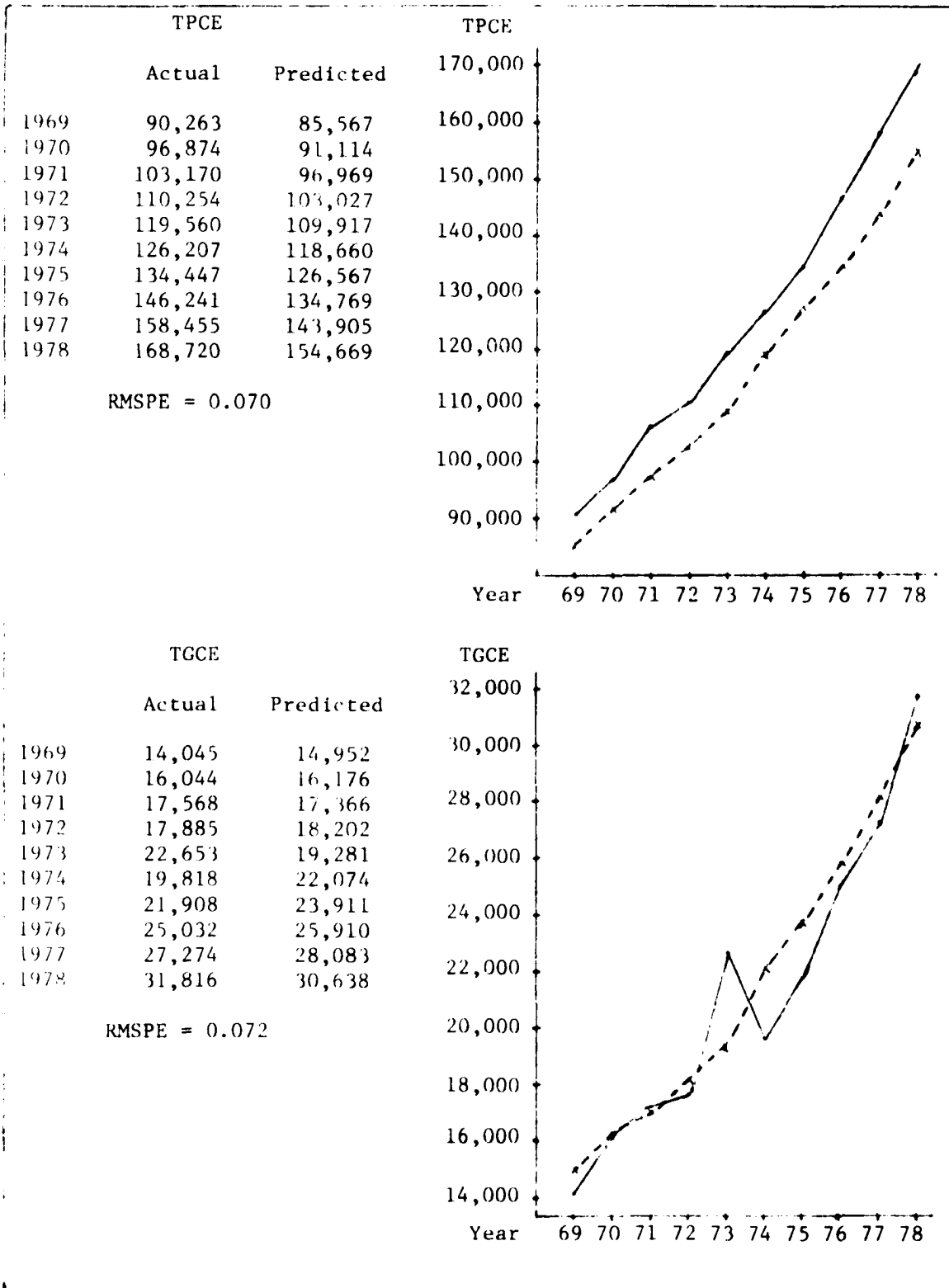
I express my deep gratitude to my mother for her support and inspiration which brought me to this stage of education.

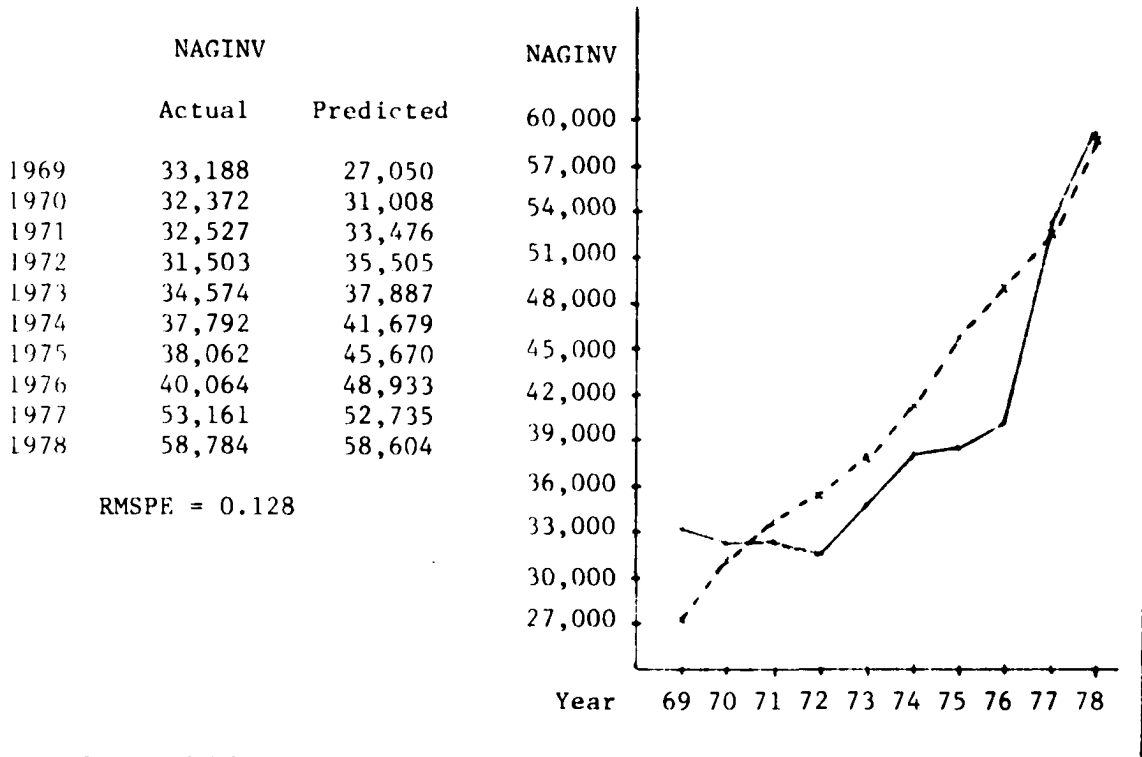
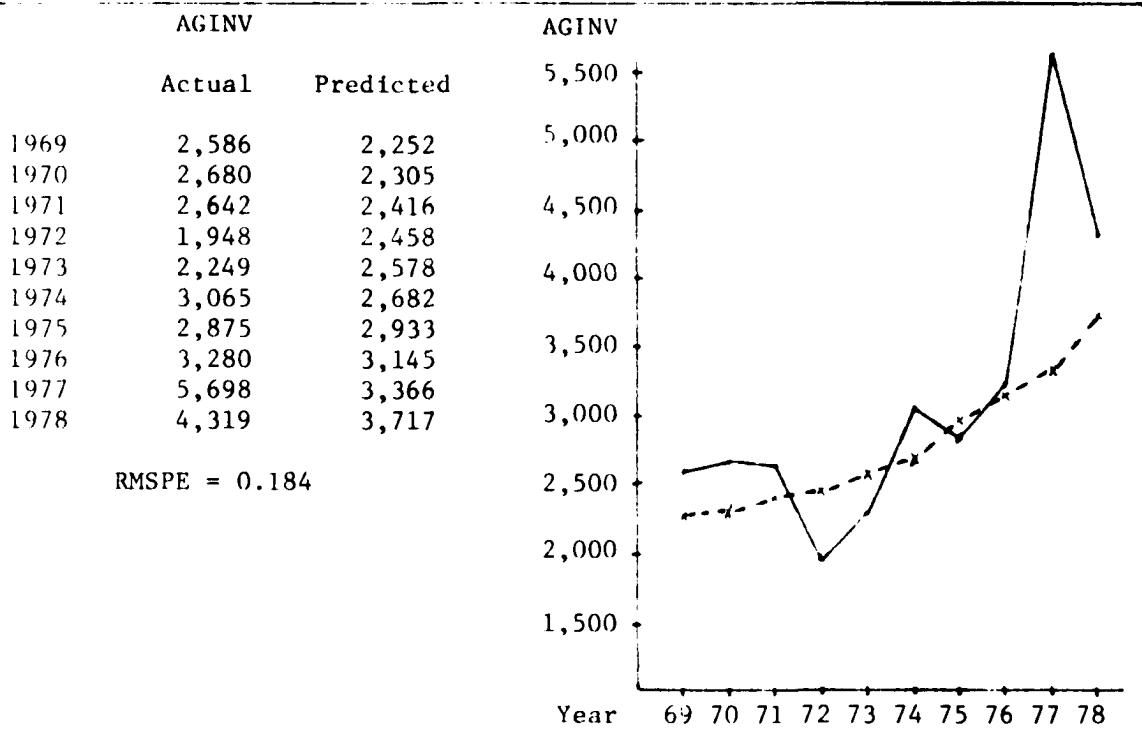
Finally, to my husband, Prasit, a special thanks for his assistance during my graduate work, his love, and his understanding, and to my

daughter, Rathakarn, for being patient and understanding when I had to leave Thailand in pursuit of my education.

APPENDIX

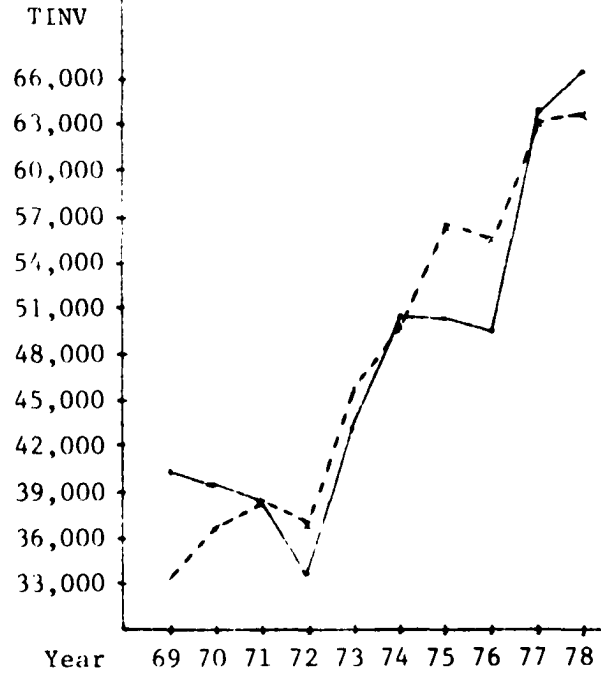
The actual and dynamic simulated values of selected endogenous variables are shown in the following tables and graphs. The solid lines in each graph represent the actual values of endogenous variable where the dotted lines represent the dynamic simulated values. RMSPE is represented root mean square percentage errors.





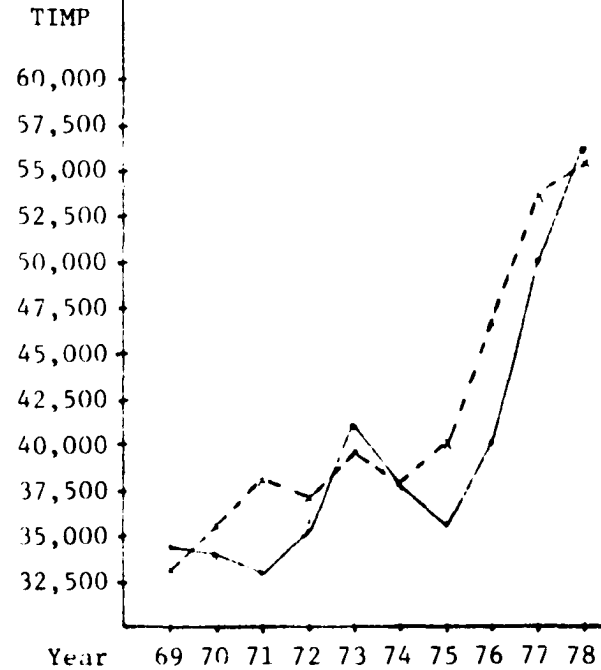
	TINV	
	Actual	Predicted
1969	40,378	33,001
1970	39,431	36,503
1971	38,936	38,252
1972	33,679	37,036
1973	43,217	45,779
1974	50,239	49,976
1975	50,142	56,634
1976	49,526	56,485
1977	63,860	60,129
1978	66,279	63,690

RMSPE = 0.097



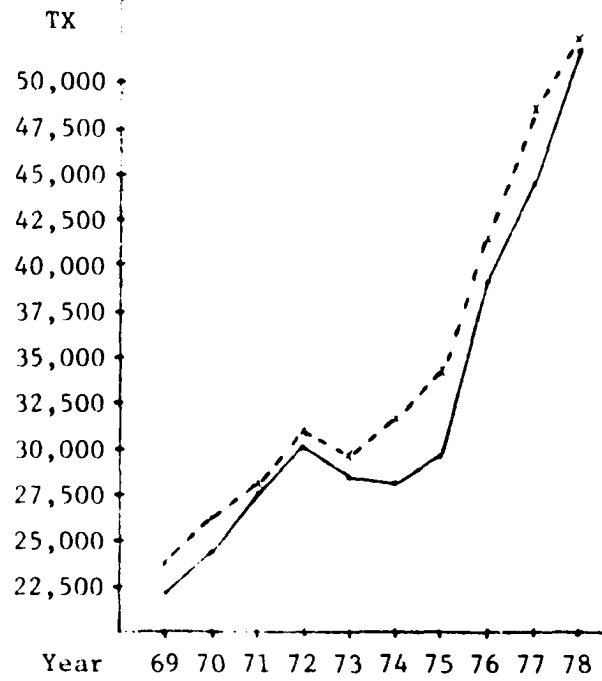
	TIMP	
	Actual	Predicted
1969	34,639	33,366
1970	33,851	35,623
1971	32,843	38,244
1972	35,385	37,277
1973	41,082	39,875
1974	37,765	37,706
1975	35,573	40,097
1976	40,287	46,787
1977	50,242	53,377
1978	56,978	55,446

RMSPE = 0.090



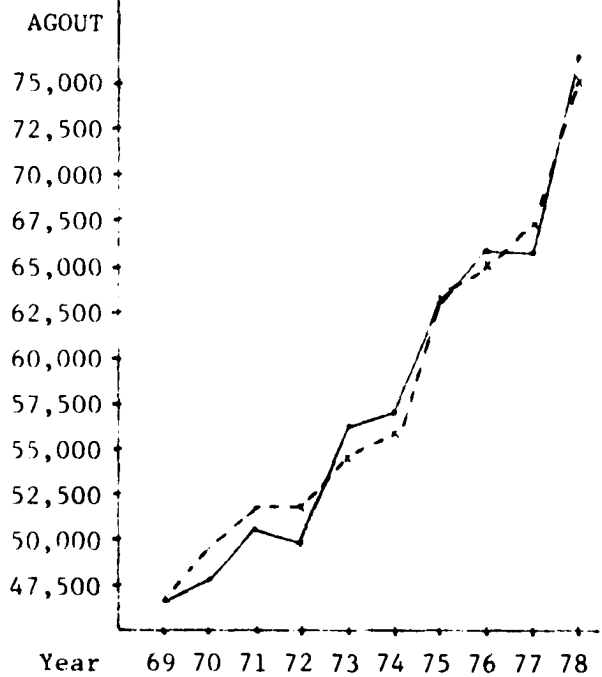
	TX	
	Actual	Predicted
1969	22,470	23,764
1970	24,438	26,306
1971	27,671	28,751
1972	30,073	31,058
1973	28,010	29,206
1974	27,848	31,958
1975	29,730	34,450
1976	38,929	41,511
1977	44,140	48,472
1978	52,005	52,118

RMSPE = 0.088



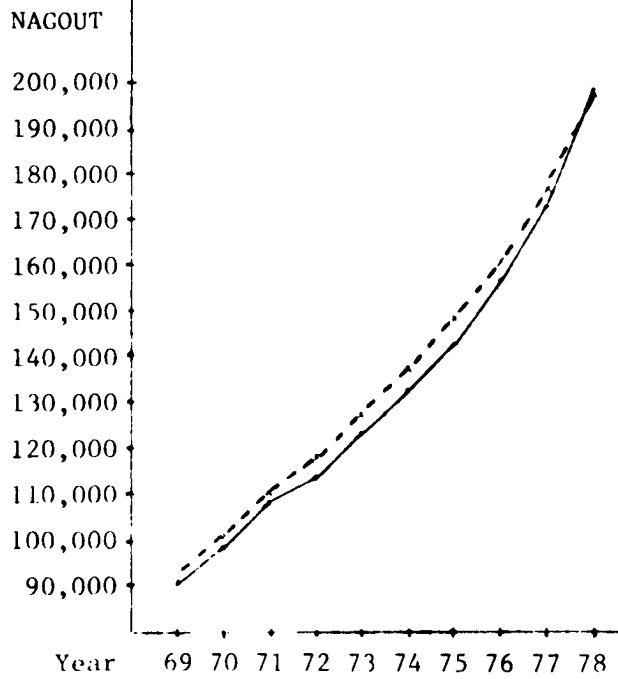
	AGOUT	
	Actual	Predicted
1969	46,710	46,710
1970	47,962	49,667
1971	50,484	51,775
1972	49,919	51,996
1973	56,237	54,389
1974	56,962	55,900
1975	62,081	60,813
1976	65,898	63,900
1977	65,537	67,422
1978	75,059	73,776

RMSPE = 0.027



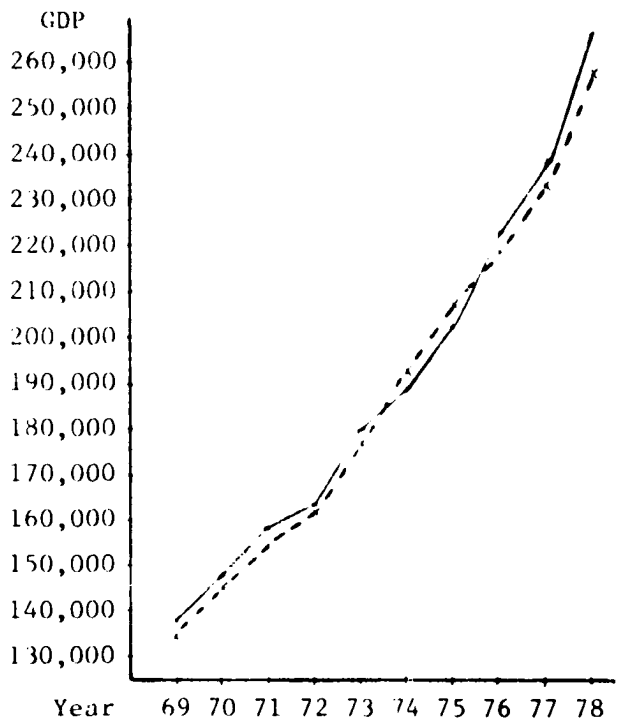
	NAGOUT	
	Actual	Predicted
1969	91,455	93,617
1970	99,058	101,908
1971	108,030	110,072
1972	114,707	118,238
1973	123,909	127,472
1974	132,988	138,741
1975	141,433	149,795
1976	156,611	160,774
1977	173,304	176,934
1978	191,781	191,518

RMSPE = 0.032



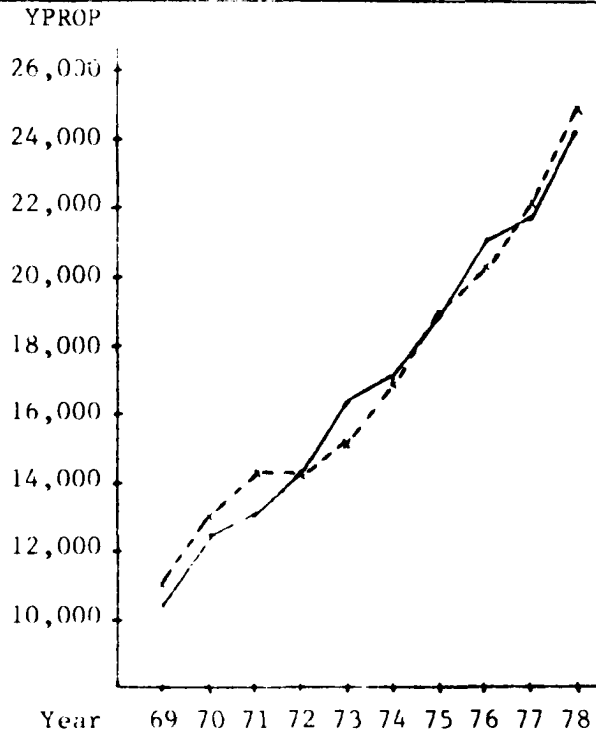
	GDP	
	Actual	Predicted
1969	138,165	134,947
1970	147,020	145,067
1971	158,514	154,476
1972	164,626	163,700
1973	180,146	176,828
1974	189,950	192,845
1975	203,514	207,466
1976	222,509	219,815
1977	238,841	233,462
1978	266,840	257,981

RMSPE = 0.020



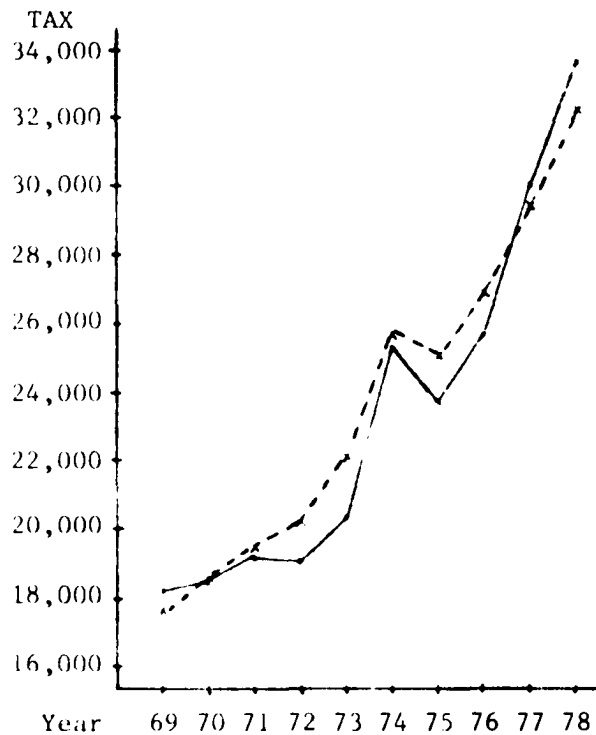
YPROP	
Actual	Predicted
10,541	11,621
12,561	13,301
13,404	14,241
14,296	14,169
16,398	15,100
16,929	16,848
18,719	18,736
21,046	20,228
21,979	22,031
24,111	24,544

RMSPE = 0.051



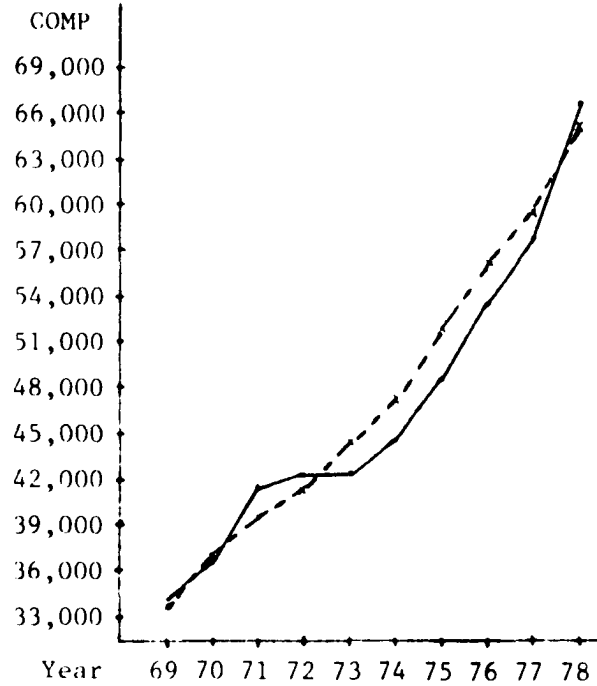
TAX	
Actual	Predicted
18,050	17,585
18,450	18,481
19,161	19,448
19,066	20,205
20,333	22,043
25,370	25,994
23,856	25,192
25,880	26,993
30,007	29,352
33,678	32,061

RMSPE = 0.045



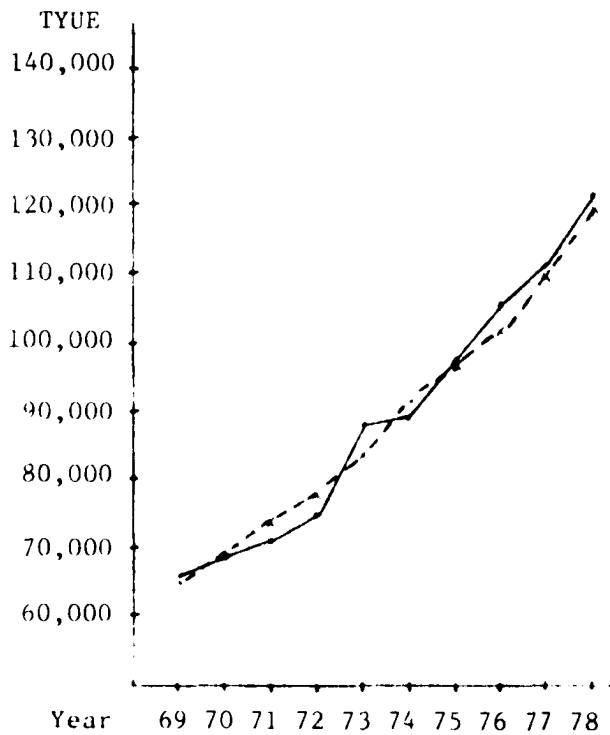
	COMP	
	Actual	Predicted
1969	34,228	34,124
1970	36,498	36,800
1971	41,724	39,400
1972	42,066	41,727
1973	42,139	44,695
1974	44,721	47,750
1975	48,488	51,674
1976	53,606	55,374
1977	57,543	59,869
1978	66,280	64,929

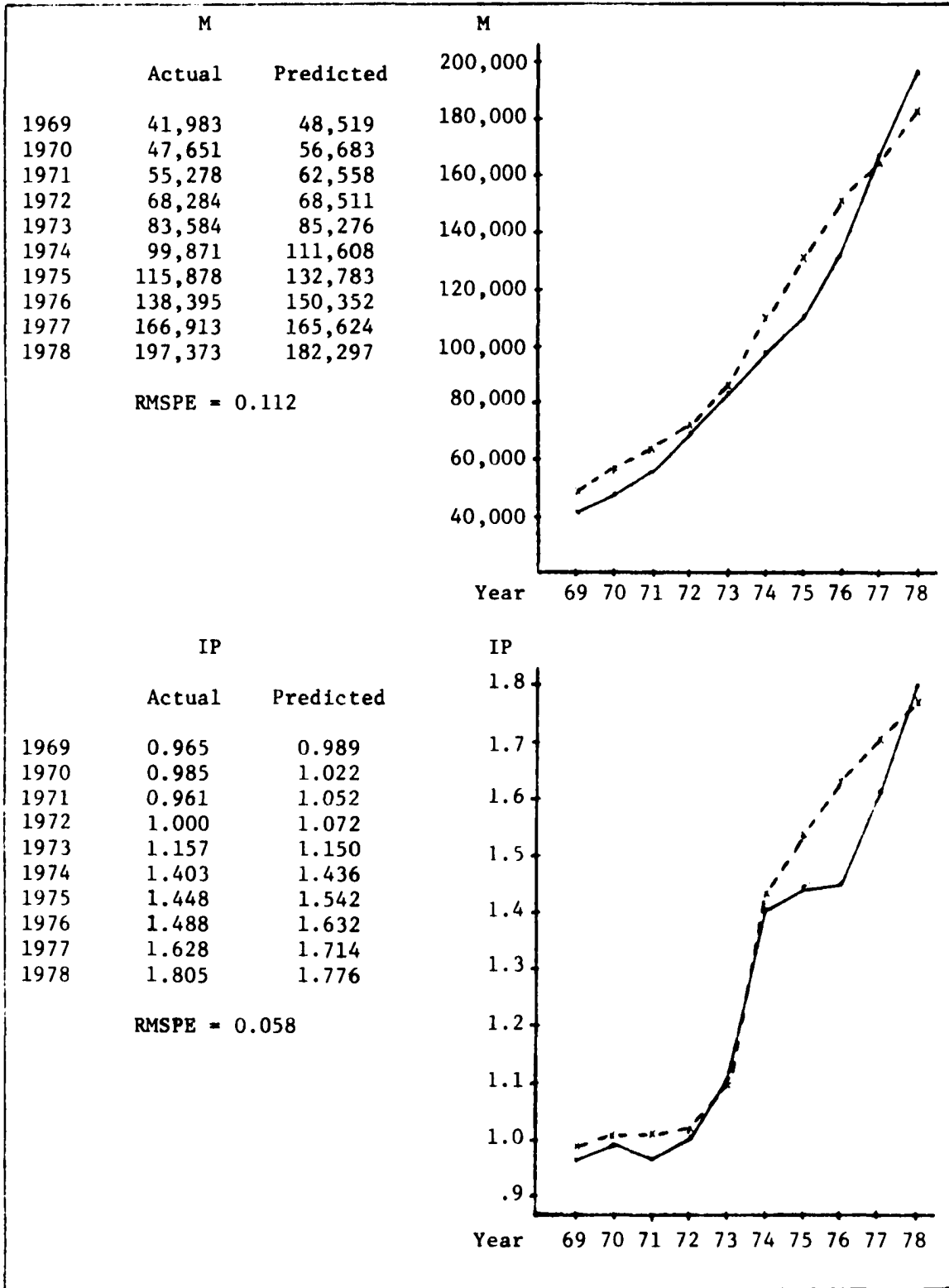
RMSPE = 0.044



	TYUE	
	Actual	Predicted
1969	64,958	63,897
1970	67,848	68,887
1971	70,076	73,606
1972	74,698	77,822
1973	87,638	83,216
1974	88,884	90,128
1975	96,688	96,077
1976	105,739	101,503
1977	110,195	109,891
1978	120,744	119,896

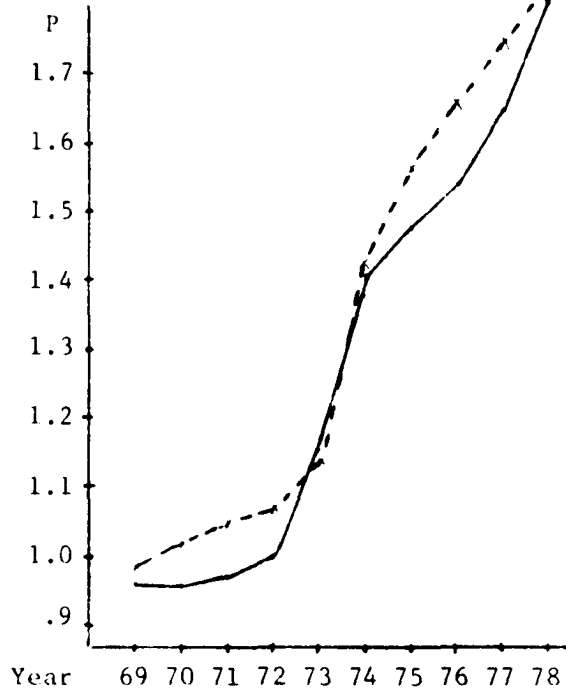
RMSPE = 0.030





	P	
	Actual	Predicted
1969	0.958	0.977
1970	0.954	1.012
1971	0.960	1.043
1972	1.000	1.065
1973	1.155	1.147
1974	1.411	1.449
1975	1.477	1.561
1976	1.539	1.657
1977	1.644	1.743
1978	1.806	1.809

RMSPE = 0.054



	PGDP	
	Actual	Predicted
1969	0.931	0.963
1970	0.925	0.999
1971	0.912	1.031
1972	1.000	1.053
1973	1.202	1.136
1974	1.429	1.444
1975	1.468	1.557
1976	1.517	1.654
1977	1.646	1.742
1978	1.789	1.809

RMSPE = 0.068

