Chapter 1

INTRODUCTION

1.1 Introduction

Changing conditions of supply and demand during recent decades have led to fluctuations in world prices and impacts on the market potential of a large number of agricultural commodities. In many countries this has led to the establishment of government measures in the form of import/export policies, price/market share stabilisation policies and agricultural production diversification schemes. Subsequently, productive resources within agricultural sectors as well as in related industries have been re-allocated.

In Thailand, the allocation of agricultural resources has been distorted by government policies (Katikarn et al (1989), Seboonsarng (1990)). The government's system of incentives and disincentives in terms of taxes, subsidies and various forms of regulation and control, both on the input demand side and the output supply side, has affected the pattern of resource utilisation in many production activities within the agricultural sector. The economic implications deserve careful investigation.

The Thai government intervenes to varying degrees in the production and marketing of cash crops such as soybeans, rice, cassava, sugarcane and rubber. This study examines the intervention, which has recently intensified, in the production and marketing of soybeans and their products. Soybeans were selected for study because of the interlinking between markets for its various products and the potential for policy spillover effects. The objectives of the government are assumed to be increased farm income and output, improved balance of trade in soybeans and their products and generation of government revenue. To date the intervention has consisted mainly of three policies: an import ban on soybeans, an import tariff on soybean oil, and an import surcharge (or variable import levy) on soybean meal. These policies are the subject of various criticisms. However, no studies thus far have provided a systematic and objective assessment of the likely impacts generated by these policies.

A summary of the major soybean policies in Thailand is presented in the next section of this chapter. A statement of the problem areas is then provided as a justification for a systematic investigation of various aspects of the policies. This is followed by a list of the research objectives in the present study and an outline of subsequent chapters.

1.2 The Soybean Policies

The Thai government's intervention policies in the soybean industry can be classified into general and specific policies. The general policy involves a targeted production of soybeans planned by the National Economic and Social Development Board (NESDB). Table 1.1 presents the targeted annual output of soybeans for the last year of each development plan. It is evident that the Thai government desired to increase domestic soybean production substantially during the 3rd, 4th and 5th plans.

Table 1.1

Targeted and Actual Production of Soybeans in Thailand, 1966-1991

Development Plan		Targeted Production[a]	Actual Production[a]
		('000t)	('000t)
1st Plan	(1962 - 1966)	35	40
2nd Plan	(1967 – 1971)	50	54
3rd Plan	(1972 – 1976)	300	114
4th Plan	(1977 – 1981)	431	132
5th Plan	(1982 – 1986)	540	309
6th Plan	(1987 – 1991)	470	578

Source: (1) The National Economic and Social Development Board
(2) Office of Agricultural Economics
[a] The figures presented are for the final year of each Development Plan.

It is also evident that during these three national plans the actual domestic output of soybeans fell substantially short of targeted levels. Actual output surpassed the targeted output for the first time during the 6th plan which had a slightly lower targeted output than the 5th plan. Various protection policies were in place during the 6th plan.

The specific policies are the various operative policies designed to promote domestic soybean production. They include the production policy, the price policy and the trade policy. These three policies are not mutually exclusive. For instance, a trade policy in the form of an import quota affects both the price and output of soybeans, while the production policy affects price through changes in output. However, the above classification facilitates policy description.

The production policy consists mainly of the direct promotion of soybean production by the Ministry of Agriculture and Agricultural Cooperatives (MOAC) which attempts to help decrease production cost and increase yield of soybeans through the distribution of improved seed and utilization of Rhizobium, as well as through the provision of training to groups of farmers. Other schemes to help promote production consist of research studies to investigate potential areas that can be developed into soybean production areas and experiments to determine appropriate planting methods using pre-selected soybean varieties suitable for various production regions.

The price policy has mainly involved control through announced guide prices for the farm-gate price of soybeans by the Ministry of Commerce and the MOAC to ensure that the farm-gate price is high enough to cover production costs and, thus, to provide sufficient incentive for farmers to increase soybean production through area expansion and/or yield improvement. This was the only direct policy for increasing the farm-gate price of soybeans during the period 1978 to 1982. Other policies were introduced later.

Oil processing plants and the feed industry purchased soybeans at a controlled minimum price. These minimum prices were set either at the farm-gate or at the factory-gate. For instance, in 1978/79 the control price was 5.50 – 6.00 *baht* per kg at the factory; in 1979/80 the control price was 6.20 – 6.40 *baht* per kg at the factory; in 1980/81 the control price was 6.50 *baht* per kg at the farm and 6.70 *baht* per kg at the factory; and in 1981/82 the control price was 7.00 *baht* per kg at the farm and 7.50 *baht* per kg at the factory. The policy was considered ineffective since, during the periods mentioned, the actual farm-gate prices were all less than the control prices For the crop years from 1978/79 to 1981/82, the average farm-gate prices were 5.39, 5.26, 5.78 and 6.81 *baht* per kg, respectively. This eventually led to the introduction of a trade policy in combination with the price policy. The trade policy, in combination with the price policy, has been operative since the crop year 1982/83.

The Ministry of Commerce launched a number of measures to restrict importation of soybeans and their products. These included import quotas on soybeans and soybean oil. Moreover, only processing plants using soybean oil as raw material were permitted to import the oil. A six per cent tax was levied on the value of soybeans imported and a 1.32 *baht*, 1.68 *baht* and 2.00 *baht* per litre tax was levied on the importation of soybean oil, hydrogenized or oxygenized soybean oil and pure soybean oil, respectively.

In addition, the Ministry of Commerce periodically announced the ratio (by weight) of permitted meal imports to domestic meal purchases (RID). This policy measure was commonly known as the 'import quota policy' and was basically designed to help increase the prices of soybean meal and soybeans. The announced ratios for the various periods are presented in section (a) of Table 1.2. Note that, since the 1987/88 crop year, there have been two announcements of the ratio each year to suit the two peak periods of soybean output and, in crop years 1986/87 and 1989/90, an added condition was imposed on the maximum quantity of meal to be imported within a specific period of time. Due to administration difficulties and various criticisms of the quota policy, the measure was abolished in January, 1990. Since then there has been no quantity restriction on the importation of meal. However, the importation is subject to a system of variable surcharges (variable import levies).

The import surcharge is designed to guarantee a certain level of domestic price of soybean meal for a certain period of time. For instance, during March 1990, for one tonne of meal, the CIF value plus pre-surcharge tax plus handling cost was 6515 *baht*. Thus, with a targeted price of 8100 *baht*, the surcharge per tonne was announced to be 1585 *baht* per tonne. The six announcements of surcharge rates to date are presented in section (b) of Table 1.2.

It should be mentioned that, during the administration of the import restriction policy on soybeans, very little soybean grain was imported (except in 1988 when about 33 000 tonnes of soybeans were imported due to crop failure in the country). For this reason, the present study analyses the impacts of the import restriction on soybeans in the form of an

Table 1.2

The Import Quota and the Surcharge Policies, 1984 to 1991

(a) The Ratio of Imported to Domestic Meal (RID)

Crop Year	RID (by weight)		Added condition
1984/85	2 : 1		
1985/86	4 : 3		
1986/87	1 : 1		imports not to exceed 120 000 tonnes during Sep 86 – Feb 87
1987/88	3 : 2	(Mar 87 – Aug 87)	
	1 : 1	(Sep 87 – Mar 88)	
1988/89	1 : 1.33	(Apr 88 – Aug 88)	
	1 : 2	(Sep 88 – Aug 89)	
1989/90	1 : 2	(Sep 89 – Mar 90)	imports not to exceed 106 000 tonnes during Sep 89 – Mar 90

(b) The Surcharge on Soybean Meal Import ($)

Month	Year	$ (*baht* per tonne)
March	1990	1585
May	1990	1975
July	1990	1472
May	1991	1730
August	1991	1430
October	1991	1031

Source: (a) Thitisub (1991).
(b) Ministry of Commerce (1990).

import ban policy for which more details are given in later chapters. Moreover, since the quota policy on soybean meal has been abolished, the present study will focus on the impacts of the import surcharge, or variable import levy. Likewise, the relevant policy for soybean oil is an import tariff.

1.3 Statement of the Problem

The import surcharge policy has been criticised widely among the various interest groups since its introduction. As the surcharge obviously acts in favour of the soybean farmers and oil processing plants, and against the feed, broiler and swine industries, each pressure group has attempted to lobby the government to adjust the surcharge rate in favour of its own interest. The surcharge policy has thus become a heated issue where criticism is mostly subjective. No attempts have been made to assess the impacts of the policy objectively.

While the major policy component of the existing policy package is the import ban (restriction) policy on soybeans, this measure seems to escape the attention of the various pressure groups. The government's objective of increasing farm income and output, as well as achieving self-sufficiency in soybeans, seems to be accepted and no objective assessments have been made to determine the impacts of the policy.

Thus far most criticisms of the impacts of existing policy have been descriptive (Wattanakul 1987; Virakul 1987; Sriplung 1987; Busbongtong 1989; Setboonsarng 1990) and concerned with the quota policy rather than the newer surcharge policy. Two research studies using single-market models by Sopitkul (1990) on quota policy and Thitisub (1991) on surcharge policy have been completed. There has been no attempt to construct a multi-market model to assess the linkage impacts of the policy package which is in place.

Although there is no extensive study on the impacts of the existing policy package, conventionally it is assumed that, as a result of distortion, the policy would result in a certain degree of efficiency loss (in terms of deadweight loss). This argument follows a first-best criterion of policy analysis. However, for a distortion-laden (or policy-laden) economy, an additional policy can as well be a corrective one as a distortive one. In this regard, the administration of an optimum policy intervention would enhance, rather than hinder, welfare. This argument follows a second-best criterion of policy analysis. Thus, in the context of a second-best environment, policy assessment with a first-best criterion would result in incorrect policy prescription. With a belief that the Thai soybean industry is faced with some kinds of distortion, a second-best policy assessment is called for.

1.4 The Research Objectives

In line with the problems as outlined in the previous section, the research objectives of the present study are five-fold, namely:

(a) to compile relevant information on the Thai soybean industry and to describe the industry as a background to policy analysis;

(b) using a graphical multi-market model for the Thai soybean industry, to assess theoretically the impacts of the existing government policy intervention in the soybean industry (particularly the import ban policy on soybeans, the import tariff policy on soybean oil and the import surcharge policy on soybean meal) using a first-best criterion;

(c) to explore the theoretical aspects of incorporating a second-best criterion in policy assessment as well as to develop methods for the estimation of the marginal resource cost ratio (MRC) and a marginal social cost curve (MSC) to be used in a second-best policy assessment;

(d) using an econometric model, assess the efficiency and distributional impacts of alternative policies in terms of both first-best and the second-best criteria (in this regard, consideration is given to both the economic efficiency and distributional impacts of the policy or policy package); and

(e) to provide policy recommendations based on the findings.

1.5 An Outline of Subsequent Chapters

In pursuit of these objectives, the current situation in the Thai soybean industry is considered in Chapter 2. This examines trends in output, yields and prices of both the national and regional levels. It reviews the production and marketing systems, and shows that although there has been a rapid increase in soybean production, a number of constraints face further expansion.

In Chapter 3 a partial-equilibrium model of the Thai soybean industry is developed. The model has the three linked sectors soybeans, soybean meal and soybean oil. The Thai government has intervened in all three markets in the pursuit of various policy objectives. Seven combinations of policy are analysed in a partial-equilibrium, net social benefit framework.

While this framework is a useful starting point, it is incomplete in a world where there are distortionary policies in the rest of the economy. The Thai industrial sector is receiving substantial government support, and a more precise evaluation of the impacts of intervention in the soybean industry can be obtained through a second-best policy analysis. The second-best model is outlined in Chapter 4.

A description of the econometric estimation of such a model is contained in Chapter 5. Although there were some data problems that reduce the robustness of some of the equations in the model, it is considered that overall it is an improvement on previous econometric estimates of Thai soybean supply and demand.

Chapter 6 proceeds to some policy analysis using the estimated model. The key result is that it does indeed seem worthwhile to consider the distortionary influences elsewhere in the economy when appraising Thai soybean policy.

Finally in Chapter 7, a summary, policy recommendations and suggestions for future research are presented.

Chapter 2

DESCRIPTION OF THE SOYBEAN INDUSTRY

2.1 Introduction

This chapter is concerned primarily with a description of the general characteristics of the Thai soybean industry. Basically. the two major agents involved in this industry are the farmers and the oil processing plants. The description thus starts with the production of soybeans at the farm and stops with the production of soybean meal and oil at the processing plant. The main purpose of the chapter is to provide sufficient background information for the analyses and policy discussion in later chapters. The contents include details of soybean production, marketing and utilization in Thailand. Some simple analyses of the yield gap, marketing margins, and self-sufficiency ratios for soybean meal and oil production are conducted.

2.2 Production

This section aims to describe in detail the important characteristics of soybean production in Thailand. This includes its growth pattern over time, regional production, cropping seasons, cropping systems, distribution of farm size, costs and returns, as well as the yield gap for soybean production In Thailand. The way growth in soybean production has been induced by government policies will be discussed more fully in Chapter 3.

2.2.1 Production growth

To describe adequately the growth pattern over time of soybean production in Thailand, figures on planted area, output and yield per *rai* for crop years 1969/70 to 1989/90 are compiled. Then, four sets of five-year average growth rates (AGRs) using these figures are estimated and presented in Table 2.1. In general, the data disclose that, prior to 1983, the production of soybeans in Thailand had been fluctuating widely. The planted area increased from 299 000 *rai* in 1970 to 1 010 000 *rai* in 1979 and then decreased to 778 000 *rai* in 1983.

Table 2.1

The Growth Pattern of Production and Yield of Thai Soybeans, 1970—1990

Crop year	Planted area (1 000 *rai*)	Output (1 000 tonnes)	Yield (kg/*rai*)
1969/70	299	48	161
1970/71	368	50	137
1971/72	359	54	151
1972/73	525	72	138
1973/74	766	104	136
1974/75	823	110	134
1975/76	738	114	154
1976/77	635	114	179
1977/78	958	96	101
1978/79	1 010	159	157
1979/80	679	102	150
1980/81	788	100	127
1981/82	797	132	165
1982/83	778	113	146
1983/84	1 008	179	178
1984/85	1 253	246	196
1985/86	1 524	309	203
1986/87	1 799	356	198
1987/88	2 260	338	150
1988/89	2 508	517	206
1989/90	3 209	672	209
AGR	(%)	(%)	(%)
(1970–75)	22.44	18.04	–3.60
(1975–80)	–3.77	–1.50	2.28
(1980–85)	13.04	19.25	5.50
(1986–90)	20.69	22.26	1.29

Note: One *rai* = 0.16 hectare.
Source: *MOAC* (1976, 1983, 1990).

With only slight differences in yields for the three mentioned years, output followed the same pattern of fluctuation. After 1983, production expanded steadily. Planted area increased by about fourfold from 778 000 *rai* in 1983 to 3 209 000 *rai* in 1990, while output increased by about sixfold from 113 000 tonnes to 672 000 tonnes during the same period. (At this juncture, it is interesting to note that 1983 was the year when the Thai government started to ban the importation of soybeans.)

Inspection on the five-year AGRs reveals the trends in planted area, output and yield of soybean during the past two decades. In general, the planted area experienced a high AGR of 22.44 per cent during 1970-75. Then the AGR dropped to -3.77 per cent during 1975-80, and increased again during 1980-85 and 1985-90, with AGRs of 13.04 per cent and 20.69 per cent, respectively. Changes in output followed the same pattern, with the five-year AGRs for the four periods being 18.04 per cent, -1.50 per cent, 19.25 per cent and 22.26 per cent, respectively.

Interestingly, the periodic AGR of yield displayed a somewhat different pattern. The AGR was -3.60 per cent during 1970-75. It increased to 2.28 per cent and 5.50 per cent for the periods 1975-80 and 1980-85, respectively, but dropped back to 1.29 per cent during 1985-90. This shows that, while the growth in output during 1980-85 depended on both area expansion and yield improvement, during 1985-90 increases in output relied more heavily on area expansion.

As the level of output was growing year by year, soybeans became the sixth most important cash crop of the country (in terms of farm value) by crop year 1989/90. To emphasise the large growth of soybean production vis-a-vis other cash crops, Table 2.2 presents the annual AGRs of farm output and farm value of soybean production in comparison with the top five cash crops of Thailand (rice, rubber, sugar cane, maize and cassava) during 1980-90. As shown in Section (a) of the table, the AGR of soybean production was as high as 20.7 per cent, while for the other cash crops (except for sugar cane, having an AGR of 10.1 per cent), AGRs are less than 10 per cent. It is noted that the most important cash crop of Thailand – rice – experienced the lowest AGR of 2.5 per cent during the period.

Table 2.2

Growth of Farm Output and Farm Value of Selected Cash Crops

(a) Growth of Farm Output

Crop	Crop year 1979/80	1989/90	AGR
	(1 000 tonnes)	**(1 000 tonnes)**	**(%)**
Rice	15 758	20 177	2.5
Rubber	534	936	5.8
Sugar cane	12 827	33 561	10.1
Maize	2 863	4 393	4.4
Cassava	11 101	20 701	6.4
Soybeans	102	672	20.7

(b) Growth of Value of Output

Crop	Crop year 1979/80	1989/90	AGR
	(Million *baht*)	**(Million *baht*)**	**(%)**
Rice	41 044	70 841	5.6
Rubber	7 673	16 077	7.7
Sugar cane	4 968	12 887	10.0
Maize	5 984	12 870	7.9
Cassava	8 548	12 834	4.1
Soybeans	537	4 928	24.8

Source: MOAC (1981, 1990).

Section (b) of the table displays a similar pattern of AGRs for value of output of the six crops, with soybeans and sugar cane having the high AGRs of 24.8 per cent and 10 per cent respectively, while all other AGRs are less than 10 per cent. However, cassava (not rice) experienced the lowest AGR of 4.1 per cent.

2.2.2 Regional production

The Kingdom of Thailand is geographically divided into four regions. These are: (a) the North-Eastern Region consisting of 17 provinces; (b) the Northern Region consisting of 17 provinces; (c) the Central Plain Region consisting of 25 provinces; and (d) the Southern Region consisting of 14 provinces. (See Appendix, Figure A.2.1 and Table A.2.1, for the map of Thailand and a list of provinces.)

Table 2.3 displays the planted area and the production of soybeans for the crop years 1985/86 – 1989/90, classified by region. In general, the North is the major production area for soybeans (e.g., accounting for about 75 per cent and 72 per cent of the total planted area and output, respectively, in 1990). The Northeast comes second in terms of contribution to total production, accounting for about 19 per cent and 18 per cent of the total planted area and output, respectively, in 1990. However, the Northeast experienced the highest expansion rate recently, with planted area and output increasing by about fourfold during the five years 1986-90 while, during the same period, both planted area and output increased by about threefold for the Centre and less than twofold for the North. Historically, there have been only negligible quantities of soybeans produced in the South. In general, both planted area and output have been expanding for all regions, except for the crop year 1987/88 when crop failure in the North caused output of the region and national output to fall below their growth trend. A similar account was given in KURDI (1991).

With respect to soybean production and marketing, a more logical grouping is: (a) the Sukhothai-Loei centre which includes one province form the upper North (Phrae), four provinces from the lower North (Sukhothai, Kamphaeng, Phet and Uttaradit) and two provinces from the Northeast (Loei and Khon Kaen); (b) the Chiang Mai centre which includes three provinces from the upper North (Chiang Mai, Chiang Rai and Mae Hong Son); and (c) the Upper Central Plain centre which includes three provinces from the lower North (Phetchabun, Nakorn Sawan and Uthai Thani), three provinces from the Central Plains (Lop Buri, Sarabari and Prachinburi) and one province from the Northeast (Nakhon Ratchasima) (Knosa-ard *et al* 1987).

Table 2.3

The Regional Production of Soybeans, Crop Years 1985/86 — 1989/90

(a) Planted area Unit: 1 000 *rai*

Region	Crop year				
	1985/86	**1986/87**	**1987/88**	**1988/89**	**1989/90**
Northeast	156	201	324	418	618
North	1 259	1 446	1 693	1 829	2 295
Centre	109	151	243	261	296
South	—	—	—	—	—
Total	1 524	1 799	2 260	2 508	3 209

(a) Output Unit: 1 000 tonnes

Region	Crop year				
	1985/86	**1986/87**	**1987/88**	**1988/89**	**1989/90**
Northeast	30	39	54	81	124
North	259	288	248	383	483
Centre	20	29	36	53	65
South	—	—	—	—	—
Total	309	356	338	517	672

Source: MOAC (1988, 1990).

Soybean output classified by these three major centres for crop years 1985/86 and 1989/90 are presented in Table 2.4. In general, the Sukhothai-Loei centre remained the dominant centre during the period, with output shares accounting for about 57 per cent and 53 per cent for 1986 and 1990, respectively. For the Chiang Mai centre, output shares dropped from 18.62 per cent in 1986 to 11.72 per cent in 1990, while for the Upper Central Plain, the share has increased from 15.4 per cent in 1986 to 22.49 per cent in 1990. This is mainly due to the slower growth in output in most of the upper North provinces in comparison with those in some of the lower North, Northeast and Central Plain provinces.

2.2.3 Cropping seasons

The two major soybean cropping seasons in Thailand are the wet season and the dry season. Moreover, with a bimodal type of rainfall in the tropics, two distinct periods of cultivation are possible for the planting of soybeans in the rainy season, namely: (a) the early wet-season crop planted early in May at the onset of the rainfall; and (b) the late wet-season crop planted around mid-August at the beginning of the second peak rainfall. For the dry-season crop, soybeans are usually cultivated after rice under irrigated conditions. Technically, the reason for immediate planting of soybeans after the harvest of rice is to make use of the remaining moisture in the soil. The usual planting period for dry-season soybeans is around late December to mid-January (Priebprom *et al* 1991, pp. 21-22).

The cultivation period for Thai soybeans is approximately three months. Major production areas for the early-wet crop are Sukhothai, Kamphaeng Phet and Uttaradit in the lower North. Major production areas for the late-wet crop are Phetchabun in the lower North, Lop Buri and Saraburi in the Central Plain, and Loei and Nakhon Ratchasima in the Northeast. For the dry-season crop, the major production areas are Chiang Mai and Phrae in the upper North, and Loei, Khon Kaen and Udon Thani in the Northeast (Ministry of Commerce 1990, p. 3).

Data on production of soybeans classified by wet and dry seasons have been collected by the Ministry of Agriculture and Co-operatives (MOAC) since 1980. The data are compiled in Table 2.5. In general, figures on planted areas (section a) and figures on output (section b) display similar characteristics during the period. First, the planted area of the wet-season crop ranged from about 59 per cent to 74 per cent, and that of the dry-season crop ranged from 26 per cent to 41 per cent of the national area. Similarly, the wet-season output ranged from 56 per cent to 74 per cent and the dry-season output ranged

Table 2.4

Major Soybean Production Centres and Output, Crop Years 1985/86 and 1989/90

Unit: 1 000 tonnes

	Crop year	
Centre	**1985/86 (1)**	**1989/90 (2)**
Sukhothai – Loei Centre	176.10	358.22
	(56.69)	(53.28)
Chiang Mai Centre	57.62	78.81
	(18.62)	(11.72)
Upper Central Plain Centre	47.66	151.25
	(15.40)	(22.49)
Other Areas	28.04	84.09
	(9.29)	(12.51)
Whole Country	309.42	672.37
	(100.00)	(100.00)

Note: Figures in brackets indicate per cent of national output.

Source: (1) Adapted from Kaosa-ard *et al* (1987).
(2) MOAC (1990).

Table 2.5

Production of Soybeans Classified by Wet Season and Dry Season, Crop Years 1979/80 — 1989/90

(a) Planted Area

Crop year	Wet Season		Dry Season	
	1 000 *rai*	(%)	1 000 *rai*	(%)
1979/80	473	69.66	206	30.34
1980/81	462	58.63	326	41.37
1981/82	528	66.25	269	33.75
1982/83	473	60.80	305	39.20
1983/84	634	62.90	374	37.10
1984/85	930	74.22	323	25.78
1985/86	1 114	73.10	410	26.90
1986/87	1 258	69.93	541	30.07
1987/88	1 450	64.16	810	35.84
1988/89	1 568	62.52	940	37.48
1989/90	2 069	64.47	1 140	35.53

(a) Output

Crop year	Wet Season		Dry Season	
	1 000 tonnes	(%)	1 000 tonnes	(%)
1979/80	64	62.75	38	37.25
1980/81	56	56.00	44	44.00
1981/82	90	68.18	42	31.82
1982/83	68	60.18	45	39.82
1983/84	108	60.34	71	39.66
1984/85	183	74.39	63	25.61
1985/86	229	74.11	80	25.89
1986/87	253	71.07	103	28.93
1987/88	195	57.69	143	42.31
1988/89	328	63.44	189	36.56
1989/90	436	64.88	236	35.12

Source: Compiled from file data provided by the Centre of Agricultural Statistics, MOAC.

from 26 per cent to 44 per cent of the national production. Second, prior to 1985, the planted area and output of both the wet-season and the dry-season crops had fluctuated considerably. Since 1985 (except for crop year 1987/88 when the wet season output was exceptionally low due to crop failure) planted area and output of both wet and dry seasons have been increasing steadily.

With three major cultivation seasons and a short gestation period, the production of soybeans in Thailand is continuous almost throughout the year. This consequently spreads the supply of soybeans throughout the year and greatly reduces the need for their storage (Kaosa-ard *et al* 1987).

How the supply of soybeans spreads through the year is better visualised by looking at data on the monthly distribution of soybean production. Table 2.6 presents two series of such information for purposes of comparison. The time frames of the two surveys are, however, slightly different. The 1985/86 survey was conducted from May 1985 to April 1986, while the 1990/91 survey was conducted from July 1990 to June 1991. Nevertheless, the two data sets are otherwise consistent and thus fairly comparable.

As expected, the two sets of data exhibit similar patterns, with a high percentage of planting occurring from May to August for the wet-season crop, and during December and January for the dry-season crop. Cropping intensities of other months were relatively low, especially in October, November, February and March, and there was no planting in April. In general, because of the gestation period, the distribution of output follows the same pattern with a lag of three to four months. Thus, a high percentage of the wet-season output was harvested during August to December, and a high percentage of the dry season output was harvested during March to May, while very little output was harvested during June and July. It is interesting to note that data on planted areas seemed to follow a trimodal distribution for 1985/86 and a bimodal distribution for 1990/91. Consequently, data on output followed the same pattern.

2.2.4 Cropping systems

Another way to study soybean farming practices is to look at cropping systems. This is a more micro-level approach which allows investigation of the planting of soybeans in conjunction with other crops in certain chosen areas. This reveals the farming system of the different localities as well as shedding some light on the crops competitive and complementary with soybeans. This section attempts to compare and contrast the

Table 2.6

Monthly Distribution of Soybean Production, Crop Years 1985/86 and 1990/91

Crop year	1985/86(1)				1990/91(2)			
	Planted Area		Output		Planted Area		Output	
Month	(1 000 *rai*)	(%)	(1 000 tonnes)	(%)	(1 000 *rai*)	(%)	(1 000 tonnes)	(%)
May	296	19.42	29	9.38	–	–	–	–
June	140	9.20	*	–	–	–	–	–
July	139	9.12	–	–	316	11.89	1	0.19
August	347	22.77	37	11.97	238	8.96	65	12.29
September	174	11.42	87	28.16	65	2.45	43	8.13
October	18	1.18	1	0.32	2	0.08	128	24.20
November	5	0.33	29	9.38	4	0.15	21	3.97
December	88	5.77	54	17.48	256	9.63	77	14.55
January	278	18.24	19	6.15	575	21.64	4	0.76
February	39	2.56	3	0.97	37	1.39	1	0.19
March	–	–	2	0.65	2	0.08	56	10.59
April	–	–	48	15.53	–	–	126	23.82
May	–	–	–	–	571	21.49	7	1.32
June	–	–	–	–	591	22.24	*	–
Total	1 524	100.00	309	100.00	2 657	100.00	530	100.00

Note: * = Insignificant quantity.
– = unavailable

Source: (1) Adapted from Kaosa-ard *et al.* (1987).
(2) Compiled from file data provided by the Centre of Agricultural Statistics, MOAC.

cropping systems of soybeans in Thailand in three different crop years. The contents are drawn heavily from previous studies conducted by Issariyanukula (1980), Kaosa-ard *et al* (1987) and Priebprom *et al* (1991).

The survey by Issariyanukula (1980) was conducted during the 1978/79 crop year. Four major soybean production provinces were included. The total sample size was 345, with 132 farms in Chiang Mai, 100 farms in Sukhothai, 43 farms in Nokarn Sawan and 70 farms in Lop Buri. The cropping calendar as presented in Figure 2.1 does not include the cropping pattern of other crops. However, lists of competitive and complementary crops were provided, as shown in Table 2.7, to help explain the cropping systems of the selected provinces.

According to the survey, in the Chiang Mai district where irrigation supplements rainfall, the dry-season crop of soybeans was planted in early January (after the harvest of the rain-fed rice) and harvested in late April or early May. The early-wet season crop was found in Sukhothai where soybeans are planted in mid-May and harvested in late September. For the wet-season crop, farmers in Nakhon Sawan and Lop Buri plant their crops a little later than the Sukhothai crop. In these two provinces soybeans can be planted either as a first crop planted in early July and harvested in late October, or as a second crop planted in mid-August and harvested in mid-December. In general, according to the survey, farmers who cultivated the first crop were not able to cultivate the second one.

As presented in Table 2.7, the major competitive crops for soybeans are: tobacco, rice and peanuts in Chiang Mai; cotton, maize and mungbeans in Sukhothai; sorghum, mungbeans and maize in Nakhon Sawan; and mungbeans, sorghum and maize in Lop Buri. The complementary crops are: rice and tobacco in Chiang Mai; cotton and maize in Sukhothai; sorghum and mungbeans in Nakhon Sawan; and mungbeans, sorghum and maize in Lop Buri.

The survey by Kaosa-ard *et al* (1987) was conducted during the 1986/87 crop year. The fieldwork included a total of 17 sample sites with 28 cropping systems, of which seven sample sites and 11 cropping systems were concerned with soybeans. (Other oil crops included were sesame, sunflowers and castor beans.) The study did not disclose the sample size for each site. As presented in Figure 2.2, the survey considered two major cropping seasons, namely, the upland cropping season (wet–season crop) and the rice-based cropping season (dry–season crop).

Figure 2.1 : The Cropping Calendar of Soybeans in Chiang Mai, Sukhothai, Nakorn Sawan and Lop Buri, Crop Year 1978/79

Province	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chiang Mai	110–120 days											
Sukhothai					110–120 days							
Nakorn Sawan							120 days (1st crop)					
								90–120 days (2nd crop)				
Lop Buri							120 days (1st crop)					
								90–120 days (2nd crop)				

Source: Adapted from Issariyanukula (1980).

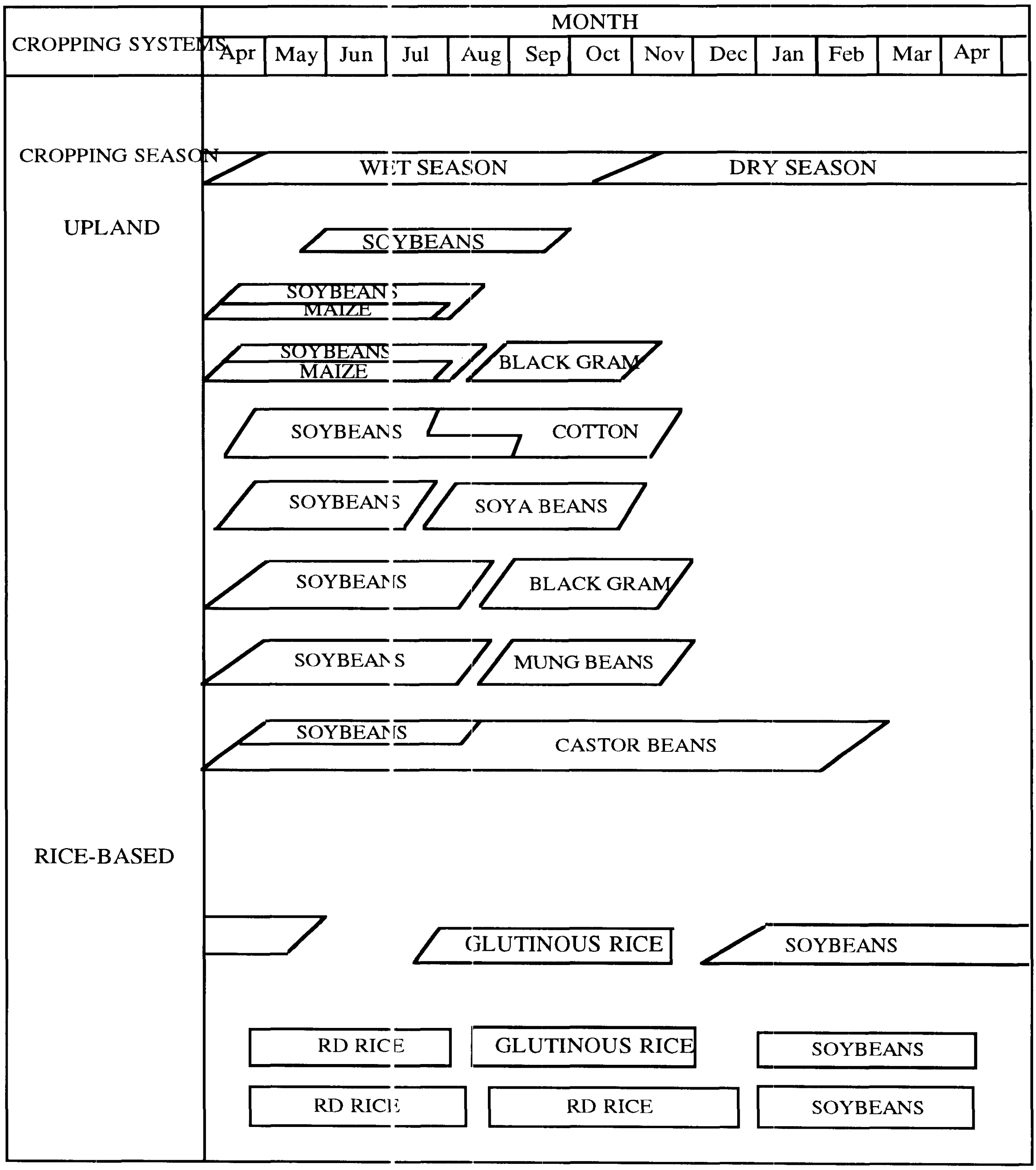
Table 2.7

Percentage of Farms Producing Crops Competitive or Complementary with Soybeans Classified by Crops and Four Selected Provinces, Crop Year 1978/79

Crops	Province				Average
	Chiang Mai	Sukhothai	Nakorn Sawan	Lop Buri	
Competing Crops:					
Mungbeans	0	11.3	28.6	62.1	21.1
Rice	12.3	4.7	0	0	5.8
Maize	0	19.8	14.3	8.1	9.2
Peanuts	7.3	0	0	1.1	2.9
Cotton	0	22.7	6.1	2.3	7.6
Sorghum	0	0	30.6	17.2	7.9
Tobacco	15.9	0	0	0	5.8
Vegetables	5.1	0	0	0	1.8
Garlic	3.6	0	0	0	1.3
Sugarcane	0	4.7	4.1	0	1.8
Watermelon	1.4	0	0	2.3	1.1
Nothing	54.4	36.8	16.3	6.9	33.7
Complementary Crops:					
Mungbeans	0	1.0	10.4	19.2	5.6
Rice	10.1	2.0	0	0	4.4
Maize	0	8.0	0	12.3	4.7
Peanuts	0	0	2.1	0	0.3
Cotton	0	18.0	2.1	1.4	5.6
Sorghum	0	0	25.0	21.9	7.7
Tobacco	6.5	0	0	0	2.5
Garlic	0.7	0	0	0	0.3
Sugarcane	0	0	4.2	0	0.5
Sweet Potato	0	1.1	0	0	0.3
Onion	0.7	0	0	0	0.3
Sesame	0	1.0	0	0	0.3
Yam Bean	0	0	4.2	0	0.6
Nothing	82.0	69.0	52.0	45.2	66.9

Source: Adapted from Issariyanukula (1980).

Figure 2.2 : Soybeans in Different Cropping Systems of Major Production Areas in Thailand, Crop Year 1986/87



Source: Adapted from Kaosa-ard *et al* (1987).

The wet–season cropping includes eight cropping systems:

1. Soybeans only, planted around mid-May to early June and harvested during September.

2. Soybeans with maize, planted (with maize as a complementary crop) around early to mid–April and harvested around early to mid–August.

3. Soybeans with maize followed by black gram, planted and harvested as in (2) and followed immediately with black gram.

4. Soybeans overlapping with cotton, planted around mid to late April and harvested around early to mid–September, with cotton relayed into stands of soybeans four to five weeks before the harvest of beans.

5. Soybeans followed by soybeans, with first crops planted around mid to late April and harvested around mid to late June, followed by the second crop planted around early August and harvested around early November.

6. Soybeans followed by black gram, planted from early April to early May and harvested around mid–August, followed shortly by black gram.

7. Soybeans followed by mungbeans, planted and harvested as in (6), followed shortly by mungbeans.

8. Soybeans overlapping with castor beans, planted and harvested as in (6) and (7) but started with a complementary crop – castor beans (which continue to grow after the harvest of soybeans and are harvested around February of the next year).

The dry-season cropping includes three cropping systems:

1. Soybeans follow glutinous rice, planted around late December to early January (as a second crop after rice) and harvested around mid–April to early May.

2. Soybeans following RD rice and glutinous rice, planted in early January and harvested in late April.

3. Soybeans following two crops of RD rice, planted and harvested as in (2).

The survey by Priebprom *et al* (1991) was conducted during the 1989/90 crop year. Four major soybean production provinces were included. The total sample size was 180 with 50 farms in Loei, 50 farms in Khon Kaen, 40 farms in Sukhothai and 40 farms in Chiang Mai. The cropping calendar is presented in Figure 2.3. According to the survey, a double cropping pattern, with rice cultivation in the wet season followed by a second crop of rice or soybeans in the dry season, was commonly found in the irrigated areas in Khon Kaen and Chiang Mai. In these areas, soybeans were planted during December to early January, and harvested during April. The major competitive crop in these areas was the second crop of rice. In the upland-rain-fed areas of Loei province, the common cropping systems were: (1) wet-season rice followed by soybeans; (2) maize followed by mungbeans; and (3) soybeans. This single crop of soybeans was planted during May and harvested in September. The popular cropping system of soybeans followed by rice was also found in Loei, particularly in areas where supplementary irrigation was available. In the rain-fed areas of Sukhothai, where supplementary irrigation was available, a cropping system with three successive crops of soybeans was possible. With this system, the early-wet crop was planted in May and harvested in August, while the late-wet crop was planted in September and harvested in December. This was followed by an irrigated dry-season crop planted in January and harvested in April.

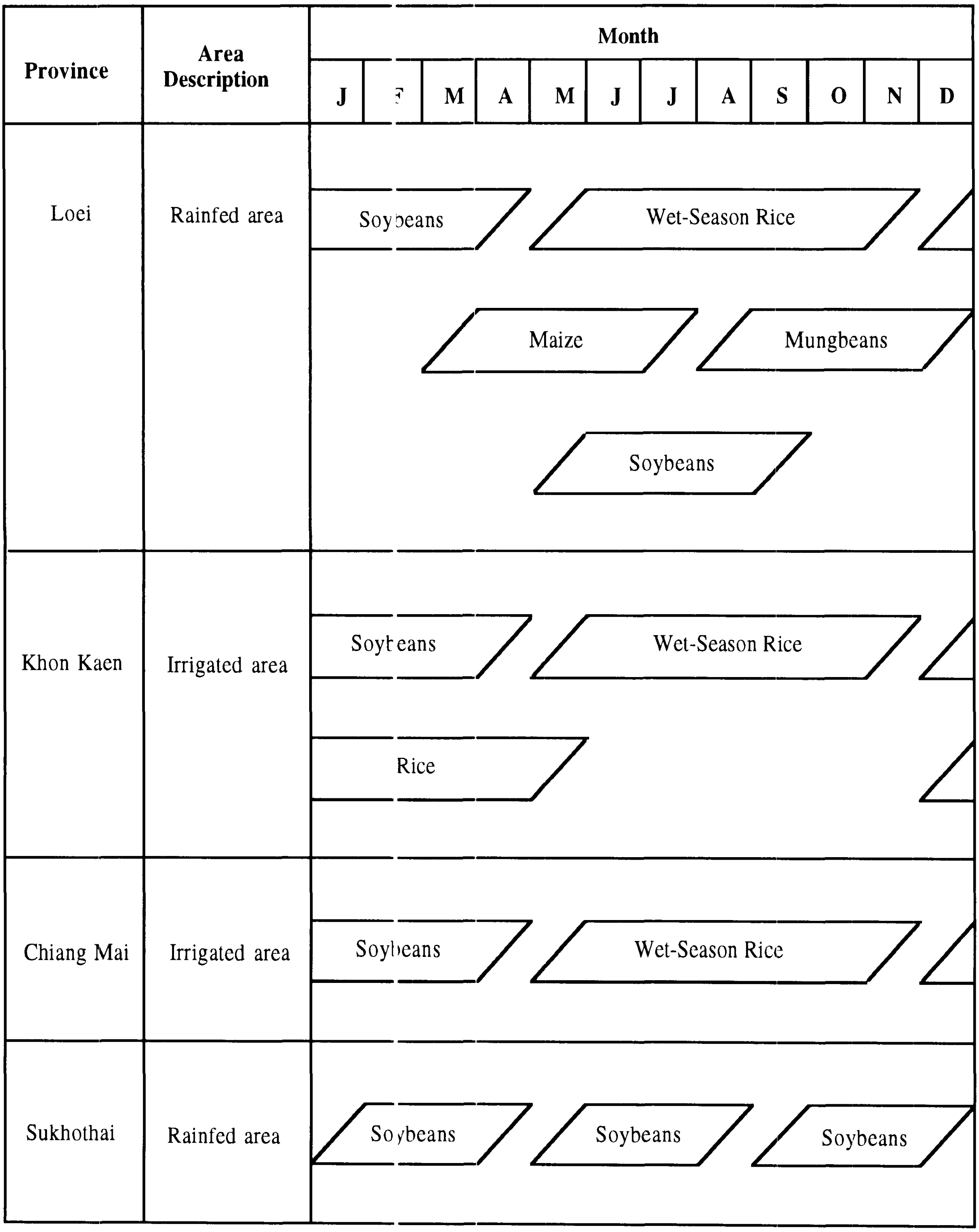
Comparing and contrasting the three surveys reveals three significant points:

1. Throughout the time span of the three surveys, which covers 12 years, the most commonly found cropping system in the rain-fed areas where supplementary irrigation was available was still dry-season soybeans followed by wet-season rice. The soybeans in these areas essentially replace the traditional second crop of rice.

2. For the upland rain-fed crops, the major competitive crops for soybeans were maize and mungbeans. Competitive crops of secondary importance were sorghum, cotton, peanuts, tobacco and garlic.

3. As time elapses, the cropping intensity of soybeans increases particularly in the major producing areas of Sukhothai province. The survey by Issariyanukula (1980) clearly reveals only one crop of soybeans in Sukhothai, while Kaosa-ard *et al* (1987) reported a double cropping system for soybeans commonly found in Sukhothai, Kamphaeng Phet, Phitsanulok and Uttaradit. According to Priebprom *et al* (1991), a triple cropping system is possible for soybeans in Sukhothai.

Figure 2.3 : The Cropping Calendar of Soybeans in Loei, Khon Kaen, Chiang Mai and Sukhothai, Crop Year 1989/80



Source: Priebprom *et al* (1991)

2.2.5 Distribution of farm size

The distribution of farm size in soybeans production varies considerably among regions. According to the study by Sriplung (1987), in Thailand there were approximately 272 000 farm households engaged in soybean cultivation during the 1985/86 crop year. Based on this population, statistics on the distribution of farm size classified by region were compiled and are presented in Table 2.8. The highest percentage of farm household in the North (43.22 per cent) and in the Northeast (38.30 per cent) falls in the range of farm size 2-5.9 *rai*. In the Central Plains, a relatively high percentage of farm households (21.19 per cent) also falls in the range 2-5.9 *rai*. However, the highest percentage of farm households (39.16 per cent) falls in the range 10-19.9 *rai*. For the whole country, the dominant farm size is between 2-5.9 *rai* (41.81 per cent). The second most common is between 10-19.9 *rai* (18.24 per cent). The majority of farm households (greater than 70 per cent) engaged in soybean cultivation were operating with a farm size of less than 10 *rai* (i.e., less than 1.6 hectares) during crop year 1985/86.

A more micro-level study was conducted by Priebprom *et al* (1991) for crop year 1989/90. The four soybean producing provinces considered were Chiang Mai (upper North), Sukhothai (lower North), Loei and Kohn Kaen (Northeast). Their study did not include provinces from the Central Plain. Farm sizes were grouped with slightly different class intervals. Moreover, sample sizes were markedly different from that of Sriplung (1987) so the two studies are not directly comparable. However, the study discloses a similar farm size distribution for soybean production. As presented in Table 2.9, except for the early-wet season crop of Sukhothai province, the majority of soybean farm households were operating with a farm size less than or equal to 10 *rai*. This ranges from 90.0 per cent of farms for the dry-season crop in Chiang Mai to 51.7 per cent for the late-wet season crop in Sukhothai. A summary from the two studies reveals the following points:

1. The majority of soybean cultivated areas are operating with farm sizes of less than 10 *rai* (1.6 hectares).

2. At a regional level, farm sizes for soybeans in the Central Plain are relatively larger than those in the North and the Northeast.

3. At a provincial level, relatively larger farm sizes were found in Sukhothai. (It is noted that Sukhothai was the largest supplier of soybeans, producing 18.39 per cent of the national output in the 1989/90 crop year.)

Table 2.8

Farm Size Distribution of Regional Soybean Production in Thailand, Crop Year 1985/86

Unit: Per cent

Region	Farm Size (*Rai*)						Total
	< 2	2-5.9	6-9.9	10-19.9	20-39.9	40	
North	15.39	43.22	13.69	17.92	9.32	0.46	100.0
Northeast	22.06	38.30	12.78	13.66	11.74	1.46	100.0
Central Plain	6.04	21.19	11.61	39.16	12.94	9.06	100.0
Whole Kingdom	15.81	41.81	13.50	18.24	9.74	0.90	100.0

Note: one *rai* = 0.16 hectare.

Source: Adapted from Sriplung (1987), Table 7.

Table 2.9

Farm Size Distribution of Soybean Production in Four Selected Provinces, Crop Year 1989/90

Unit: Per cent

Province (Season)	n	Farm Size (*Rai*)							Total
		< 6	6–10	11–15	16–20	21–25	26–30	> 30	
Loei:									
(EWS)	47	25.5	36.2	17.0	8.5	6.4	4.3	2.1	100.0
(DS)	29	58.6	31.0	–	6.9	3.5	–	–	100.0
Khon Kaen:									
(DS)	50	28.2	34.0	14.0	18.0	6.0	–	–	100.0
Chiang Mai:									
(DS)	40	52.5	37.5	7.5	2.5	–	–	–	100.0
Sukhothai:									
(EWS)	40	17.5	20.0	7.5	22.5	7.5	10.0	15.0	100.0
(LWS)	29	34.5	17.2	13.8	13.8	13.8	3.4	3.4	100.0

Note: EWS = early-wet season; LWS = late-wet season; DS = dry season; n = sample size (no. of farms); one *rai* = 0.16 hectare.

Source: Compiled from Priebprom *et al* (1991).

4. Notwithstanding that Chiang Mai was the most important province for dry-season soybean production, the relative farm size for its dry-season crop is smaller than those of Loei and Khan Kaen.

5. Where multiple cropping was possible, not every farm cultivating the first crop would cultivate the second crop of soybeans. (The percentage of farmers who produced the second crop in Loei and Sukhothai were 62 per cent and 72 per cent, respectively.)

2.2.6 Costs and returns

The assumption made is that, though farmers basically planned their production in response to price changes, what really determines their incentives and welfare is profit. This section examines the average level of farm profit from soybean production, both over time and cross-sectionally, in comparison with some major competitive crops. Table 2.10 presents a series of data on costs, return, profit, price and yield of soybean production in Thailand for crop years 1980/81 to 1989/90. Again, it is noteworthy that farm profit has been positive and increasing since 1983, but prior to 1983 farm profit was negative in two out of the three crop years considered Inspection of data on prices and yields discloses that the negative profits in crop years 1980/81 and 1982/83 were due primarily to the concurrence of low yield and low price. By contrast, the relatively high farm profit in crop year 1988/89 came about because both price and yield were relatively high.

Given that farmers actually allocate their arable land among a number of feasible competitive crops, it is worthwhile examining the farm profit from soybeans in comparison with those of competitive crops. Table 2.11 presents data on cost, revenue, profit and the revenue-cost ratio for soybean production in comparison with maize, mungbeans and dry-season rice. The data are complied at the regional level for crop year 1988/89. It is noted that, due to lack of information on prices of the crops at the regional level, the national average prices were used to compute the farm revenues for all regions. The prices are 8.46 *baht* per kg for soybeans, 8.59 *baht* per kg for mungbeans, 2.62 *baht* per kg for maize and 3 678 *baht* per tonne for dry-season rice.

In all regions, the wet-season soybeans generated higher profit per *rai* than the dry-season soybeans. In general, the production of soybeans (both wet and dry seasons) generated higher profit per *rai* than the production of mungbeans and maize. Compared with

Table 2.10

Cost, Revenue, Profit, Price and Yield for Soybean Production in Thailand, Crop Years 1980/81 — 1989/90

Crop Year	Cost (*Baht/rai*)	Revenue (*Baht/rai*)	Profit (*Baht/rai*)	Price (*Baht*/kg)	Yield (kg/*rai*)
1980/81	843.64	734.06	–109.58	5.78	127
1981/82	913.30	1 123.65	210.35	6.81	165
1982/83	931.20	747.52	–183.68	5.12	146
1983/84	977.06	1 080.46	103.40	6.07	178
1984/85	953.13	1 176.00	222.87	6.00	196
1985/86	929.05	1 236.27	292.32	6.09	203
1986/87	943.95	1 217.70	273.75	6.15	198
1987/88	968.81	1 201.50	232.69	8.01	150
1988/89	1 051.43	1 742.76	691.33	8.46	206
1989/90	1 133.36	1 531.97	398.61	7.33	209

Source: Office of Agricultural Economics, MOAC.

Table 2.11

Cost, Revenue, Profit and Revenue–Cost Ratio for Soybeans and their Major Competitive Crops, Crop Year 1988/89

Crop and Region	Cost (*Baht/rai*)	Revenue (*Baht/rai*)	Profit (*Baht/rai*)	Revenue/ Cost
Wet-Season Soybeans:				
WK	1005.46	1768.14	762.68	1.76
N	1020.66	1785.06	764.40	1.75
NE	982.22	1751.22	769.00	1.78
CP	952.81	1725.84	773.03	1.81
Dry-Season Soybeans:				
WK	1129.63	1700.46	570.83	1.51
N	1143.75	1759.68	615.93	1.54
NE	1090.43	1539.72	449.29	1.41
CP	1086.30	1514.34	428.04	1.39
Dry-Season Rice:				
WK	1530.58	2342.89	812.31	1.53
N	1504.89	2350.24	845.35	1.56
NE	1254.96	1802.22	547.26	1.44
CP	1587.91	2456.90	868.99	1.55
Mungbeans:				
WK	606.83	790.28	183.45	1.30
N	618.50	790.28	171.78	1.28
NE	531.88	755.92	224.04	1.42
CP	589.29	824.64	235.35	1.40
Maize:				
WK	734.22	1068.96	334.74	1.46
N	728.08	1071.58	343.50	1.47
NE	752.34	1074.20	321.86	1.43
CP	726.03	1058.48	332.45	1.46

Note: WK = Whole Kingdom, N = North, NE = Northeast and CP = Central Plain.
Source: Office of Agricultural Economics, MOAC (1990).

dry-season rice, however, dry-season soybeans were less profitable. This may partly explain the reason why farmers have switched their production from maize and mungbeans to soybeans recently.

Since capital is scarce in the Thai agricultural sector, it is logical to look at the revenue-cost ratio as another indication of the incentive for farming. In this context, the whole-kingdom average revenue-cost ratios are 1.76 for wet-season soybeans, 1.51 for dry-season soybeans, 1.53 for dry-season rice, 1.30 for mungbeans and 1.46 for maize. This further emphasises the incentive to switch from maize and, particularly, mungbeans to soybeans. Dry-season rice and dry-season soybeans, with almost equal revenue-cost ratios, are competitive with each other. It should be noted that these average figures are given only to provide added information and they do not tell us prescriptively the way in which farmers should shift their cropping patterns. With an assumption that farmers are profit maximisers, they would theoretically maximise profit by equating price with their individual marginal cost in farming, rather than attempting to maximise the average profit of the community.

2.2.7 Yield gap

Inspection of statistics on the provincial yield of soybeans reveals wide yield differences across provinces. As presented in Table 2.12, the 45 soybean producing provinces in crop year 1989/90 (out of a total of 73 provinces in Thailand) are listed with the respective provincial average yield. The yield ranges from 244 kg per *rai* in Pranchuap Khiri Khan to 107 kg per *rai* in Surin. Yields from the top-ten major producing provinces (figures in brackets) are all greater than 200 kg per *rai* except in Tak where yield is marginally lower than 200 kg per *rai*. The wide yield gap suggests a possibility for Thailand to increase soybean production through yield improvement. There is also a comparatively lower yield of Thai soybeans compared with the major producing countries in the world. For instance, the equivalent yields per *rai* in 1989 are 349 kg in the USA and 315 kg in Brazil.

The potential to increase yield especially in the low-yield, newer producing provinces (e.g. Ubon Ratchathani, Surin and Buri Ram) is quite promising. The cross-provincial yield gap in Thailand is quite probably due to technology gaps among provinces rather than geographical differences in the productivity of land. Inspection of the historical yields of the top-ten producing provinces will help explain the argument. Table 2.13 presents the average yield per *rai* of soybean production of the ten selected provinces during the past decade.

Table 2.12

Provincial Soybean Yield in Thailand, Crop Year 1989/90

Province	Yield	Province	Yield
Whole Kingdom:	209	Nan	191
Nakhon Phanom	188	Phrea	207
Sakon Nakhon	117	Lampang	191
Nong Khai	175	Sukhothai	(223)
Udon Thani	197	Uttaradit	(204)
Loei	(210)	Chiang Mai	(207)
Mukdahan	184	Chiang Rai	180
Ubon Ratchathani	118	Mae Hong Son	217
Kalasin	155	Lamphun	199
Khon Kaen	(201)	Phayao	130
Maha Sarakham	150	Lop Buri	(224)
Buri Ram	123	Saraburi	192
Si Sa Ket	176	Chai Nat	198
Surin	107	Sing Buri	180
Chaiyaphum	188	Suphan Buri	178
Nakhon Ratchasima	194	Ang Thong	191
Nakhon Sawan	(202)	Kanchanaburi	204
Phetchabun	(224)	Prachuap Khiri Khan	244
Uthai Thani	216	Phetchaburi	135
Kamphaeng Phet	(225)	Ratchaburi	219
Tak	(198)	Chachoengsao	234
Phichit	188	Prachin Buri	225
Phitsanulok	192	Chanthaburi	215

Note: Figures in brackets are from the top ten producing areas.

Source: Compiled from the Agricultural Statistics of Thailand, Crop Year 1989/90, MOAC (1990).

The potential to increase yield especially in the low-yield, newer producing provinces (e.g. Ubon Ratchathani, Surin and Buri Ram) is quite promising. The cross-provincial yield gap in Thailand is quite probably due to technology gaps among provinces rather than geographical differences in the productivity of land. Inspection of the historical yields of the top-ten producing provinces will help explain the argument. Table 2.13 presents the average yield per *rai* of soybean production of the ten selected provinces during the past decade.

Historically, the yields in all ten provinces were commonly low during the first few years of the decade. After 1983, yields for all provinces increased. According to the trend, all of these provinces had managed to increase their yields up to 180 kgs per *rai* or higher in 1986 and up to about 200 kgs per *rai* or higher in 1990. With the knowledge of the yield trend as mentioned above, it is quite possible that in the newer producing provinces (where productivity is low), yield per *rai* can commonly be increased by about 20 to 30 kg for each period of three to four years, until productivity reaches the national standard. Thus far, the standard yield set by the government is 210 kgs per *rai* (OAE 1992, p. 32). Given the fact that low yields are prevailing in most of the new producing provinces, an increase in output through yield improvement can most likely be expected along with area expansion.

2.3 Marketing and Utilization of Soybeans

This section describes the general characteristics of the marketing and utilization of soybeans in Thailand. The marketing sector is concerned mainly with an outline of the various marketing channels for soybeans, an inspection of the marketing costs and marketing margin involved, and a brief description of the grading and standardisation of soybeans in Thailand. The utilization sector is concerned mainly with the description of various sources of soybean utilisation followed by a brief account of the oil processing industry and a concise analysis of self-sufficiency in soybean oil and soybean meal production of the country.

2.3.1 Marketing channels

The major characteristics of soybean marketing in Thailand have remained unaltered during the past decade. As cited in the literature (Raysanon 1983; Wattanakul 1987; Tongpan *et al* 1987; Katikarn *et al* 1989) soybeans are basically channelled through three levels of markets, namely, the local markets, the assembly markets and the terminal markets. The major marketing activities can be depicted as shown in Figure 2.4.

Table 2.13

Soybean Yield Classified by Top-Ten Production Provinces, Crop Years 1980/81 – 1989/90

Province / Year	(1) Sukhothai	(2) Loei	(3) Chiang Mai	(4) Kamphaeng Phet	(5) Phetchabun
1980/81	117	153	143	119	145
1981/82	178	159	154	193	148
1982/83	139	152	169	130	121
1983/84	193	156	193	147	129
1984/85	209	192	190	199	182
1985/86	209	205	211	221	179
1986/87	204	202	206	210	187
1987/88	119	172	206	129	158
1988/89	228	194	213	203	202
1989/90	223	210	207	225	224

Province / Year	(6) Uttaradit	(7) Lop Buri	(8) Nakhon Sawan	(9) Tak	(10) Khon Kaen
1980/81	102	136	116	97	–
1981/82	179	157	185	151	130
1982/83	178	142	197	112	181
1983/84	156	199	185	138	185
1984/85	234	188	218	179	158
1985/86	212	197	234	183	176
1986/87	197	191	214	173	186
1987/88	127	159	164	171	171
1988/89	221	208	206	173	202
1989/90	204	224	202	198	201

Source: Compiled from the Agricultural Statistics of Thailand, MOAC (1984, 1986, 1990).

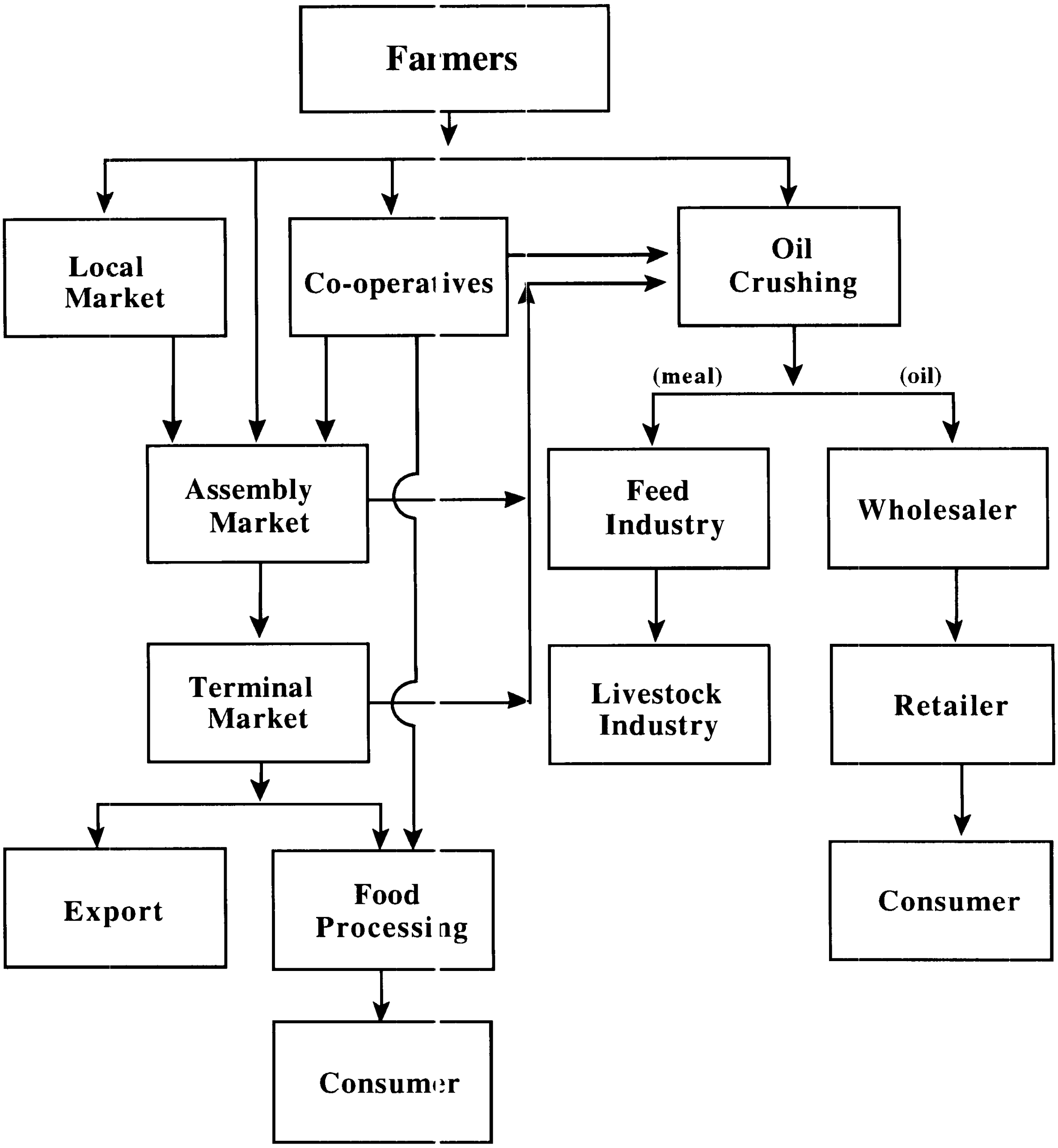
In the local markets (usually scattered around the village nearby the farms) farmers sell their products directly to the local buyers. These buyers are generally local people who act as middlemen and resell the product immediately (without storing for price speculation) to the assembly wholesale markets, local retail outlets and/or processing plants. In some areas farmers also sell directly to the assembly markets, the processing plants, or through the local farmers' co-operatives.

Beside being regular sources of demand for farmers' product, most middlemen also provide credit to farmers to finance farm production or satisfy family consumption purposes. The condition for obtaining a loan is that farmers must sell their product to the respective middleman with price usually determined by them. Therefore, in this market, the farmers are necessarily price takers. The percentage of farmers who take loans is quite high. For instance, according to a previous study, 90 per cent of the soybean farmers in Sukhothai were getting financial support from their buyers (Thammasat University 1985).

The assembly markets are usually located at, or in the vicinity of, centres of communication and major soybean production areas, where large quantities of soybeans are traded. These markets operate on a regional scale with marketing activities covering areas of several provinces. Assembly merchants purchase soybeans from the middlemen in the local markets or directly from farmers. The products are then resold to the local processing plants, local retail outlets or the terminal market in Bangkok. These merchants are influential agents in the determination of marketing terms such as trading units, weighing standard, grading and quality tests of the product. At this level of marketing some short-period storage activities are conducted for price speculation. These markets are usually located at the major district (Amphoe) of the major soybean production provinces (e.g., Amphoe Muang in Chiang Mai, Amphoe Sawankhalok in Sukhothai, Amphoe Khok Samrong and Amphoe Chai Badan in Lop Buri, and Amphoe Phra Phuttahabat in Saraburi).

The terminal market is the Bangkok market where soybeans and soybean products are traded for household consumption, as raw materials for soybean processing plants and for export. The Bangkok market is the only important terminal market in Thailand. Important buyers in this market are the wholesale merchants, soybean processing plants and exporters. Middlemen in the Bangkok market also conduct inter-regional trade in soybeans and soybean products by assembling the commodities from the surplus areas and distributing them to the deficit areas. They are influential agents in determining prices and providing marketing information. Storage activities are also performed on a larger scale for price speculation.

Figure 2.4 : Marketing Channels for Soybeans in Thailand



2.3.2 Marketing costs and marketing margin

The marketing costs are all the costs incurred in moving the output from farmers to the final consumers through time and space. These basically include transportation cost, handling cost, storage cost, cost of weight loss as well as other operating costs and taxes. Studies on marketing costs for soybeans in Thailand are few. The most recent information dates back to 1982, when a survey on such cost items was conducted by Katikarn (1983). As reported, the marketing cost and marketing profit, respectively, were approximately 3.60 per cent and 2.88 per cent at the local market, 6.83 per cent and 5.04 per cent at the assembly market, and 3.95 per cent and 2.88 per cent at the terminal market. The figures are percentages of the average wholesale price paid by the processing plants in Bangkok. This yields a total marketing cost and profit of about 14 per cent and 11 per cent, respectively. Thus the marketing margin is approximately 25 per cent.

Figures on marketing margins as the difference between the consumers' price and the producers' price are easier to obtain. However, there is a slight problem in the time series data for soybeans in this regard. Since most farmers sell their output at a mixed-grade price, this price should logically be the producers' price in the calculation of the marketing margin. However, at the other end of the marketing chain, soybeans are typically graded into first and second grades. The first grade soybeans are further classified by province and labelled with slightly different prices. Moreover, price data on the second grade soybeans are rather scanty. Fortunately, some data on farm-gate prices classified by first and second grades are also available. Based on the available data the marketing margins of the two grades of soybeans are estimated and presented in Table 2.14. During the seven-year span the ranges of the marketing margin are between 0.78 to 1.83 *baht* and between 0.63 to 1.23 *baht* per kg for first grade and second grade soybeans, respectively. The percentage margin based on the Bangkok wholesale price varies from 11.26 to 19.12 per cent for first grade, and from 9.24 to 16.73 per cent for second grade. Clearly, all margins are much lower than the 25 per cent figure reported by Kitikarn (1983). The difference is most probably due to differences in the method of estimation and differences in the sample frame of the two sources.

Table 2.14

Marketing Margin for Soybeans in Thailand, 1981-1987

	Farm-gate price (*baht*/kg)	Whoelsale price (*baht*/kg)	Marketing Margin (*baht*/kg)	Marketing Margin (%)
(First grade)				
1981	6.68	7.77	1.09	14.03
1982	6.20	7.39	1.19	16.10
1983	6.80	7.58	0.78	10.29
1984	6.60	8.16	1.56	19.12
1985	6.40	7.48	1.08	14.44
1986	6.38	8.21	1.83	22.29
1987	8.75	9.86	1.11	11.26
(Second grade)				
1981	6.12	7.35	1.23	16.73
1982	5.79	6.90	1.11	16.09
1983	5.90	6.84	0.94	13.74
1984	6.09	7.15	1.06	14.82
1985	6.19	6.82	0.63	9.24
1986	6.01	7.02	1.01	14.39
1987	7.91	8.80	0.89	10.11

Note: (1) % figures are based on wholesale prices.

(2) Since there is no whole-country average price for first-grade soybeans at the Bangkok wholesale level, the Chiang Mai price is used.

Source: Office of Agricultural Economics, MOAC.

2.3.3 Grading and standardisation

There is no official grading standard for soybeans (Tongpan *et al* 1987; Priebprom *et al* 1991). However, grading is generally based on inspection of such things as size of grains, their moisture content, colour, percentage of damaged kernels and foreign matter. Based on these criteria, soybeans are normally classified into first or second grade. (In some areas, soybeans have recently been classified into three grades, and in many areas they are traded as one mixed grade.) The quality of soybeans is highly dependent on the location and season of their production. For instance, soybeans harvested from the late-wet season in Saraburi (Central Plain) and from the dry season in Chiang Mai (North) and Khon Kaen (Northeast), are higher priced than other crops from their respective regions. They are better in quality and generally are traded as first grade soybeans. Examples of second grade soybeans are those harvested in the early-wet season from Loei and Suthothai.

The first grade soybeans are primarily sold as seeds and as raw materials for various types of food processing (e.g., soya sauce, soybean curd, and soyamilk). However, in times of shortage, the second grade soybeans are also used in the food industry (Priebprom *et al* 1991 p. 86). The second grade and any third grade soybeans are mainly used as raw material in the oil crushing industry. In connection with the minimum price scheme enforced by the Thai government, minimum standards for second grade soybeans are usually set by the processing plants for price discounting. One example of such a standard is that for soybeans to qualify, the oil content must not be less than 17 per cent while the moisture, foreign materials and damaged kernels must not be more than 13 per cent, three per cent and five per cent, respectively.

In general, the standardisation mentioned above is practised at the trading level and not at the farm level. If any grading standard is used in buying soybeans from farmers at all, they will be classified as merely 'good' or 'poor' quality. In most instances, soybeans are considered as being of average quality and are traded at the mixed grade price. This system seems to provide no incentive for farmers to improve the quality of their crops.

2.3.4 Utilization of soybeans

The utilization of soybeans in Thailand can be roughly classified into three end-use categories. These are use as seeds, use in oil crushing and use in food processing, animal feed and direct human consumption.

2.3.4.1 *Seed requirement*

The exact quantity of soybeans used as seed in each year is unknown. The normal level used per *rai* as cited in the literature varies considerably. It has been reported as five kg in Vanpee (1977), seven kg in Cho.ivanit (1989) and 10 kg in Charaeonpokpan (1990). Basically, the recommended quantity of seed varies with the variety of seed. For instance, the recommended level is between five to seven kg per *rai* for variety (SJ-1) and (SJ-2) and between seven to 10 kg per *rai* for variety (SJ-4) and (SJ-5) (Ministry of Commerce 1990).

As part of the yield improvement program, the Thai government has been providing good quality seed to farmers through the Department of Agricultural Extension (DAE). The operating program is a seed exchange scheme under which DAE supplies farmers with good-quality seed, normally with variety (SJ-4) or (SJ-5), at a rate of 10 kg per *rai* in exchange for farmers' own seed harvested from the previous season. For the dry-season crop, the exchange ratio is 1:1 (by weight) between DAE soybeans and farmers' paddy. For the wet-season crop, the exchange ratios are 1:1 between DAE soybeans and farmers' soybeans (or mungbeans) and 1:3 between DAE soybeans and farmers' maize (DAE 1989).

Recent statistics reveal that the DAE seed exchange scheme can satisfy about one-third of the country's seed requirement. Table 2.15 presents the seed requirement projection and the DAE seed output compiled by the Office of Agricultural Economics. According to these figures, DAE's seed exchange scheme would have supplied about one-fourth of the total seed requirements in crop year 1989/90 and about one-third of them in crop years 1990/91 and 1991/92. The balance of seed requirements is satisfied by purchase of commercial seed or from farmers' own seed harvested from the previous season. In the latter case, part of the wet-season output is used for seed in the immediate dry-season and *vice versa*. In the former case, the commercial seed cost about 15 *baht* per kg in 1991/92.

Table 2.15

Soybean Seed Requirement and Government's Seed Supply

Crop Year	Seed Requirement Projection (tonne)	DAE Seed Output (tonne)	DAE's Share of Seed Supply (%)
1989/90	23 500 – 25 000	6 000	24.00 – 25.53
1990/91	24 930 – 26 520	8 000	30.17 – 32.09
1991/92	26 630 – 28 330	10 000	32.89 – 36.55
1992/93	27 360 – 30 400	–	(–)
1993/94	29 420 – 32 690	–	(–)
1994/95	29 920 – 35 190	–	(–)
1995/96	30 000 – 37 500	–	(–)

Source: Adapted from OAE (1990).

2.3.4.2 *Input for oil processing*

Another use of soybeans is as raw material in the oil crushing industry which produces two main joint outputs - soybean meal and soybean oil. The utilization of soybeans in this industry has recently captured the major share of the country's total supply. As presented in Table 2.16, prior to 1984 the quantity of soybeans used in this industry had been fluctuating (slightly in terms of absolute quantity and more drastically in terms of percentage of the total supply). Figures on both quantity and percentage dropped considerably in crop year 1983/84 and then took on an upward trend from 1984. The increase in the utilization is quite dramatic during the period. The quantity increased steadily from about 68 000 tonnes in 1984 to about 544 000 tonnes in 1990. This gives an annual average growth rate of 41 per cent during the six-year span. Spontaneously, its share of utilization as a percentage of the country's total supply increased steadily, from about 38 per cent in 1984 to about 81 per cent in 1990. At this juncture, it bears repeating that the implementation of the import quota policy on soybean meal was started in 1984. This subsequently caused meal prices to increase and the industry to expand. The number of soybean oil processing plants has increased from three plants in 1983 (Tongpan *et al.* 1987, p. 330) to seven plants in 1989 (Ministry of Commerce 1990, p. 5; Chareonpokpan 1990, p. 89).

2.3.4.3 *Input for food processing*

Soybeans are used by a wide range of food processing industries. Since there are no detailed statistics on the quantity of soybeans used in these industries, data on these quantities are generally obtained from estimates of the difference between the total supply of soybeans of the country and the quantity used in the oil processing industry each year. These residual figures mainly include the quantity of soybeans used for seed and for other purposes such as animal feed mix and direct human consumption, as well as changes in stock. It is imperative that, being residual figures, they be used and interpreted with a certain degree of caution. As shown in Table 2.16, the percentage of soybeans used in food processing decreased steadily as the percentage of soybeans used in oil crushing increased steadily. The percentage used in food processing fell from a high of 62 in 1984 to a low of 19 in 1990.

Table 2.16

Shares of Soybean Utilization in the Oil Processing and Food Processing Industries, Crop Years 1980/81 – 1989/90

Unit: 1000 tonnes

Crop Year	(1) Domestic Output	(2) Net Import	(3) Total Supply	(4) Use in Crushing	(5) Use in Food Processing & Other
1980/81	100.02	2.88	102.90	93.05	9.85
			(100.00)	(90.43)	(9.57)
1981/82	131.53	1.33	132.86	78.60	54.26
			(100.00)	(59.16)	(40.84)
1982/83	113.39	-0.73	112.66	87.86	24.80
			(100.00)	(77.99)	(22.01)
1983/84	179.13	-1.07	178.06	67.86	110.20
			(100.00)	(38.11)	(61.89)
1984/85	246.45	-1.97	244.48	120.97	123.51
			(100.00)	(49.48)	(50.52)
1985/86	309.42	-2.45	306.97	174.84	132.13
			(100.00)	(56.96)	(43.04)
1986/87	356.48	-0.34	356.14	238.84	117.30
			(100.00)	(67.06)	(32.94)
1987/88	337.74	33.32	371.06	250.75	120.31
			(100.00)	(67.58)	(32.42)
1988/89	516.81	-0.02	516.79	400.91	115.88
			(100.00)	(77.58)	(22.42)
1989/90	672.37	-0.02	672.35	543.91	128.44
			(100.00)	(80.90)	(19.10)

Note: Figures in brackets are percentage of total supply. (2) and (4) are figures based on the marketing year for soybeans (i.e., from September to August of the following year).

Source: (1) and (2) from Agricultural Statistics of Thailand, MOAC (1984, 1986, 1990), (4) from Office of Agricultural Economics.

2.3.5 The oil processing industry

Due to its relative importance as a major user of soybeans and given the policy issues involved, more details on the oil processing industry are given in this section. As revealed in the study by Chareonpokpan (1990), of the seven oil processing plants operating in Thailand, two deal exclusively with soybeans while the rest process a mixture of soybeans, rice bran, cotton and kapok. The combined total annual crushing capacity of these seven plants is approximated as 835 000 tonnes per year. In addition, two new plants are under construction with an additional combined capacity of about 165 000 tonnes per year. This will yield a total crushing capacity of the order of 1 000 000 tonnes per year in the near future.

Given the plant capacity compared with the present quantity of soybeans being processed in the industry, there is clearly a high degree of under-utilization of production capacity in the country. For these plants to run with full capacity under the soybean import ban policy, domestic output needs to be increased substantially.

The crushing of soybeans produces two major joint products, soybean meal and soybean oil. The conversion factors by which beans are transformed into meal and oil vary slightly with the crushing technology and quality of soybeans. In countries with high crushing efficiency and good quality of beans, the ratios (by weight) are (100:80) between beans and meal and (100:20) between beans and oil. The above conversion factors result in no weight loss. In Thailand, with lower bean quality and crushing efficiency, processing always results in a certain weight loss.

Conversion ratios gathered from various sources from 1972 to 1990 are presented in Table 2.17. The ratios differ slightly among the four sources. Based on the conversion ratios, output of meal and oil can be estimated from the quantity of soybeans being processed. The output of oil can be further transformed from kilograms to litres by multiplying the figure by a factor of 1 087.

Table 2.17

Conversion Ratios for Soybean Oil Crushing in Thailand, 1972-1990

Year	Conversion Ratios			
	Beans	Oil	Meal	Waste
(1) 1972	100	14	80	6
(2) 1978	100	16	77	7
(3) 1988	100	15.5	77	7.5
(4) 1990	100	17	78	5

Source: (1) Rangsaritkul (1972).
(2) Sriplung (1978).
(3) Virakul and Sasanavin (1988).
(4) Setboonsarng (1990).

Table 2.18 and Table 2.19 present the domestic output, net import, total requirement (demand) and the self-dependence ratio (SDR) of soybean oil and soybean meal, respectively. To be consistent with the data provided by the office of Agricultural Economics, the ratios as used by Virakul and Sasanavin (1988) are used in the transformation. The total requirement is simply the summation of domestic output and net import. The SDR, being the ratio of domestic output to the total requirement, provides a basic indicator of what proportion of the country's total demand has been satisfied by domestic output. Thus, it also provides an indicator of by how far domestic production would have to be expanded to attain self-sufficiency.

As presented in Table 2.18, the SDR for oil increased steadily from 0.22 in 1984 to 0.94 in 1990. This indicates a high potential for Thailand to become self-sufficient in soybean oil production in the near future. The SDR for soybean meal, displays a similar trend. It increased steadily from 0.13 in 1984 to 0.69 in 1990. Given the fixed output proportion between oil and meal, the much lower value of SDR in meal implies that, if Thailand manages to attain self-sufficiency in meal production, there will be a sizeable excess output in oil production. The same point has been mentioned by Wonghanchao and Nabangchang (1987) and Virakul and Sasanavin (1988).

Before leaving this chapter it seems appropriate to provide some discussion about the competitiveness of the various markets. This is to simplify the modelling part of Chapter 3. Theoretically a market is considered to be competitive when all the agents concerned are price takers. Since the meal and oil markets are operating in an open economy with sizable imports particularly of soybean meal, and with a small country assumption all agents are assumed to face an exogeneous world parity price. For soybean production, the local bean prices are assumed to be determined by market forces. This is due to the fact that soybeans are usually traded in mixed grades and usually demanded by various industries - food processing, oil extraction and direct utilization as animal feed or for human consumption purposes. According to the study of Kornchareon (1991) in the small village of Kornkane province alone there are at least 50 agencies buying soybeans from farmers. The percentage distribution of various kind of purchasers is presented in Table 2.20.

Table 2.18

Domestic Output, Net Import, Total Requirement and Self-dependence Ratio for Soybean Oil, 1981-1990

Year	(1) Domestic Output (1 000 litre)	(2) Net Import (1 000 litre)	(3) = (1) + (2) Total Requirement (1 000 litre)	(4) = (1)/(3) Self Dependence Ratio
1980/81	15.67	12.05	27.72	0.57
1981/82	13.24	13.14	26.32	0.50
1982/83	14.80	15.33	30.13	0.49
1983/84	11.43	41.14	52.57	0.22
1984/85	20.38	27.15	47.53	0.43
1985/86	29.46	3.65	33.11	0.88
1986/87	40.24	2.50	42.74	0.94
1987/88	42.25	3.73	45.98	0.92
1988/89	67.54	6.80	74.34	0.91
1989/90	91.64	6.20	97.84	0.94

Source: (1) Estimated from Table 2.16.
(2) Compiled from file data, Centre of Agricultural Statistics, MOAC.

Table 2.19

Domestic Output, Net Import, Total Requirement and Self-dependence Ratio for Soybean Meal, 1981 - 1990

	(1) Domestic Output (1 000 tonnes)	(2) Net Import (1 000 tonnes)	(3) = (1) + (2) Total Requirement (1 000 tonnes)	(4) = (1)/(3) Self Dependence Ratio
1980/81	71.65	138.59	210.24	0.34
1981/82	60.52	188.34	248.84	0.24
1982/83	67.65	200.89	268.54	0.25
1983/84	52.25	239.97	292.22	0.18
1984/85	93.15	223.13	316.78	0.29
1985/86	134.63	229.15	363.78	0.37
1986/87	183.91	225.28	409.19	0.45
1987/88	193.08	232.18	425.26	0.45
1988/89	308.70	191.00	499.70	0.62
1989/90	418.81	187.83	606.64	0.69

Source: (1) Estimated from Table 2.16.
(2) Compiled from file data, Centre of Agricultural Statistics, MOAC.

Table 2.20
Purchasers of Soybeans in Khon Kaen Province Classified by Type of Agent
Crop Year 1989/90

Type of Purchasers	% of Soybean Purchasers
Local Buying Agents	6.00
Passing-by Merchants	6.00
District Buyers	1.98
Provincial Buyers	28.01
Cooperatives	1.98
Bank for Agriculture and Agricultural Cooperatives	13.98
Crop Promotion Centre	22.07
Other	19.98

Source : Kornchareon (1991)

Chapter 3

A Model of the Thai Soybean Industry

3.1 Introduction

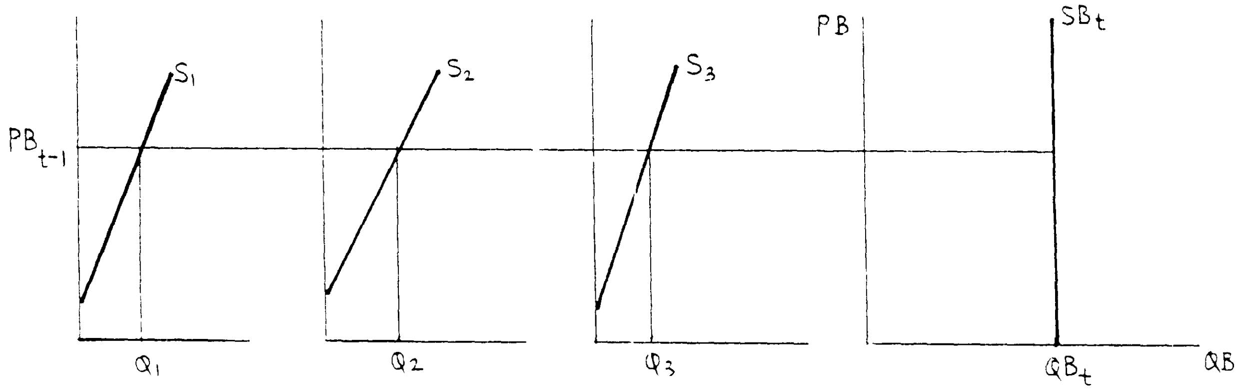
This chapter will attempt to develop partial equilibrium models to depict the Thai soybean industry. The purpose of the modelling is to provide a simple yet sufficiently-detailed analytical framework for the policy analyses which follow. With the contention that the existing government intervention in the Thai soybean industry would result in relatively small changes in all the parameters concerned, the model is confined to the use of linear supply and demand schedules together with parallel shifts of the schedules. The analysis commences with a simple closed-economy system with a short-run situation in which farmers do not adjust their farm output in response to price change. This is then extended to a longer-run situation in which farmers have sufficient time to adjust their output in response to price change and then to a long-run open economy where international trade is possible.

The modelling begins with the supply curves of soybeans and the demand curves for soybeans and their products, soybean oil and soybean meal. Then these supply and demand schedules are brought together to form a multi-market model of the Thai soybean industry. Step by step, the modelling considers the following situations: the short-run closed economy regime, the long-run closed-economy regime and the long-run open-economy regime. This will yield a conceptual structure of the intended model amenable to subsequent policy analyses. Then the impacts of the Thai government's intervention in the soybean industry in terms of single policy and policy combinations are explained and analysed .

3.2 The Supply of Soybeans

The production areas of soybeans are grouped into three distinct production regions. As depicted in Figure 3.1, the three supply schedules are denoted by S_1 to S_3. They are positively sloped as a function of lagged price (i.e., at time *t* the supply of soybeans from each region is a function of the price of soybeans in the previous period, PB_{t-1}).

Figure 3.1: The Regional and Total Supply of Thai Soybeans



In this simple model, the horizontal summation of all the supplies from these three regions would yield the total quantity of soybeans supplied in the whole country in year t, QB_t. A similar framework on aggregation and disaggregation of the supply schedule can be found in McCalla and Josling (1985) and Timmer (1986).

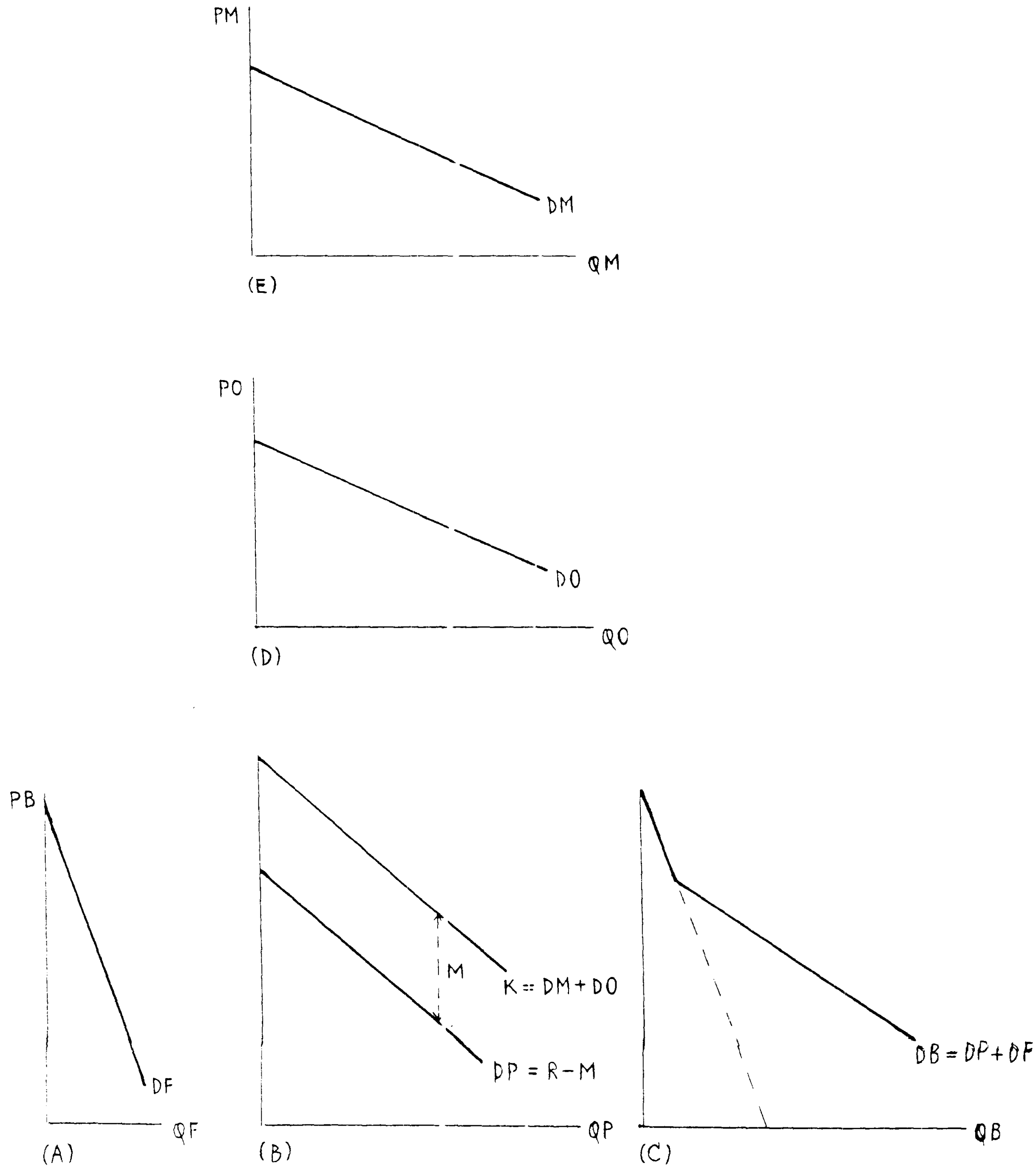
Since the supply of soybeans is not a function of price in the same period, the short-run supply function SBS_t is a vertical line as depicted in the right-most graph of Figure 3.1. That is to say, for any given period of time (t) the quantity supplied of soybeans is predetermined and thus fixed.

3.3 The Demand for Soybeans and their Products

Basically, the demand section of the Thai soybean model consists of five demand functions. These are linked together with a number of working assumptions and technical relationships. As shown in Figure 3.2, the vertical summation of the demand curve for meal (DM) in section (E) and the demand curve for oil (DO) in section (D) yields a revenue function (R) for the oil processing industry as depicted in section (B). Then, by subtracting the crushing and handling spread or margin (M) from R (which is assumed constant for the moment) the demand schedule for soybeans as input in oil processing (DP) is formed. Then, horizontally summing DP with the demand schedule of soybeans in the food industry (DF) as given in section (A) yields the country's aggregate demand for soybeans (DB) as shown in section (C).

It is noted that, in this simple model, section (A), (B) and (C) represent the soybeans (grains) market, whereas section (D) and (E) represent the soybean oil and soybean meal markets, respectively. In linking the three markets together the three horizontal axes QP, QO and QM are made consistent such that $QP = V^{-1}QO = W^{-1}QM$, where V and W are the technical conversion factors by which beans are transformed into oil and meal respectively. In the bean market, the segregation of total demand for soybeans, DB, into demand for beans used in oil processing, DP, and demand for beans used in the food industry, DF, is mainly for purposes of subsequent policy analyses (i.e., the segregation will enable the model to detect more clearly the inter-market effects of policy interventions).

Figure 3.2: Demand Curves of Soybeans and Soybeans Products



The representation of DO and DM as different markets is justified by the fact that soybean oil and soybean meal are two distinct commodities demanded by two entirely different markets. However, although the two products are independent in terms of consumption, they are closely linked in terms of production in that they are joint products produced in fixed proportion from the oil crushing process. This, together with the device used to transform the QO and QM axes, justifies the vertical relationships between the DO, the DM and the DP curves.

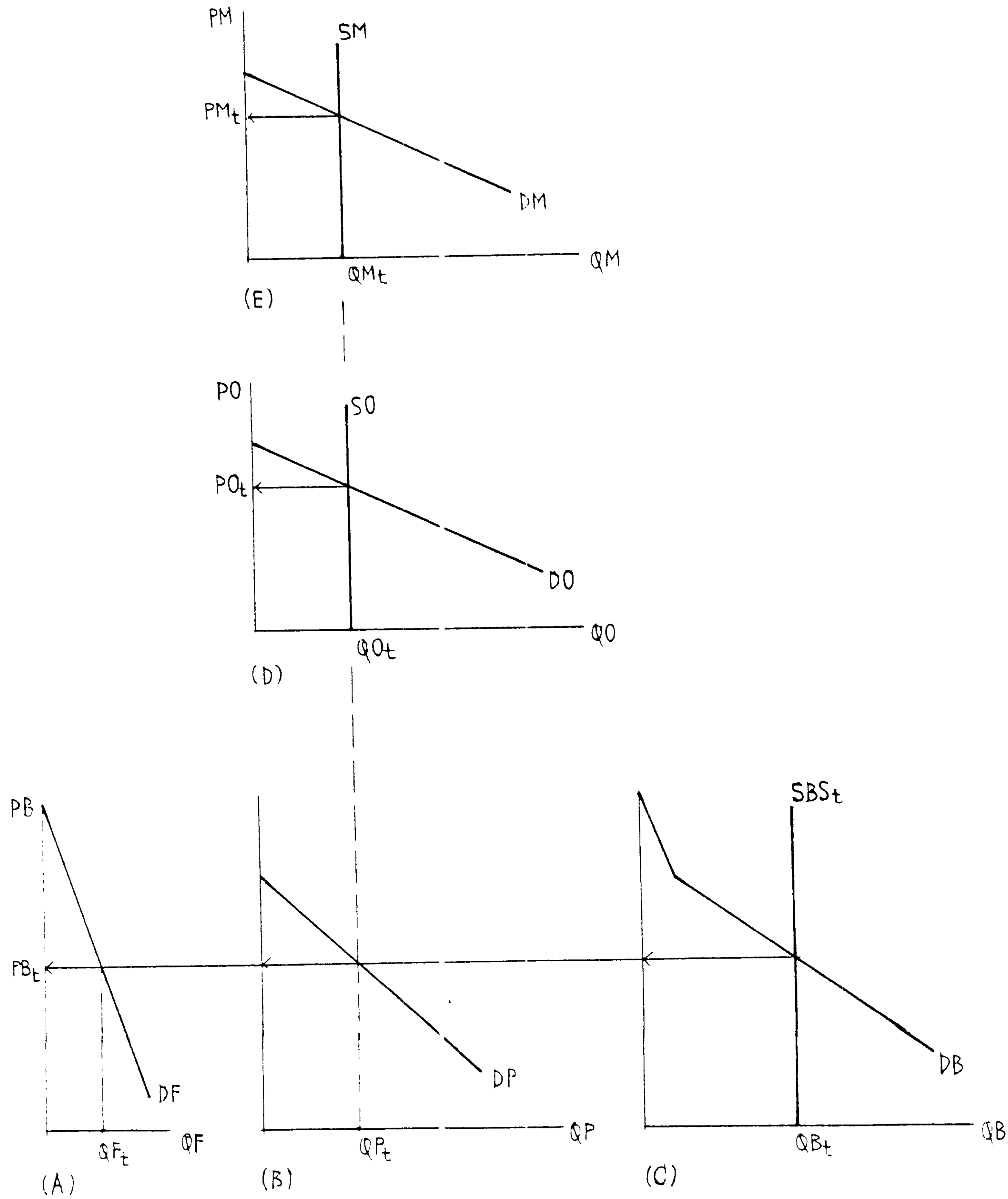
3.4 Price Formation

The process of price formation for soybeans and their products can be explained by bringing together the demand and supply schedules postulated so far into the same framework, as shown in Figure 3.3. In this simple short-run, closed-economy situation, the intersection of the predetermined level of the supply of beans, QB_t, which is denoted by a vertical supply curve, SBS_t, and the aggregate demand schedule, DB, would determine the equilibrium market price of soybeans, PB_t. Instantaneously, this price would clear the market by rationing the total supply of soybeans QB_t (section C) to satisfy the demand for soybeans in the food industry, QF_t (section A) and the demand for soybeans in oil crushing QP_t (section B).

As mentioned earlier, the crushing of a certain quantity of soybeans in the oil processing industry would yield given quantities of oil and meal dictated by the fixed technical conversion factors. With an assumption that stocks of oil and meal are negligible, at any period (t) the quantity of beans demanded in oil processing, the quantity of oil supplied and the quantity of meal supplied are determined simultaneously. According to the present model, with bean price PB_t and the quantity of beans demanded in crushing QP_t, the quantities of oil and meal supplied must be QO_t and QM_t, respectively. This implicitly yields a vertical supply curve of oil, SO (section D), and a vertical supply curve of meal, SM (section E), which intersect, respectively, the demand schedules DO and DM to yield the equilibrium market price for oil, PO_t, and meal, PM_t.

This model is completed by noting that the equilibrium price of beans in period t, PB_t, would help determine the quantity of soybeans supplied in the following period, SB_{t+1}, which again intersects with the given total demand schedule of beans to yield

Figure 3.3: The Price Formation of Soybeans and their Products



an equilibrium price of beans for period t + 1 and so the process repeats. The revenue function, R, being not directly used for any subsequent analyses, is left out of the model subsequently.

3.5 The Quasi Supply Curve

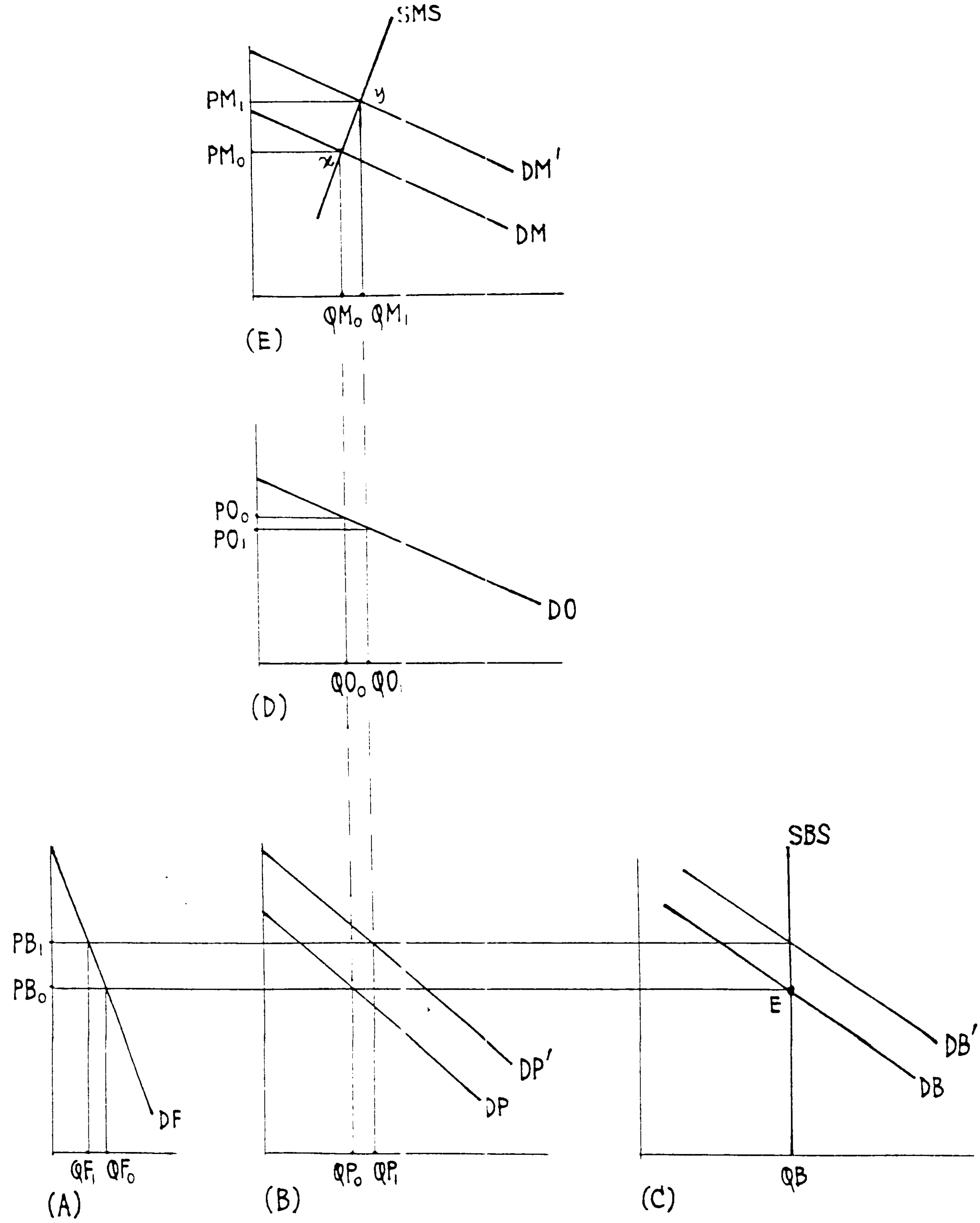
The foregoing model can be further generalized by introducing quasi supply curves for oil and meal to constitute a more complete short-run closed-economy model of the Thai soybean industry. Starting with an equilibrium point, E, where the short-run supply curve of soybeans, SBS, intersects the total demand curve of soybeans, DB, as depicted in section (C) of Figure 3.4, a quasi supply curve of oil or meal can be traced out by assuming an autonomous shift in the demand curve for the commodity.

For illustration purposes, a rightward shift of the demand curve of meal from DM to DM' is assumed, as depicted in section (E). As a consequence, fostered by the underlying relationship with which the model is constructed, DP in section (B) and DB in section (C) must instantaneously shift to DP' and DB', respectively.

The rightward shift of DB to DB' (section C) would cause bean price to increase from PB_0 to PB_1. This alters the share of beans going to the food industry and the crushing industry. With the new demand curve DP' and the higher price PB_1, the quantity of beans demanded by the crushing industry would increase by $QP_1 - QP_0$ (section B) and, given the demand curve in the food industry, DF, the higher price of beans would cause the quantity of beans demanded by the food industry to decrease by $QF_0 - QF_1$ (section A). It is noted that with this very short-run situation in which the total supply of beans is fixed, the model ensures that $QP_0 - QP_1$ just equals $QF_0 - QF_1$ to clear the markets.

Again, being dictated by the fixed conversion factors of the crushing process, the increase in the quantity of beans demanded from QP_0 to QP_1 (section B) implies an increase in the quantity of oil supplied from QO_0 to QO_1 (section D) and an increase in the quantity of meal supplied from QM_0 to QM_1 (section E). In the meal market, with a new demand curve DM' and a new (higher) level of supply of meal QM_1, the meal price would increase from PM_0 to PM_1. In the oil market, with a constant demand curve DO and a higher level of supply of oil QO_1, the oil price would decrease from PO_0 to PO_1. This is a common joint-product phenomenon by which an increase in the demand of one product would increase price of that product but depress the price of its joint product.

Figure 3.4 : Derivation of a Short-run Quasi Supply Curve of Meal



Returning to the meal market (section E), if we denote the point of intersection between the quantity of meal supplied QM_0 and price PM_0 as point *x* and that between QM_1 and PM_1 as point *y*, a short-run quasi supply curve of meal (SMS) can be traced out by drawing a line joining *x* and *y*. It is interesting to note that even in this very short-run situation with a fixed vertical supply level of soybeans as denoted by SBS (section C), the derived quasi supply curve SMS is positively sloped (section E). By the same token, a positively sloped quasi supply curve of oil can be derived using the same construct.

3.6 The Short-Run Closed Economy Model

With the existing information, a short-run, closed-economy, multi-market model of the Thai soybean industry which depicts one particular equilibrium situation can be presented as shown in Figure 3.5. Basically, the model consists of five negatively-sloped demand curves, (DF for the food industry, DP for the oil crushing industry, DB for the aggregate demand for beans, DO for soybean oil and DM for soybean meal), two positively sloped quasi supply curve (SOS for oil and SMS for meal) and a vertical supply curve of beans, SBS.

3.7 The Long-Run, ClosedEconomy Model

For a longer-run situation in which bean production is allowed to vary in response to price incentives, a somewhat different model is constructed. As depicted in Figure 3.6, a long-run model can be constructed by adding one additional, positively-sloped, long-run supply curve of beans (SBL) superimposed on section C of Figure 3.4.

Starting at the equilibrium point, e, where the aggregate demand curve and aggregate supply curve of beans intersect, one can compare short-run and long-run adjustment to a rightward shift in the demand for meal from DM to DM'. In this longer-run situation, the assumed rightward shift of DM to DM' would again result in a rightward shift of DP to DP' in the oil crushing industry and DB to DB' in the aggregate bean market. However, due to the difference in the slope of the short-run supply curve of beans, SBS, as opposed to the slope of the long-run supply curve of beans, SBL (as depicted in section C), the (same) initial autonomous shift in the demand curve of meal, through inter-market repercussions, produces quite different impacts on prices and quantities produced and consumed in all markets. Compared with the short-run situation, two marked differences are noted: (1) the rightward

Figure 3.5: Short-run Closed Economy Model of the Thai Soybean Industry

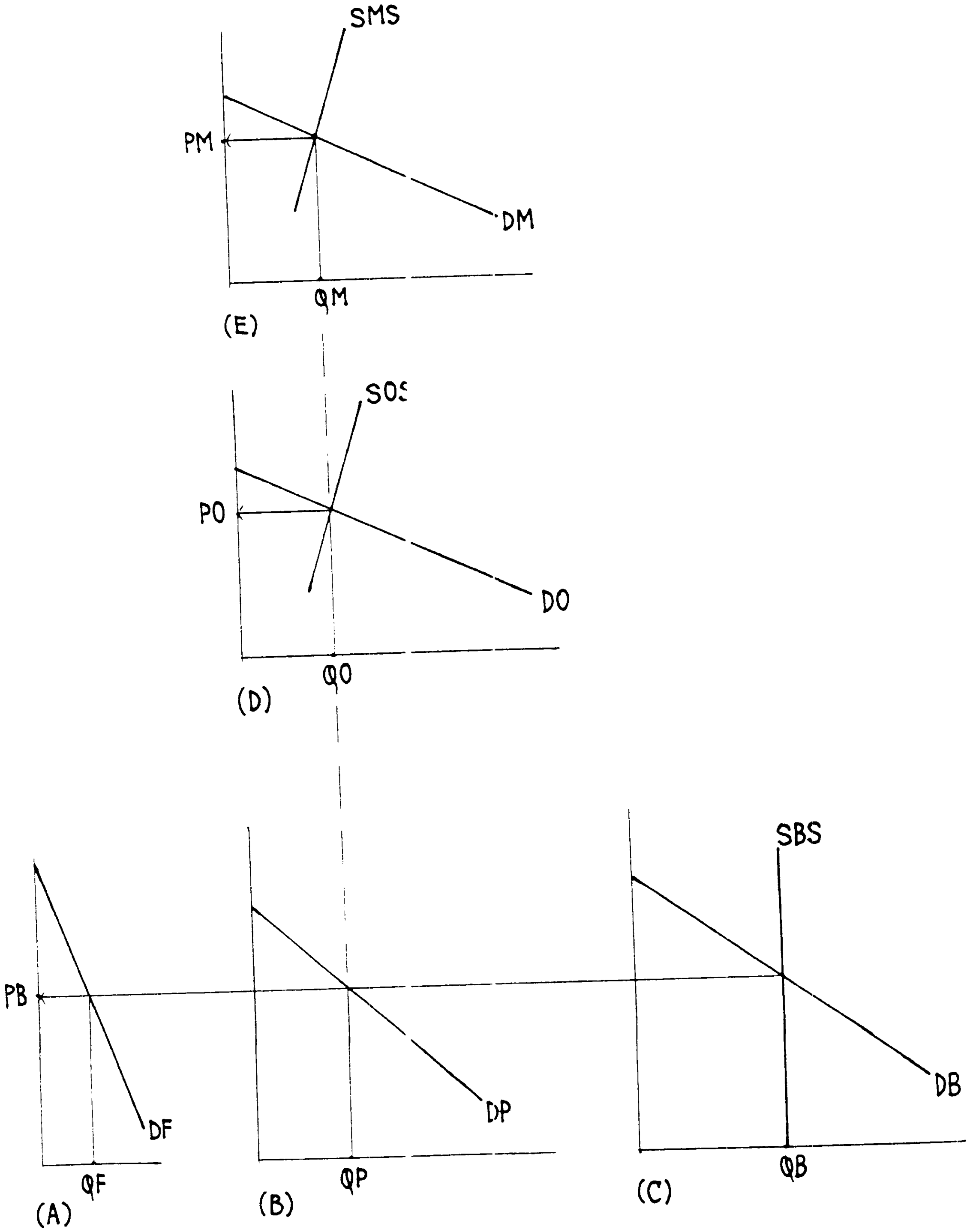
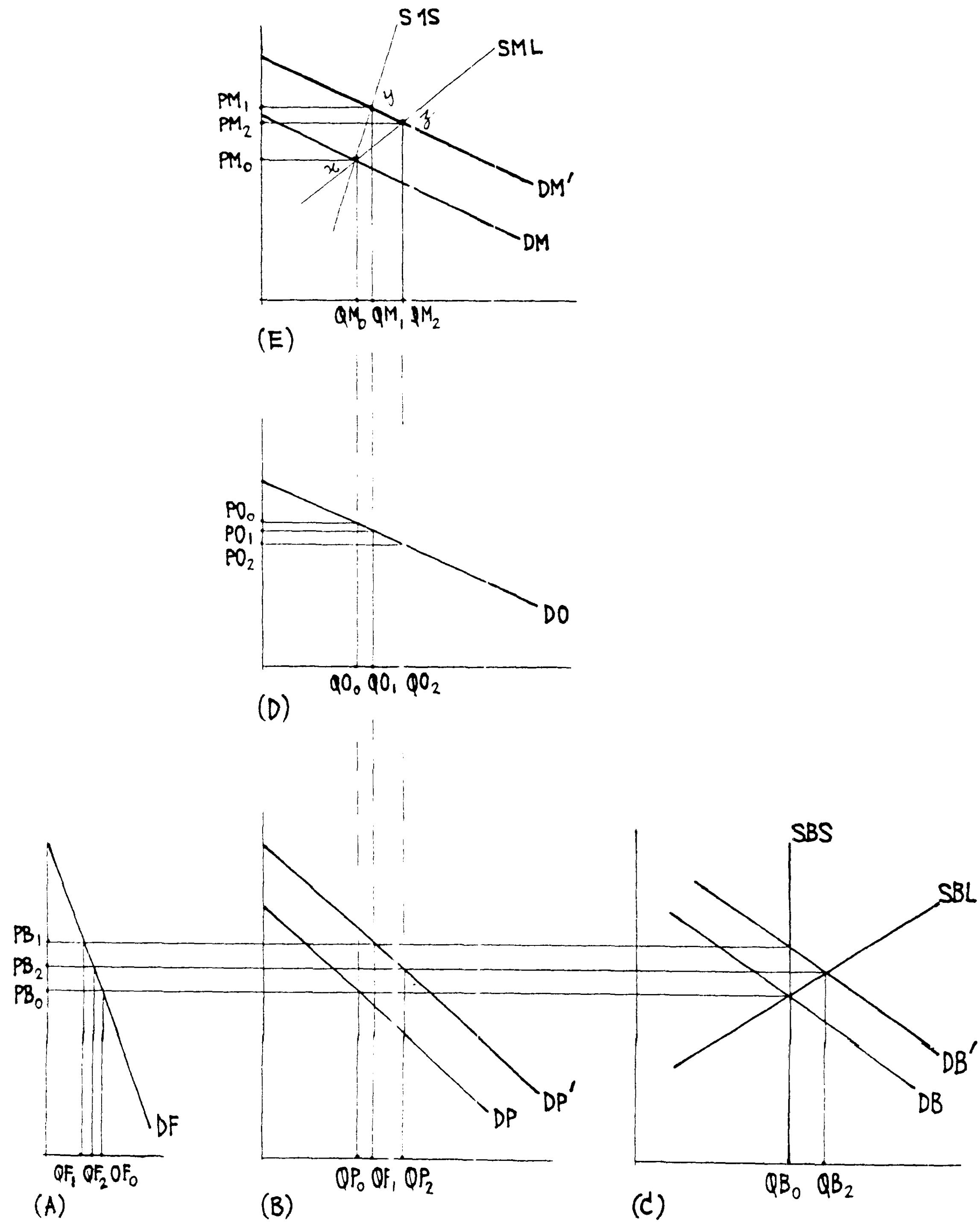


Figure 3.6: Derivation of a Long-Run Quasi Supply Curve of Meal



shift in the long-run case results in a production expansion of soybeans while in the short-run case the production of soybeans remains constant; and (2) the impact on price is less in the long-run case (i.e. $PB_2 - PB_0$ is less than $PB_1 - PB_0$).

For the oil processing industry (section B), a rightward shift of the demand curve from DP to DP', in the long run gives a higher price PB_2 with a higher level of the quantity of beans demanded as input in oil crushing (OP_0 to OP_2). For the food industry (section A), the higher bean price of PB_2 and constant demand schedule DF result in a lower level of demand (from QF_0 to QF_2).

Again, two marked differences are noted between the short-run and long-run cases: namely: (1) the increase in the quantity of beans demanded as input in oil crushing in the long-run case is greater than that would occur in the short-run case (i.e., $QP_2 - OP_0 > QP_1 - QP_0$) and the decrease in quantity of beans demanded for the food industry in the long-run case is less than that in the short-run case (i.e., $QF_0 - QF_2 < QF_0 - QF_1$); and (2) compared with the short-run case in which bean output is fixed so that the quantity of beans released from the food industry must be just sufficient to satisfy the increase in the quantity of beans demanded in oil crushing, in the long-run case it is the increase in local bean production $QB_2 - QB_0$ (section C) plus what is released from the food industry, $QF_0 - QF_2$ (section A), which satisfies the greater increase in input demand for beans in the crushing process, $QP_2 - QP_0$ (section B).

The greater quantity of beans being used as input in oil crushing instantaneously means a higher level of oil output (from QO_0 to QO_2 in section D) and higher level of meal output (from QM_0 to QM_2 in section E). Note that the increase in meal price in the long-run case is less than that of the short-run case (i.e. $PM_2 - PM_0 < PM_1 - PM_0$), whereas the decrease in oil price in the long-run case is greater than that of the short-run case (i.e., $PO_0 - PO_2 > PO_0 - PO_1$).

Once again, if we denote the point of intersection between the production level QM_2 and the price PM_2 by point z, then drawn a line joining x and z as depicted in section E, the result would be a long-run quasi supply curve of meal (SML). To sum up, compared with the short-run situation, in this longer-run case an autonomous rightward shift of DM to DM' in the meal market would produce the following different levels of impact: (1) to the food industry, less price increase and less decrease in quantity demanded; (2) to the oil crushing industry, less price increase and greater increase in quantity demanded; (3) to the aggregate beans market, less price increase and increases in quantities supplied and demanded; (4) to the oil market, a greater price decrease and greater increase in quantity supplied and demanded; and (5) to the meal market, less price increase and greater increase in quantity supplied and demanded. Finally, it is worth noting that with a more elastic supply schedule of beans (section C) in the long-run model, the derived quasi supply curve of meal is also more elastic (section E). Putting all the information together, a long-run, close-economy multi-market model of the Thai soybeans industry can be postulated as shown in Figure 3.7.

3.8 The Open-Economy Model

What has been conducted so far can be viewed as an attempt to develop a basic foundation for the development of an analytical framework for the present study, namely; a long-run partial equilibrium, open-economy, multi-market model of the Thai soybean industry. The remaining steps are to transform the model into one where international trade is possible.

Moving from the closed--economy model to the open economy model at once necessarily involves changes in the slopes and positions of several of the demand and supply schedules. For clearer illustrative purposes, it is chosen to move from the closed-economy model toward the open-economy model step-by-step by relaxing one (or some) of the assumptions sequentially. It is believed that the chosen procedure is preferable to the all-at-once move from the closed-economy to the open-economy in that it allows greater intuitive appeal in model postulation as well as model comparisons.

The model transformation starts again at the equilibrium point *e* as presented previously in Figure 3.6. The procedure first attempts to derive the slope of the quasi supply curve of soybean meal that would prevail in an open economy, while keeping all other equilibrium points constant. This can be done by assuming: (1) the international trade opportunities are open only to soybeans but not to soybean oil and soybean meal; and (2) the prevailing world price of soybeans (WPB) is just equal to the closed-economy equilibrium price (PB_0). Then, as presented in Figure 3.8, an open-economy quasi supply curve of soybean meal can be derived by the same procedure used in the previous section, namely, by assuming a rightward shift of the demand curve of meal from DM to DM' (the same shift is assumed for purposes of comparison).

Figure 3.7: Long-Run Closed Economy Model of the Thai Soybean Industry

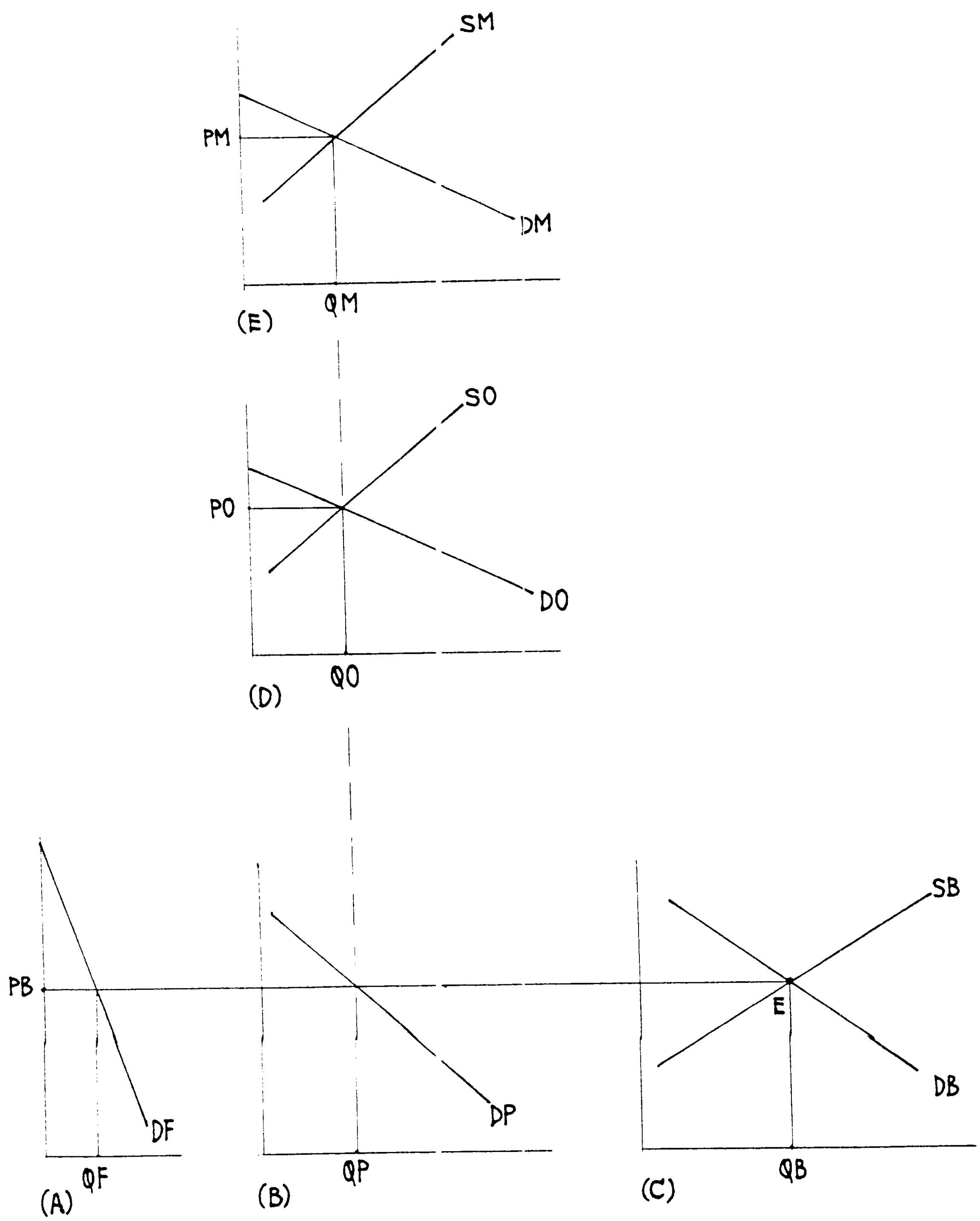
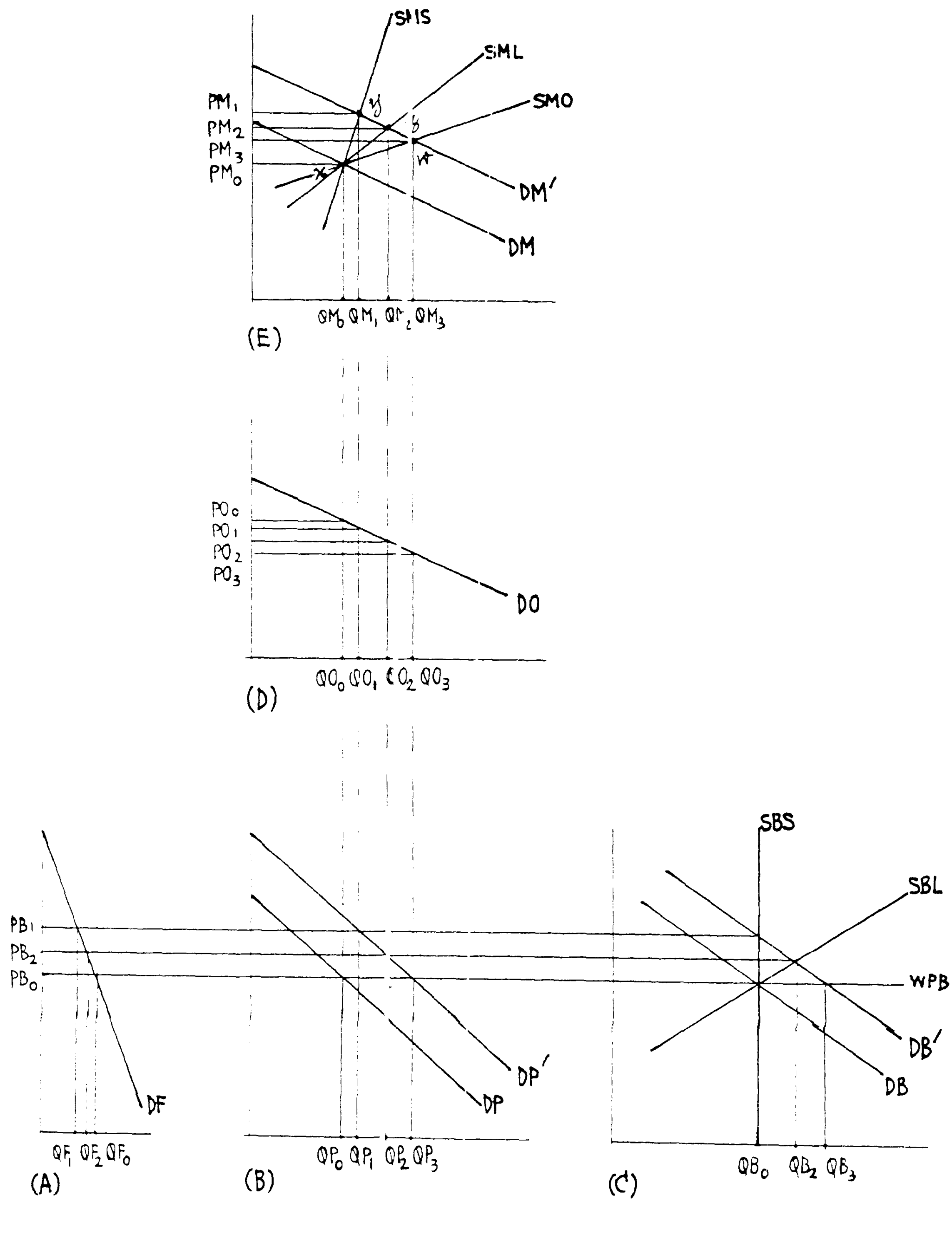


Figure 3.8: Derivation of an Open-Economy Quasi Supply Curve of Meal



The supply curve of soybeans is perfectly elastic at the world (import parity) price (section C). As a consequence, the shift of DM to DM' in the meal market which will result in the same shift as previously of DP to DP' in the crushing industry and, instantaneously, DB to DB' in the aggregate bean market, produces different impacts on prices and quantities supplied and traded in all markets. This is again due to the difference in the slope of the supply curve of soybeans (this time WPB as opposed to SBL or SBS).

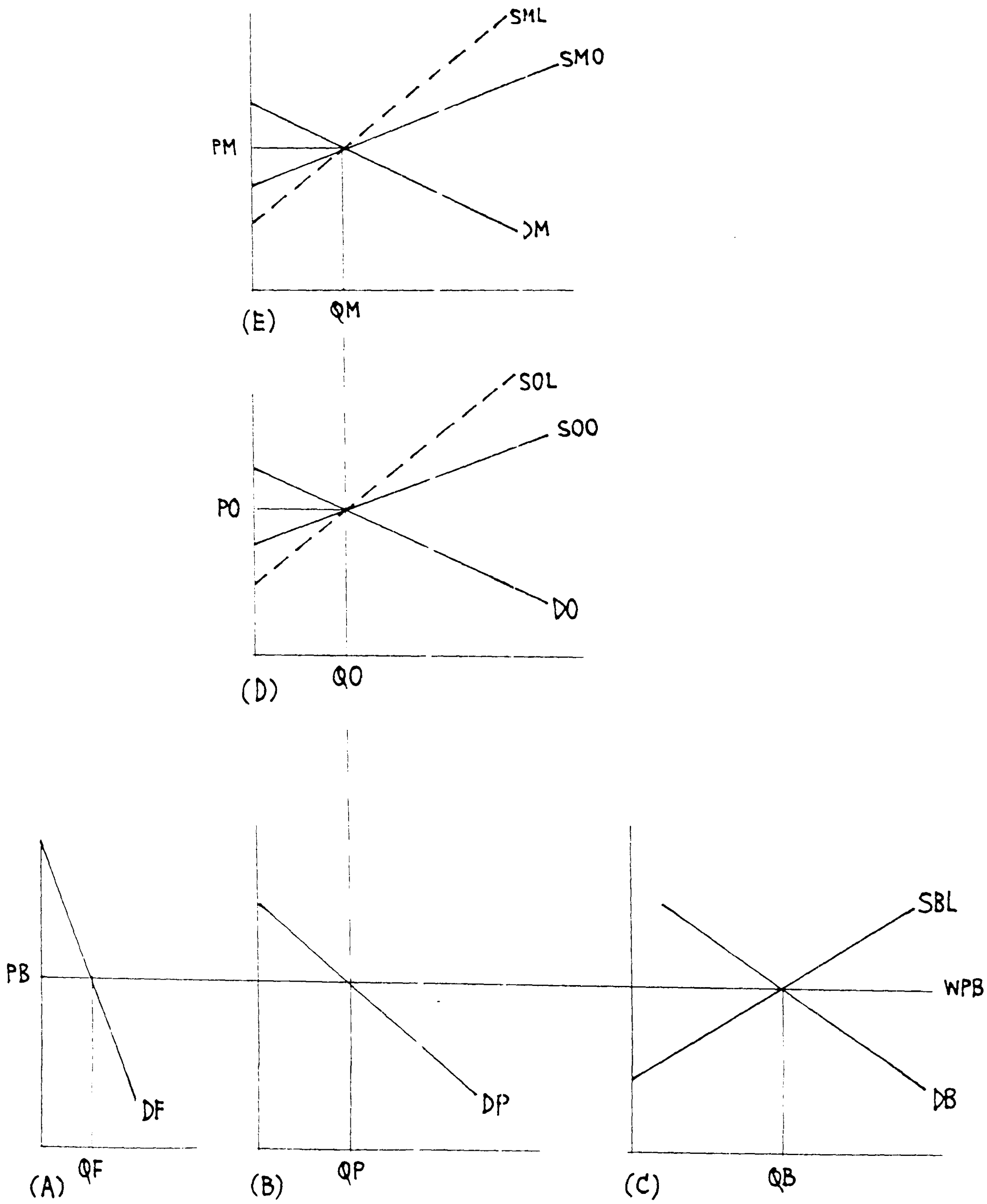
With the assumption of a given world price of soybeans, the shift of DP to DP' and consequently DB to DB' would only affect the quantity of beans demanded and not their price. With a fixed world price of beans, the quantity of soybeans demanded by the food industry would remain constant (section A), while the quantity of soybeans demanded for oil crushing would increase by $QP_3 - QP_0$ (section B).

As shown, this increase in the quantity of beans demanded by the crushing industry is higher than in the former two cases where the two less–elastic supply curves of soybeans (SBS and SBL) are assumed. Moreover, since there is no change in the quantity of beans used in the food industry, this increase in demand necessarily is equal to the increase in the total demand ($QB_3 - QB_0$) of the aggregate bean market. Moreover, according to the model, the increase is totally satisfied by importation (section C).

Again, because of the fixed conversion factors, the resultant increase in soybean oil production is $QO_3 - QO_0$ (section D) and in soybean meal is $QM_3 - QM_0$ (section E). In the meal market, with a new position of the demand curve and a greater (as compared to the former two cases) increase in meal production (to QM_3), meal price would increase from PM_0 to PM_3. Instantaneously, in the oil market with a constant demand curve DO the increase in oil production would cause oil price to drop from PO_0 to PO_3.

Again denoting the point of intersection between the (new) level of meal production QM_3 and the (new) price PM_3 by *w* (section E), then drawing a line joining point *x* and *w* yields a quasi supply curve of meal SMO. The quasi supply curve of oil can be derived in the same way. The model thus far developed is given in Figure 3.9. The long-run closed-economy quasi supply curves of soybean oil and meal are also given (in broken lines) for purposes of comparison (sections D and E).

Figure 3.9: Induced Change in the Slope of the Supply Curves of Oil and Meal Due to Change in the Slope of Supply of Beans



Two assumptions underlying the model development thus far are: (1) the world price of soybeans is equivalent to the closed-economy equilibrium market price; and (2) trade opportunities are open only to the bean market but not to the oil and meal markets. The relaxation of these two assumptions will yield the final model intended for use in the present study.

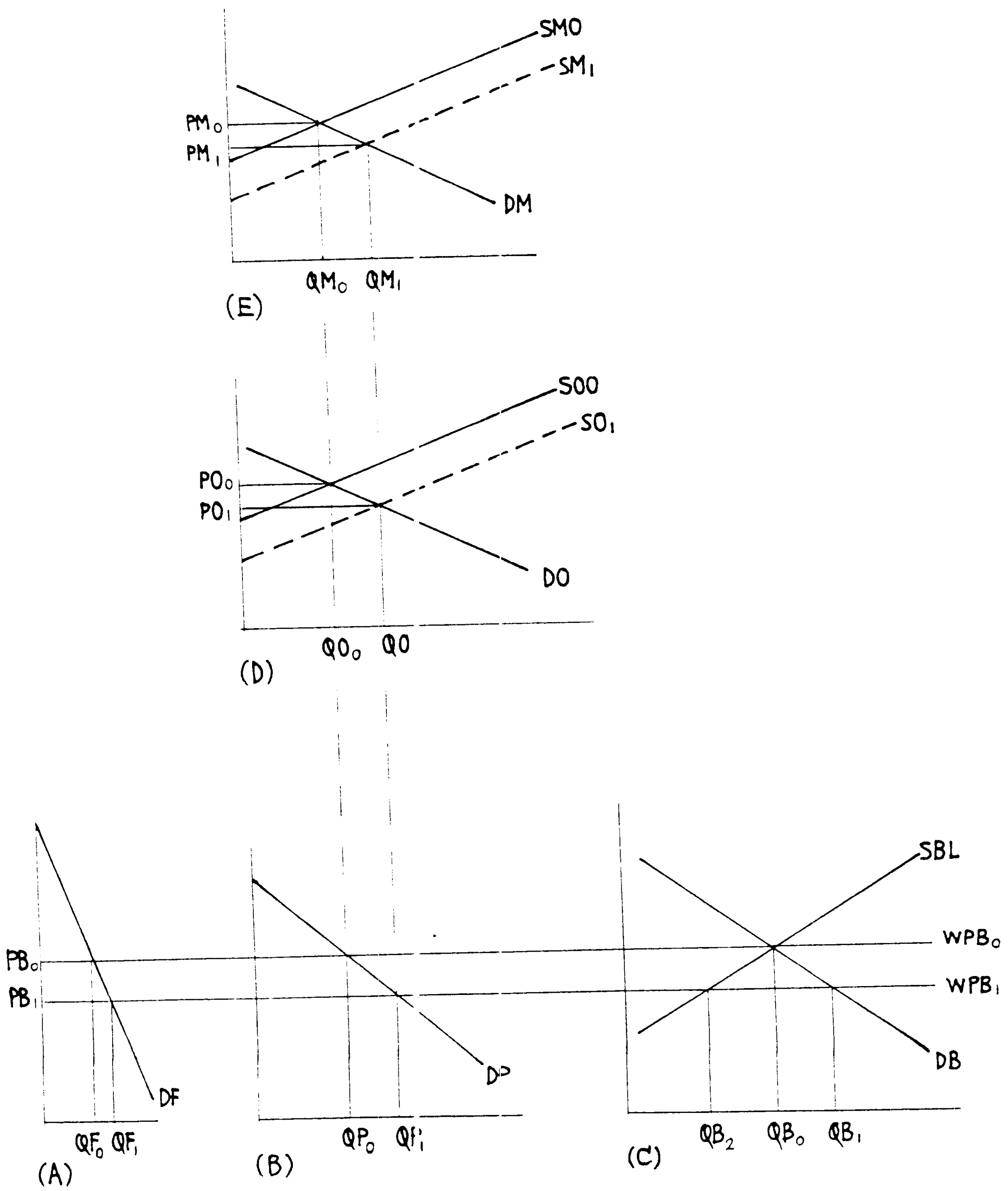
Regarding (1), the world price can be either higher or lower than the closed-economy equilibrium price. To be compatible with the current situation, a lower world price is chosen. Relaxing assumption (1) is equivalent to assuming a decrease in the world price of soybeans from, say, the former assumed level of WPB_0 to WPB_1 as depicted in section C of Figure 3.10. This results in several changes. In the aggregate soybean market the lower price causes the quantity of soybeans demanded to increase by $QB_1 - QB_0$ and local soybeans supplied to decrease by $QB_0 - QB_2$. The balance ($QB_1 - QB_2$) is totally satisfied by importation.

The increase in the quantity of soybeans demanded in the aggregate bean market (section C) is composed of the increase in the quantity demanded by the food industry ($QF_1 - QF_0$ in section A) and the increase in quantity demanded by the oil crushing industry ($QP_1 - QP_0$ in section B) which, according to the model, sums to $QB_1 - QB_0$. Consequently, governed by the fixed conversion factors in oil crushing, the increase in the use of soybeans as input for crushing along the derived demand curve of beans DP means a spontaneous increase in the production of oil by $QO_1 - QO_0$ (section D) and in the production of meal by $QM_1 - QM_0$ (section E).

In terms of cross-price effects, this fall in the price of beans as an input to oil crushing is characterized by a rightward shift of the supply curve of oil from SOO to SO_1 (section D) and that of meal from SMO to SM_1 (section E). In other words, it can be noted that, according to the present linear, three-market model the quantity of oil supplied, the quantity of meal supplied (assuming insignificant stocks so that the production level equals supply) and the quantity of beans demanded as input in oil crushing must be proportional to one another.

Thus, the supply function of oil, the supply function of meal and the derived demand function of beans as an input in oil crushing are related by one technical relationship, which is manifested as an elasticity condition: the own price elasticity of any one of the three function is equal to the sum of the cross-price elasticities of the remaining two functions (by virtue of having normalised the quantity units). Consequently, with the given demand curve

Figure 3.10: Impacts of a Decrease in World Price of Beans



of oil, DO, and demand curve of meal, DM, the increase in the production (thus supply) of the two commodities (in response to a lower input price) causes oil and meal prices to decrease by $PO_0 - PO_1$ and $PM_0 - PM_1$, respectively.

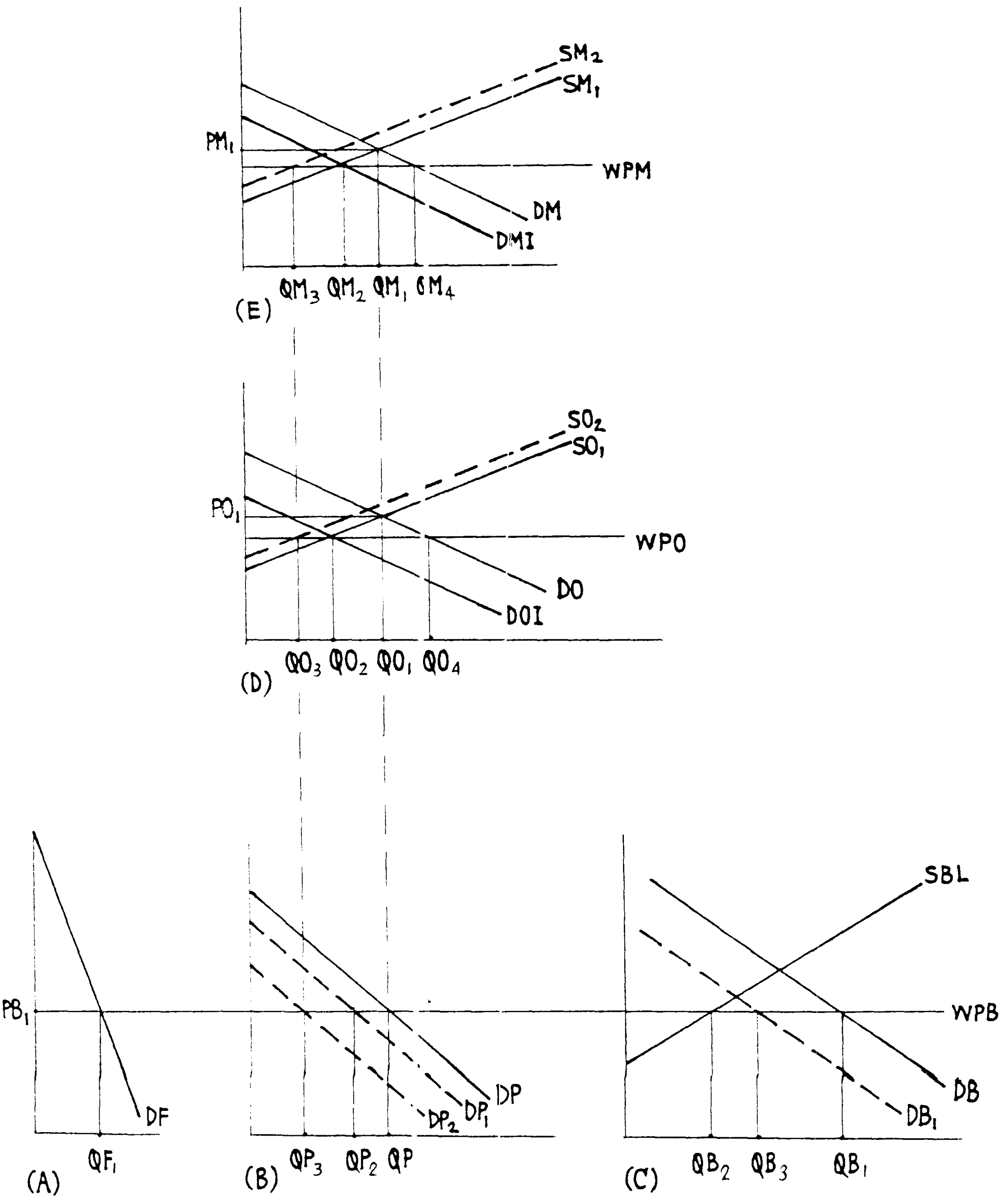
Finally the model is developed by relaxing assumption (2), (i.e., by introducing international trade opportunities to the oil and the meal markets). To do this, assumption (2) is dropped for both markets at the same time, since similar impacts would occur in relaxing the assumption to either market separately.

As presented in sections D and E of Figure 3.11, it is assumed that Thailand is faced with a world price of oil WPO and a world price of meal WPM. As before, these prices are chosen to be lower than the closed-economy equilibrium prices, PO_1 for oil and PM_1 for meal, to conform with the current situation. Faced with a lower price, the production of oil and meal would decrease by $QO_1 - QO_3$ and $QM_1 - QM_3$, respectively. In each of the markets, the decrease in supply is basically caused by an own-price effect (i.e., moving down the supply curve as price of the product decreases) as well as a cross-price effect (i.e., leftward shift of the supply schedule due to a decrease in price of its joint product). The demand for oil and meal would increase by $QO_4 - QO_1$ and $QM_4 - QM_1$, respectively. This results in the importation of oil equivalent to $QO_4 - QO_3$ and of meal equivalent to $QM_4 - QM_3$.

The cross–price effects resulting from price decreases in the oil and the meal markets would cause two successive leftward shifts in the derived demand curve for beans as oil-crushing input, moving DP eventually to DP_2. With the given world price of beans, this causes the quantity of beans demanded for crushing to decrease from $QP_1 - QP_3$. The aggregate demand curve of soybeans also shifts leftward from DB to DB_1 as quantity demanded and imports of beans decrease by $QB_1 - QB_3$.

As far as the relationship (the vertical additivity) among the three demand schedules DO, DM and DP is concerned, it is interesting to note that the opening of trading opportunities to the meal market which causes meal price to decrease from PM_1 to WPM (and thus domestic production to decrease by $QM_1 - QM_2$) can be equivalently visualized as an (implicit) leftward shift in the demand curve from DM to DMI. Fostered by the underlying relationships, the derived demanded curve DP would also shift leftward to DP_1, causing quantity demanded in this industry to decrease from QP_1 to QP_2. By the same token, opening trade opportunities to the oil market can be equivalently visualized as

Figure 3.11: Impact of Opening International Trade Opportunities to the Oil and the Meal Markets.



an implicit leftward shift in the demand curve of oil from DO to DOI thus causing DP to shift further leftward from DP_1 to DP_2 and hence, the quantity demanded further decreases from QP_2 to QP_3.

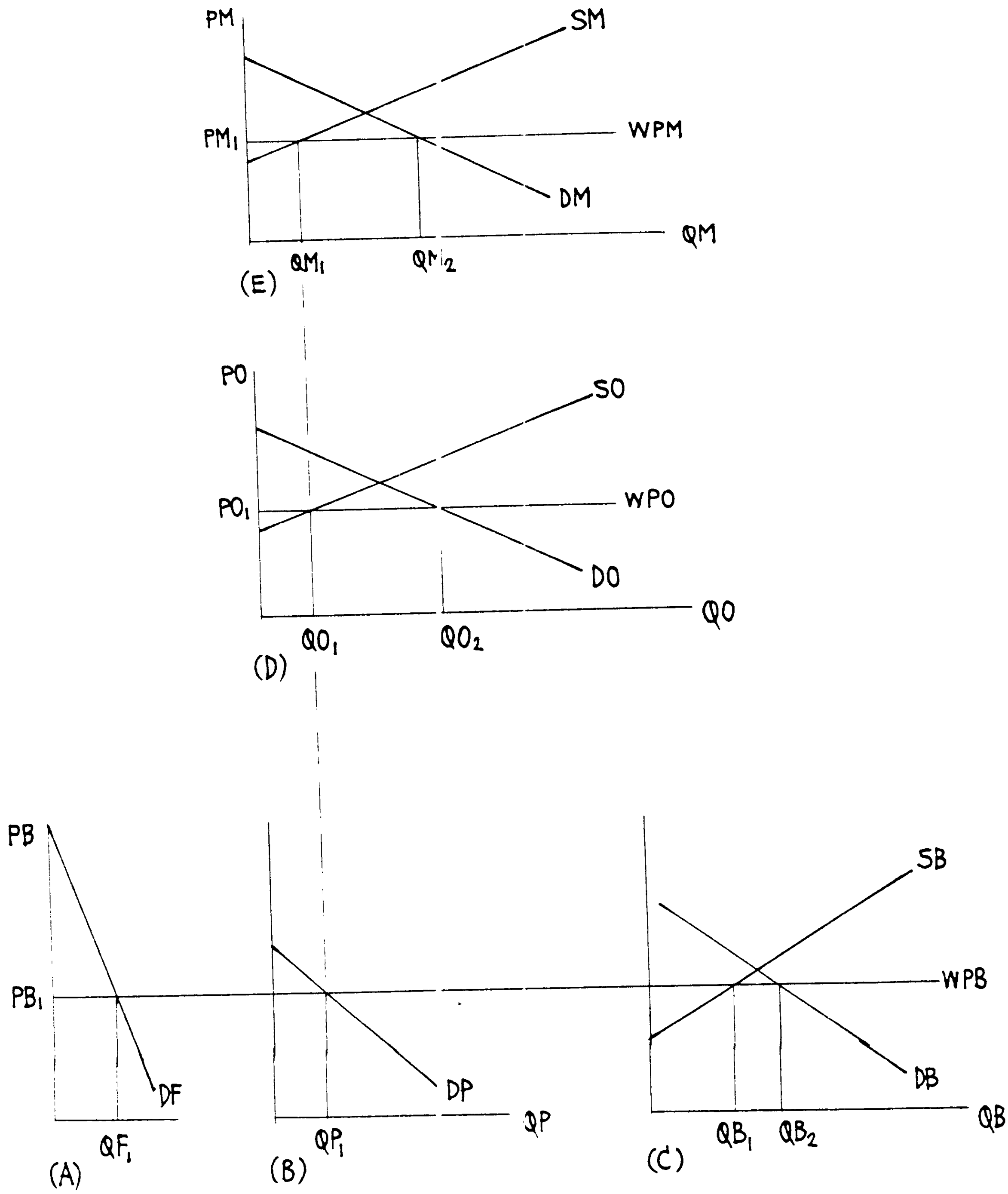
Though interesting in its own right, the device just mentioned is less appealing in model analyses than the concept of own and cross–price effects. Thus, only the latter will be used in subsequent analyses. Putting all the information together, and retaining only the final positions of all the supply and demand schedules, and renaming some of the the schedules as well as quantity points on the horizontal axis, a model of the Thai soybean industry to be used for policy analyses is presented in Figure 3.12.

3.9 Policy Analyses with the Model

Given the analytical framework developed thus far, this section aims to address some policy issues existing in the Thai soybean industry. The focal point of the analysis is to investigate theoretically the impacts of the Thai government's policy interventions, at various market levels of the Thai soybean industry, on the various concerned agents. The three major policy measures to be investigated are: (1) the import ban on soybeans; (2) the import tariff on soybean oil; and (3) the import surcharge on soybean meal. Following the major theme of the thesis, namely, to analyse the impacts of policy on resource use within the Thai soybean industry, emphasis will be given to measuring the changes as well as the net gain or loss in production and consumption of the three commodities as a result of the policy. This is to help determine the effectiveness and efficiency of the policy package in terms of its contribution to the net national income of the country as well as, though with less precision, its impacts on income distribution.

In the present study, determining 'effectiveness' means examining how well the policy package serves the government's objectives (e.g. increase farm-gate price, improve balance of trade), whereas to determine 'efficiency' means examining how the net result of the policy package affects resource allocation and aggregate welfare of the country. The policy analyses are carried out within a somewhat restrictive partial-equilibrium framework. The word 'restrictive' here refers to the fact that, in analysing any policy impacts with the present framework, feed-backs other than those explicitly accounted for in the model are assumed away. However, given the nature of the problem at hand, the framework is believed to be general enough to capture all the significant impacts of the policy interventions, at least in a comparative-static sense.

Figure 3.12: A Mode: of the Thai Soybean Industry



The use of the partial equilibrium framework has been recently referred to as the 'standard' or 'familiar' tool in analysing impacts of policy intervention, (e.g. see Lutz and Saadat 1988, Calegar and Schuh 1988 Tamin and Meyanathan 1988, Rahman and Mahmud 1988 and Myoung and Lee 1988). Also, according to Braverman, Hammer and Ahn (1987), two standard techniques frequently used by World Bank economists in their assessment of agricultural pricing policies are measurement of the domestic resource cost and the effective protection rate for various crops, and measurement of the consumers' and producers' surpluses within a partial-equilibrium framework. Occasionally, the choice of the partial-equilibrium model as an analytical framework has been defended on the grounds of it being a simple and time-saving device as opposed to its more complicated and time consuming counterpart — the general-equilibrium model (Currie, Murphy and Schmitz 1971, McCalla and Josling 1985).

While some authors have expressed their preference for the partial approach, others have proposed using the partial-equilibrium analysis with discretion and, when necessary, to extend the framework to take account of prevailing factors which traditionally have been considered as falling outside of its domain. These include market failure, risk and uncertainty, multi-market effects, income distribution and so forth. In general, the adjustments mainly consist of correcting the values of elasticities by appropriate factors to reflect these additional market characteristics (Scandizzo and Bruce 1980, p. 29). Still others, while accepting the conceptual superiority of the general-equilibrium framework, but anticipating the likely problems of information constraints and costs involved in constructing a reliable general-equilibrium model, advocate the use of a partial-equilibrium model which accounts for prevailing general-equilibrium effects as a practical approach (Setboonsarng 1983, p. 31, Braverman, Hammer and Ahn 1987, p. 469).

The adjustment to the framework takes various forms depending on research objectives and personal beliefs of the researchers. For instance, in analyzing wheat and maize price policies in Hungary, Braverman, Hammer and Marduch (1987) extended their analytical framework to include substitution possibilities in production and consumption of the two commodities and other closely related commodities such as sunflower seed and fodder. The authors were of the view that by the inclusion of the factor markets which link the agricultural and industrial sectors, the models would come close to a general-equilibrium representation.

This approach recently has become known as 'multi-market analysis'. It is the basic framework intended for the present study. Most analyses along this line of investigation are conducted using such a framework in order to take account for the interaction effects between closely interlinked commodities, both on the supply and demand sides. Depending on the underlying research objectives, these analyses take account of influences such as input price distortions, variability of border price and over-or under-valued exchange rates. Examples of such analysis can be found in Moon and Kang (1989), Myoung and Lee (1988), Lutz and Saadat (1988) and in Braverman, Hammer and Ahn (1987).

At this juncture it is worth noting that the framework of the present study does not take into account inter-market impacts involving some related commodities (e.g. between soybean meal and fishmeal) but, rather, concentrates on *directly* related commodities (i.e. soybeans, soybean oil and soybean meal). The model permits multi-market and multi-policy analyses and makes possible the appraisal of various policy combinations. Also the model is modified to account for problems of distortion elsewhere in the economy. The latter is a second-best policy assessment, the full details of which are given in Chapter 4.

In conducting the policy analyses attention will first be given to each policy measure in isolation (i.e., assuming there is only one policy at a time). Then investigation of the net impacts of certain policy combinations will be conducted. To be systematic, the description of policy impacts will follow a sequence:

(1) impact on price of the commodity *directly* affected by the policy, then changes in its level of production, consumption and net import;

(2) where applicable, impact on price of the related commodities *indirectly* affected by the policy and changes in their level of production, consumption and net imports;

(3) change in the welfare level of agents concerned, the government's revenue from tax, direction of the welfare transfer among agents and the net gain or loss for the community in terms of economy efficiency;

(4) assessment of the consistency between the net policy impact and the government's underlying policy objectives of raising farm income, raising farm output and improving the balance of international trade; and

(5) where applicable, differences will be highlighted between the analytical results of the multi-market model being used and those that would be generated from using a single-market model.

In the welfare analyses that follow, linear demand and supply schedules with parallel shifts are assumed and competitive market clearing is imposed. In view of Harberger's (1971) three postulates (the competitive demand price for a given unit measures the value of that unit to the demander; the competitive supply price for a given unit measures the value of that unit to the supplier; and, when evaluating the net benefits or costs of a given action policy, the costs and benefits accruing to each member of the relevant group should normally be added without regard to the individual(s) to whom they accrue), standard surplus measures are used as measures of welfare change. The same assumptions have been used by Alston and Hurd (1990) and referred to as having important implications in multi-market analyses.

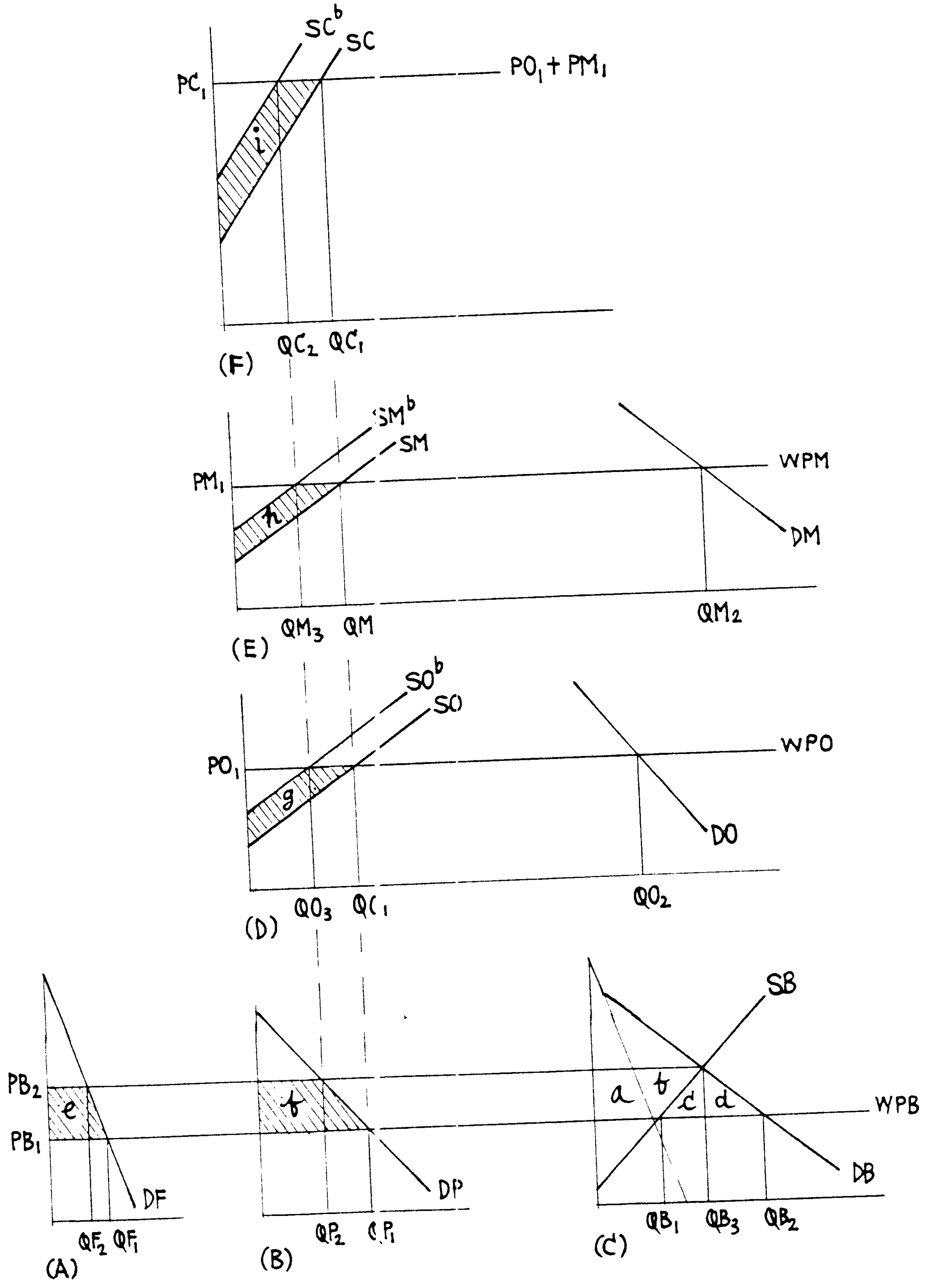
For a clearer presentation of welfare analyses, a supply schedule for the combined production of soybean oil and soybean meal (SC) has been added to diagrams as presented in section (F) of Figure 3.13. Being the vertical summation of the supply of oil (SO) and supply of meal (SM), SC can be viewed as the marginal cost curve of producing the combined output of oil and meal. In this context, along the horizontal axis, QC represents both the quantity of oil and quantity of meal being produced, expressed as the equivalent quantity of beans (QP) being processed.

Starting with this structural model the impact of policy interventions in the Thai soybean industry in the form of single policy and policy combinations can be analysed.

3.10 The Ban Only

This analysis shows *theoretically* how the imposition of an import restriction in the form of a ban on the importation of soybeans (grains), with the oil market and the meal market facing a free-trade situation, would affect the community.

Figure 3.13: Impacts of an Import Ban on Soybeans



(1) In the grain market, with a free-trade situation and facing the world price of beans (WPB), the prevailing domestic price is the import-parity price (PB_1). Following the conventional approach in this area of economic investigation, PB_1 is taken as approximately equal to the world price and represents both the wholesale price facing the demanders of beans and farm-gate price facing the farmer. That is, for simplicity, price differences resulting from marketing margins and other costs are assumed away at this stage of analysis. This is done with the contention that policy impacts are measured by the differences in prices and in quantities rather than by their absolute levels. If price transmissions at all levels of the marketing channel are fairly uniform (which is fostered by the competitive market assumption), it is anticipated that policy impacts measured with the so-called 'Dupuit' triangle analysis would approximately produce the same result regardless of what absolute level has been used.

With the demand curve (DB), the supply curve (SB) and a free-trade price of beans (PB_1) as given in section (C) of the diagram, the total quantity of beans demanded would be QB_2 of which QB_1 would be supplied from domestic production and the rest, $QB_2 - QB_1$, from imports. With an autarky situation where the government enforces an import ban on soybeans, the domestic price would increase to PB_2, and the total quantity demanded would decrease to QB_3 of which all would be satisfied by domestic production. The decrease in total demand for beans consists of a decrease in quantity demanded in the food industry of $QF_1 - QF_2$ and a decrease in quantity demanded in the oil crushing industry of $QP_1 - QP_2$.

(2) The decrease in demand for beans as input in oil crushing instantaneously means decreases in the production of oil and meal by $QO_1 - QO_3$ and $QM_1 - QM_3$, respectively. Facing a world price of oil (WPO) and a world price of meal (WPM), the demand for oil and meal would remain constant at QO_2 and QM_2, respectively. Consequently, importation of oil and meal would increase by $QO_1 - QO_3$ and $QM_1 - QM_3$, respectively, to replace the decrease in domestic production. These decreases in production with constant price are characterised by a leftward shift in the quasi-supply curve of oil from SO to SO^b (section D) and a leftward shift in the quasi-supply curve of meal from

SM to SM^b (section E) or equivalently by a leftward shift in the supply curve of the combined product SC to SC^b (section F).

(3) Considering the welfare effects of the policy (as depicted in section C), this market intervention in the form of import ban on soybeans would entail a gain in producer surplus of area $a + b$, and a loss in consumer surplus of area $a + b + c + d$. It is noted that the total welfare loss in consumption consists of a welfare loss in consumption in the food processing industry (area e in section A) plus a welfare loss in consumption in the oil processing industry (area f in section B), (where $e = a$ and $f = b + c + d$).

From the diagram, the leftward shift in supply curves would result in a welfare loss of area g in the oil market (section D), area h in the meal market (section E) and area i in the combined product diagram (section F). Because of the way in which the model is constructed $g + h = i$, and since the change in the producer surplus measured off the supply schedule in the output market is equivalent to the change in the consumer surplus measured off the derived demand schedule in the input market, the welfare-change impact of the policy on the oil crushing industry can be measured either by: (1) area f; (2) area $g + h$; or (3) area i. Similar accounts are given in Just, Hueth and Schimitz (1982) and also in Alston (1990).

According to this hypothetical case the policy intervention would result in a welfare transfer from the producers and consumers in the food industry and the producers in the oil crushing industry to the soybean farmers. There is no impact on government revenue and, all-in-all, the intervention results in a net deadweight loss of area $c + d$ (section C) to the society, comprising a net efficiency loss in production (NELP) represented by area c and a net efficiency loss in consumption (NELC) represented by area d.

(4) The policy impacts are consistent with the government's objective of raising farm income and output. The impact on the balance of trade is obscure without a numerical result. At this stage, it can only be concluded that the balance of trade will be better or worse depending on whether $PB_1 (QB_2 - QB_1)$ is greater or less than $PO_1(QO_1 - QO_3) + PM_1(QM_1 - QM_3)$.

(5) Since the import ban on soybeans does not induce price changes in the two related markets (oil and meal), there are no feedback impacts from the oil and meal markets to the bean market. In this case, all concerned industries in fact can be considered as explicitly (though crudely) represented in the aggregate bean market. Therefore, a multi-market model (the full diagram of Figure 3.13) or a single-market model (only section C of Figure 3.13) would generate the same result for the measurement of the overall welfare impacts. However, more detailed information can be obtained from the full model. For instance, without a full model one might mistakenly conclude that an import ban on soybeans can definitely improve the balance of trade.

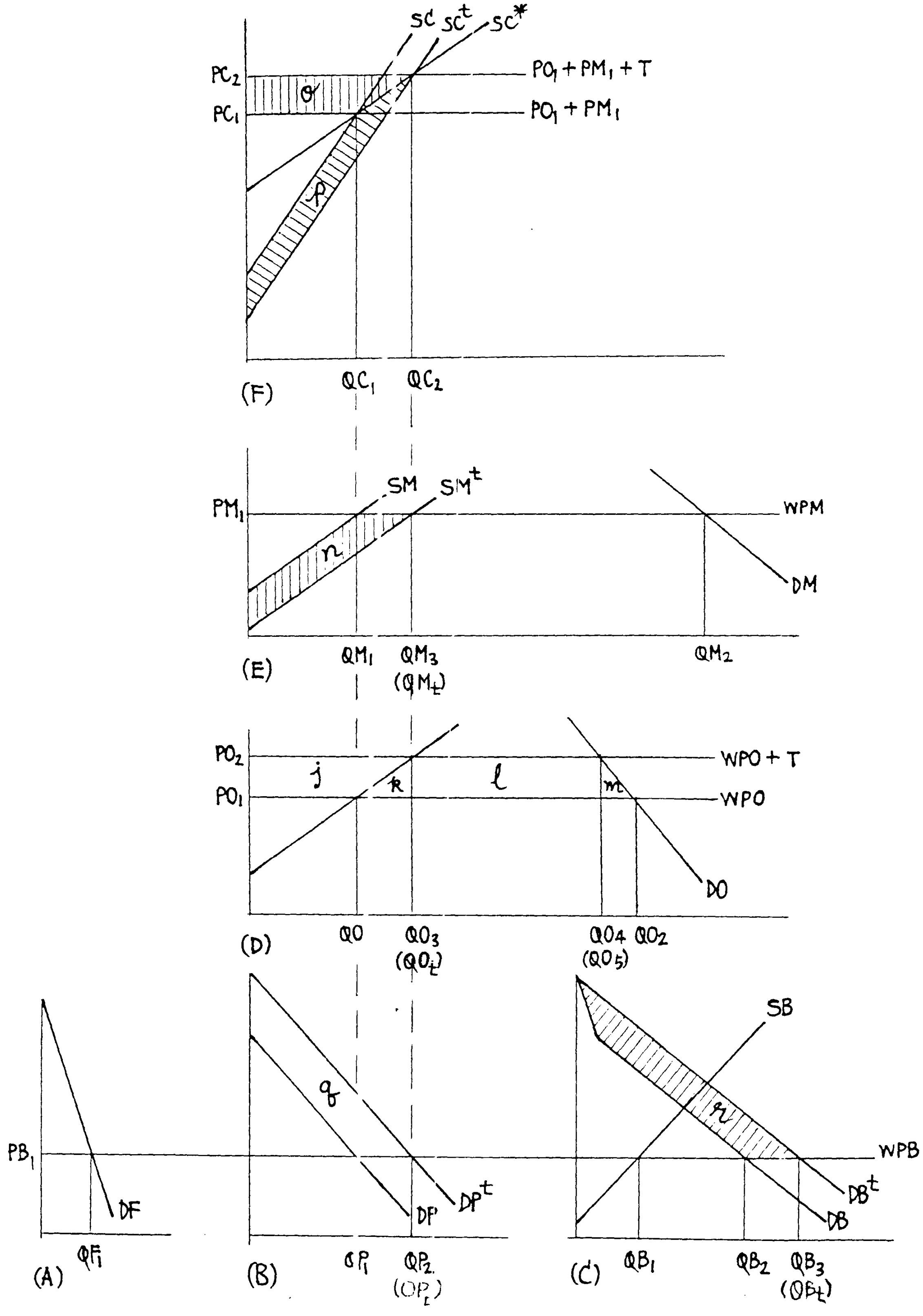
3.11 The Tariff Only

This section analyses the impacts of a tariff imposed on the importation of soybean oil while, again, the bean market and the meal market are assumed to operate with a free-trade system.

(1) In the oil market, as depicted in section D of Figure 3.14, the imposition of an import tariff of *T* would cause the import parity price of soybean oil to increase from PO_1 to PO_2. Consequently, domestic supply would increase from QO_1 to QO_3 and domestic demand would decrease from QO_2 to QO_4. This leads to a decrease in the level of imports from a free-trade level of QO_2 - QO_1 to a level of QO_4 - QO_3.

(2) In the related markets, the joint production of meal (section E) would increase from QM_1 to QM_3. With the given meal price PM_1, this is represented by a rightward shift of the quasi-supply curve of meal from SM to SM^t. Consequently, imports would decrease by QM_3 - QM_1. What happens in the oil and meal markets can also be detected from the combined production supply schedule which faces the same increase in price (from PC_1 to PC_2 where $PC_2 - PC_1 = PO_2 - PO_1$) and a rightward shift of the supply schedule from SC to SC^t as reflected by the meal market. Joining the two points of the price-production pair would yield a quasi supply curve of the combined production of oil and meal (SC*) as depicted in section (F).

Figure 3.14: Impacts of an Import Tariff on Soybean Oil



In the input market, the increase in the demand for beans as input to produce more oil (and meal) with the given price of beans PB_1 is characterized by a rightward shift of the derived demand curve of beans for oil crushing from DP to DP^t (section B), and the aggregate demand curve of beans from DB to DB^t (section C). The increase in the utilization of beans as input in oil crushing is QP_2 - QP_1 and is totally satisfied by an equal increase in the importation of beans of QB_3 - QB_2. Since the bean price is unchanged, the demand for beans from the food industry remains the same at QF_1.

(3) As far as the welfare effects of the imposition of an import tariff on soybean oil are concerned, as depicted in section D, the loss in the consumer surplus is the area $j + k + l + m$. The gain in the producer surplus is area j. The government's tax revenue is area l. This results in a transfer of welfare from the oil consumers to the oil producers and government with a deadweight loss of area $k + m$, where k is the NELP and m is the NELC. Again, area j in the oil market and area n in the meal market are equal to area o and area p, respectively, in the combined output diagram.

The increase in the level of the combined joint output of meal and oil in response to an increase in oil price from PO_1 to PO_2 (while meal price and bean price are constant), or equivalently, an increase in the price of the combined products from PC_1 to PC_2, would result in an increase in the producer surplus of area o (not $o + p$) as reflected from the quasi supply curve SC*. Thus, in this joint product case, it is interesting to note that though an import tariff on oil would result in an increase in oil production along the supply schedule of oil in response to higher price (section D) and a spontaneous increase in meal production (as a joint product of oil) at any given price characterized by a rightward shift of the supply curve of oil (section E), the measure of the producer surplus in the oil market (i.e., area j) alone would represent the total increase in producers' welfare. The inclusion of area n of section E as part of the increase in producers' welfare would, by analogy, be equal to the inclusion of area p of section F as part of the increase in producers' welfare and, thus, result in an over-estimate of the surplus value. Again, because of the relationship between the output-supply and input-demand schedules, the increase in the producer surplus (j or o) can also be measured by area q (section B) or by area r (section C).

(4) The present scenario assumes free trade for the bean market and, hence, the ruling price in the bean market is the import parity price. Therefore, the increase in domestic price of oil as a result of the import tariff does not induce an increase in the farm price of beans. It can be concluded that the oil tariff does not meet the government's objectives (of raising farm income and farm output). However, it may contribute to the trade objective by saving some foreign earnings as a result of additional oil crushing activity, depending on whether the foreign exchange saved from lower importation of meal and oil is greater than what must be paid for the increased importation of beans.

(5) Again, since the tariff on oil does not induce price changes in the two related markets (of meal and beans), there are no feedback impacts. Thus, a single-market model (section D) and a multi-market model (the full diagram of Figure 3.14) would produce identical net overall welfare impacts of the policy measure. However, the full model sheds more light on balance of trade issues.

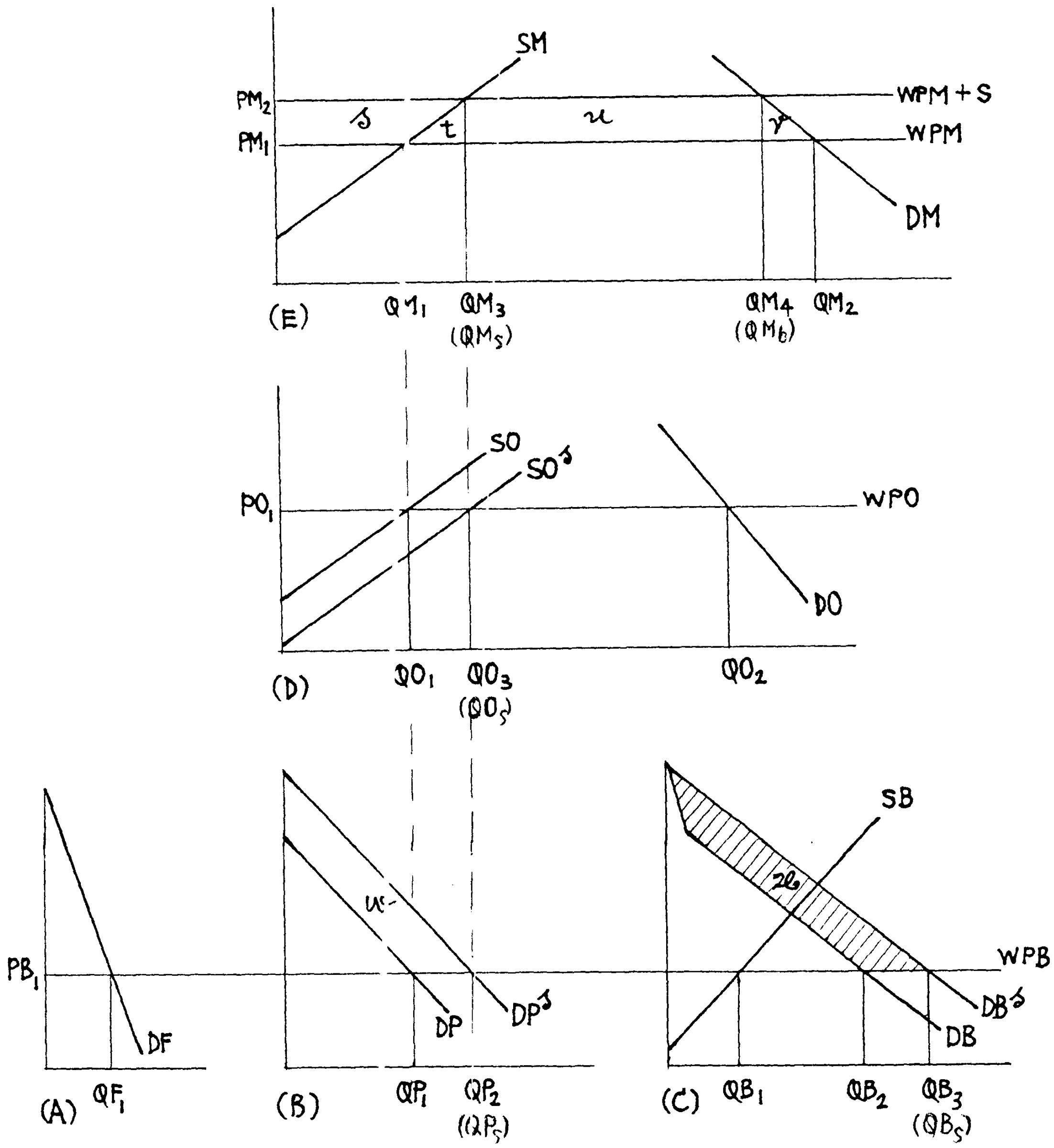
3.12 The Surcharge Only

In analysing the impacts of a system of variable surcharges on the importation of soybean meal, it is assumed that a free trade situation for the two related markets (beans and oil) applies. The investigation focuses on the impacts resulting from the increase in the average domestic meal price resulting from the imposition of the surcharge. The supply schedule of the combined output, having served the purpose of identifying the relationship among surplus values, is dropped from the full diagram for simplicity.

(1) In the meal market (section E), a surcharge of *S* would cause the import parity price of meal to increase from PM_1 to PM_2. As a consequence, domestic meal production increases by QM_3 to QM_1 while consumption decreases by QM_2 - QM_4 and net imports decrease from QM_2 - QM_1 to QM_4 - QM_3.

(2) In the oil market (section D), as a joint product of meal, production increases instantaneously from QO_1 - QO_3. This is characterized by a rightward shift of the supply curve of oil from SO to SO^s. Since demand is unchanged, imports decrease by the same amount as the increase in domestic production.

Figure 3.15: Impacts of an Import Surcharge on Soybean Meal



There is an increase in demand for beans as input in oil crushing represented by a rightward shift of the derived demand curve of beans from DP to DP^s (section B) and a rightward shift of the aggregate demand curve of beans from DB to DB^s (section C). The quantity of beans demanded as input in oil crushing increases by QP_2 - QP_1 which is equal to the increase in imports of beans (QB_3 - QB_2).

(3) As depicted in section E, the increase in producer surplus is area *s* (or equivalently, area *w* in section B or area *x* in section C) and the decrease in consumer surplus is area $s + t + u + v$. With government surcharge revenue of area *u*, the total dead weight loss is area $t + v$, where *t* is the NELP and *v* is the NELC. Like the case of a tariff on oil, this policy intervention results in a transfer of welfare from consumers of meal (the feed and the livestock industries) to the oil crushing industry and the government.

(4) The surcharge alone does not result in an increase in the farm price of soybeans and, hence, does not contribute to the government's objective of raising farm income and output. However, in addition to the possibility of improving the balance of trade, the system of surcharges might contribute to the government's price stabilisation objective given that the surcharge is variable.

(5) Since the surcharge does not induce price changes in the two related markets (of beans and oil), there are no feedback impacts. The single-market model and the multi-market model are identical in providing information on the overall welfare impacts of the policy, while the latter provides more information with regard to balance of trade.

3.13 Policy Combinations

Given that there are three related markets and three market interventions under consideration, the number of possible policy combinations is numerous. The four policy combinations and their impacts that are considered are thought to be the most relevant. They are:

(1) the marginal impacts of an import tariff on oil with the import ban on beans already in place;

(2) the combined net impacts of the import tariff on oil and import ban on beans;

(3) the marginal impacts of a system of import surcharges on meal with an import tariff on oil and an import ban on beans already in place; and

(4) the combined net impacts of the three policy measures.

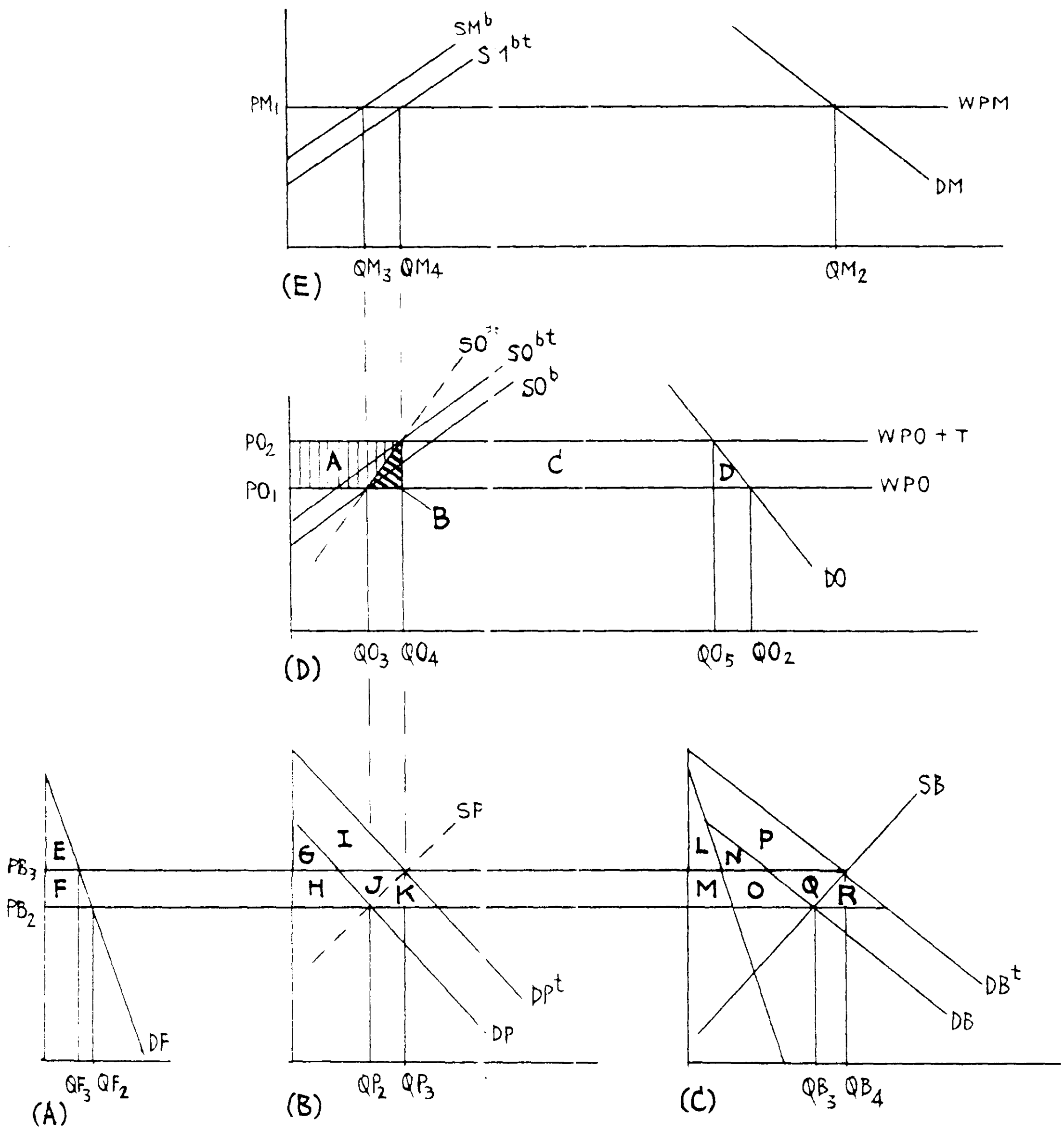
3.14 Marginal Impacts of Oil Tariff with Ban on Bean Imports

To detect the marginal impacts of an import tariff on oil while the import ban on beans is already in operation, the analysis starts with the market configuration described in the post-ban situation (of Figure 3.13) Then a tariff rate of *T* is imposed on the import of oil as depicted in section D of Figure 3.16.

In the oil market (section D), the tariff causes price to increase from PO_1 to PO_2. The producers' response is to increase oil production along the supply curve SO^b. (This is the position of the curve after the ban and thus the superscript b). The increase in oil production means a higher level of meal production and higher demand for beans as input. Hence, the supply curve of meal, the derived demand curve of beans and the aggregate demand curve of beans shift to the right. However, unlike the situation where the bean market is facing a free-trade situation and demanders of beans are facing a perfectly elastic supply curve (i.e., the world price), with an import ban on beans in place bean prices are determined by domestic demand and supply conditions. In other words, purchasers are facing a positively sloped supply curve, SB, as depicted in section C of the diagram.

As a consequence, the increase in demand for beans results in a higher bean price. The higher bean price causes the supply curve of oil and that of meal to shift leftward. After successive rounds of adjustment, a new equilibrium is reached in which: (1) the supply curve of oil has shifted leftward from SO^b to SO^{bt}; (2) the supply curve of meal has shifted rightward from SM^b to SM^{bt}; (3) the demand curve for beans as input to crushing has shifted rightward from DP to DP^t; and (4) the aggregate demand curve for beans has shifted rightward from DB to DB^t.

Figure 3.16: **Impacts of an Import Tariff on Soybean Oil with an Import Ban on Soybeans.**



In the oil market, a new quasi supply curve of oil (SO^*) can be formed by drawing a line joining the point of intersection between PO_1 and SO^b, and that between PO_2 and SO^{bt}. The curve SO^* is termed 'general equilibrium supply curve' that incorporates equilibrium adjustment of input use and input price as output price changes. It has the important property that the change in producer surplus defined with respect to the curve measures the net change in quasi-rent for all affected industries for which adjustments have been considered (Just, Hueth and Schmitz 1982).

However, with exogeneous output prices for oil and meal, one additional assumption is needed before SO^* is a true general equilibrium supply curve; namely, the production of beans (as an input) faces perfectly elastic supply curves for all factors of production. This is probably not an unrealistic assumption in the case of Thai soybean production, at least within the context of marginal changes in production as a result of policy intervention. The increase in soybean production is mainly realized from the decrease in production of its competitive crops. Though one might argue that a different crop may require different input intensities, the differences are assumed to be insignificant for the present study for simplicity.

The marginal impacts of the tariff can be summarized as follows.

(1) In the oil market (section D) price would increase from PO_1 to PO_2. Domestic oil output increases from QO_3 to QO_4 while demand falls from QO_2 to QO_5, resulting in a net decrease in imports of $(QO_2\text{-}QO_5) + (QO_4\text{-}QO_3)$.

(2) In the meal market (section E), production increases by QM_4 - QM_3. Imports would fall by the same amount. In the bean market (section A, B, and C), demand for beans as an input in oil crushing increases by QP_3-QP_2. With an import ban policy already existing, this increase in demand causes the bean price to increase from PB_2 to PB_3. Consequently, the demand for beans in the food industry decreases by QF_2-QF_3. This results in a net increase in demand for beans of $(QP_3\text{-}QP_2) - (QF_2\text{-}QF_3)$, which is totally satisfied by the increase in the domestic supply of beans, QB_4-QB_3.

At this juncture, it is worth noting that, drawing a line joining the point of intersection between PB_2 and DP, and between PB_3 and DP^t, as shown by the broken line in section B, would yield a quasi-supply curve of beans to the oil crushing industry (SP). For every level of bean price, SP = SB-DF. This has the following interesting implications for the measurement of welfare.

(3) In the oil market, the increase in the producer surplus in this case is denoted by area A. (It is noted that if the producers were facing a constant input price of beans the producer surplus would be measured in association with SO^b rather than SO^* and would thereby be greater in value.) The loss in consumer surplus is $A+B+C+D$. With area C as a tax revenue going to the government, the deadweight loss to society is $B+D$, where again B is the NELP while D is the NELC.

In the bean market, the sum of areas *E, F, G, H, I, J* and *K* (of section A and B) are equal to the sum of areas *L, M, N, O, P, Q* and *R* (of section C). Considering the aggregate bean market, as farmers increase their output from QB_3 to QB_4 as a result of the tariff on oil, the producer surplus (of farming) increases by area $M+O+Q$ whereas the change in the consumer surplus is denoted by area P-M-O. Therefore the net increase in welfare is equal to $(P-M-O) + (M+O+Q) = P+Q$. This is equal to areas $I+J$ of section B, which, in turn, must equal A of section D because of the relationship between an equilibrium output curve and its input demand schedules mentioned earlier.

This has the implication that, with a general equilibrium supply curve SO^* which allows feedbacks from the input market to be explicitly accounted for in the model, the measure of the producer surplus (associated with this equilibrium supply curve), in addition to reflecting the change in the producers' welfare of the oil crushing industry, includes changes in the welfare of all parties concerned in the input market as well.

However, detecting welfare change from the bean market provides the added advantage that the welfare transfer can be studied in more detail. Apart from knowing that the tariff has resulted in a welfare transfer from the oil consumers to the government (by area C) and to oil producers (by area A), farmers gain area $M + O + Q$, and food consumers lose area $F(=M)$. Therefore, the net gain (or loss) of the oil processing industry can be determined by either $(A–O–Q)$, $(A–H–J)$, $(I–H)$ or $(P–O)$.

(4) With an import ban on beans, the tariff on oil is consistent with the government's objective of raising farm income and output as well as improving the balance of trade.

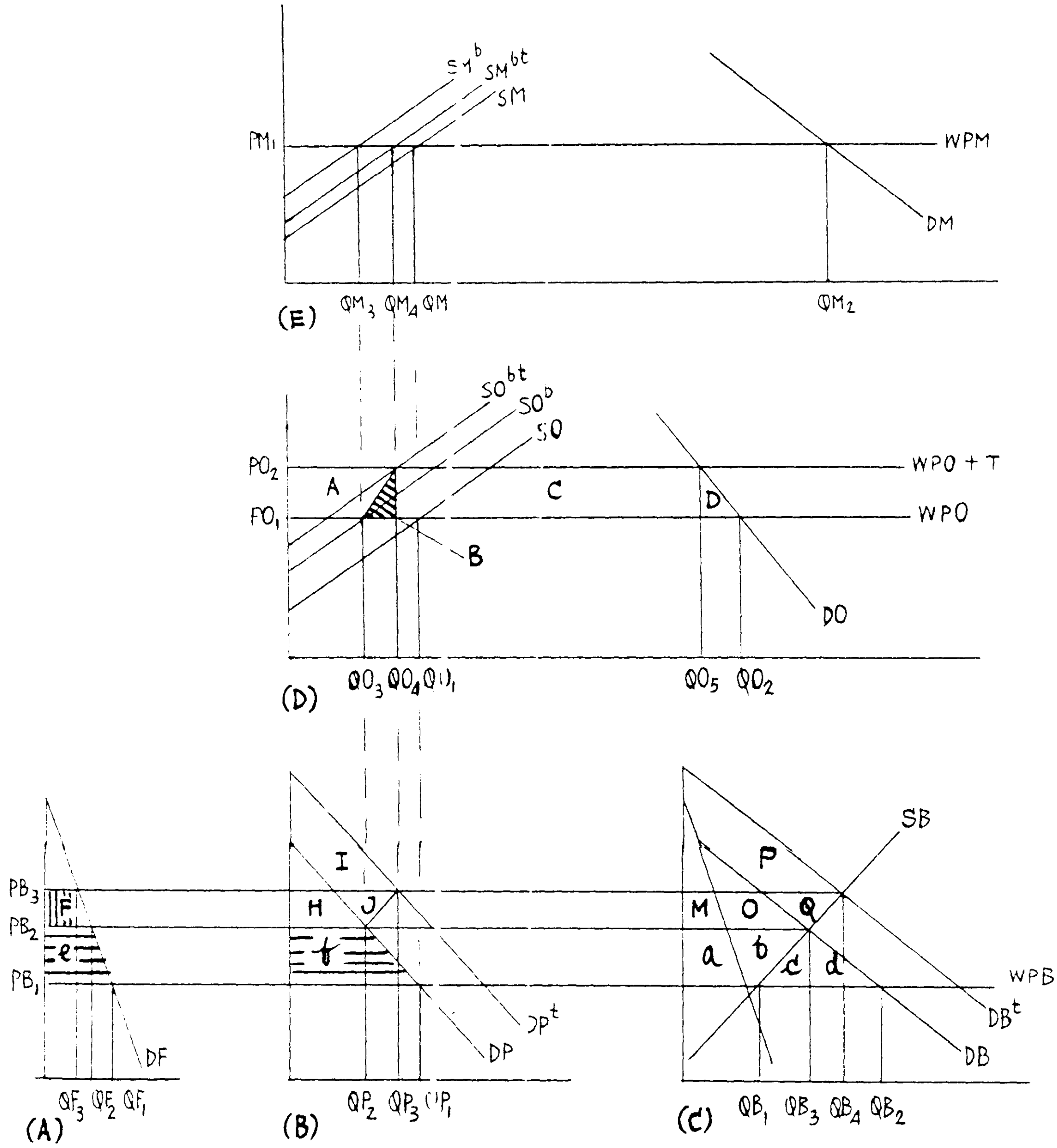
(5) Using a single market model would result in measuring all responses in association with the ordinary supply curve SO^b instead of the equilibrium supply curve SO^*. This would result in an over-estimate of the increase in domestic production of oil (and meal), an over-estimate of the change in producer surplus, an over-estimate of the improvement in balance of trade, an under-estimate of the government's tax revenue and an over-estimate of the NELP, and thus an over-estimate of the deadweight loss.

3.15 Total Impacts of Tariff and Ban

To investigate the total impacts of an import tariff on oil with the import ban on beans, Figure 3.16 is superimposed on part of Figure 3.13 to form the diagram shown in Figure 3.17. The total impacts of the combined policy can be detected by comparing all the quantities produced, traded and consumed, as well as the level of prices in the pre- and the post-policy (two-policy) situations.

(1) In the oil market, with an exogeneous world price (WPO), the import ban on beans does not alter the import parity price of oil. Only the import tariff on oil itself would affect price. Thus, the impact of the tariff alone and that of the tariff plus the ban would result in the same increase in price (i.e., from PO_1 to PO_2). For oil production, the import ban on beans has caused output to decrease from QO_1 to QO_3 while the tariff causes output to increase from QO_3 to QO_4. This results in a net decrease in production of $QO_1 - QO_4$. It is noted that this result is dependent on the level of the world price of soybeans as well as the tariff rate (e.g., if the tariff rate is 2T or WPB is much higher than the assumed level, other things being constant, the net impact of the combined policy measures of tariff and ban would result in a net increase in oil production; that is, the positive impact of the tariff on oil would outweigh the negative impact of the import restriction on beans). Other impacts have similar varying outcomes dependent on the relative size of the ban and the tariff. However, for simplicity, impact investigation is conducted

Figure 3.17: **Total Impacts o' an Import Tariff on Soybean Oil and an Import Ban on Soybeans**



at given assumed levels of the elements, but with the awareness that the analytical results are meaningful only to the given scenario, and that the exact impacts can be determined only by empirical measurements.

With this decrease in production and a decrease in consumption from QO_2 to QO_5 in response to the higher tariff-induced oil price, the net import of oil would decrease by (QO_2 - QO_5) - (QO_1 - QO_4).

In the bean market, price would increase from PB_1 to PB_3 (i.e., from PB_1 to PB_2 as a result of the ban and a further increase from PB_2 to PB_3 as a result of the tariff). As a consequence, farm output increases from QB_1 to QB_4. Beans utilization as input in the oil crushing industry decreases from QP_1 to QP_2 as a result of the ban and increases from QP_2 to QP_3 as a result of the tariff, with a net decrease denoted by QP_1 - QP_3. For the food processing industry bean consumption decreases from QF_1 to QF_3. Purely as a result of the ban, net imports decrease by QB_2 - QB_1.

(2) In the market for soybean meal, neither policy intervention results in a change in meal price. Thus, total consumption of meal remains unaltered. However, as a joint product with oil, the net output of meal would decrease from QM_1 to QM_3 as a result of the ban and then increase from QM_3 to QM_4 as a result of the tariff. This results in a net decrease in meal production of QM_1 - QM_4, and an increase in net importation by the same amount.

(3) Regarding the combined welfare effects of the two policy measures, in the bean market farmers' welfare in terms of producer surplus increases by the area $M + O + Q + a + b$. Consumer surplus in the food processing industry decreases by area $F + e$ whereas the net welfare of the producers in the oil crushing industry changes by area $I - H - f$. In the oil market the decrease in the consumer surplus is area $A + B + C + D$. The government's tax revenue is C. The net deadweight loss to the society is $B + D + c + d$.

The combined policy measures result in a net transfer of welfare from the consumers of oil to the government and to farmers on one hand, and a net transfer of welfare from the utilisers of beans from the food processing industry and oil processing industry to the farmers on the other.

The combined impact on the oil crushing industry can only be determined empirically in that the net welfare effect is positive when *I* is greater than *H* + *f*, and it is negative otherwise.

(4) The combined policy package supports the government's objectives in raising farm income and output. Moreover, according to the present scenario, it also contributes to improvement in the balance of trade if the increase in the value of imported meal is outweighed by the combined value of the decrease in the imports of oil and beans.

3.16 Marginal Impacts of Surcharges with Tariff and Ban

To determine the marginal impacts of imposing an additional system of variable surcharges on soybean meal on top of the two already imposed policy measures (tariff on oil and ban on beans), the analysis starts with all the demand and supply schedules, and all the quantities produced, consumed and traded, assuming positions as shown in the post-ban and post-tariff situation (of Figure 3.17). Then, an average surcharge rate of *s* is imposed on the meal market as depicted in section E of Figure 3.18.

(1) With the surcharge being imposed on the importation of meal at an average rate of *s*, meal price would increase from PM_1 to PM_2. As a consequence, meal production increases by QM_5 - QM_4, consumption decreases by QM_2 - QM_6 and imports decrease by (QM_5 - QM_4) + (QM_2 - QM_6).

(2) As a joint product, production of oil would increase by QO_6 - QO_4. With a constant price and thus unchanged level of consumption, imports would decrease by the same amount. In the bean market, demand for beans as input to oil crushing increases by QP_4 - QP_3, while the bean price increases from PB_3 to PB_4 as demand expands causing the quantity of beans demanded as input to the food industry to decrease by QF_3 - QF_4, and the quantity of beans supplied to increase by QB_5 - QB_4. With a ban policy in place, there is no importation and the increase in domestic production plus that quantity of beans released from the food industry just suffice to satisfy the increase in demand for beans as input to the oil industry.

(3) In the meal market, producers' welfare increases by area *R*, while consumer surplus decreases by area $R + S + T + U$. With *T* going to the government as surcharge revenue, the deadweight loss to the society is area $S + U$, with *S* as NELP and *U* as NELC. In general, this policy results in a welfare transfer from the meal consumers to the meal producers, the farmers and the government. As in the case of the tariff, area *R* can also be measured by area $Y + X$ in section *B* or area $y + x$ in section *C*, which represents the net welfare change of the producers of the two industries. Furthermore, it can be detected from the bean market that the producer surplus of farmers increases by area $v + w + x$ while the food processing industry suffers a decrease in welfare by area V which is transferred to the farmers as bean prices increase.

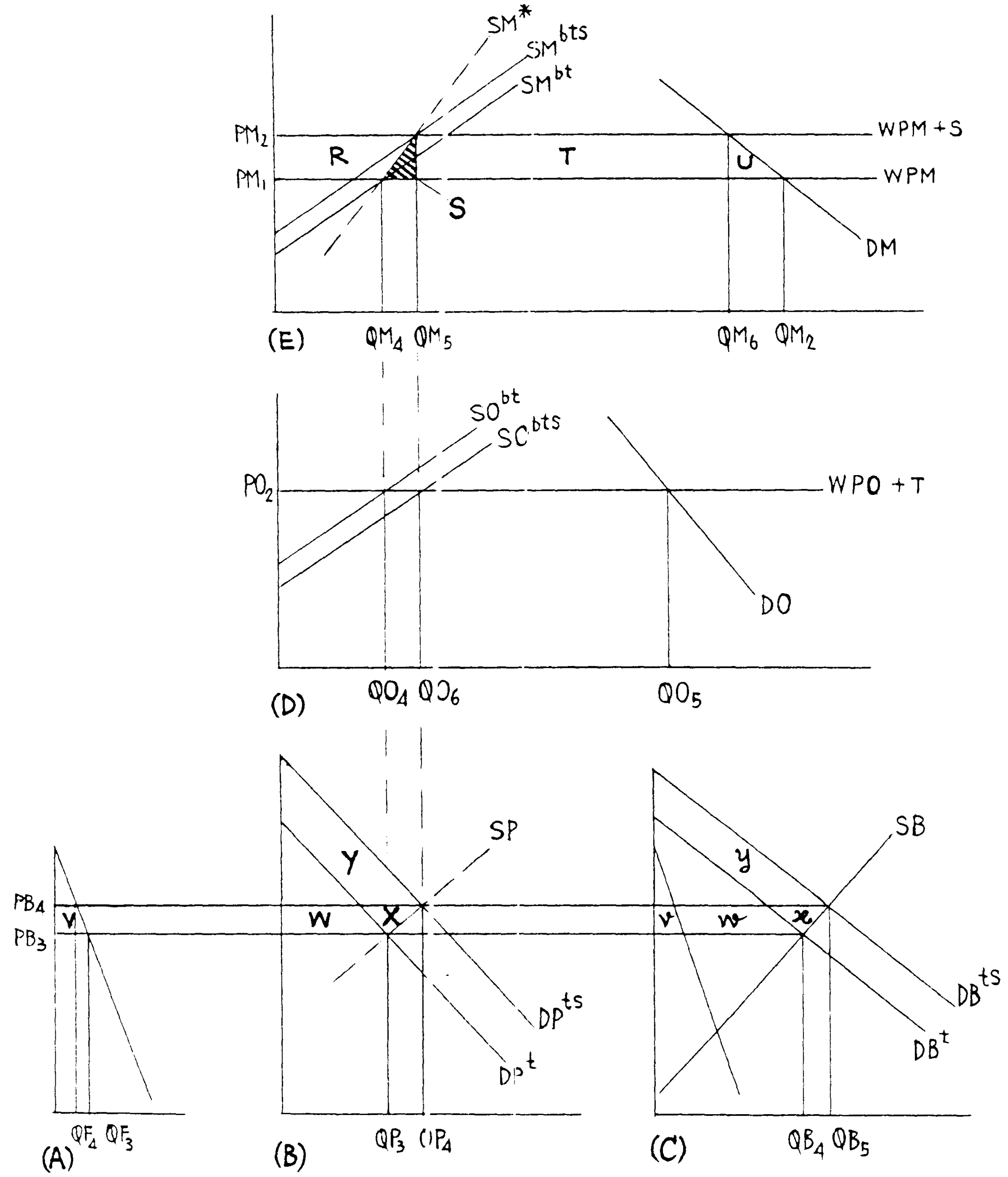
(4) In this marginal case the surcharge is consistent with the government's objectives of raising farm income and output. With a ban, this surcharge policy also results in a decrease in imports of both oil and meal, thus also contributing to the improvement of the balance of trade.

(5) As in the case of a marginal tariff, using a single model would result in the measurement of responses based on the ordinary supply curve SM^{bt}, instead of the equilibrium supply curve SM*. As a consequence, there would be an over-estimate of the increase in domestic production of meal (and oil), the producer surplus and the improvement in the balance of trade. There also would be an under-estimate of the government's surcharge revenue and an over-estimate of the NELP and deadweight loss.

3.17 Total Impacts of Surcharge with Tariff and Ban

To analyse the total impacts of the three combined policy measures of a surcharge on meal, a tariff on oil and a ban on beans, Figure 3.18 is superimposed on Figure 3.17 to form a final diagram as depicted in Figure 3.19. The total impacts of the three combined measures on society are determined by measuring all changes between the free-trade situation and the autarky situation.

Figure 3.18: **Marginal Impacts of Import Surcharge on Soybean Meal with an Import Tariff on Soybean Oil and an Import Ban on Soybeans**



(1) In the oil market, oil price increases from PO_1 to PO_2. Oil production changes from QO_1 to QO_6, while oil consumption decreases from QO_2 to QO_5, with a net decrease in oil importation of $(QO_6 - QO_1) + (QO_2 - QO_5)$. (It is noted that while $QO_6 > QO_1$ in Figure 3.19, QO_6 can be _ QO_1 depending on the own price and cross-price elasticities of all the concerned curves. The same applies to the meal and the bean market.)

In the meal market, meal price increases from PM_1 to PM_2. Meal production changes from QM_1 to QM_5, while meal consumption decreases from QM_2 to QM_6, with a net decrease in meal importation of $(QM_5 - QM_1) + (QM_2 - QM_6)$.

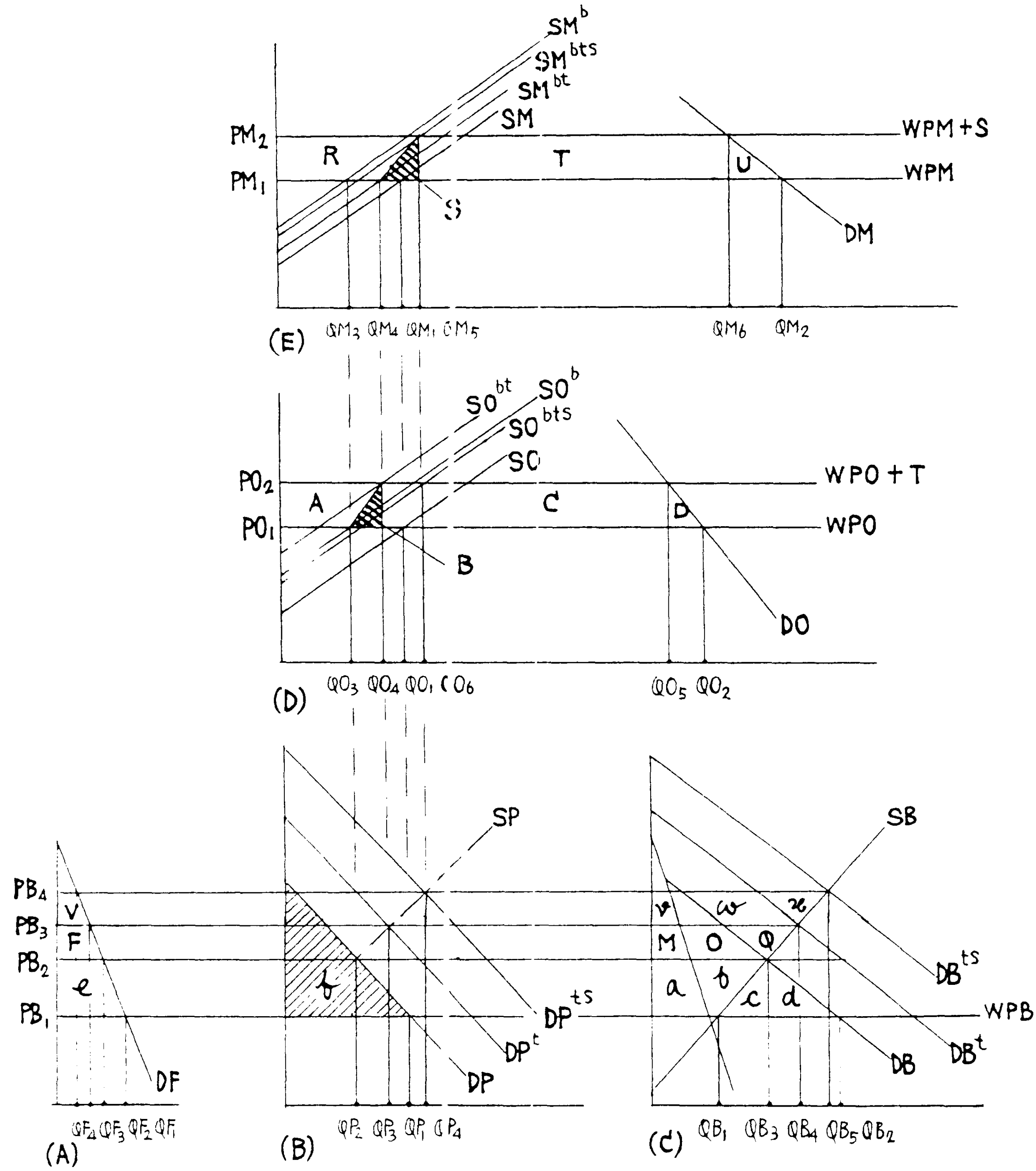
In the bean market, price increases from PB_1 to PB_4. Farm output of beans increases by $QB_5 - QB_1$, while the quantity of beans demanded as input in oil crushing changes by $QP_1 - QP_4$, and that demanded as input in food processing decreases by $QF_1 - QF_4$. The net import of beans decreases from $(QB_2 - QB_1)$ to nil.

(2) The cross-commodity effects have already been considered.

(3) Though producer surplus of the oil crushing activity can be measured in several ways as mentioned earlier, only the simplest forms of surplus valuation are chosen here . This is to avoid complication in triangle analyses and to keep impact explanations tractable.

From Figure 3.19 it is clear that the welfare loss of the consumers in the meal industry is area $R + S + T + U$, the welfare loss of the consumers in the oil industry is area $A + B + C + D$, and the welfare loss of those from the food processing industry is area $V + F + e$. These are the clear losers when prices rise. On the other hand, it is clear that farmers' welfare in terms of producer surplus increases by area $v + w + x + M + O + Q + a + b$, again a result of rising bean prices.

Figure 3.19: Total Impacts of An Import Surcharge on Soybean Meal with an Import Tariff on Soybean Oil and an Import Ban on Soybeans



While it is also clear that the government's total revenue is area $T + C$, the direction of net change in the welfare of the oil crushing industry is rather ambiguous. In fact, the value is dependent on the slopes of the demand and supply schedules as well as the relative size of interventions. However, with assumed levels of world prices of the three commodities and assumed tax rates, other things being constant, this welfare impact can be determined empirically.

Turning to partial measures of welfare in oil crushing, it can be inferred from the above analyses that the total change in the welfare of the oil crushing industry consists of three parts namely: (1) area $(R - w - x)$ which is the net increase in producer welfare as a result of the surcharge; (2) area $(A - O - Q)$ as a net increase in producer welfare as a result of the tariff; and (3) area f as a net decrease in producer welfare (measured off the derived demand curve to avoid overlapping of surplus values) as a result of the ban. All in all, the deadweight loss to the society is area $S + U + B + D + c + d$.

(4) The combined policy has fostered farm income and output. Furthermore, with the import ban on beans as an important element, it can be initially (i.e., without considering the deeper question of comparative advantage in the domestic production of the three commodities) concluded that the policy package would improve the balance of trade. Questions on comparative advantage are discussed in Chapter 4.

(5) Clearly, a single-commodity model cannot be used to analyse this policy scenario.