Chapter 4

FRAMEWORK FOR SECOND-BEST POLICY

4.1 Introduction

The partial-equilibrium analyses of the government's market intervention in the Thai soybean industry, described in the previous chapter, though essential for subsequent analyses, provide only a first sketch of the various potential impacts that the policy measures might have on the economy. This is due to the fact that the use of efficiency-triangle analyses, as outlined so far, must be conducted under a set of standard, but restrictive, assumptions inherent in most partial-equilibrium analyses. Of particular importance is the assumption that the supply and demand schedules postulated in the model must necessarily reflect the marginal social cost (MSC) and marginal social benefit (MSB) of the goods in question. In other words, there is an implicit assumption that no significant distortions occur elsewhere in the economy to significantly affect the analytical results of the framework being used. Such distortions would invalidate the first-best analyses of the previous chapter.

However, since the Thai economy has various kinds of distortions, particularly a high degree of protection in the manufacturing sector (Setboonsarng 1983; TDRI 1987), in assessing the impacts of market intervention on the soybean industry it is logical to resort to second-best policy assessment. In other words, there is a need to modify the existing model to incorporate effects due to the existence of distortions in the rest of the economy.

This chapter starts by outlining some important assumptions inherent in most partial-equilibrium analyses. This is followed by a brief consideration of the costs of protection in terms of efficiency loss in production and consumption within the context of first-best policy assessment. In so doing, an attempt is made to compare the analytical results obtainable from using a standard partial-equilibrium model and a two-sector general-equilibrium model. Then, the conceptual framework is expanded to take account of the problem of factor-price distortions. This involves: (1) developing a three-sector general equilibrium model which enables factor-price distortions to be considered explicitly in the analytical framework; (2) modifying the partial equilibrium framework to take account of the divergence between the marginal private cost(benefit) and the marginal social cost(benefit); (3) explaining the similarity between the use of a marginal social cost curve and the use of domestic resource cost coefficients (DRC) in the problem of resource allocation, particularly within the context of second-best pricing policy; and (4) showing how a MSC curve can be derived using information from the DRC calculation and a supply model.

4.2 Assumptions in the Partial-Equilibrium Model

The use of a partial-equilibrium framework involves the construction and analysis of a simplified model abstracted from a complicated real-world situation. The level of acceptable simplification depends largely on the purposes and required precision in the analysis, as well as the nature of the problem under investigation. If a model is to be of any practical usefulness it should include all the essential components of the system being investigated so that analytical results obtained from the model will adequately serve the underlying research objectives. The validity of a model depends heavily on its underlying assumptions.

Essentially, all economic models are constructed with a certain number of working assumptions (whether implicitly or explicitly) which allow researchers to simplify the research framework to a desired level. When any of the assumptions appear to be unrealistic to the extent that the analytical results are rendered invalid, the assumption should be dropped and the model extended to include additional elements. For instance, when efficiency-triangle analyses are used to compute the impacts of market intervention (of, say, an import tariff) within a single-market context, the assumptions typically include at least the following:

(P.1) The demand curve must be a 'constant utility' one that reflects only substitution effects. The income effects from the policy-induced change are assumed to be zero or negligible.

(P.2) The imposition (or removal of an existing) tariff would not cause the real exchange rate to be significantly appreciated (or depreciated).

(P.3) The inter-market repercussions of the policy impacts are non-existent, or so insignificant that they can be ignored. (Perhaps, this is the prime justification for using a single-market framework.)

(P.4) Only the impacts of intervention on a particular product or industry are being determined. There are no distortions elsewhere, or the distortions in the rest of the economy generate both negative and positive impacts whose net effects on the market being investigated are zero or negligible.

When any of the assumptions are not applicable to the existing model, the framework is no longer valid. For a partial equilibrium analysis to have any value at all, the model should be extended to take account of additional feature(s) that are observed in the context being studied (Corden 1985, p.22).

Considering the above four assumptions within the context of the analytical framework of the present study, assumptions P.1 and P.2 are considered applicable on the grounds that the soybean industry in Thailand is relatively small as compared to the whole economy (i.e., vis-a-vis the farming of other cash-crops combined and vis-a-vis the manufacturing sector). Considering assumption P.3, in realisation of the inadequacy of a single-market model, the present framework has accounted for the linkage effects of the three closely related markets (as described in Chapter 3). However, it still retains a less restrictive assumption that significant repercussions exist only within the postulated three-market framework. Repercussions from the rest of the economy are viewed as negligible.

As for assumption P.4, no distortion elsewhere means that, in the existing framework, the supply schedule must reflect marginal social costs and the demand schedule must reflect marginal social benefit. This is an essential assumption for a first-best policy assessment. However, when this assumption is not closely approximated, as in Thailand, the framework should be adjusted to accommodate the effects from the rest of the economy. From such a perspective the policy problem to be addressed would turn into a second-best one. This might lead to quite different outcomes of policy assessment and policy implications. Details of these differences are given in Section 4.4.

4.3 Basic Framework for Detecting Cost of Protection A Brief Review

This section provides a concise comparison between a partial-equilibrium model and a two-commodity general-equilibrium model in assessing the cost of protection resulting from a market intervention measure. Since the concepts to be discussed are of a standard text-book nature and their introduction into this section is only for providing an adequate basis for subsequent model modification and development (in Section 4.4), the presentation is brief. The concepts discussed are abstracted and modified mostly from the articles by Johnson (1960) and Corden (1985) Similar frameworks can be found in Parikh *et al* (1988), Kenen (1985), Michaely (1977) and Corden (1957).

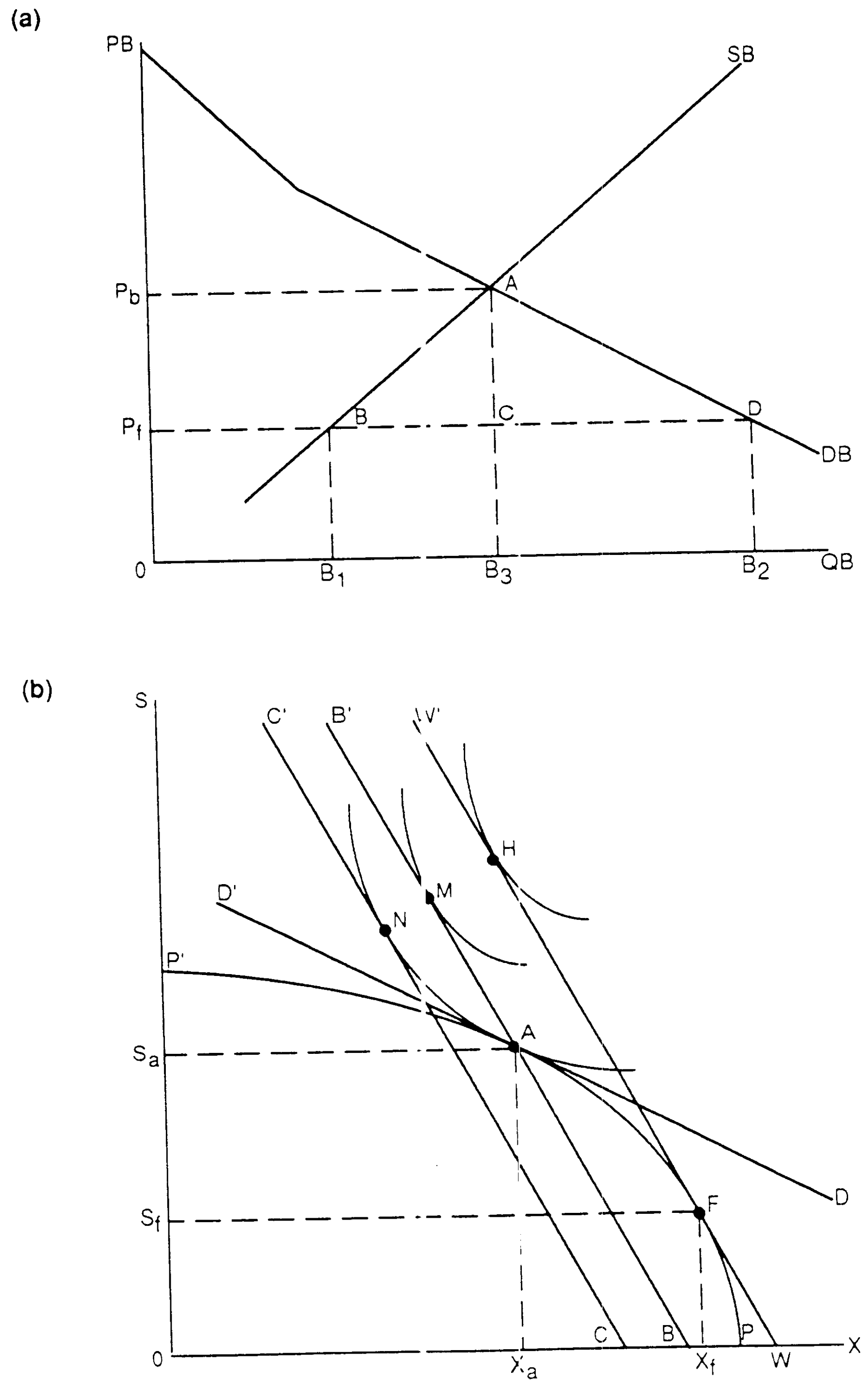
For illustrative purposes, a single-market partial-equilibrium model used to analyze the effects of an import ban is presented in section (a) of Figure 4.1, along with its counterpart — a two-commodity general equilibrium model in section (b). As depicted, a ban on soybean importation has driven the bean price up from P_f to P_b, thus causing an expansion in the domestic production of soybeans from B_1 to B_3 and resulting in a net efficiency loss in production, equivalent to the area ABC.

The efficiency loss in production measured by the model is due to the wrong price signal that causes soybean production to expand. This results in a social cost (the net output foregone due to the various factors of production having been bid away from other productive activities into soybean production) higher than the social benefit (the value of extra soybeans produced valued at their import parity price). For this result to come about, the model must conform to the assumptions cited earlier, especially assumption P.4, which asserts that the supply curve must reflect marginal social cost. This implies that, in addition to the non-existence of distortion elsewhere in the economy, markets are highly competitive and producers are profit maximisers so that marginal cost pricing is the rule. By the same token, if the demand curve reflects marginal social benefit, the same wrong price signal would cause consumption to be less than a socially-optimal level, thus incurring an efficiency loss in consumption equal to ACD.

By contrast, the effect of inefficiency due to the intervention measure can be detected conceptually using a two-commodity general-equilibrium model as shown in section (b). In so doing, a number of basic assumptions are needed for the model to be conceptually valid, namely:

G.1 The production possibility curve PP', being concave to the origin, displays a diminishing marginal rate of production transformation between the two goods, (i.e., between the import-substitution crop, soybeans (vertical axis) and its best alternative export crop, say, crop X (horizontal axis)).

Figure 4.1: Cost of Protection in Partial and General Equilibrium Models



G.2 There are no other distortions except the one being considered or, if they are present, either (i) their impacts are negligible, (ii) their positive and negative impacts cancel, or (iii) their impacts are already accounted for by the model.

G.3 Producers are profit maximisers subject to resource constraints. They allocate their productive resources to produce that combination of the two goods where the rate of marginal transformation equals the output price ratio.

G.4 The quadrant SOX contains a map of community indifference curves, and the consumers' objective is to maximize utility subject to an income constraint. Thus, the utility maximizing consumption level is located at the highest attainable utility curve where the marginal rate of substitution between the two goods is equal to their price ratio.

In what follows, to detect the cost of protection, the potential terms of trade effects as envisaged by Corden (1985) and Johnson (1960) are assumed away. This is due to the relative smallness of the size of consumption and production of soybean vis-a-vis the rest of the economic sectors, both locally and internationally. In other words, the inclusion of the 'small country' assumption is justified because the policy-induced changes in the quantity of the importable and the exportable commodities would not affect their international price ratios.

As depicted in section (b) of Figure 4.1, the import ban policy has driven up the domestic price of soybean relative to its best alternative crop thus causing the domestic price ratio D'D to diverge from the international price ratio W'W. This results in reallocation of resources which causes the production combination to move along the P'P curve from a free-trade level at point F (with S_f units of soybeans and X_f units of exportable crop) to an autarky level at point A (with S_a units of soybeans and X_a units of exportable crop).

The cost of protection of a policy can be determined by assessing its impacts on either the changes in the level of the community's utility or the changes in its equivalent income counterpart. According to Corden (1985), with a free-trade situation, production would take place at F and trade would occur with the free-trade price ratio W'W. The highest attainable utility level is at point H where the marginal rate of substitution in consumption, the marginal rate of transformation in production and the prevailing price ratio between the two goods in question are the same. By contrast, in an autarky situation, where the farming of soybeans has been protected and the community faces a distorted domestic price ratio D'D, production would be at A and a lower level of utility would be achieved with consumption also at A, since the measure is an import ban. In this case, the difference in the level of utility between H and A constitutes the total cost of protection.

To distinguish the production cost of protection from the consumption cost of protection, Corden (1985) further assumed a situation in which the protective measure of the government has caused production to take place at A, without altering the price relativities of the two goods (e.g. by subsidizing soybean production through a poll tax instead of the import ban). Production is inefficient due to misallocation of productive resources, but consumption remains efficient with a correct price ratio facing the consumers. In this case, production would take place at A while consumption would take place at M, and the difference between H and M denotes the production cost of protection (i.e., inefficient production, lower consumption and lower utility). Combining the two scenarios, the consumption cost of protection is the difference between M and A.

By contrast, with this same model one can look at the cost of protection in terms of the equivalent income loss due to inefficiency in production and consumption. Using the exportable good valued at world prices as numeraire, Johnson (1960) proposed that the total income generated from the free-trade production combination at F and the autarky production combination at A (after translating the value of the importable into that of the exportable) are OW and OB, respectively. This yields a production cost of protection equivalent to BW. Considering that the autarky consumption takes place at A with a total expenditure of OB (with trade opportunities and correct price signals facing the consumers), whereas the same utility can in fact be attainable at point N with a lower expenditure OC, there is a consumption cost of protection equivalent to CB. Thus, CB plus BW constitutes the total cost of protection, CW.

In the foregoing analysis of the cost of protection, the general equilibrium approach can be considered conceptually superior to the partial equilibrium approach in that, besides being able to be extended to account for the income effect and terms of trade effect, the model explicitly puts forward the notion of opportunity cost in producing each of the two goods. That is, given the resource constraint, more of one good can be produced only at the cost of foregoing some production of the other good. More importantly, the model shows explicitly how social welfare can be optimized. The same principle can be extended and generalized to a situation of several products.

Marginal social cost is much more general than what is conceptualized in a two-good general equilibrium model in which factors of production are pulled only from one, and only one best alternative. An alternative procedure involves using a partial-equilibrium model, in which the supply curve reflects marginal social cost in an n-commodity situation. In such a model, though, the marginal cost curve can reflect the opportunity cost of producing only one good. In contrast, the meaning of marginal social cost in terms of the marginal value of output foregone due to various productive resources having been pulled away from their best alternative occupations in the production of an additional marginal unit of the good in question is by no means partial.

With the above supply schedule that reflects marginal social costs, the production of the good in question is considered efficient when output is expanded to a point where its marginal social cost equal marginal social revenue. In a restrictive sense, (i.e., assuming no linkage effects or that such effects have been accounted for in the value of MSC and MSR), a necessary though not sufficient condition for welfare optimization is obtained. Referring to Figure 4.1, this condition holds only at point B in the partial-equilibrium model and at point F in the general-equilibrium model. Both occur only under free trade. Thus, with *all the assumptions as mentioned*, this confirms the advocation of trade liberalization for welfare improvement. Or, in other words, the 'right' prices which warrant production efficiency in this case are the free-trade prices. Hence, to get the prices right, the protective measures should be dropped.

4.4 A Framework for Second-best Pricing Policy

Based on the models described in the previous section, this section attempts to extend the conceptual framework for policy analysis to cases where assumption P.4 (or assumption G.2) mentioned earlier is invalid. The extension consists of taking into account problems caused by the existence of externalities or policy distortion elsewhere. This is essential for policy analysis in a country like Thailand where an appreciable number of production systems are subject to state intervention of various forms (e.g., tariffs, quotas, subsidies and direct controls).

The protective industrial policy is fostered by the Thai government's desire to promote its import substitution industries, particularly in the manufacturing sector. During the last two decades or so, tariffs have been an important form of protection. However, it is the exemption from import tariffs on machinery and income tax holidays that constitute major sources of policy distortion. While they promote manufacturing outputs explicitly, they implicitly provide a disincentive for agricultural production (TDRI 1987). Because of this, the analytical framework as described in Section 4.3 is inadequate for policy analysis of the Thai soybean industry. This calls for model refinement and, accordingly, a second-best policy analysis.

Attempts to incorporate aspects of the theory of second best into economic analysis have been evident since the 1950s (Harberler 1950; Little 1950). However, useful insights in the application of the theory are most appropriately attributed to the work of Mead (1955) who was among the first to deal with the problem systematically. The elements of the problem were generalized in a more rigorous form by Lipsey and Lancaster (1956) whose work is referred to as 'The General Theory of Second Best' and has served as a major source of reference for most subsequent investigations in this area of economic studies. The most-often quoted passage of their article is the following:

> The general theorem for the second best optimum states that if there is introduced into a general equilibrium system a constraint which prevents the attainment of one of the Paretian conditions, the other Paretian conditions, although still attainable, are, in general, no longer desirable. In other words, given that one of the Paretian optimum conditions cannot be fulfilled, then an optimum situation can be achieved only by departing from all the other Paretian conditions (Lipsey and Lancaster 1956, p.11).

The importance of incorporating aspects of second-best theory into economic analysis has been emphasized by Little and Mirrlees (1977) on the grounds that the first-best optimum contemplates a competitive equilibrium which is unlikely to exist in real life. Hence, the pursuit of second-best policies will, in the long run, take economies in the right direction.

4.4.1 A Three-sector general equilibrium model

Using the Thai government's intervention policy in the farm production of soybeans as a case in point, a three-sector general equilibrium model is developed in this section. It is an extension of the standard two-commodity model described in the preceding section. It is used to explain how the existence of distortions elsewhere in the economy could explicitly be accounted for in the analytical framework. In this way, the validity of the model is improved and the cost of protection is more correctly determined.

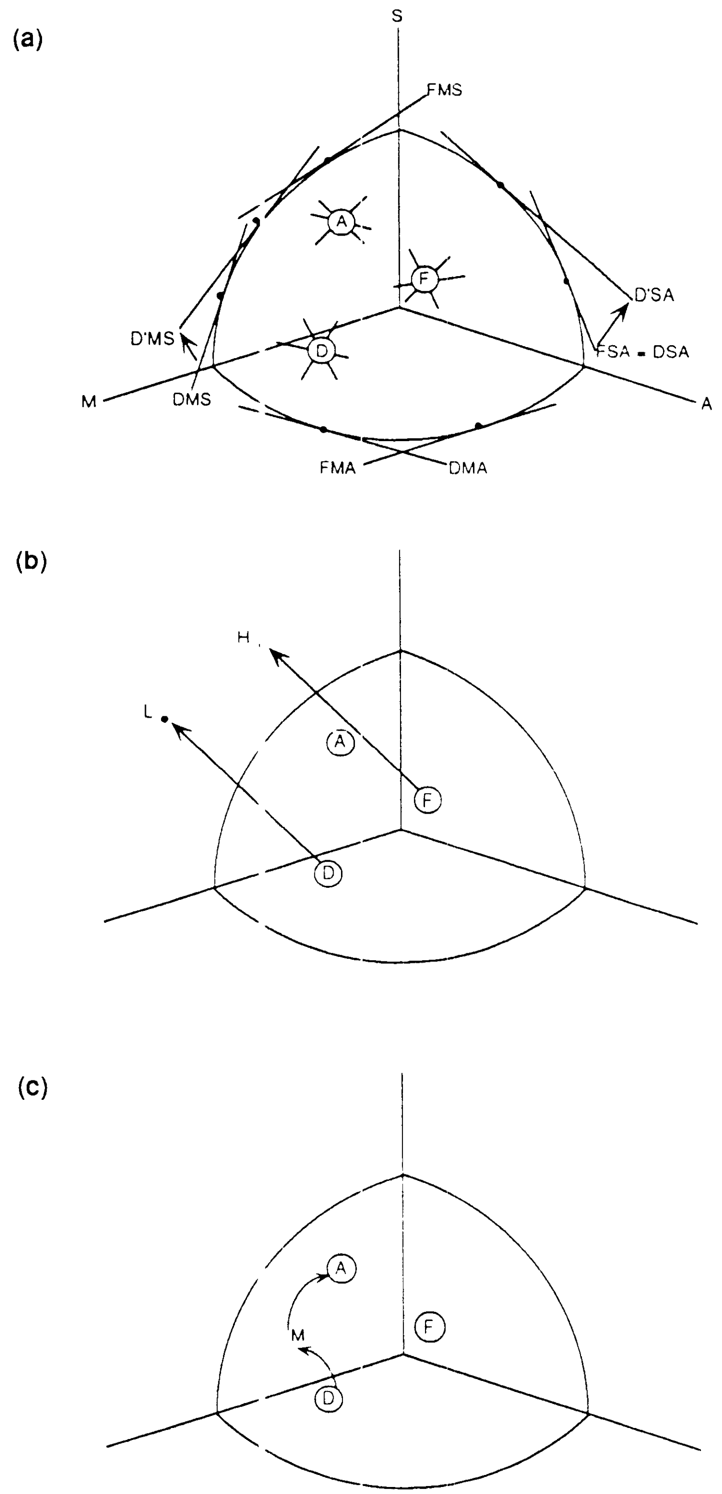
As depicted in section (a) of Figure 4.2, a three-dimensional production possibility surface is constructed concave to the origin and denoted by the surface SMA. With given resources, any point on this surface represents a possible combination of production of the manufacturing goods (M), soybeans (S) and other agricultural products (A).

In this case, the free-trade price ratio and the domestic price ratio between good *i* and good *j* are denoted by F_{ij} and D_{ij}, respectively (e.g. the free trade price ratio between soybeans and other agricultural products is denoted by F_{SA}). In a free-trade situation, the production combination of the three goods would be at point F where the marginal rates of production transformation and the price ratios of each pair of the three goods are equal. Now imagine a situation where the government's intervention policy has favoured the manufacturing industry and discriminated against the agricultural sector. The prevailing domestic price ratio between manufacturing goods and soybeans, and that between manufacturing goods and other agricultural products, would be D_{MS} and D_{MA}, respectively.

While these two domestic price ratios are different from their respective free-trade price ratios (F_{MS} and F_{MA}) in a situation in which the government has not intervened in the soybean market, the domestic price ratio between soybeans and other agricultural products D_{SA} is still equal to the free-trade price ratio F_{SA}. In this situation, the production combination would be at point D where, again, the rate of production transformation and the respective price ratio between each pair of goods are equal. Referring to section (b) of Figure 4.2, the production combination at F, being a free-trade optimal level, would generate the highest level of welfare by allowing the community to reach the highest possible utility surface at H where the marginal rate of substitution, the marginal rate of transformation and the price ratio of each pair of goods are equal. With this same condition, the distorted production combination at D would give a lower level of welfare at L.

Given that this problem of distortion elsewhere cannot be removed, the point of reference for analysing the effects of the government's intervention policy on soybean production should be D and not F (as in the partial-equilibrium model). This leads the analysis into a second-best one. Now, suppose the protective measures have resulted in a higher domestic price of soybeans, thus causing the domestic price ratio between soybeans and other agricultural products, and that between manufacturing goods and soybeans, to change to D'_{SA} and D'_{MS}, respectively. This causes the production combination to move from D to A. Unlike the first-best situation where the movement from the free-trade

Figure 4.2: The Three-Sector General Equilibrium Model and a Second-best Welfare Optimization



production combination to the autarky production combination (i.e., from F to A as described in the two-good general equilibrium model in section (a) of Figure 4.1) would surely decrease welfare, in the second-best situation, the movement from D to A can either increase or decrease welfare.

As shown in section (c) of Figure 4.2, the movement from D to A could be visualized as consisting of two successive movements, one from D to M which lowers welfare (by causing the domestic price ratio between soybeans and other agricultural products to deviate from the free-trade price ratio) and the other from M to A which increases welfare (by causing the distorted price ratio between manufacturing goods and soybeans to move towards their free-trade counterpart). Thus, the movement from a distorted situation like D to another distorted situation like A can result in either welfare increasing or decreasing, depending on whether the positive effect is greater or less than the negative effect. Finally, it is possible to conceive of a second-best optimum and a policy with regard to soybeans which moves the economy towards this second-best optimum.

4.4.2 Piecemeal policy reform

The previous section has outlined a situation in a second-best world in which the use of the usual economic rules deemed suitable for the first-best world (e.g., marginal cost pricing) does not necessarily lead to welfare optimization. To date, application of second-best reasoning to derive quantitatively-exact second-best solutions has been considered infeasible due mainly to lack of required information (Mishan 1962, p.205; George and Shorey 1984, p.132; Vousden 1990, p.208). However, authors have invariably advocated recognition of second-best theory in welfare improvement. In some instances, difficulties in deriving some second-best solutions (e.g., second-best optimum tariffs on intermediate inputs and imported capital goods) have led to recommendatrions when ever possible to correct distortions at their source and move the economy back toward first-best equilibria (Tower 1984, p.10).

Thus far, it is assumed that a first-best world is not conceivable in real life and a second-best optimization is not feasible in practice. The practical suggestion seems to be to make best use of the available information to enhance welfare — a sort of third-best solution as termed by Mishan (1962), Ng (1977) and Blackorby (1990). Attempts to deal with the problems of second-best more systematically have led to the development of some generalized piecemeal policy rules (Davis and Whinston 1967; Hatta 1979). A good summary of piecemeal policy reforms is given in Vousden (1990). Two simple piecemeal rules have, thus far, received particular attention, namely: (1) the uniform reduction rule which contemplates equi-proportionate reduction of all trade taxes; and (2) the harmonization rule which contemplates reduction of the highest trade tax first. Conforming with the principles of systematically moving towards a more uniform tax structure, both rules are considered to be a proper approach for welfare improvement.

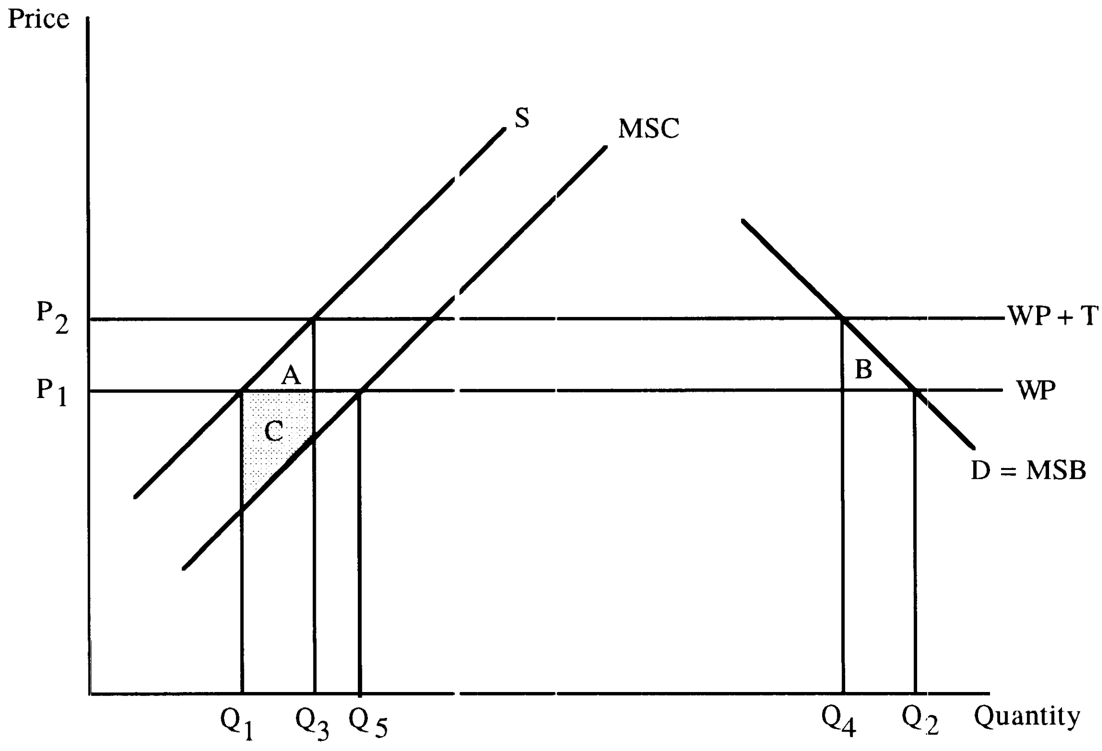
As far as the uniformity of a tax structure is concerned, in instances where tax reduction has been ruled out (due to whatever reasons), it turns out that a tax increase (to an optimal level) can also improve welfare. For instance, following the optimal-tariff argument in the trade literature, Roumasset and Setboonsarng (1988) advocated that the right price for Thai rice involves optimal price distortion in terms of a second-best export tax. A simple and intuitive example of how an optimal import tariff can enhance welfare in the second-best world is given in Corden (1985) where the beneficial effect is termed the 'negative cost of protection'.

Both these articles share the same feature of extending the partial-equilibrium models for policy analyses by incorporating into the analytical framework the notion of a marginal social cost curve and/or marginal social benefit curve. For purposes of illustration, a simplified version of such models is presented in Figure 4.3 to show how divergence between marginal social cost and the marginal private cost can alter policy implications.

Imagine a certain industry producing an importable good with a supply schedule (S) and a demand schedule (D) and facing a world price (WP) and an import tariff (T). Suppose there exist unalterable distortions elsewhere in the economy which cause a divergence between the pattern of private cost of production and social cost of production such that the marginal social cost curve is located to the right of the marginal private cost curve (i.e., the supply schedule), while the distortion does not significantly affect the pattern of consumption of the good in question so that the demand schedule still reflects marginal social benefit.

In this particular case, since producers would invariably plan their production in accordance with S, the tariff would cause price to increase from P_1 to P_2, production to increase from Q_1 to Q_3, consumption to decrease from Q_2 to Q_4 and imports to decrease from $(Q_2 - Q_1)$ to $(Q_4 - Q_3)$. However, by ignoring the problem of distortion elsewhere in

Figure 4.3 : The Use of the Marginal Social Cost Curve in Policy Analysis



the economy and assessing the effect of the tariff using the conventional first-best rules (i.e., in association with S rather than MSC), one would measure an incorrect cost of protection with a total deadweight loss denoted by area A + B, where A represents the net efficiency loss in production and B represents the net efficiency loss in consumption.

The problem arises from using the first-best rule, which identifies the optimal (free-trade) level of production as Q_1 (while in fact from a social point of view it should be Q_5). Thus, the tariff-induced increase in production is mistakenly considered to produce a social loss (area A) due to the production level moving away from its mistaken optimum (Q_1), while in fact it is moving towards its optimal level (Q_5) thus producing a social gain (area C). In fact, with the correct second-best rule, the cost of protection consists of a positive cost on the consumption side (area B) and a negative cost on the production side (area C) giving a net protection cost of (B – C).

This value can be negative, zero or positive depending on the relative size of B and C. In this context, it is possible to conceive of an optimal tariff that maximizes social gain by maximizing the value of (C – B). Thus far, the remaining major problem seems to be how to postulate a marginal social cost curve with reasonable level of precision. This is discussed below.

4.4.3 The Domestic Resource Cost of Production

The position of the marginal social cost curve is defined by use of the domestic resource cost of production. The next two subsections provide necessary background information for achieving this. Two recent empirical studies on DRC of soybeans and soybean meal are also discussed.

As cited in the literature (Chenery 1961; Pearson 1976), the concept of measuring resource cost dates back to the 1950s when the government of Israel attempted to develop a systematic procedure for measuring comparative advantage as a basis for allocating investment funds and foreign exchange. The calculation involved an index expressing the cost in domestic resources of a dollar earned or saved. The concept expresssed in terms of DRC was popularised by Bruno (1963, 1967, 1970, 1972).

Among the later contributors to the development of the concept and methodology of DRC, Pearson (1976), and Pearson, Akrasanee and Nelson (1976) provided intuitively appealing and systematic expositions of a modified version of DRC. According to Bruno (1972), in evaluating a system of production, all domestically produced inputs are treated as non-tradable, and defined with respect to actual government policy, while according to

Pearson *et al* (1976), a domestically produced input is classified as tradable if it is fully traded (i.e., if the country actually imports some of the goods), or non-tradable if it is not fully traded (i.e., if the country does not import any of the goods). Then, the non-tradable inputs are decomposed into tradable components and primary domestic factors by moving backward through the input-output chain. The social opportunity costs of all inputs, like primary domestic factors, are estimated with reference to actual government policy.

For purposes of illustration a simplified version of DRC (adopted from Pearson *et al* 1976, pp.130-133) can be defined as in equation (4.1):

$$(4.1) \qquad DRC_j^* = \frac{\sum_{s=2}^{m} \bar{f}_{sj} V_s - E_j}{(U_j - \bar{M}_j - R_j) V_1^*}$$

where: DRC_j^* is the modified form of the DRC coefficient in the production of commodity j;

$\bar{f}_{sj}$ is the total (direct plus indirect) quantity of the sth primary domestic factor employed by the jth activity;

V_s is the shadow price of the sth factor of production (in domestic currency);

E_j is the measure of the net external benefits or costs imparted by the jth activity to the rest of the domestic economy;

U_j is the total value at world price (in foreign currency) of the output of the jth activity;

$\bar{M}_j$ is the total (direct plus indirect) value (in foreign currency) of tradable materials used by the jth activity;

R_j is the total (direct and indirect) value (in foreign currency) of repatriated earnings of foreign-owned factors of production employed by the jth industry (including repatriated portions of the direct foreign factor costs, $f_{ij}V_1$, and of the indirect foreign factor costs);

V_1 is the shadow price of foreign exchange, expressed as a ratio of local currency to foreign currency; and

V_1^* is the official exchange rate.

Then, the criterion for comparative advantage is

$$\frac{DRC_j^*}{V_1/V_1^*} < 1.$$

The coefficient is simplified as given in equation (4.2) to facilitate later explanation:

$$(4.2) \quad DRC_j = \frac{DC_j}{NVA_j} \quad \text{or}$$

$$DRC_j = \frac{DC_j}{SR_j - TI_j}$$

where DRC_j is the domestic resource cost ratio in the production of commodity j;

DC_j is the domestic factor cost at opportunity cost; and

NVA_j is the value added at world prices, in domestic currency and expressed at the shadow exchange rate.

SR_j is the social revenue generated from the system of production j.

TI_j is the social value of tradable inputs used in the production process j.

Then, the criterion for comparative advantage is having the value of the domestic resource cost ratio less than one, namely:

$DRC_j < 1$.

The intuitive interpretation is that, in assessing a production system for commodity j, if the social benefit realized in terms of net value added (NVA_j) is greater than the social cost foregone in terms of the opportunity cost of the primary factors being used in the production process (DC_j), then it is socially profitable to expand the production of that commodity.

Recently the concept of DRC has been incorporated into a policy analysis matrix (PAM) framework as an integral part of a set of key indicators used in the evaluation of agricultural policy by Pearson and Monke (1987), and Monke and Pearson (1989). Besides emphasizing further the practical use of DRC in policy evaluation, this has made explicit the logical relationship between the concept of DRC and other important indices such as the effective protection coefficient (EPC). A summary of the PAM approach (extracted from Chapter 2 of Monke and Pearson 1989) is given below.

Table 4.1
Policy Analysis Matrix

	Revenues	Costs		Profits
		Tradable inputs	Domestic factors	
Private prices	A	B	C	D[1]
Social prices	E	F	G	H[2]
Effects of divergences and inefficient policy	I[3]	J[4]	K[5]	L[6]

1 Private profits, D, equal A minus B minus C.
2. Social profits, H, equal E minus F minus G.
3. Output transfers, I, equal A minus E.
4. Input transfers, J, equal B minus F.
5. Factor transfers, K, equal C minus G.
6. Net transfers, L, equal D minus H; they also equal I minus J minus K.

Source: Monke and Pearson (1989).

Table 4.1 presents the PAM as a product of two accounting identities; one defines profit as the difference between revenues and costs and the other measures the effects of divergences (distorting policies and market failures) as the difference between observed parameters and parameters that would exist if the divergences were removed. Simple calculation using the given data from PAM will provide a number of important indicators deemed useful for policy analysis, namely:

(1) The private cost ratio

PCR = C/(A – B);

(2) The domestic resource cost ratio

DRC = G/(E – F);

(3) The nominal protection coefficient on tradable outputs

NPCO = A/E;

(4) The nominal protection coefficient on tradable inputs

NPCI = B/F;

(5) The effective protection coefficient

EPC = (A – B)/(E – F);

(6) The profitability coefficient

PC = (A – B – C)/(E – F – G) or D/H; and

(7) The subsidy ratio to producers

SRP = L/E or (D – H)/E.

In Thailand, a number of studies have attempted to determine the comparative advantage of various production systems. Most early studies were conducted using the Pearson, Akarasanee and Nelson (1976) approach. They include, for example: Chatdarong (1975) on the Thai industrial sector; Akrasanee and Wattananukit (1976) on rice production; Limskul (1979) on the production of rice, maize, cassava and sugar; Sukharomana (1979) on the vegetable oil industry; The Industrial Finance Corporation of Thailand, IFCT (1980) on the textile and cement industries; Kunnadhilok *et al* (1981) on the development of Thai export industry; IFCT (1981) on the electronics and wood-processing industries; Sornman (1981) on the textile industry; Ajanant *et al* (1984) on trade and industrialization of Thailand; Tanarangkoon (1984) on automobile parts and components industry; and Harrington and Sat-thaporn (1984) on wheat production. Recently, additional research projects have been conducted using the PAM approach. They include, for example: Pannop (1989) on beef production; Likhitvidhayavuth (1989) on milk production; Setboonsarng (1989) on feed grains production; Setboonsarng (1989) on pig production; Tubpun (1989) on boiler production; Titapiwatanakun (1989) on the beef industry; Titapiwatanakun (1989) on the milk industry; and Katikarn *et al* (1989) on Thai agricultural production systems including cassava, maize, soybeans, dairy products, hogs, beef, broilers and eggs.

Since most DRC studies were conducted at an industrial and/or regional level and present a long list of DRC estimates, only those directly concerned with the present study are reported. In Table 4.2, section (a) presents the result of the DRC calculation of Katikarn *et al* (1989) on soybeans and soybean meal. The study was conducted at a regional level using 1986/87 data. With the values of DRC less than one for soybeans and greater than one for soybean meal in all regions, the study suggests comparative advantage in soybean production and comparative disadvantage in soybean meal production.

Section (b) of Table 4.2 presents an interesting contrasting result of DRC calculation provided by Setboonsarng (1989). The study was also conducted at a regional level using 1986/87 data, but solely for the production of soybean meal. A slight difference in terminology was used in the report: namely, DRC refers to the domestic resource cost coefficient and RCR refers to the resource cost ratio. In essence, these DRCs and RCRs are the domestic resource cost ratios converted using the official exchange rates and shadow exchange rates, respectively. This is slightly different from the terminology of Pearson *et al* (1976) in that DRC refers to a domestic resource cost ratio converted at shadow exchange rates. With the values of DRCs and RCRs all less than unity, as opposed to Katikarn *et al*'s (1989) result, the study advocates comparative advantage in soybean meal production for the country.

The marked difference in the two sets of DRCs on soybean meal production seems to be due to the difficulty in obtaining a detailed cost structure of oil crushing from the private sector. Setboonsarng (1989) used the average domestic crushing margin of the past three years (1628 *baht*/ton) as a proxy for the private processing cost. With the argument that importing oil and meal is equivalent to importing beans plus crushing, the study treated the crushing service as tradable. Thus, the social processing cost is the crushing margin valued at world prices.

Table 4.2

The Domestic Resource Cost and Resource Cost Ratio for Soybeans and Soybean Meal Production

(a) DRC for Soybeans and Soybean Meal

Region	Soybeans	Soybean Meal
North	0.60	1.56
Northeast	0.65	1.69
Central	0.62	1.62

Source: Katikarn *et al* (1989), p.49.

(b) DRC and RCR for Soybean Meal

Region	DRC	RCR
North	0.61	0.55
Northeast	0.67	0.61
Central	0.70	0.64

Source: Setboonsarng (1989), p.98

Since calculation of the margin using Rotterdam prices yields a negative value due to heavy export subsidies of oil and meal from Brazil and Argentina, the author went further to calculate the margin at the border using adjusted c.i.f. prices. This yields a social processing cost of 753 *baht*/ton for soybean meal (for details, see Setboonsarng 1989, pp. 68–80).

Katikarn *et al*'s (1989) report does not provide details or explanation on the DRC calculation. An interview with one of the authors revealed that the social valuation of some cost items was conducted by converting the available private cost items with some published standard conversion factors. This is in fact a popular (broad-bush) procedure conducted by most studies using the PAM approach. The difference between the results of the two studies is due mainly to the fact that Setboonsarng treated processing cost as fully traded while Katikarn *et al* did not, and that there exists a marked difference between the domestic crushing margin and the foreign crushing margin. Another source of difference is due to the difference in social pricing of the output. In Kitikarn *et al*, a 1987 average c.i.f meal price of

5.83 *baht* per kg was used to value soybean meal production from all regions, while in Setboonsarng the price was adjusted to 6.35, 6.25 and 6.04 *baht* per kg of meal produced from the North, Northeast and Central regions, respectively to account for differences in location and quality of the output (see Appendix, Table A.4.1 to Table A.4.4).

4.4.4 DRCs of Soybean Production and Soybean Oil Extraction

This section attempts to estimate the DRCs of soybean grain production and soybean oil extraction using 1990 data. Typically, to carry out DRC estimation in empirical studies one might follow the following steps :

a) Identify a commodity or production system of interest.
b) Collect data on physical units and market prices of inputs and outputs of the system.
c) Classify and decompose input items into their corresponding tradable, non-tradable and tax (or subsidy) components.
d) Compile or estimate the social prices of all the inputs and outputs including the shadow exchange rate.
e) Convert prices of inputs and outputs to their appropriate private and social values.
f) Construct a private/social commodity budget and finally estimate the value of the DRC for the production system.

4.4.4.1 *Identification of A System*

At present the Thai government is attempting to promote domestic production of soybeans. The desire for self sufficiency in soybean production is evident in various crop diversification schemes in which soybeans are proposed to replace other crops, e.g., cassava in the Northeast, and irrigated rice and mungbeans in the upper Central Region and in the North. Various policy measures as mentioned earlier have resulted in price distortions (of various degrees) at different stages of the soybean grain, meal and oil production, processing and marketing activities. To investigate the likely impact of such policies the identified systems are (1) the soybean grains production system and (2) the soybean oil extraction system.

4.4.4.2 *Collection of Data*

The basic information needed for DRC estimation consist of data on the physical units and the market prices of inputs and outputs of the production system. For the identified systems, these necessarily include items in a detailed farm budget, the transportation cost components and/or the processing cost components as well as other cost items, such as storage costs, port charges, import/export taxes, etc.

Most farm budget information are available from the Office of Agricultural Economics (OAE), the Ministry of Agriculture and Agricultural Cooperatives. Other cost items are obtainable from the same office or from other sources such as the Bank of Thailand, the National Economics and Social Development Board or from field survey and/or interviews with the concerned agents. For the oil processing budget, most information is obtainable from private agencies.

4.4.4.3 *Classification & Decomposition of Input Cost Items*

An important step in DRC estimation is the classification and/or decomposition of all input cost items into three distinct categories, namely (1) the tradable components, (2) the non-tradable components and (3) taxes and/or subsidies. Then all cost components (when applicable) are expressed as the quantity of the physical units of input used in the production system (actually per *rai* of crop output or per tonne or kg of commodity) multiplied by their corresponding market prices.

Such a break down of cost items facilitates the shadow pricing of the underlying input use. In this context, imported inputs such as fertilizers and pesticides are decomposed into their constituent tradable and domestic components. By the same token, domestically produced inputs and services such as fuel and transportation are decomposed in the same way. In essence, most input items are decomposed into tradable components and primary domestic factors by moving backward through the input-output chain.

4.4.4.4 *Compilation & Estimation of Shadow prices*

To determine a set of appropriate shadow prices is a complex task. Typical shadow prices required for the estimation of DRC normally consist of (1) the shadow exchange rate, (2) the import and export parity prices of tradable inputs and outputs, (3) the shadow wage rates for domestic labour, (4) the social interest rate for capital and (5) the opportunity cost of land.

(1) The Shadow Exchange Rate

A foreign exchange rate is a rate at which one unit of domestic currency can be exchanged for one unit of an internationally traded currency. An appropriate exchange rate can be used to value prices of imports and exports so that domestic prices of various commodities can be readily compared with their equivalents in the world market. When an official exchange rate (OER) does not fully reflect the mentioned property, a shadow exchange rate (SER) which theoretically reflects this property should be used instead. Under certain circumstances, the SER can be estimated from the OER using a standard conversion factor (SCF) as suggested in the UNIDO methodology, Curry and Weiss (1993) and Ahmet (1983) such that:

$$SCF = \frac{OER}{SER}$$

While the SCF can be estimated with the following simple formula :

$$SCF = \frac{M + X}{M(1+t_m) + X(1-t_x)}$$

where
- M := CIF value of imports,
- X := FOB value of exports,
- t_m := average tax on imports, and
- t_x := net average tax on exports.

In 1990, with a total values of imports and exports equal to 844 448 and 589 813 million *baht* respectively, and with an average import tariff rate of 0.1064 and a negative export tax rate of -0.032 (see Appendix Table A.4.7), the SCF turns out to be :

$$SCF = \frac{844448 + 589813}{844448(1+0.1064) + 589813(1+0.032)}$$

$$= 0.9295$$

Therefore, given an official exchange rate of 25.29 baht for one US dollar in 1990, the shadow exchange rate is estimated as :

$$SER = \frac{OER}{SCF}$$

$$= \frac{25.29}{0.9295}$$

$$= 27.207$$

In cases where divergence exists between SER and OER, to convert the values of tradable inputs and outputs from foreign currencies into their domestic currency equivalents, the SER should be used in stead of the OER.

(2) The Import & Export Parity Prices of Tradable Inputs and Outputs

Social valuation of inputs and outputs at the farm gate is normally done by multiplying the quantities with their respective parity prices. At the border, the import and export parity prices are the CIF and FOB prices. These prices are used as reference prices, since they represent what a commodity can earn as an export or cost as an import. When these prices are converted into domestic currency with a shadow exchange rate, they become the social border prices.

The farm-gate import (export) parity prices are derived from border parity prices by allowing for the social costs associated with moving imports (exports) from (to) the border. The scheme as outlined in Figure 4.4 provides a simplified example of how the import parity price of soybeans (for used in oil crushing industry) is derived from its corresponding border price. Details on the derivation of parity prices are given in Appendix Tables A.4.10 to A.4.12 for soybeans fertilizers and pesticides, respectively.

Figure 4.4 Derivation of Import Parity Price of Soybeans

CIF Bangkok ($/ton)

×

Shadow Exchange Rate (B/$)

=

Border Parity Price (B/ton)

+

Transport & Marketing Cost
(border to factory)

=

Factory-Gate Parity Price

-

Transport & Marketing Cost
(farm to factory)

=

Farm-Gate Parity Price

(3) The Shadow Wage Rate

With a fairly unregulated labour market in the rural sector coupled with various off-farm employment opportunities and relatively free movement of labour forces among regions, it can be assumed that the prevailing market wage rates approximate the opportunity costs of skilled labour. In other words, it is assumed that the market wage rate would adequately reflect the marginal value product (VMP) of labour. For unskilled labour, however, the shadow wage rates of labour can be quite different from the actual market rates. Theoretically, they should be equal to the values of marginal product of labour employed in their next best alternative occupations.

Without the knowledge of VMP of labour in their next best employment, for the farm production budget as presented in Appendix Tables A.4.13 to A.4.15 the present study resorts to an approach used by FAO (1993), with the following formula:

$$SW = \frac{(WP + 0.5WO)}{2}$$

where	SW	=	Shadow wage
	WP	=	Peak-season wage rate
	WO	=	Off-peak season wage rate

Moreover, the actual wage rates paid by the farmers are used as WPs whereas for WOs the existing off-farm average wage rates in the regions are used. For the processing budget of oil extraction a conversion factor of 0.92 is used to transform private labour cost to its social counterpart (see Appendix Table A.4.8 for a selected list of conversion factors).

(4) The Social Interest Rate

When the financial institutions of the country function effectively with minimal distortion on the supply of capital, the prevailing market interest rate would approximate the social rate of return on capital. However, when the capital market is distorted by policy interventions which cause transfers (tax or subsidy), the social interest rate should be estimated and used in social valuation of the opportunity cost of the investible funds. This involves quite a complex exercise. The estimation is even more difficult when there are quantitative restrictions on the supply of capital or controls on interest rates.

Under these circumstances, as suggested by Monke and Pearson (1989), information on the rates of return to investment provided by national or international sources could be used. When information sources are not available or unreachable, discretionary rules of thumb might be used such that, (based on existing empirical studies) the real rates of return are approximated as 10 to 15 per cent and 2 to 6 per cent for low income and high income countries respectively.

As a compromise between the two approaches, another device suggested by Monke and Pearson (1989) is to estimate the social interest rate based on the market lending rate adjusted for the rate of inflation to reflect the real opportunity cost of capital with the following simple formula :

$$\frac{1+i^N}{1+f} = 1 + i^R$$

where ; i^N = private interest rate
f = inflation rate
i^R = social interest rate

In 1990, with a monthly average lending interest rate (MLR + 1) of 15.625 per cent and an inflation rate of around 6 per cent, the social interrest rate is approximated as 9.08 per cent. The i^N and i^R as estimated will be used in the estimation of DRCs.

(5) The Opportunity Cost of Land

In DRC estimation, the opportunity cost of land is usually measured as the value of marginal product generated from its next best alternative use. In farming, this is, essentially, the net return to land of the best competitive crop valued at social prices. In this context, the net return to land is defined as the social revenue per unit of land minus all other social costs in farming except land rent. In cases where it is difficult to identify major competitive crops, however, Yao (1993) suggested some arbitrary methods which include the use of land rent or the opportunity costs of land of some similar crops as a proxy.

For the present study, for the farm budget of soybean production, it is assumed that the average rented rate of land in each region approximately reflects the opportunity cost of land, whereas for the processing budget of soybean oil extraction the land rent is approximated by the capital cost of purchasing the land. The full details are presented in Appendix Tables A.4.13 to A.4.15 and Table A.4.19.

4.4.4.5 *Construction of Private and Social Commodity Budgets and estimation of DRC*

The present study needs to construct two commodity budgets; one for soybeans and another for soybean meal and oil. For soybean production, this starts with a private farm budget (per *rai* of farm production) with all the private values of revenue and costs decomposed into their respective physical units and unit prices. In addition, where applicable, the cost items are decomposed into their tradable, non-tradable components and transfers (tax or subsidy). All the output and input components are then multiplied by their corresponding shadow prices to arrive at the social crop budget. In this context, for cost items where detailed cost structures are not available, the items will be classified as either tradable or non-tradable inputs depending on whether the items are actually traded internationally or not. These items are multiplied by some published conversion factors to arrive at their social values.

A properly prepared farm budget would provide all the needed information for DRC estimation. This basically includes the values of revenues, tradable costs and non-tradable costs valued at both private and social prices. The detailed crop budgets for DRC estimation are presented in Appendix Tables A.4.13 to A.4.15. In these tables, some input cost items are converted into their most-used input equivalent costs. For instance, the various pesticides and fertilizers costs are converted into the most frequently used pesticides (Monocrotophos) and fertilizers (formula N-P-K=15-15-15) to ease the cost decomposition procedure.

For soybean oil processing, the processing budget (per tonne of soybean extraction) is decomposed into fixed and variable costs. The fixed cost consists mainly of depreciation of imported and local made machinery, building and construction, equipment and utilities, motor vehicles, and land rent. The variable cost can further be classified into cost of soybeans and other variable costs such as fuel, electricity, labour and maintenance costs, etc. Estimation of DRC for soybean oil extraction follows similar procedures as those for the bean production. It is interesting to note that in soybean processing the variable costs capture more than 98 per cent of the processing budget with the material cost of soybeans alone accounts for about 88 per cent of the total budget.

With all the data extracted from the summary table of a farm or a processing budget (Appendix Tables A.4.13 to A.4.15 or A.4.19) the estimation of the DRC can be done with ease. The estimation of the DRC for beans is straight forward. For example, using data for the North (Table A.4.13) :

$$DRC = \frac{DC}{SR - TI}$$

$$= \frac{872.237}{(1366.135 - 273.815)} = 0.799$$

This gives a value of the DRC = 0.799 for the production of soybeans in the Northern region of Thailand. For the oil processing industry, estimation of the DRC for the combined joint products (meal and oil) follows the same method. For example, using data for soybeans from the North as material input in oil extraction (Appendix Table A.4.19) :

$$DRC = \frac{DC}{SR - TI}$$

$$= \frac{5643.747}{(8386.18 - 1541.182)} = 0.825$$

This gives a value of the DRC = 0.825 for the combined production of meal and oil. DRCs of all the concerned products (of the Thai soybean industry classified by region) are estimated using data from Tables A.4.7 to A.4.19. A summary of the empirical results is presented in Table 4.3. Comparing these figures with those in Table 4.2, DRCs for soybeans are greater than those of Katikarn (1989) by about 20 to 30 per cent, whereas DRCs for meal and oil are less than those of Katikarn (1989) by about 50 per cent and greater than those of Setboonsang (1989) by about 20 to 35 per cent.

Table 4.3

The Domestic Resource Cost of Soybean Production and Soybean Oil Extraction Classified by Region, Crop Year 1989/90

DRC estimation	Beans	Meal and Oil
North	0.799	0.825
Northeast	0.772	0.804
Central	0.802	0.821
Average	0.791	0.816

With all DRC values less than one, this implies that a comparative advantage exists for the production of soybeans and for the processing of (locally produced) soybeans into meal and oil. And basically, with the slightly higher values of DRCs for meal and oil, the oil processing industry has a lower comparative advantage in its production than the farm sector. This implies that production of soybeans and their products domestically would generate some value-added income for the country. This is a general conclusion, thus far, under particular circumstances. In the next section the issue is examined in more detail.

4.4.5 DRC in Empirical Studies : A Quest for Careful Interpretation

There are some problems with the interpretation of DRC results. The problems are inherent in the method of calculation but do not appear to capture sufficient attention from researchers. This section attempts to address some of these problems, particularly in association with the use of DRC as (1) an *ex ante* indicator of comparative advantage and (2) an *ex post* measure of the cost of protection. These are the two major uses of DRC (Bruno 1972, p.7 and Pearson 1976, p.320). Subsequent studies, though different in refinements, followed similar lines of investigation. These studies usually provided a number of DRC calculations. A production system was inferred to be comparatively advantageous and warranting expansion when its DRC was less than one.

Comparing the value of DRC with one is implicitly comparing soybean farming and oil extraction with other industries in the economy. In this regard, in conducting DRC estimation, the industries to be compared are clear in some instances and obscure in other instances. For the present study, the industry to be compared with soybean farming is the next best alternative crop. This can be rice, mungbeans, maize or some other crops depending on the specific location. For oil extraction, however, it is not obvious which industry would directly compete for resources used in oil processing. Presumably, the plam oil processing industry could be a good candidate.

It is worth mentioning that the use of a DRC or PAM framework entails an assessment of the whole system of production rather than its marginal products (Scandizzo and Bruce 1980; Monke and Pearson 1989). Thus, the use of the DRC and other indices from PAM are most appropriately interpreted in an average sense.

As far as the use of DRC as an indicator of comparative advantage is concerned, Morris (1990) showed that, technically, the DRC approach does not really measure true comparative advantage. Since the social prices of the tradable inputs and outputs used in the calculation of DRCs are the world prices, which most probably themselves reflect significant policy-induced distortions, a DRC index indicates merely one country's ability to compete with prevailing world prices rather than providing a true measure of relative efficiency in the production of a certain commodity. However, this does not negate the usefulness of the approach. As long as similar distortions are expected to continue in world markets, the use of the DRC is a correct indicator of future competitiveness in production relative to such distorted markets.

It is noted that using DRC in this narrower sense is not without problems. Technically, the difficulty arises in the shadow pricing of the tradable inputs and outputs, as well as all the primary factor costs of the system. The basic problem in assigning shadow prices to tradable inputs and outputs using their world prices (adjusted for quality, location, etc.) has long been recognized in the literature. The commonly perceived problem is that world prices can be highly volatile and the suggested solution is to use a long-term trend of world prices (in addition to the given world prices) and/or to resort to sensitivity analysis with different level of assumed world prices (Akrasanee and Wattananukit 1976; Herdt and Lacsina 1976; Unnevehr 1986).

According to the DRC framework, the shadow price of a primary factor is, conceptually, the value of the output foregone from withdrawing the factor from its best alternative employment. However, practically, the shadow pricing of some primary factors is obtained from multiplying their market values by published conversion factors. The validity of the DRC results is thus subject to the validity of the conversion factors.

The foregoing problems are trivial as long as the conversion factors are logically sound and the interpretation of the DRC result is conducted with an acknowledgement of the difficulty of the calculation procedure. However, looking at the DRC framework more closely will reveal more subtle problems. The following revisit to the DRC framework will argue for a more careful interpretation of the DRC results. This involves the use of DRC in static, dynamic and comparative static contexts.

In a static sense, the interpretation of DRC in empirical work is well defined and straightforward. A DRC less than one implies that the system can operate with social cost less than social benefit and thus the system's operation would enhance welfare in terms of its contribution to national income. Moreover, since the numerator is the social opportunity cost foregone as a result of withdrawing some primary factors of production from other productive activities and the denominator is the benefit realized in terms of net foreign exchange earned or saved, a DRC less than one also implies that the system is competitive *vis-a-vis* the world market. Thus, in this purely static sense with given shadow prices and fixed input/output relationships, the interpretation of the empirical results from the DRC calculation is clear and, in some senses, comparable to a social cost-benefit ratio in project evaluation.

However, for a long-run perspective, the notion of dynamic comparative advantage has been proposed. For instance, Chenery (1961) put forward the view that, since there is much scope for technological improvement in both the agricultural and the industrial sectors, comparative advantage should be measured over time. Abbott and Thompson (1987) proposed a similar view; in evaluating a country's potential for agricultural trade, consideration of initial conditions in terms of endowments and sector specificity, as well as explicit integration of capital theory with comparative advantage theory, are called for. In this context, comparative advantage must not be considered as a purely static concept. English (1988) advocated that, in a developing country, movement toward a coherent industrial policy would require careful determination of dynamic comparative advantage.

In a dynamic context, the DRC approach is confined to the use of sensitivity analysis undertaken on major variables to approximate the effects of dynamic changes. This can involve the use of different assumed future world prices and projection of long-run trends in the costs of primary factors as well as the changing pattern of production technologies (Pearson *et al* 1976; Monke and Pearson 1989). What is of most concern in the present study is something between the strictly static and the dynamic aspects of DRC. This deals with the use of DRC in a comparative static analysis, particularly in determining the effects of a price policy.

Comparative static analysis with DRC can involve the determination of a marginal or non-marginal change in the level of a certain production system. Basically, the use of DRC is best prescribed within the context of marginal change. This is in conformity with Tower's (1984) conclusion:

> '... except under extraordinary circumstances DRC is a cost-benefit ratio only for marginal changes, and all we can say with precision is that a small expansion (contraction) of any industry with a DRC which is less than (exceeds) unity is a good thing.'

However, change in the level of production in most cases is non-marginal to the extent that it results in alterations of the input/output relationship as well as changes in shadow prices (Bhagwati and Wan 1979; Tower 1984). This can pose problems in the interpretation of the DRC results as pointed out by Scandizzo and Bruce (1980):

> 'For all policy changes of significant proportions, therefore, accounting prices of factors and shadow exchange rates should be calculated for the situation existing before and after the suggested policy changes and the corresponding two sets of DRC's considered to

> evaluate the policies. As in similar index number problems, this two-fold evaluation would be conclusive in some cases (where the DRC's before and after the change offer the same qualitative advice for an expansion or contraction of a given sector) and inconclusive in others.'

To facilitate further discussion. all major elements used in the calculation of DRC are grouped into three categories, namely: (1) the world prices of all tradables; (2) the opportunity costs of primary factors; and (3) the input/output relationships of production. Then a change in the level of any production system (no matter how large in absolute quantity) is defined as marginal as long as it does not invalidate the following assumptions:

(D.1) The change in production does not significantly induce changes in the world prices of the tradable inputs and outputs (including the shadow exchange rates);

(D.2) The change in production does not significantly induce changes in the opportunity costs of the primary factors; and

(D.3) The change in production does not significantly alter the input/output relationships.

Parallel to the above quote from Scandizzo and Bruce (1980), Monke and Pearson (1989) provided a simplified diagrammatic exposition of how and why a non-marginal change in output can affect the average cost and benefit of a system. A modified version of their diagram is reproduced in Figure 4.5 as a heuristic tool to pave the way for further discussion. An additional cost/revenue scale has been added for DRC calculation.

According to the authors the diagram demonstrates two interesting points, namely:

(1) Measuring the total costs of a whole production system with the use of a marginal cost curve or a corresponding point on the average cost curve will provide the same result For example, with the market price P_1 and the production level Q_1, the total cost measured in association with the marginal cost curve is area $FGEQ_1O$, and this is equal to area C_1DQ_1O when the total cost is measured using the average cost curve.

(2) In this example, P_2 is the social price and P_1 is the private market price (due to some distorting policies) Any corrective policies that cause price to increase from P_1 to P_2 would simultaneously cause the average cost of production to increase from C_1 to C_2 (due to diminishing returns to factors of production).

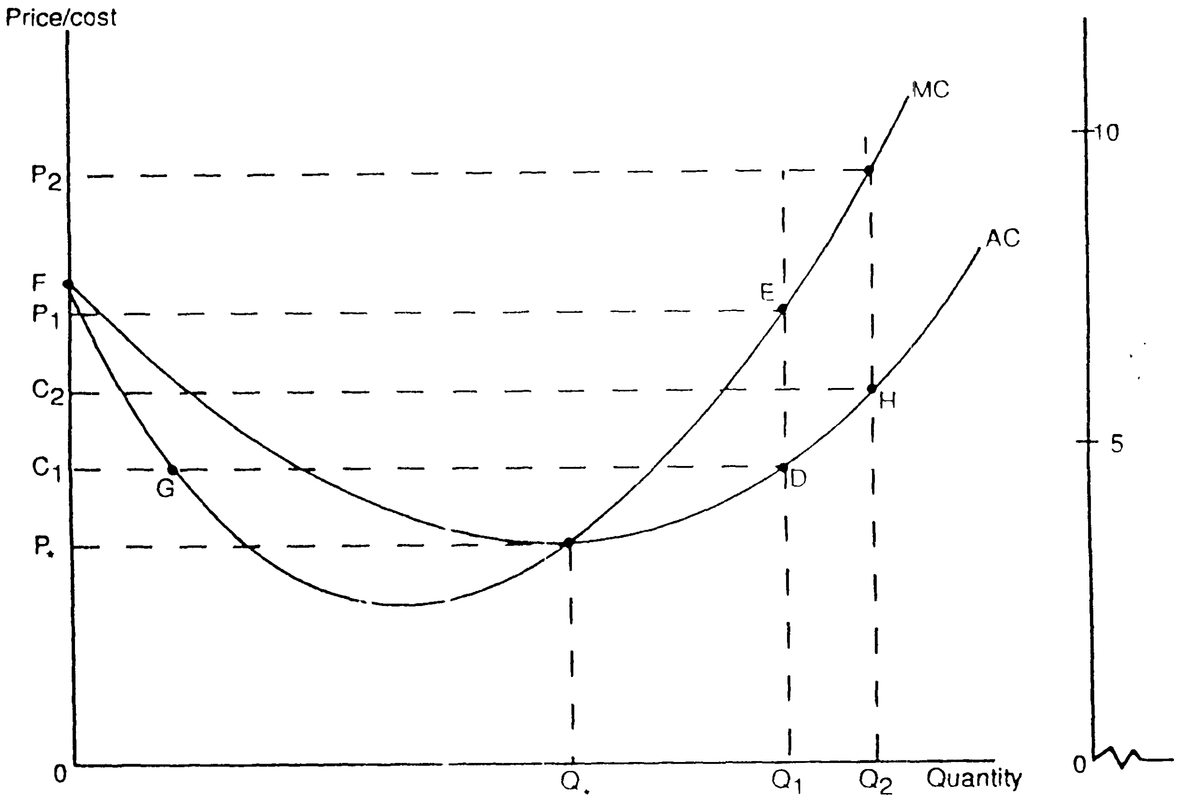
The average social profitability of production might be used as one of the criteria to determine the desirability of the corrective policies. In this context, the use of budgets associated with point D (the existing budgets) as a basis for calculation would result in an over estimate of the social profit per unit of output ($P_2 - C_1$). The correct estimate is ($P_2 - C_2$) and is measured in association with point H.

Three points are worth mentioning at this juncture. First, the DRC and PAM frameworks give emphasis to the production side. The demand side and trade pattern are taken as given. As pointed out by Abbott and Thompson (1987), this is a prevailing feature in the comparative advantage literature. Thus, the policy impacts as described in Figure 4.5 tell only part of the story, an important part though. Second, the example conforms to a marginal change in the sense of partial-equilibrium analysis (i.e., no shift in the costs schedules). However, it is a non-marginal change in the sense of cost-benefit analysis, since it violates assumption D.3, above. Third, with additional information on the average level of tradable inputs used in the two levels of production, a two-fold calculation of DRC as suggested above by Scandizzo and Bruce (1980) can be conducted.

A numerical example is given below to illustrate the difference in DRC results before and after the corrective policies. For simplicity, two assumptions are invoked, namely: (1) there is no significant distortion elsewhere in the economy and, hence, private costs and social costs are identical; and (2) the proportionality between foreign costs and domestic costs valued at market prices are approximately 3:7 at point D and 4:6 at point H. This is based on the fact that when producers expand their outputs in response to increases in price along their supply curves, a higher level of AVC and lower level of AFC will be used to produce each marginal unit of output. Usually VC would contain higher percentage of tradable input cost.

Let DRC_1 and DRC_2 represent the two domestic cost ratios before and after the corrective policies, with production levels Q_1 and Q_2, respectively in Figure 4.5. Then, with equation (4.2) and assumptions (1) and (2), the two ratios can be calculated as shown in Example 4.1.

Figure 4.5 : A Nonmarginal Policy Induced Change in Production and Its Effect on the Cost-Benefit Ratio



Source: Adapted from Monke and Pe ırson (1989, p.212)

When both DRC values fall on the same side of unity (in this case both less than one), there seems to be no problem in interpreting the results. It is conclusive, and the policy prescription is to implement measures that would result in the expansion of the system. However, a closer look at the conventional calculation procedure as outlined above discloses a fundamental inconsistency between the use of DRC and the use of partial-equilibrium analysis (PEA) in resource allocation problems. Referring to Figure 4.5, at production level Q_1, the marginal social cost is P_1 and the marginal social benefit is P_2. According to PEA, this implies a sub-optimal level of output, and production should be increased to a level at which marginal social cost and benefit are equal (i.e., to the level Q_2). In this case, the DRC calculation above seems to provide a consistent result; $DRC_1 < 1$ implies the desirability of product expansion.

However, at production level Q_2, the marginal social cost and benefit are equal (with price and cost both equal to P_2). In accordance with PEA, this is an optimal production level beyond

Example 4.1

$DRC_1 \text{ (at D)} = \dfrac{DC_1}{NVA_1}$	$DRC_2 \text{ (at H)} = \dfrac{DC_2}{NVA_2}$
$= \dfrac{C_1 - TI_1}{P_2 - TI_1}$	$= \dfrac{C_2 - TI_2}{P_2 - TI_2}$
$= \dfrac{5 - 1.5}{9 - 1.5}$	$= \dfrac{6 - 2.4}{9 - 2.4}$
$= 0.47$	$= 0.54$

which output expansion would decrease welfare. But this is contradictory to the DRC result, since $DRC_2 < 1$ implies that a further product expansion is desirable.

Basically, there should be no fundamental contradiction between the PEA approach and the DRC approach. Both conceptual frameworks are well defined and, therefore, should yield consistent implications. However, contradictions can occur in some instances. This is due to the fact that the use of average production cost in DRC calculations will result in an underestimate of the DRC, except in some special cases, (e.g., where supply curves do not slope upward). The problem has been cited in the literature (Herdt and Lacsina 1976; Anderson and Ahn 1984), but no method has been developed to deal with the problem systematically.

The present study attempts to re-emphasize the fact that using average cost instead of marginal cost in DRC calculations yields under-estimates of DRCs. The steeper the slope of the supply curve of the product, the higher the bias that is generated. The numerical example has shown that as far as (1) the use of DRC as an *ex ante* indicator of comparative advantage and (2) the use of DRC as an *ex post* measure of the cost of protection are concerned, DRC_1 does not provide (2) while DRC_2 provides neither (1) nor (2). The next section attempts to resolve the problem.

4.4.6 The Marginal Resource Cost Ratio and the Marginal Social Cost Curve

One of the advantages of the DRC approach is its relatively slight requirement of time series data. In most cases only one, or a few years, of cross-sectional data are sufficient for carrying out the research. In these empirical studies, since marginal cost structures for all conceivable production levels are not available, and cannot be reliably generated from the data, researchers are compelled to use an average cost structure instead. The contention is that, as a broad-brush measure, the approximation is not considered ill-founded as long as it provides the correct direction for policy change.

In this context however, it has been demonstrated above that an incorrect recommendation regarding direction for policy change can result from the data inadequacy. The present study proposes that, under some conditions, the validity of the DRC approach can be greatly improved by invoking two additional working assumptions. Additional information on supply response of the product is needed, however, to help modify the method. Before turning to this, further illustration on the consistency between PEA and DRC is called for.

To emphasize the superiority of using marginal rather than average costs in DRC calculations, two additional resource cost ratios are estimated using marginal cost instead of average cost as the basis for calculation. The ratios are termed 'marginal resource cost ratios (MRCs)' to differentiate them from the conventional DRCs. With the same information as given in Figure 4.5 and a new ratio of tradable:nontradable components (as in 5:5), the two ratios are calculated as shown in Example 4.2.

Example 4.2

$MRC_1 = \frac{DC_1}{NVA_1}$	$MRC_2 = \frac{DC_2}{NVA_2}$
$= \frac{P_1 - TI_1}{P_2 - TI_1}$	$= \frac{P_2 - TI_2}{P_2 - TI_2}$
$= \frac{7 - 3.5}{9 - 3.5}$	$= \frac{9 - 4.5}{9 - 4.5}$
$= 0.64$	$= 1$

The MRCs results are consistent with the PEA approach. At production level Q_1, the MRC_1 less than one implies that it is beneficial to expand production, and at production level Q_2, the MRC_2 equal to unity implies that the optimal production level has been attained. Three points are worth noting here. First, MRC_2 equals unity in the example due to the fact that the model in Figure 4.5 assumes no distortion elsewhere in the economy other than the ones in question. Second, it is pointed out in Pearson and Monke (1987) that a main analytical limitation of PAM (including DRC) for price policy analysis is its inability to calculate how much systems will expand or contract when prices change. Thus, PAM results need to be complemented with estimates of supply elasticities. The use of MRC when complemented with a supply response model, however, can provide not only an inference on how a system would alter its production level in response to price incentives (which is purely the contribution of the supply model), but also an inference on how much a system should be changed to attain an optimal level of output. This point will be elaborated shortly. Third, as opposed to the conventional DRC which provides a measure for the whole system (on an average basis), the MRC as formulated provides a measure only at (or within very close margins of) a specific production level.

In the above discussion, the use of a resource cost ratio, whether calculated with average cost (thus DRC) or calculated with marginal cost (thus MRC), does not seem to provide any great added advantage over the use of an ordinary supply curve. However, in a real-world situation, distortion is the norm rather than the exception. Thus, the use of an ordinary supply curve (i.e., the portion of a marginal private cost curve which lies above the average variable cost curve) can no longer provide correct implications for efficient resource allocation (Mears 1976). Correct guidelines must be based on the knowledge of a MSC curve and/or resource cost ratio.

As an extended example, two linear curves (S = MC) and (AC) are depicted in Figure 4.6 to approximate the marginal cost curve and average cost curve as defined from the relevant range of output from Figure 4.5 (i.e., to the right of Q*). Replace the assumption of no distortion elsewhere in the economy with assumptions that:

(1) $\frac{TI}{PTI} = 0.9$

(2) $\frac{DC}{PDC} = 0.8$

where

TI = tradable inputs per unit of output valued at shadow prices;

PTI = tradable inputs per unit of output valued at market prices;

DC = domestic factor costs per unit of output valued at shadow prices; and

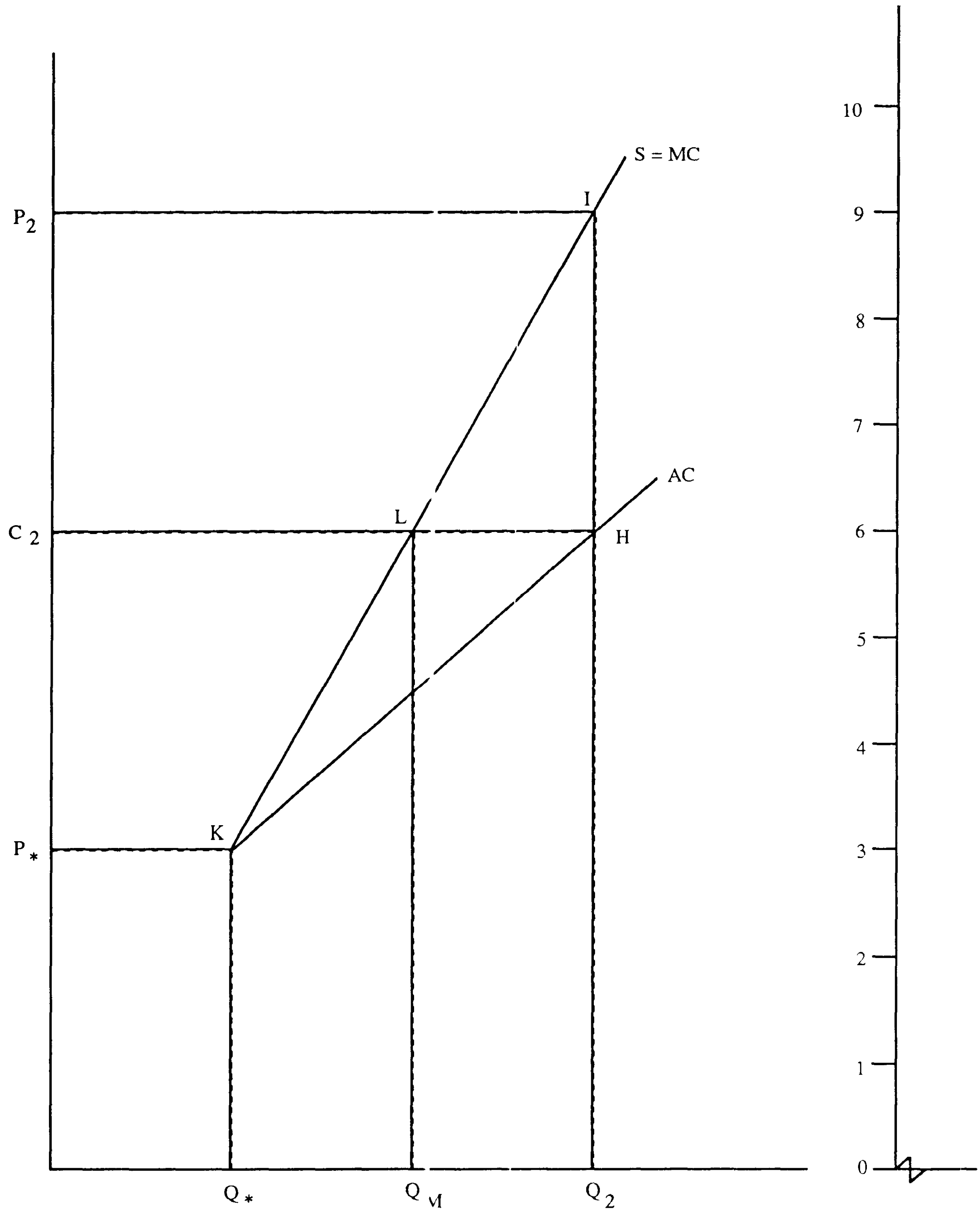
PDC = domestic factor costs per unit of output valued at market prices.

In other words, it is assumed that the distortions elsewhere in the economy have caused the per unit private costs of tradable inputs and domestic factors to be greater than their true social costs by about 11.1 per cent and 25 per cent, respectively. Retaining the former assumption that the proportionality between foreign costs and domestic costs is 4:6 for the average cost and 5:5 for the marginal cost, at production level Q_2 the resource cost ratios are calculated as shown in Example 4.3.

Example 4.3

$DRC = \frac{DC}{NVA}$	$MRC = \frac{DC}{NVA}$
$= \frac{(.8)(.6)(6)}{9 - (.9)(.4)(6)}$	$= \frac{(.8)(.5)(9)}{9 - (.9)(.5)(9)}$
$= 0.42$	$= 0.73$

Figure 4.6 : Relationships Among a Production Supply Curve, Marginal Cost Curve and Average Cost Curve



Due to the fact that an average cost (6) and a marginal cost (9) are used in the calculation of DRC and MRC, respectively, the two ratios are markedly different. As shown in the above example, the calculation yields a value of 0.73 for MRC and an underestimated value of 0.42 for DRC.

As opposed to the result that $MRC_2 = 1$ in Example 4.2, which implies Q_2 is an optimal production level, in this example a MRC = 0.73 implies that production at Q_2 is still less than optimal and the system should be expanded. In this second-best situation, the use of an ordinary supply curve will not provide correct guidelines for efficient resource allocation. However, if a MSC curve can be contemplated, it will yield policy implications consistent with that of MRC.

If information on marginal costs can be collected and compiled into a commodity budget following the same procedure used in DRC calculation, the data so generated when complemented with the information from a supply function, assumed to be a private marginal cost curve, can be used to generate a MSC curve. If the assumptions of constant factor shares of production cost between tradeable inputs and primary factors and constant percentage distortion in tradeable inputs and primary factors hold within the relevant range of production, the social marginal cost curve can be derived from the private marginal cost curve by applying these constant factor shares and constant percentage of distortion. For production levels Q_M and Q_2 the calculation is as shown in Example 4.4.

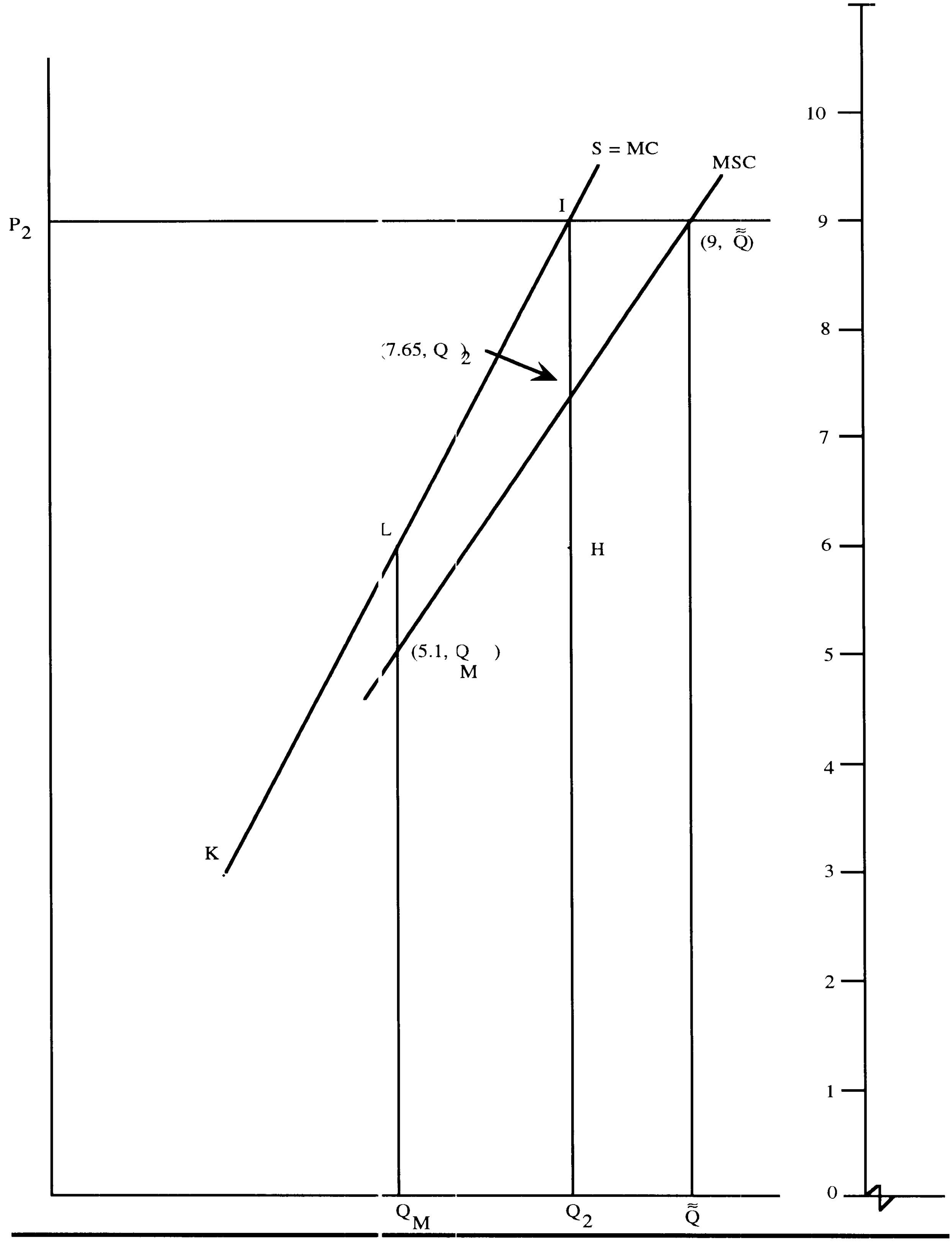
Example 4.4

MSC_M	=	$TI_M + DC_M$	MSC_2	=	$TI_2 + DC_2$
	=	(.9)(.5)(6) + (.8)(.5)(6)		=	(.9)(.5)(9) + (.8)(.5)(9)
	=	5.1		=	7.65

With the information generated from Example 4.4, a MSC curve can be generated by drawing a line joining the two points of cost/output combination (5.1, Q_M) and (7.65, Q_2) as depicted in Figure 4.7. In addition, the curve is extrapolated to point (9, $\bar{Q}$) where the MSC curve intersects with the social price line (P_2) to determine the optimal level of production $\bar{Q}$.

In this instance, a policy that causes the private supply curve to shift rightward towards the MSC curve or, in other words, causes production to increase from Q_2 towards $\bar{Q}$ (say a production subsidy), should enhance welfare.

Figure 4.7 : Derivation of a Marginal Social Cost Curve and Its Extrapolation



4.4.7 The Marginal Resource Cost Ratio : A Summary

Before leaving this chapter, it s worthwhile looking at the four assumptions required in the calculation of MRC, particularly in cases where there exist non-marginal policy-induced changes in the level of production. They are:

(M.1) the change in production does not significantly induce changes in the world prices of the tradable inputs and outputs (including the shadow exchange rates);

(M.2) the change in production does not significantly induce changes in the opportunity costs of the primary factors;

(M.3) the factor shares of production cost between the tradable inputs and the domestic factors (valued at market prices) are constant in the relevant range of production; and

(M.4) the percentage distortions in the cost of tradable inputs and in the cost of domestic factors are constant in the relevant range of production.

It is noted that, compared with assumptions (D.1) to (D.3) invoked in the previous section for the calculation of DRC, assumptions (M.1) and (M.2) are identical to assumptions (D.1) and (D.2) while assumptions (M.3) and (M.4) are used to replace assumption (D.3). In this context, MRC is less restrictive than DRC. Moreover, as long as the above assumptions hold, once one MRC has been calculated, a whole range of MRCs (in association with different market prices and thus different levels of output) can be generated using the existing information and equation (4.3) as shown below:

Define $$g = WP/\left[\left(\frac{TI}{PTI}\right)\left(\frac{a}{a+b}\right) + \left(\frac{DC}{PDC}\right)\left(\frac{b}{a+b}\right)\right]$$

$$= WP/SPCF$$

$$k = \frac{TI}{MSC}$$

Then $$MRC = \frac{DC}{NVA}$$

$$= \frac{MSC - TI}{WP - TI}$$

$$= \frac{1 - (TI/MSC)}{(WP/MSC) - TI/MSC)}, \quad \text{or}$$

(4.3) $$MRC = \frac{1 - k}{(g/p) - k}$$

where:

WP	=	social price of output (i.e., adjusted import or export parity price);
TI	=	tradable inputs valued at shadow prices;
PTI	=	tradable inputs valued at market prices;
DC	=	domestic inputs valued at shadow prices;
PDC	=	domestic inputs valued at market prices;
a/(a+b)	=	factor share of tradable inputs = PTI/(PTI + PDC) ;
b/(a+b)	=	factor share of domestic inputs = PDC/(PTI + PDC) ;
SPCF	=	social private conversion factor
NVA	=	net value added;
MSC	=	marginal social cost;
p	=	market price; and
g, k	=	constants [as for assumptions (M.1) to (M.4)]

Equation (4.3) expresses MRC as a function of the market price. In a similar manner, MSC can be expressed as a function of price, as in equation (4.4).

(4.4) $$MSC = \left[\left(\frac{TI}{PTI}\right)\left(\frac{a}{a + b}\right) + \left(\frac{DC}{PDC}\right)\left(\frac{b}{a + b}\right)\right](p)$$

$$= (SPCF)(p)$$

The two equations are used in the second-best policy assessment for which full details are given in Chapter 6.

4.4.8 MRC in Empirical Studies

In empirical studies, it is seldom that an analyst can manage to obtain the marginal cost structure of a commodity, since most information comes either in the form of average cost structure for a number of production units or simply cost structure from a single firm. The MRC must be estimated from information contained in the average cost structure. This can be done by decomposing the average cost structure into fixed and variable components then multiplying the various components of the variable cost structure by a marginal variable cost conversion factor (MVCF) defined as

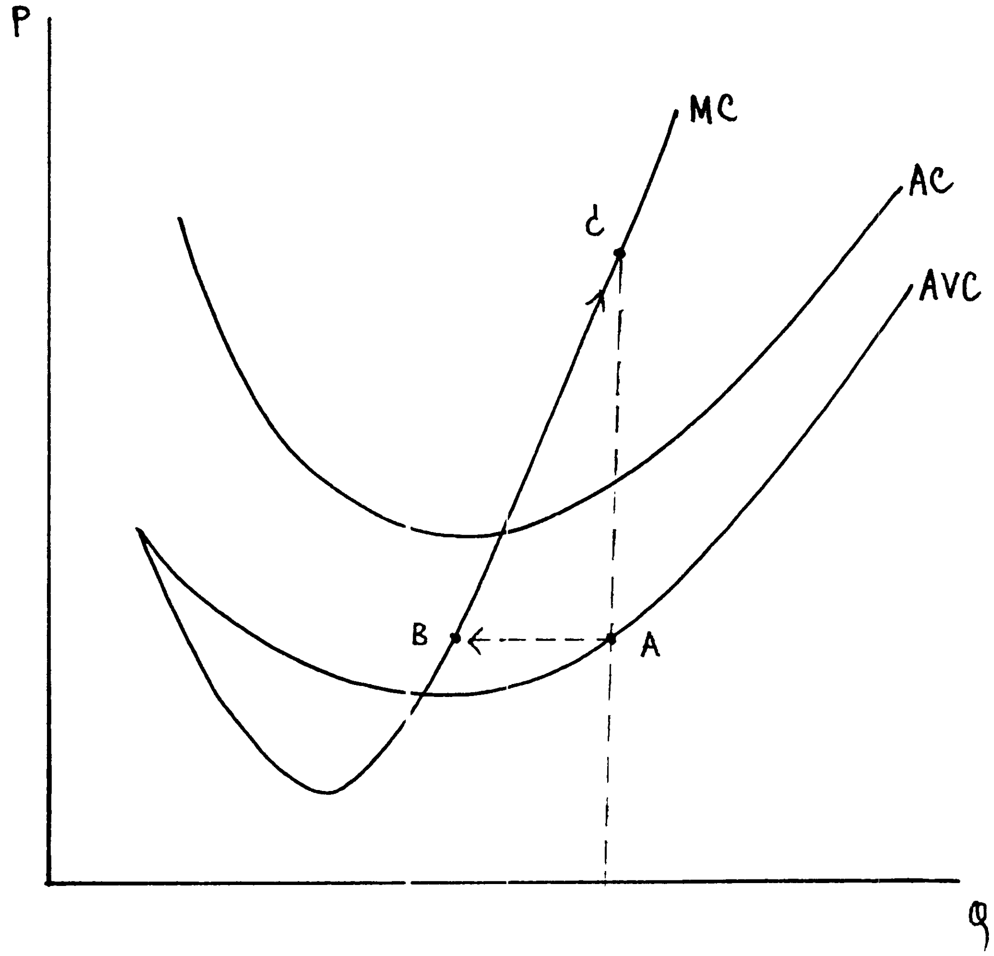
$$MVCF = \frac{P}{AVC} = \frac{MC}{AVC}$$

where : P = the observed market price assumed to equal the marginal cost (MC) of the concerned commodity

AVC = the average variable cost in the production and marketing of the commodity

The derivation of the marginal cost from average variable cost can be best described with graphs as depicted in Figure 4.8. With the observable average variable cost at point A the approximation of marginal cost can be obtained from making an inference from A to B, then from B to C. Some bias may occur if there are marked differences between the marginal cost and the average variable cost (i.e., if the fixed cost component is large). For, the soybean industry, however, the fixed cost components are negligible ; as mentioned earlier the fixed cost components account for only about 2 per cent of the total cost in soybean processing industry. For the production of soybeans at the farm level, it can be argued that all costs can be considered variable cost, since Thai farmers actually change their level of production in response to incentives by switching crops. Responses to price incentives are mostly by changing acreage of arable land rather than changing other yield increasing inputs which alter the production process. This is evident from the study of Vesdapan and Priebprom (1986) (as presented in Table 5.1) that the elasticity of yield response (0.08) is 49 times less than that of the acreage response (3.94).

Figure 4.8 : Derivation of the Marginal Cost from Average Variable Cost



With a very small percentage of fixed factors the transformation of average variable cost to marginal cost will not result in significant bias since the three curves are close to one another. Thus, if the policy induced changes are small, the methodology can be justified on the ground that the empirical results (estimated from the transformed data) will provide correct implications for policy analysis. It is noted that in a distorted economy, with similar device, the MSC can be estimated using equation (4.4) with TI, PTI, DC and PDC as components of the variable cost.

With the data contained in Appendix Tables A.4.13 to A.4.15 and A.4.19 and the methodology generated thus far, the value of MRC, MSC and related statistics are estimated and presented in Table 4.4. The DRCs estimated are also presented in the same table for purposes of comparison.

In general, the values of MSC and MRC obtained from the present study have logical implications for the Thai soybean industry. For soybean production, the MSCs for the North, the Northeast and the Central Regions are 7170, 7230 and 7605 *baht* per tonne respectively. These values are almost identical to the marginal private cost (i.e., the market prices of soybeans at the corresponding level of production), which are 7211, 7191 and 7595 *baht* per tonne for the respective regions. This is consistent with the finding, mentioned earlier, that the divergence between the social costs and the private costs are small. The MRCs for the three regions are 1.102, 1.115 and 1.118. From an efficiency perspective, this implies that Thailand has over-protected soybean farming and, at the levels of production under existing policy, the marginal social cost foregone in terms of domestic factor costs are greater than the marginal value of net foreign exchange earned or saved by about 10, 11 and 12 per cent in the North, Northeast and Central Regions, respectively. The policy implication is to restrain production to the level where MSC equals MSR (i.e., import parity price). Note that using DRC in this instance would result in an incorrect policy implication that the production should be expanded rather than restrained.

Table 4.4

Estimation of MSC, MRC and SPCF for Soybean Production and Soybean Oil Extraction, Classified by Region, Crop Year 1989/90

Unit : Baht/tonne of soybeans

	North	Northeast	Central	Average
(a) Soybeans at Farm Gate				
(1) WP (Social Revenue)	6631.721	6615.923	6941.130	6729.591507
(2) TI	1329.201	1264.831	1294.977	1296.33659
(3) PTI	1380.086	1316.897	1353.389	1350.123746
(4) DC	4234.162	4132.122	4528.941	4298.408304
(5) PDC	4214.807	4051.588	4462.813	4243.069185
(6) P (Private Revenue)	7211.040	7191.440	7594.922	7332.467333
(7) a/(a+b)	0.247	0.245	0.233	0.241
(8) b/a+b)	0.753	0.755	0.767	0.759
(9) SPCF	0.994	1.005	1.001	1.000
(10) g	6669.305	6581.025	6931.933	6727.725
(11) MSC	7170.403	7229.575	7604.999	7334.502
(12) k	0.185	0.175	0.170	0.177
(13) MRC	1.102	1.115	1.118	1.111
(14) DRC (based on ATC=AVC)	0.799	0.772	0.802	0.791
(b) Meal & Oil at Factory Gate				
(1) WP (Social Revenue)	8386.180	8386.180	8386.180	8386.180
(2) TI	1512.592	1452.828	1388.156	1451.192
(3) PTI	1556.929	1498.033	1446.162	1500.374
(4) DC	5544.887	5454.038	5620.470	5539.798
(5) PDC	7491.291	7550.187	7602.058	7547.846
(6) P (Private Revenue)	9821.750	9821.750	9821.750	9821.750
(7) a/(a+b)	0.172	0.166	0.160	0.166
(8) b/a+b)	0.828	0.834	0.840	0.834
(9) SPCF	0.780	0.763	0.775	0.773
(10) g	10751.715	10986.169	10826.660	10853.970
(11) MSC	7660.821	7497.332	7607.791	7588.648
(12) k	0.197	0.194	0.182	0.191
(13) MRC	0.894	0.872	0.889	0.885
(14) DRC (based on ATC)	0.825	0.804	0.821	0.816

Note : (2) to (5) of the soybean oil extraction are components from average variable cost.

Source: Tables A.4.13, A.4.14, A.4.15 and A.4.19.

Turning to soybean oil extraction, the MSCs of processing for the North, the Northeast and the Central Regions are 7661, 7497 and 7608 *baht* per tonne, respectively.

With respective weighted market prices (private revenue of processing one tonne of soybeans) of 9822 baht for the three regions, MSCs are less than marginal private cost by about 33 per cent. The MRCs for the three regions are 0.894, 0.872 and 0.889, respectively. This implies that Thailand has a comparative advantage in the oil crushing industry. The policy implication is that promoting the industry would enhance welfare. It is noted that MRCs are greater than DRCs in both soybean farming and soybean oil extraction.

Chapter 5

ECONOMETRIC MODELLING AND ESTIMATION

5.1 Introduction

The prime objective of this chapter is to describe the specification and estimation of econometric models consistent with the theoretical framework of the Thai soybean industry as outlined in previous chapters. The chapter starts with a review of the available econometric models, particularly those concerned with the demand and supply of soybeans and their products. Based on these previous modelling efforts, a set of econometric models was developed for the present study. Model refinement and modifications compared with those of previous studies are discussed throughout. A brief account is also given of the type of data used in model estimation, the data problems and the need to generate missing data, and the choice of estimation technique. Results of model estimations are presented and discussed in terms of their statistical properties and their theoretical qualities. The relevant statistical results are used in policy analysis in Chapter 6.

5.2 Brief Review of Past Studies

This section reviews major relevant studies of econometric modelling of the supply and demand of soybeans and soybean products. The purpose of the review is to provide a basis from which econometric work in the present study can proceed. The review is focussed on the studies by Issariyanukula (1980), Vesdapan and Priebprom (1986) and DOAE (1977) which are considered to be the most relevant to the present study.

5.2.1 The Issariyanukula model

Issariyanukula's (1980) model contained 13 behavioural equations and three identity equations, with 16 endogenous and 26 predetermined variables. The model was for the period 1950 to 1977. Basically, the purposes of the study were parameter estimation on one hand, and using the estimation results for policy simulation on the other. The model can be summarized by the following equations.

(5.1) $\ln ASN_t = f(PFS_{t-1}, ASN_{t-1}, PWG_{t-1}, PF_t, U_t)$

(5.2) $ASNE_t = f(PFS_{t-1}, ASNE_{t-1}, PWR_{t-1}, T_t, U_t)$

(5.3) $ASC_t = f(PFS_t, ASC_{t-1}, T_t, U_t)$

(5.4) $ASS_t = f(PFS_t, ASS_{t-1}, T_t, U_t)$

(5.5) $YSN_t = f(PFS_t, RN_t, PF_t, U_t)$

(5.6) $YSNE_t = f(PFS_t, RNE_t, PF_t, U_t)$

(5.7) $YSC_t = f(PFS_t, RC_t, U_t)$

(5.8) $YSS_t = f(PFS_t, RS_t, PF_t, U_t)$

(5.9) $\ln QDO_t/N_t = f(\ln PFS_t/CPI_t, \ln Y_t/N_t \bullet CPI_t, U_t)$

(5.10) $\ln QDC_t/N_t = f(\ln PFS_t/CPI_t, \ln PWM_t/CPI_t, \ln Y_t/N_t \bullet CPI_t, U_t)$

(5.11) $QSP_t/N_t = f(PFS_t/CPI_t, PWM_t/CPI_t, Y_t/N_t \bullet CPI_t, U_t)$

(5.12) $QSF_t/N_t = f(PFS_t/CPI_t, PWM_t/CPI_t, Y_t/N_t \bullet CPI_t, U_t)$

(5.13) $\ln QSX_t/NW_t = f(\ln PFS_t/CPI_t, \ln PFSUS_t/CPIUS_t, CHMS_t, U_t)$

(5.14) $QSTO_t/N_t \equiv (QDO_t + QOX_t - QOI_t)/N_t$

(5.15) $QSTC_t/N_t \equiv (QDC_t + QCX_t - QCI_t)/N_t$

(5.16) $(ASN_t \bullet YSN_t) + (ASNE_t \bullet YSNE_t) + (ASC_t \bullet YSC_t) + ASS_t \bullet YSS_t)$
$\equiv QSP_t + QSF_t + QSX_t + SD_t$

where

ASN = area planted to soybeans in the North (1000 *rai*);
ASNE = area planted to soybeans in the Northeast (1000 *rai*);
ASC = area planted to soybeans in the Central region (1000 *rai*);
ASNS = area planted to soybeans in the South (1000 *rai*);
YSN = yield of soybeans in the North (kg per *rai*);
YSNE = yield of soybeans in the Northeast (kg per *rai*);
YSC = yield of soybeans in the Central region (kg per *rai*);
YSS = yield of soybeans in the South (kg per *rai*);
QDO = quantity of soybean oil consumed in Thailand (1000 tonnes);
QDC = quantity of soybean meal consumed in Thailand (1000 tonnes);
QSP = quantity of soybeans used in oil processing (1000 tonnes);
QSF = quantity of soybeans used in food processing (1000 tonnes);
QSX = quantity of soybeans exported (1000 tonnes);
QSTO = quantity of soybean oil produced in Thailand (1000 tonnes);
QSTC = quantity of soybean meal produced in Thailand (1000 tonnes);
QOI = quantity of soybean oil imported (1000 tonnes);
QCI = quantity of soybean meal imported (1000 tonnes);
QCX = quantity of soybean meal exported (1000 tonnes);
SD = quantity of soybeans used as seed (1000 tonnes);
PFS = farm price of soybeans (*baht* per kg);

PFSUS	=	farm price of soybeans in the United States (dollar per bushel);
PWG	=	wholesale price of groundnuts (*baht* per kg);
PWM	=	wholesale price of mungbeans (*baht* per kg);
PWR	=	wholesale price of rice (*baht* per tonnes);
PF	=	price of imported fertilizer (*baht* per tonnes);
Y/N	=	per capita income in Thailand (*baht*);
CPI	=	consumer price index for Thailand (October 1964 to September 1965 = 100);
CPIUS	=	consumer price index for the United States (1967 = 100);
N	=	population in Thailand (1000 million persons);
NW	=	population in the rest of the world excluding Thailand (million persons);
CHMS	=	cattle in Hong Kong, Malaysia and Singapore (1000 head);
RN	=	annual rainfall in the North (millimetres);
RNE	=	annual rainfall in the Northeast (millimetres);
RNC	=	annual rainfall in the Central region (millimetres);
RNS	=	annual rainfall in the South (millimetres);
T	=	linear time trend (1951 = 1, 1952 = 2, etc.);
U	=	disturbance term; and
t	=	time subscript.

Thus there are four regional area equations and four yield equations comprising the supply side. On the demand side there are equations for soybean oil, soybean meal, soybeans used in oil processing and in food processing, and an export demand function. Finally there are equations for the production of soybean oil and soybean meal.

Ordinary least squares (OLS) was used for the estimation of the parameters in the recursive equation (5.1) and (5.2) and two stage least squares (2SLS) was used for the simultaneous equations (5.3) to (5.13). The use of OLS as an estimator for the first two acreage response equations was claimed to be inappropriate since the models contain lagged acreage in an adaptive expectations framework which causes OLS to produce inconsistent estimates. In this regard Issariyanukula advocated an estimation method devised by Liviation (1963) as an ideal substitute of OLS. However, the OLS technique was used by the author following the argument of Duloy and Watson (1964) and Schmitz (1968) that, where small samples are involved, the use of other asymptotically unbiased estimators may not be justified and that OLS estimates generally have smaller variances and are frequently close to estimates obtained by these other apparently more appropriate methods.

5.2.2 The work of Vesdapan and Priebprom

Vesdapan and Priebprom (1986) attempted to update Issariyanukula's (1980) model. With slight changes in some exogenous variables and the functional form of various equations (from linear to log-linear and *vice versa*), their contribution was basically an empirical one.

There were four changes worth mentioning. First, in the updated model of Vesdapan and Priebprom (1986), only the current prices of soybeans were used in the estimation of the acreage response and yield response equation, while in Issariyanukula (1980) lagged prices of soybeans were used in the first two of the eight response equations. Second, in the acreage response equations, different substitute crops were included. Lagged prices of corn were used instead of lagged prices of rice in the Northeast equation, while lagged prices of groundnut were dropped from the North equation but added to the South equation. Third, the time trend variable (T) was removed from most of the response equations, while lagged endogenous variables were added to some equations and dropped from others. Fourth, a price variation variable (PV) was added to the first two acreage response functions to reflect elements of risk in the model.

Among other things, the changes in the functional form and the inclusion or exclusion of variables was based on the statistical fit of the estimation results as well as the personal belief of the authors (Vesdapan and Priebprom 1986, p. 13). Parallel to the study of Issariyanukula (1980) the purposes of their study were parameter estimation and policy simulation with the estimated results. The data range covered the period from 1961 to 1983. 2SLS estimation was used for all equations. The model consists of 13 behavioural equations and seven identity equations with 20 endogenous variables and 25 predetermined variables. The model is as follows:

(5.17) $ASN_t = f(PS_t, PF_t, PV_t, U_t)$

(5.18) $ASNE_t = f(PS_t, PF_t, PC_{t-1}, PV_t, U_t)$

(5.19) $ASC_t = f(PS_t, PF_t, ASC_{t-1}, U_t)$

(5.20) $ASS_t = f(PS_t, PG_{t-1}, ASS_{t-1}, U_t)$

(5.21) $YSN_t = f(PS_t, PF_t, RN_t, YSN_{t-1}, U_t)$

(5.22) $YSNE_t = f(PS_t, PF_t, RNE_t, YSN_{t-1}, U_t)$

(5.23) $YSC_t = f(PS_t, RC_t, YSC_{t-1}, U_t)$

(5.24) $YSS_t = f(PS_t, RS_t, YSS_{t-1}, U_t)$

(5.25) $QDO_t/N_t = f(PS_t/CPI_t, Y_t/N_t \bullet CPI_t, U_t)$

(5.26)	QDC_t/N_t	=	$f(PS_t/CPI_t, PWM_t/CPI_t, Y_t/N_t \bullet CPI_t, U_t)$
(5.27)	$lnQSP_t/N_t$	=	$f(lnPS_t/CPI_t, lnPWM_t/CPI_t, lnY_t/N_t \bullet CPI_t, U_t)$
(5.28)	$lnQSF_t/N_t$	=	$f(lnPS_t/CPI_t, lnY_t/N_t \bullet CPI_t, U_t)$
(5.29)	$lnQSX_t/NW_t$	=	$f(PS_t, YW_t/NW_t, U_t)$
(5.30)	PRN_t	=	$ASN_t \bullet YSN_t$
(5.31)	$PRNE_t$	=	$ASNE_t \bullet YSNE_t$
(5.32)	PRC_t	=	$ASN_t \bullet YSN_t$
(5.33)	PRS_t	=	$ASS_t \bullet YSS_t$
(5.34)	$QSTO_t/N_t$	=	$(QDO_t + QOX_t - QOI_t)/N_t$
(5.35)	$QSTCt/N_t$	=	$(QDC_t + QCX_t - QCI_t)/N_t$

(5.36) $PRN_t + PRNE_t + PRC_t + PRS_t = QSP_t + QSF_t + QSX_t + SD_t$

In this modified model, most variables are identical to those of Issariyanukula. The different and additional variables are:

PS	=	farm price of soybeans (*baht* per kg);
PG	=	farm price of groundnuts (*baht* per kg);
PC	=	farm price of corn (*baht* per kg);
PV	=	farm price variation of soybeans (*baht* per kg);
PRN	=	soybean production in the North (1000 tonnes);
PRNE	=	soybean production in the Northeast (1000 tonnes);
PRC	=	soybean production in the Central region (1000 tonnes);
PRS	=	soybean production in the South (1000 tonnes);
N	=	population in Thailand (million persons);
CPI	=	consumer price index in Thailand (1983 = 100);
Y	=	national income (1000 million *baht*); and
YW	=	world income excluding Thailand (1000 million dollars).

5.2.3 The DOAE model

The work of DOAE (1977) represents one of the earliest attempts to construct an econometric model for the Thai soybean industry at the national level. The structural model consists of four behavioural equations and one market clearing condition, with five endogenous variables and seven predetermined variables. Due to limited availability of data, a relatively short series (1966 - 1975) was used in the estimation. The purposes of the study were to construct a basic model of the Thai soybean market, to collect relevant information (especially all the available time series data related to the soybean industry), and to analyse the supply and demand conditions in the Thai soybean market.

The analysis was undertaken in order to support production and marketing planning. The chosen estimator was 2SLS and the structural model can be outlined as follows:

(5.37)	Mill Cons	=	f(SBCPR – BWPSB, CHPR, $PROD_t$, $PROD_{t-1}$, T)
(5.38)	Exports	=	f(FOBPR – BWPSB, $PROD_t$ – $PROD_{t-1}$)
(5.39)	Consumption	=	f(BWPSB, $PROD_t$ + $PROD_{t-1}$)
(5.40)	$PROD_t$	=	f(BWPSB, AREA, T)
(5.41)	Mill Cons + Exports + Consumption = $PROD_t$ + Import		

where

Mill Cons	=	quantity of soybeans used in oil processing (tonne);
Export	=	quantity of soybeans exported (tonne);
Consumption	=	quantity of soybeans used in the food industry (tonne);
$PROD_t$	=	production of soybeans (tonne);
Import	=	quantity of soybeans imported (tonne);
BWPSB	=	Bangkok wholesale price of soybeans (*baht* per kg);
SBCPR	=	price of soybean meal (*baht* per kg);
CHPR	=	chicken price (*baht* per kg);
FOBPR	=	FOB price of soybeans (*baht* per kg);
AREA	=	area planted to soybeans (1000 *rai*);
$PROD_{t-1}$	=	lagged production of soybeans (tonne);
T	=	linear time trend; and
t	=	time subscript;

5.2.4 Elasticities in the three models

It is interesting to compare and contrast some of the features of the three models just outlined. Basically, what the three models share in common is the modelling of the effects of price changes on the supply and demand for soybeans and their products. Since the three models were constructed with some differences as regards the size of the model, sample period and, particularly, to functional form of the equations and units of measurement of the variables, what remains partly comparable are the elasticities from the estimated models. However, not all the price and income elasticities were given, and only those reported are described here.

The comparison is best conducted by grouping the values of elasticities into: (1) the own-price elasticities of supply of soybeans: (2) the own-price and income elasticities of the demand for soybeans; and (3) the own-price and income elasticities of the demand for soybean oil and soybean meal.

Table 5.1 presents the own-price elasticities of supply of soybeans compiled from the studies of Vesdapan and Priebprom (1986) and DOAE (1977). Because of different regional definitions, the values of the two sets of elasticities must be compared judiciously. The output elasticity given in DOAE (1977) was estimated for the whole Kingdom, while those given in Vesdapan and Priebprom (1986) were estimated at the regional level and further classified into elasticities with respect to acreage response and yield response.

The comparison at least sheds some light on the change in the direction of the elasticities of supply. In general, the data in Table 5.1 reveal that: (1) for the sample period 1961 to 1983, acreage responses are elastic with elasticity values ranging from 1.91 to 3.94, whereas yield responses are inelastic with elasticity values equal to 0.08 for the Northeast and 0.11 for the North; and (2) for the sample period 1966-1975 the value of the elasticity of output (0.08) is considerably less than those mentioned in (1). This may indicate an increase in responsiveness to prices in soybean farming in recent years. However, the interpretation of the data should be made with the awareness that the DOAE (1977) model was estimated with a small sample size of 10, and thus the results must be used with discretion.

Table 5.1
The Price Elasticities of Acreage, Yield and Output Response of Soybeans in Thailand

	Sample Period	Region	Acreage	Yield	Output
(a)	(1961-1983)	Northeast	3.94	0.08	*
		North	2.87	0.11	*
		Central	3.41	*	*
		South	1.91	*	*
(b)	(1966-1975)	Whole Kingdom	*	*	0.08

Note: * = Variables were not specified in the model or values of estimates were not given.
Source: (a) Vesdapan and Priebprom (1986)
(b) DOAE (1977)

Table 5.2 presents the own-price elasticities and income elasticities of demand for soybeans classified by source of demand, namely, demand for soybeans used in the food industry, demand for soybeans used in oil processing and export demand. Again, two points emerge: (1) from Vesdapan and Priebprom (1986), the values of the income elasticities (i.e., 0.98 for food industry and 1.88 for oil processing) are higher, in absolute value, than the values of the price elasticities (i.e., –0.68 for the food industry and –0.72 for oil processing); and (2) comparing the elasticities over time discloses a decreasing trend in the values of the price elasticities of demand. Again it must be acknowledged that the results come from different studies and the comparison must be treated with caution.

Table 5.3 presents the own-price elasticities and income elasticities of demand for soybean meal and soybean oil, compiled from the two studies of Vesdapan and Priebprom (1986) and Issariyanukula (1980). The comparison reveals that: (1) the income elasticities of demand are higher in absolute value than the price elasticities of demand; and (2) overtime, the income elasticities have decreased while the price elasticities have increased.

Table 5.2
The Price and Income Elasticities of Soybeans in Thailand, Classified by Source of Demand

	Sample Period	Demand for	Price Elasticity	Income Elasticity
(a)	(1961–1983)	Food Industry	–0.68	0.98
		Oil Processing	–0.72	1.88
		Export	–0.06	*
(b)	(1950–1977)	Food Industry	*	*
		Oil Processing	*	*
		Export	–0.44	*
(c)	(1966–1975)	Food Industry	–0.88	*
		Oil Processing	–2.71	*
		Export	–3.46	*

Note: * = Variables were not specified in the model or values of estimates were not given.
Source: (a) Vesdapan and Priebprom (1986)
(b) Issariyanukula (1980)
(c) DOAE (1977)

Table 5.3
The Price and Income Elasticities of Demand for Soybean Meal and Oil in Thailand

	Sample Period	Demand for	Price Elasticity*	Income Elasticity
(a)	(1961–1983)	Oil	–1.38	1.79
		Meal	–1.91	2.58
(b)	(1950–1977)	Oil	–0.78	2.56
		Meal	–0.79	3.28

Note: * = Due to lack of data, soybean prices were used as a proxy for oil and meal prices in both studies.
Source: (a) Vesdapan and Priebprom (1986)
(b) Issariyanukula (1980)

5.2.5 Further comparisons

In estimating the demand equations for soybean meal and soybean oil, bean prices were used as a proxy for the meal and oil prices in the studies of Vesdapan and Priebprom (1986) and Issariyanukula (1980). This was due to the lack of price data (particularly on soybean oil). Therefore, the estimated demand equations for both meal and oil in the two studies are not really the standard 'Marshallian' demand curves in a theoretical sense. The equation might serve well in the simulation exercises conducted in the two studies (with an assumption that oil and meal prices are highly correlated with bean prices), but such equations cannot be used in the welfare triangle analysis, as proposed in Chapter 3 of this study.

In the DOAE (1977) model, the price of soybean meal was introduced into the 'Mill Cons' equation (i.e., the demand for beans in oil processing equation). However, the price variable which affects the demand decision was expressed in terms of differences (between the price of soybean meal (SBCPR) and the wholesale price of soybeans (BWPSB). This essentially expressed quantity demanded as a function of the marketing margin rather than price of the commodity, thus again diverging from the meaning of the 'Marshallian' demand curve. Therefore, the meaning of the equation must be interpreted with discretion and, again, the demand equation cannot be used for welfare triangle analysis.

Supply equations for oil and meal were not explicitly estimated in the three models. This was again, perhaps, due to the lack of sufficient information on prices of soybean meal and soybean oil. In the Issariyanukula (1980) and Vesdapan and Priebprom (1986) models, the supplies of meal and oil were implicitly subsumed in the demand equation for beans in oil processing. The quantities of oil and meal supplied were determined from the quantity of beans demanded via the use of conversion factors. This is again satisfactory for simulation but cannot be readily used for welfare triangle analysis.

5.3 The Use of the Previous and the Present Models

As far as the use of the three previous models is concerned, only the Issariyanukula's (1980) model was used explicitly in forecasting and policy simulation. The model was used to predict the extent to which the exogenous variables (e.g. lagged price, rainfall, price of competitive crops) would affect the endogenous variables (e.g. price, acreage and yields of soybean in each region). Comparisons were made between the short and long-run impacts of change in prices of competitive crops (such as rice and mungbeans), per capita income, population and the CPI on the change in bean price, acreage, yields and downtree demand. Simulations were undertaken to assess how two major policy measures, export promotion of soybeans and import restrictions on soybean meal, would affect the production, prices and demand for soybeans and their products.

The Vesdapan and Priebprom (1986) and DOAE (1977) models were used less extensively. However, Vesdapan and Priebprom's study incorporated a systematic way of forecasting the level of variables such as output and consumption of soybeans based on the average growth rates of exogenous variables such as rainfall and prices of competitive crops. No extensive simulation experiments were reported. The DOAE's model was intended to be used in policy planning and in the prediction of the level of output, consumption and prices of beans and their products. However, no explicit forecasts or simulations were reported.

Inspection on the usage of the three models reveals that, though useful, they leave a gap in knowledge concerning the impacts of the existing government's intervention policies in the soybean industry as described in Chapter 3. This led to the development of an econometric model of the Thai soybean industry, the details of which are discussed in the next section.

5.4 An Econometric Model of the Thai Soybean Industry

The econometric modelling in the present study is based on the model structures of the three studies mentioned in the previous sections. However, in conformity with the theoretical framework (as given in Chapter 3) and types of policy analyses intended, as well as the availability of data, model development has undergone some modifications. The model refinement mainly consists of model simplification, model extension and changes in variables used in the estimation. This can be best described by first listing the model:

(5.42)	DO_t	=	$f(POAR_t, POC_t, CER_t, U_t)$
(5.43)	DM_t	=	$f(PMAR_t, L_t, PFMR_t, T_t, U_t)$
(5.44)	DF_t	=	$f(PBR_t, I_t, U_t)$
(5.45)	DB_t	=	$f(PBR_t, POAR_t, PMAR_t, I_t, U_t)$
(5.46)	SB_t	=	$f(PBR_t, PCR_{t-1}, Y_t, T_t, U_t)$
(5.47)	DB_t	=	$SB_t + MBA_t - XBA_t$
(5.48)	DP_t	=	$DB_t - DF_t$

where	DO_t	=	quantity of soybean oil demanded (1000 tonnes);
	DM_t	=	quantity of soybean meal demanded (1000 tonnes);
	DF_t	=	quantity of soybeans demanded in food industry (1000 tonnes);
	DB_t	=	aggregate quantity of soybeans demanded (1000 tonnes);
	DP_t	=	quantity of soybeans in oil processing (1000 tonnes);
	SB_t	=	aggregate quantity supplied of soybeans (1000 tonnes);
	$POAR_t$	=	real adjusted price of soybean oil (*baht* per kg);
	$PMAR_t$	=	real adjusted price of soybean meal (*baht* per kg);
	$PFMR_t$	=	real price of fishmeal (*baht* per kg);
	PBR_t	=	real price of soybeans (*baht* per kg);
	PCR_{t-1}	=	lagged real price of corn (*baht* per kg);
	POC_t	=	percentage of palm oil consumption relative to total oil consumption
	CER_t	=	real consumption expenditure
	L_t	=	livestock index (number of chickens, million birds);
	I_t	=	real income per capita (1000 *baht*);
	Y_t	=	average yield of soybeans (kg per *rai*);
	T_t	=	linear time trend (1970/71 = 1, 1971/72 = 2, etc.);
	MBA_t	=	adjusted quantity of imports of soybeans (1000 tonnes);

XBA_t	=	adjusted quantity of exports of soybeans (1000 tonnes);
U_t	=	disturbance term; and
t	=	time subscript.

The equations in the above model can be classified into two groups. Equations (5.42) and (5.43) are estimated as single equations. This is due to a 'small country' assumption, mentioned in Chapter 3 that implies the two demand sources are facing import parity prices which are exogenous to the industry. The two equations are graphically presented in sections (D) and (E) of Figure 3.12. Equations (5.44) to (5.48) are estimated as a system of simultaneous equations. The system can be represented by the corresponding demand and supply schedules as presented in sections (A), (B) and (C) of Figure 3.13. It is worth recapitulating that the model needed to be estimated simultaneously, and not recursively due to the import-ban policy on soybeans that divorces the relationship between the domestic and world prices of soybeans. Basically, the system of equations contains three behavioural equations and two identities, with five endogenous variables, (namely, DF_t, DP_t, DB_t, SB_t, and PBR_t) to be jointly determined within the structural model.

Compared with previous models, the present model has been simplified with respect to functional form. All equations are postulated as linear, whereas some equations in the Vesdapan and Priebprom (1986) and Issariyanukula (1980) models were log-linear or semi-loglinear. This is due mainly to the objective of using the model for policy analysis. As mentioned in Chapter 3, the linearity in supply and demand schedules, together with their parallel shifts, rendered a certain degree of tractability to the welfare triangle analyses. Another simplification is that supply response is expressed in aggregate terms like that of DOAE (1977), rather than breaking the analysis into regional area and yield responses as in Vesdapan and Priebprom (1986) and Issariyanukula (1980). This is again due to the nature of the type of policy analysis intended in the present study. Practically, the use of an aggregate rather than a regional supply model has decreased the size of the system somewhat. Econometrically, this is considered a reasonable trade off, particularly for models with moderate sample size. The export equation is also left out of the model and replaced by an exogenous variable to reflect the current situation.

As a major extension of the previous studies, the present study has included supply equations for soybean oil and soybean meal. The need for these is clear from the graphical models presented in Chapter 3. However, the present econometric model does not involve explicit estimation of these two supply equations. Instead, by making use of the fixed conversion factors from which soybeans are transformed into their constituent joint products of soybean oil and meal on the one hand, and by postulating the prices of soybean oil (POAR) and meal (PMAR) as two of the demand shifters in the demand equation of soybeans (DB) on the other, the two supply curves (SO for oil and SM for soybean meal) can be indirectly constructed through the use of equation (5.45) of the system.

Compared with the former studies, there are considerable changes in the variables included in the present model. The most important change in model specification is the inclusion of the prices of soybean oil and soybean meal in their respective demand equations and as demand shifters in the aggregate demand equation for soybeans. This has increased the validity of the model for price policy analysis and thus constitutes a major improvement in modelling. For the demand equation for soybean oil since there is no adequate data on the cross price (price of palm oil) data on the percentage of palm oil consumption relative to total oil consumption are used as instrumental variable. And since incorporation of the real income variable (I) into the equation invalidate the homogeneity condition of demand equation, the I variable is replaced by the consumption expenditure variable (CER). In addition, in the demand equation for soybean meal, the price of mungbeans has been replaced by the price of fishmeal which is considered a more relevant competitive commodity in demand for soybean meal. The per capita income variable was replaced by a livestock quantity index, this being one of the more appropriate demand shifters. In the supply equation for soybeans, the lagged price of corn was chosen as the price of the competitive crop on the basis of pre-testing. Also, the rainfall variables were dropped and replaced by an average yield variable which provided much better statistical results in prior testing.

5.5 Data Sources, Generation and Transformation

Most of the published and unpublished annual data used in the estimation of the econometric model were obtained from the Office of Agricultural Economics (OAE), the Department of Agricultural Extension and the Ministry of Agriculture and Agricultural Cooperatives (MOAC). Some monthly data were compiled from file data provided by the Centre of Statistics, OAE. Various issues of 'Agricultural Statistics of Thailand', OAE proved indispensable while additional statistics were obtained from other sources such as the National Economic and Social Development Board, the Department of Interior Trade, the Department of Customs, and the Ministry of Commence.

In processing the data, there were two major problems. First, the time frames of some published data are not consistent with that required by the present analysis. Second, the time series data on soybean oil are inadequate compared with the other data series. Details of the two problems, as well as their solutions, are presented in turn.

Basically, the time frame for the production, trade and utilization of soybeans can be the crop year, the trading year and the marketing year. The crop year covers the period from May of each year to April of the following year. This is mainly due to the fact that the production of most crops starts in May after the first onset of rain. The trading year covers the period from January to December of each year. This mainly reflects the usual practice of the Department of Customs recording the trade statistics (e.g. imports and exports). The marketing year for cash crops differ due to their difference in physiology, particularly the gestation period of each crop. This naturally starts at the time when the first crop of the year is harvested and ready to be marketed. For soybeans, the marketing year covers the period from September of each year to August of the following year.

To make all the data on production, trade and utilization consistent for supply and demand analysis, some adjustment was needed. In this regard, the trade-year data on imports and exports of soybeans and their products, as well as the domestic price series of soybean meal and soybean oil, need to be adjusted from this trade-year timeframe into the marketing-year timeframe. This is because, while soybean production is recorded by crop year, the prices of soybeans received by farmers are actually the marketing year prices when soybeans are actually sold. The necessary adjustment mainly requires a re-estimate of the average annual prices and quantities of imports and exports using monthly data to suit the marketing-year timeframe (e.g. the average annual marketing-year price for 1980/81 would be re-estimated using average monthly price from September 1980 to August 1981). The adjusted data are presented in columns (11) to (18) of Appendix Table A.5.2, along with other data used in model estimation.

A more crucial problem encountered in the present study was the lack of a sufficiently long series of data. To make best use of the available information, the longest available data set would be used. This is, of course, with the added consideration that the series should not be too long that there exist changes in the values of the underlying parameters. The longest sample size is usually determined by the shortest series of one of the variables. As far as the present study is concerned, however, the shortest series of data is that for the adjusted wholesale price of soybean oil (POA), with a sample size of only seven. A series this short is clearly impractical for econometric estimation, and it initially was decided to replace the wholesale price of soybean by the CIF price (CIFSBO), for which a longer series was available. The sample size of the present model is thus 20, being determined by the second shortest available series of data on the wholesale price of fishmeal (PFM). The sample covers the period from 1970/71 to 1989/90.

Because the use of CIFSBO in model estimation resulted in a poor statistical fit, an adjusted POA series had to be used. The missing data were generated by estimating an OLS equation with monthly data of the wholesale price of soybean oil (MPO) as a dependent variable and the corresponding monthly data on the CIF price of soybean oil (MPOCIF) as an independent variable. Then, the missing annual data on POA were estimated by substituting the annual CIFSBO data into the estimated equation. The series of monthly data and estimation results of the OLS model are given in Table 5.4. As presented in section (a), prices are based on the most recently available data set. Since there are no monthly data on oil prices prior to 1983, and after April 1985, the monthly import figures are rather scattered due to the fact that monthly imports of soybean oil into Thailand have become irregular.

The results of OLS estimation as given in section (b) show a positive correlation between the monthly domestic wholesale price of soybean oil (MPO) and the corresponding monthly CIF price (MPOCIF). The t-ratios for both the slope (3.91) and the intercept (4.58) are quite high. Inspection of the corresponding probability (PV) values indicate that the two statistics are significant at the 0.9996 and 0.9991 levels, respectively. However, the rather low value of $\bar{R}^2$ (0.37) indicates that the variation in MPOCIF can explain only 37 per unit of the variation in MPO. This implies that the model can be improved by incorporating more independent variables into the equation. However, this was not done, under the contention that the model can approximately serve the purpose of data generation well enough. Another limitation of the above model is the underlying assumption that the monthly relationship between the two price series can explain their yearly relationship satisfactorily. The assumption is hard to defend. However, since there is no better alternative at the moment, the assumption is imposed, and considered as acceptable, but with the awareness of the limitation. With the above OLS equation, the missing price data on POA (the first 13 items) were generated as presented in column (18) of Appendix Table A.5.2.

Table 5.4

Monthly Domestic Wholesale Price and CIF Price of Soybean Oil and the Result of OLS Estimation

(a) The monthly price data

Yr/Mth		MPO	MPOCIF	Yr/Mth		MPO	MPOCIF
1983:	Apr	15.00	10.59	1984:	May	21.25	17.11
	May	15.07	10.90		Jun	21.35	22.55
	Jun	15.04	10.62		Jul	21.75	18.53
	Jul	15.05	11.87		Aug	21.00	17.62
	Aug	15.07	16.17		Sep	21.25	14.89
	Sep	15.87	11.86		Oct	21.25	16.07
	Oct	18.26	16.86		Nov	21.25	16.07
	Nov	20.44	18.88		Dec	22.52	19.22
	Dec	20.63	15.98	1985:	Jan	18.50	18.44
1984:	Jan	21.63	15.63		Feb	18.50	18.44
	Feb	22.52	15.74		Mar	18.50	19.26
	Mar	20.90	15.84		Apr	18.50	19.28
	Apr	20.72	16.06		–	–	–

Source: OAE (1987)

(b) The OLS Results

(5.49) $\hat{MPO}$ = 10.472 + 0.544 MPOCIF

t = (4.58) (3.91)

PV = (0.0001) (0.0004)

N = 25

SE = 2.09

$\bar{R}^2$ = 0.37

The final essential step is data transformation, by which the series for some variables are transformed into their respective final forms ready for econometric estimation. There are two types of generation. One is a conventional transformation while the other is a transformation specific to the present study. The conventional transformation involved deflating the price and income data using the consumer price index (CPI).

The transformation specific to the present study concerned the estimation of the quantities of soybean oil (DO) and soybean meal (DM) demanded. With the use of the fixed conversion factors described in Chapter 2, by which one tonne of soybeans can be transformed into 0.155 tonne of oil and 0.77 tonne of meal, DO is approximated by multiplying the demand for soybeans used in oil processing (DP) by a factor of 0.155 and adding the adjusted net import of oil (MOA-XOA). DM is approximated by multiplying DP by 0.77 and adding the adjusted net import of meal (MMA-XMA).

The single demand equations were estimated using OLS while the system of simultaneous equations was estimated using 2SLS.

5.6 Empirical Results

(1) Demand equation for soybean oil

(5.50) DO	=	–17.07	–	3.08 POAR	-	1.42POC	+	12.39CER
t		(–0.48)		(–3.02)		(-2.51)		(5.58)
EM		(–0.49)		(–2.07)		(-1.68)		(5.24)

$n = 14$

$SE = 8.80$

$\bar{R}^2 = 0.84$

(2) Demand equation for soybean meal

(5.51)	DM	=	−431.27	−	12.82 PMAR	+	4.58L	+	21.69 PFMR	+	19.83T
t			(−3.30)		(−1.87)		(3.22)		(2.68)		(6.67)
EM			(−1.95)		(−0.55)		(1.37)		(1.19)		(0.94)

n = 20
SE = 34.99
$\bar{R}^2$ = 0.96

(3) Demand equation for soybeans in the food industry

(5.52)	DF	=	65.22	−	17.95 PBR	+	7.43 I
t			(0.89)		(−2.70)		(3.99)
EM			(1.06)		(−2.25)		(2.19)

n = 20
SE = 28.05

(4) Aggregate demand equation for soybeans

(5.53)	DB	=	−732.82	−	38.61 PBR	−	6.63 POAR	+	7.93 PMAR	+	52.44 I
t			(−5.11)		(−1.54)		(3.34)		(0.55)		(10.98)
EM			(−3.76)		(−1.54)		(1.00)		(0.38)		(4.92)

n = 20
SE = 47.06

(5) Domestic supply equation of soybeans

(5.54)	SB	=	−939.53	+	83.16 PBR	−	72.59 LPCR	+	3.12 Y	+	18.34 T
t			(−3.16)		(2.77)		(−1.89)		(3.20)		(3.79)
EM			(−4.77)		(3.27)		(−1.02)		(2.54)		(0.98)

n = 20
SE = 82.86

(6) Derived supply equation of soybean oil

(5.55) SO = (dDB/dPOAR)(bean to oil conversion factor) POAR
= (6.63)(0.155)POAR = 1.03POAR

(7) Derived supply of soybean meal

(5.56) SM = (dDB/dPMAR)(bean to meal conversion factor)PMAR
= (7.93)(0.77)PMAR = 6.11PMAR

The presentation of the empirical results follows one of the common forms as given in Wonnacott and Wonnacott (1979). The symbols t, EM, n, SE and $\bar{R}^2$ stand for the conventional t-ratio, elasticity at mean, sample size, standard error of estimate and adjusted R-square, respectively.

For equations (5.50) and (5.51) estimated by OLS, the overall empirical results can be considered satisfactory. All the signs of the estimated coefficients are consistent with economic theory. Except for the t-ratio of the intercept in equation (5.50) (with a low value of –0.48) all t-ratios are greater than 2, thus displaying a high degree of statistical discernability for the estimated coefficients. The high values for $\bar{R}^2$ also suggest adequacy of model specification.

For equations (5.52), (5.53) and (5.54) estimated by 2SLS, interpretation of the statistical properties must be done with discretion. In using 2SLS as an estimation method, the $\bar{R}^2$ is not well defined. Also the usual t- and F-tests are invalid (White *et al* 1987). Caution in interpreting the t-ratios in 2SLS is also used by authors of applied studies. For example, Piggott (1974) refrained from calling the ratio of the regression coefficient its standard error a 't' statistic. At most, this ratio might approximate a t-distribution, but there still exists a problem in determining the correct number of degrees of freedom in hypothesis testing. However, all estimated values of the coefficients are consistent with economic theory, and all ratios of coefficients to their respective standard errors are quite high, with exceptions in equation (5.53) where the ratio is only moderately high for one of the variables (–1.54 for PBR) and rather low for another (0.5[illegible] for PMAR).

Inspection of the values of price and income elasticities reveals some important points. The demand for soybean oil is price elastic (–2.07) and elastic with respect to change in the percentage of palm oil consumption (-1.68) and the level of real consumption expenditure (5.24). The demand for soybean meal is price inelastic (–0.55) while the cross-price elasticity is moderate (1.19). Both the price elasticity of demand for soybeans in the food industry (–2.25) and the income elasticity (2.19) are elastic. The aggregate demand for soybeans is price elastic (–1.54), while the two cross-price elasticities are unitary elastic and inelastic (1.00 for POAR and 0.38 for PMAR) and the income elasticity is very elastic (4.92). This again conforms with the past studies as presented in Table 5.2, (i.e., that in general, the income elasticity assumes a higher value (in absolute terms) than the price elasticities). Regarding supply, the own-price elasticity is high (3.27) while the cross-price elasticity is close to unity (–1.02). The value of the own-price elasticity of supply in the present study can be considered close to those of Vesdapan and Priebprom (1986) as presented in Table 5.1, though the two sets of elasticities are not directly comparable due to the use of different endogenous variables. In short, the author regards the estimated model as sufficient for policy analysis although there are clearly limitations to be kept in mind.

Before leaving this chapter, it is worthwhile to mention that, with the simple model of the present study the inherent endogeny of some rihgt-hand side variables e.g., POC, CER, Y and particularly I cannot be ruled out. Take I for example; policy interventions in most instances would alter the level of GNP of the country, thus, variable I of the model. However, since the soybean industry is relatively small comparing to the rest of the economy, the use of I as exogeneous variable would result in only insignificant bias.

Chapter 6

POLICY ANALYSIS WITH THE MODEL

6.1 Introduction

This chapter presents an analysis of the likely impacts of government intervention in the soybean industry. The analysis was conducted for the seven policy scenarios described graphically in Chapter 3. The assessment was carried out applying both first-best and second-best criteria, and by examining the effects of policy intervention on price, production, consumption and net import of soybeans, soybean meal and soybean oil. Changes in economic surplus values for farmers, the oil processing industry, the food industry, meal users and oil consumers are estimated, along with the government's tax revenue and the deadweight loss to society for each policy scenario. Optimal tariff and surcharge rates are also estimated and used to demonstrate the second-best, optimal tariff argument under which a tax may increase welfare. Finally, the effects of each policy measure on the pattern of income distribution are examined. Some possible trade-offs between the efficiency objective and the equity objectives of government policy are also analysed and explained with a graphical model.

6.2 Policy Analysis

The type of policy analysis of the present study, though similar to the standard partial-equilibrium approach in the literature (e.g., as outlined in ADB 1988, McCalla and Josling 1985), is complicated to the extent that it must take into account two added elements: (1) the multi-market and multi-policy effects; and (2) the second-best considerations. In this regard, the initial information needed for the analysis consists of the estimated values of the slope coefficients of all the relevant supply and demand schedules, as well as prices and quantities produced, consumed and traded internationally, both with and without policy intervention.

Elasticities are used in welfare-triangle analysis with the contention that the analytical results would hold approximately for 'small' policy change. Elasticity values have the advantage that they are unit free and, hence, thus are more readily used in policy analysis especially when the values are obtained from past studies. For the present study, however, the values of slopes, as opposed to elasticities, are used in policy analysis mainly because model adjustment for the second-best policy analysis is more tractable and more intuitively appealing with the use of slopes rather than elasticities.

The most recent crop-year (1989/90) for which all relevant data are available is chosen for analysis. There is a need to forecast the no-intervention prices and quantities for the three commodities. To do this, the values of the tariff rate on soybean oil and average surcharge rate on soybean meal are first estimated, then transformed into real terms along with all the prices. The movements of prices and quantities due to policy intervention are estimated through the use of the estimated values of slope coefficients and the fixed conversion factors by which soybeans are transformed into soybean oil (CFO) and soybean meal (CFM).

For the marketing year 1989/90, the importation of soybean oil was subject to an import tariff of 1.32 *baht* per litre plus a special charge of 0.5 per cent on the CIF value. This is equivalent to 1.52 *baht* per kg. After conversion into real terms, the real tariff rate (T) is approximately 1.36 *baht* per kg. As for soybean meal, a surcharge rate of 1585, 1975 and 1472 *baht* per tonne was imposed on its importation since March, May and July 1990, respectively. As presented in Table 6.1, the average surcharge is approximated at 1120 baht per tonne for the marketing year 1989/90. There is an additional pre-surcharge tariff of six per cent on the CIF value of all imports. This is equivalent to 1.56 *baht* per kg. After deflating, the real average surcharge rate (S) is approximately 1.39 *baht* per kg.

The other important factors are the derivatives dPBR/dPOAR and dPBR/dPMAR which determine how soybean price would change with respect to changes in the oil price and meal price, respectively. The supply and demand equations of soybeans as outlined in section 5.4 are used to derive the two coefficients. The residual terms and the time subscripts are dropped to simplify the derivation. The equations are:

$$(6.1) \quad DB = d_o + d_1PBR + d_2POAR + d_3PMAR + d_4I$$

$$(6.2) \quad SB = s_o + s_1PBR + s_2LPCR + s_3Y + s_4T$$

For a closed economy model as in the case of Thai soybeans where an import ban policy is imposed, the price of beans (PBR) can be determined by equating (6.1) and (6.2) and solving for PBR such that:

Table 6.1

Monthly Import of Soybean Meal and the Average Surcharge Rate, Marketing Year 1989/90

Marketing Year (1989/90)		(1) Imports (1000 tonnes)	(2) Surcharge (*baht*/tonne)
1989	Sep	1.26	–
	Oct	0.00	–
	Nov	0.49	–
	Dec	11.42	–
1990	Jan	27.28	–
	Feb	17.45	–
	Mar	46.81	1585
	Apr	4.26	1585
	May	15.04	1975
	Jun	11.69	1975
	Jul	28.58	1472
	Aug	23.55	1472
Total		187.83	
Weighted average			1120

Source: (1) File data, Centre of Statistics, OAE.
(2) Thitisub (1991).

$$(6.3) \quad PBR = \frac{(s_0 - d_0)}{(d_1 - s_1)} - \frac{d_2}{(d_1 - s_1)} POAR - \frac{d_3}{(d_1 - s_1)} PMAR$$

$$- \frac{d_4}{(d_1 - s_1)} I + \frac{s_2}{(d_1 - s_1)} LPCR + \frac{s_3}{(d_1 - s_1)} Y + \frac{s_4}{(d_1 - s_1)} T$$

According to the reduced form equation 6.3, the coefficients associated with POAR and PMAR provide estimates of dPBR/dPOAR and dPBR/dPMAR, respectively.

The available information is combined to make forecasts for the values of prices, production and consumption for the three commodities under various policy scenarios. This allows for the final step, welfare analysis of the policy interventions. The relevant data are complied in Table A.6.1 to facilitate further reference. The estimated values are listed in Table 6.2 and an outline of their estimation is given in Table A.6.2.

The empirical analysis of the welfare effects of government interventions in the Thai soybean industry follows the theoretical analysis outlined in Chapter 3. To be systematic, discussion of the various policy effects will conform as far as possible to the graphical models. Since the same kind of analysis and discussion will be made repeatedly for various policy scenarios, standard summary tables are constructed to facilitate the presentation and discussion of the welfare effects. Analogous to the previous theoretical analysis, the empirical analysis starts with the single policy scenarios and then moves on to the multi-policy scenarios, following the sequence :

(1) an import ban on soybeans (B);

(2) an import tariff on soybean oil (T);

(3) an import surcharge on soybean meal (S);

(4) the marginal impacts of an import tariff on oil with the import ban on beans already in operation (T/B);

(5) the combined net impacts of an import tariff on oil and an import ban on beans (B + T);.

(6) the marginal impacts of an import surcharge on meal with an import tariff on oil and an import ban on beans already in operation (S/(B + T)); and

(7) the combined net impacts of the three policy measures (B + T + S).

Table 6.2
Values of Prices, Production and Consumption of Soybeans, Soybean Oil and Soybean Meal Under Various Policy Scenarios, Marketing Year 1989/90

(1) Symbols	(2) Description	(3) Values
PB_1	Import parity price of soybeans	5.50
PB_2	Price of soybeans (with ban)	6.38
PB_3	Price of soybeans (with ban and tariff)	6.45
PB_4	Price of soybeans (with ban, tariff and surcharge)	6.54
PO_1	Import parity price of soybean oil	16.17
PO_2	Price of soybean oil (with tariff)	17.53
PM_1	Import parity price of soybean meal	6.46
PM_2	Price of soybean meal (with surcharge)	7.85
QB_1	Soybean production (free trade)	585.51
QB_2	Soybean consumption (free trade)	692.67
QB_3	Soybean production and consumption (with ban)	658.69
QB_4	Soybean production and consumption (with ban and tariff)	664.51
QB_5	Soybean production and consumption (with ban, tariff and surcharge)	672.00
QP_1	Soybeans used in oil processing (free trade)	545.90
QP_2	Soybeans used in oil processing (with ban)	527.72
QP_3	Soybeans used in oil processing (with ban and tariff)	534.80
QP_4	Soybeans used in oil processing (with ban, tariff and surcharge)	543.91
QF_1	Soybeans used in food industry (free trade)	146.77
QF_2	Soybeans used in food industry (with ban)	130.97
QF_3	Soybeans used in food industry (with ban and tariff)	129.71
QF_4	Soybeans used in food industry (with ban, tariff and surcharge)	128.09

Table 6.2 (continued)

QO_1	Soybean oil production (free trade)	84.61
QO_2	Soybean oil consumption (free trade)	94.20
QO_3	Soybean oil production (with ban)	81.80
QO_4	Soybean oil production (with ban and tariff)	82.89
QO_5	Soybean oil consumption (with ban and tariff); (or with tariff only)	90.01
QO_6	Soybean oil production (with ban, tariff and surcharge)	84.31
QM_1	Soybean meal production (free trade)	420.34
QM_2	Soybean meal consumption (free trade)	624.46
QM_3	Soybean meal production (with ban)	406.34
QM_4	Soybean meal production with ban, and tariff)	411.80
QM_5	Soybean meal production (with ban, tariff and surcharge)	418.81
QM_6	Soybean meal consumption (with ban, tariff and surcharge); (or with surcharge only)	606.64
QB_t(*)	Soybean consumption (with tariff only)	701.61
QP_t(*)	Soybeans used in oil processing (with tariff only)	554.90
QO_t(*)	Soybean oil production (with tariff only)	86.01
QM_t(*)	Soybean meal production (with tariff only)	427.27
QB_s(*)	Soybean consumption (with surcharge only)	703.69
QP_s(*)	Soybean used in oil processing (with surcharge only)	556.92
QO_s(*)	Soybean oil production (with surcharge only)	86.32
QM_s(*)	Soybean meal production (with surcharge only)	428.83

Note: (1) Symbols marked with (*) are changed from those of Figure 3.14 and Figure 3.15 to avoid symbol repetition with those used in policy combination analysis.

(2) (With ban, tariff and surcharge) indicates a combination of an import ban on soybeans, an import tariff on soybean oil and an import surcharge on soybean meals, etc.

(3) the units are baht per kg and 1000 tonnes for prices and quantities, respectively.

Source: Symbols, except the (*) are from Figure 3.19; values are calculated as outlined in Table A.6.2.

To facilitate further discussion, the terms 'with ban', 'with tariff' and 'with surcharge' will be used to denote an import ban on soybeans, an import tariff on soybean oil and an import surcharge on soybean meal, respectively. In addition, the abbreviations PS, CS, GR, NELP, NELC, DL and BT are used to stand for producer surplus, consumer surplus, government revenue, net efficiency loss in production, net efficiency loss in consumption, deadweight loss and balance of trade (in million *baht*), respectively.

6.2.1 The first-best policy assessment

A brief exposition is given below on how the surplus values, government revenue, balance of trade and the deadweight loss are calculated. The policy scenario involving the import tariff on soybean oil with an import ban on soybeans in existence (T/B) is chosen for demonstration due to its representativeness in impact estimation. The changes in price, production, consumption and net imports of the three commodities as a result of the policy intervention are presented in the last column of Table 6.3. A description of the policy impacts is provided in parallel with that given in Section 3.14 of Chapter 3.

In the oil market, as a result of tariff imposition, the oil price would increase by 1.36 *baht* per kg. Domestic oil output increases by 1090 tonnes while demand drops by 640 tonnes, resulting in a net decrease in imports of 1730 tonnes. In the meal market, production increases by 5460 tonnes. With a constant import parity price (of 6.46 *baht* per kg), and thus unchanged demand, the net import of meal would also decrease by 5460 tonnes. In the bean market, the demand for beans as an input in oil crushing increases by 7080 tonnes. With an import ban on soybeans already existing, this increase in demand causes bean prices to increase by 0.07 *baht* per kg. Consequently, the demand for beans in the food industry decreases by 1260 tonnes. This results in a net increase in demand for beans of 5820 tonnes, which is totally satisfied by the increase in the domestic supply.

Given these changes in prices and quantities, the welfare impacts in terms of changes in surplus values, government's revenue and balance of trade can be determined following the conventional partial-equilibrium approach. The same symbols used in Figure 3.16 are used for purposes of cross referencing.

Table 6.3
The Marginal Impacts of an Import Tariff on Soybean Oil with an Import Ban on Soybeans

Impacts on Price and Quantity — Unit: 1000 tonnes, unless otherwise specified

	Pre-intervention		Post-intervention		Impacts	
	(1) Symbol	(2) Value	(3) Symbol	(4) Value	(5) Symbol	(6) Value
Beans:						
Price (*baht* per kg)	PB_2	6.38	PB_3	6.45	$PB_3 - PB_2$	0.07
Production	QB_3	658.69	QB_4	664.51	$QB_4 - QB_3$	5.82
Consumption (P)	QP_2	527.72	QP_3	534.80	$QP_3 - QP_2$	7.08
(F)	QF_2	130.97	QF_3	129.71	$QF_3 - QF_2$	-1.26
(B)	QB_3	658.69	QB_4	664.51	$QB_4 - QB_3$	5.82
Net Import	–	0.00	–	0.00	–	0.00
Oil:						
Price (*baht* per kg)	PO_1	16.17	PO_2	17.53	$T = (PO_2 - PO_1)$	1.36
Production	QO_3	81.80	QO_4	82.89	$QO_4 - QO_3$	1.09
Consumption	QO_2	94.20	QO_5	90.01	$QO_5 - QO_2$	-4.19
Net Import	$QO_2 - QO_3$	12.40	$QO_5 - QO_4$	7.12	$(QO_5 - QO_4) - (QO_2 - QO_3)$	-5.28
Meal:						
Price (*baht* per kg)	PM_1	6.46	PM_1	6.46	–	0.00
Production	QM_3	406.34	QM_4	411.80	$QM_4 - QM_3$	5.46
Consumption	QM_2	624.45	QM_2	624.45	–	0.00
Net Import	$QM_2 - QM_3$	218.11	$QM_2 - QM_4$	212.65	$(QM_2 - QM_4) - (QM_2 - QM_3)$	-5.46

Source: (1), (3) and (5) are from Figure 3.16 and Section 3.14 of Chapter 3; (2) and (4) are from Table 6.2.

The various impacts can be calculated as listed below:

1. NELP due to increase in oil output

$$(B) = (1/2)(PO_2 - PO_1)(QO_4 - QO_3) = (0.5)(1.36)(1.09) = 0.74$$

2. NELC due to decrease in oil consumption

$$(D) = (1/2)(PO_2 - PO_1)(QO_2 - QO_5) = (0.5)(1.36)(4.19) = 2.85$$

3 Change in PS in the oil market

$$(A) = (PO_2 - PO_1)(QO_4) - NELP = (1.36)(82.89) - 0.74 = 111.99$$

4. Change in the CS in the oil market

$$-(A + B + C + D) = -[(PO_2 - PO_1)(QO_5) + NELC] = -[(1.36)(90.01) + 2.85] = -125.26$$

5. Government's revenue (GR) on tariff

$$(C) = (T)(QO_5 - QO_4) = (1.36)(7.12) = 9.68$$

6. Change in bean price due to change in oil price

$$(PB_3 - PB_2) = \frac{-(dDB/dPOAR)(PO_2 - PO_1)}{(dDB/dPBR - dSB/dPBR)} = \frac{-(6.63)(1.36)}{-38.61 - 83.16} = 0.07$$

7. Change in the PS in the bean market

$$M + O + Q = (PB_3 - PB_2)(QB_4) - (1/2)(PB_3 - PB_2)(QB_4 - QB_3) = (0.07)(664.51) - (0.5)(0.07)(5.82) = 46.31$$

8. Change in the CS in the food industry

$-(F) = -[(PB_3 - PB_2)(QF_2) - (1/2)(PB_3 - PB_2)(QF_2 - QF_3)]$

$= -[(0.07)(129.71) + (0.5)(0.07)(1.26)]$

$= -9.12$

9. Net change in CS in oil processing.

(The change in PS in the oil market is equal to the change in PS in farming plus the change in CS in oil processing plus the change in CS in the food industry)

$(I - H) = J + J - H - J$

$= A - H - J$

$= A - O - Q$

$= A - M - O - Q + M$

$= A - (M + O + Q) + M$

$= A - (M + O + Q) + F$

$= 111.99 - 46.31 + 9.12$

$= 74.80$

10. The deadweight loss to society

$DL = B + D = 0.74 + 2.85$

$= 3.59$

11. Change in the balance of trade

$BT = (PO_1)[(QO_2-QO_3) - (QO_5-QO_4)] + (PM_1)[(QM_2-QM_3) - (QM_2-QM_4)]$

$= 85.38 + 35.27$

$= 120.65$

Using the same procedure of estimation as outlined above, the impacts of the government's total intervention in the Thai soybean industry were estimated. The results are presented in Table 6.4. The table provides estimates of all the changes in price, production, consumption and net imports of the three commodities, as well as the annual changes in welfare of the concerned parties under the seven chosen scenarios. The annual welfare impacts of the policy are classified by affected groups, namely: the farmers, the oil processing industry, the food industry, the meal users (i.e., the feed industry and the meat consumers), the oil consumers and the government. Effects on the balance of trade and the deadweight loss of the policies are classified by the three markets. A more detailed exposition of the impact of each policy scenario is given in Appendix Tables A.6.3 to Table A.6.9. The empirical results given in Table 6.4 form the basis of the policy assessment of the Thai government's interventions in the soybean industry.

Table 6.4
Annual Impacts of the Thai Government's Intervention in the Soybean Industry: Seven Policy Scenarios

Unit: 1000 tonnes, unless otherwise specified

Impacts	Policy Scenario						
	B	T	S	T/B	B+T	S/(B+T)	B+T+S
Bean:							
Price (*baht* per kg)	0.88	0.00	0.00	0.07	0.95	0.09	1.04
Production	73.18	0.00	0.00	5.82	79.00	7.49	86.49
Consumption (P)	−18.18	9.00	11.02	7.08	−11.10	9.11	−1.99
(F)	−15.80	0.00	0.00	−1.26	−17.06	−1.62	−18.68
(B)	−33.98	9.00	11.02	5.82	−28.16	7.49	−20.67
Net Imports	−107.16	9.00	11.02	0.00	−107.16	0.00	−107.16
Oil:							
Price (*baht* per kg)	0.00	1.36	0.00	1.36	1.36	0.00	1.36
Production	−2.81	1.40	1.71	1.09	−1.72	1.42	−0.30
Consumption	0.00	−4.19	0.00	−4.19	−4.19	0.00	−4.19
Net Imports	2.81	−5.59	−1.71	−5.28	−2.47	−1.42	−3.89
Meal:							
Price (*baht* per kg)	0.00	0.00	1.39	0.00	0.00	1.39	1.39
Production	−14.00	6.93	8.49	5.46	−8.54	7.01	−1.53
Consumption	0.00	0.00	−17.82	0.00	0.00	−17.82	−17.82
Net Imports	14.00	−6.93	−26.31	−5.46	8.54	−24.83	−16.29
Welfare: (m *baht*)							
Farmer	547.45	–	–	46.31	593.76	60.14	653.90
Food Industry	−122.21	–	–	−9.12	−131.32	−11.60	−142.92
Oil Processing	−472.39	116.02	590.17	74.80	-397.60	528.74	131.14
Meal Users	–	–	−855.60	–	–	−855.60	−855.60
Oil Consumers	–	−125.26	–	−125.26	−125.26	–	−125.26
Government Revenue: (m *baht*)	–	5.44	247.14	9.68	9.68	261.07	270.75
From Tariff	–	5.44	–	9.68	9.68	–	9.68
From Surcharge	–	–	247.14	–	–	261.07	261.07
Balance of Trade: (m *baht*)	453.50	17.58	137.00	120.65	574.15	183.36	757.58
Soybeans	589.38	-49.50	−60.61	–	589.38	–	589.38
Soybean Oil	−45.44	90.39	27.65	85.38	39.94	22.96	62.90
Soybean Meal	−90.44	44.77	169.96	35.27	−55.17	160.40	105.23
Deadweight Loss: (m *baht*)	47.15	3.8	18.28	3.59	50.74	17.25	67.99
Soybeans	47.15	–	–	–	47.15		47.15
Soybean Oil	–	3.8	–	3.59	3.59	–	3.59
Soybean Meal	–	–	18.28	–	–	17.25	17.25

Source: From Table A.6.3 to A.6.9

It is clear that there are both efficiency and equity consequences of policy intervention. If policy assessment is made solely on 'economic efficiency' grounds, the desirability of the policy can best be judged by its contribution to real GNP. However, problems of income distribution are always an issue in the realm of economic investigation so that policy assessment must be made on 'distributive efficiency' or 'equity' grounds as well. More often than not, policy measures designed for an economic efficiency objective will have adverse distributive efficiency effects and *vice versa*. (Another overriding issue is the concern for 'dynamic efficiency' or the 'growth' objective of a country, especially for LDCs. However, since the thrust of the economic analysis in the present study is strictly comparative statics, the issue is passed over but preserved as a major issue for future studies.)

Since normative judgement is required to make trade-offs between conflicting goals, and normative judgement cannot effectively be justified without an adequate knowledge of the social welfare function of the society, the desirability of each policy measure cannot be determined objectively. What remains feasible in the way of policy assessment is to compare and contrast the impacts of the seven policy scenarios by taking various policy objectives of the Thai government as given. Then the 'normative' judgement can be passed back to the policy makers, and what remains for economic investigation is to make 'positive' assessment or predicitons of the outcomes of each policy measure without bothering further with the notion of a social welfare function. The presumption is that the policy objectives of the government are: (1) to increase farm income and output of soybeans; (2) to improve the balance of trade in soybeans and their products; and (3) to generate government revenue. The seven policy scenarios are assessed and compared, first in terms of their effectiveness and efficiency in connection with the given objectives and, second, in terms of their impact on economic efficiency and income distribution. To be consistent with the econometric model estimation, all prices and values are expressed in real terms (i.e., in 1987 prices).

6.2.1.1. *The objective of increasing farm income and output*

As presented in Table 6.4 the farm output of soybeans would increase by 73180, 0, 0, 5820, 79000, 7490 and 86490 tonnes with policy scenarios B, T, S, T/B, B+T, S/(B+T) and B+T+S, respectively, while producer surplus as a measure of farm income increases by 547.44, 0, 0, 46.32, 593 94, 60.14 and 654.08 million *baht*, respectively.

The single most effective policy for meeting these objectives is the import ban on soybeans. Farm income and output increase substantially with scenarios B, B+T and

B+T+S. The import tariff on soybean meal is not effective without a simultaneous imposition of an import ban on soybeans. Scenario T or S alone results in no increase in farm output or farm income, while the marginal scenarios T/B and S/(B+T) yield moderate increases in both output and income.

The most effective scenario in serving the farm income and output objective (B+T+S) suffers the highest deadweight loss. This is due mainly to the policy-induced increase in soybean output with private revenue far greater than the world price for the commodity. It is interesting to note that, either in isolation or imposed with an import ban policy, the tariff on oil results in less deadweight loss than the surcharge on meal.

6.2.1.2 *The objective of improving the balance of trade*

Similar to the results in the previous section, the most effective policy for improving the balance of trade is the import ban on soybeans; the balance of trade improves substantially with scenario B, B+T and B+T+S. Again, the tariff on oil and the surcharge on meal would result in greater improvement in the balance of trade when operated in conjunction with the imposition of an import ban. However, as opposed to the previous case where a tariff or surcharge working in isolation would not serve the objectives of farm income and output generation, in this case the tariff or surcharge alone would result in some improvement in the balance of trade.

6.2.1.3 *The objective of generating government revenue*

As opposed to the former two cases, the most effective single policy for generating government revenue is the import surcharge on soybean meal. The high revenue-generating policy scenarios are those with the surcharge in isolation (S) or the surcharge operating with other policies, S/(B+T) and B+T+S. In general, the tariff on oil generates much lower revenue while, understandably, the import ban policy working in isolation would generate no revenue at all. Inspection of deadweight losses discloses that only moderate efficiency loss would occur with the imposition of a surcharge policy either in isolation or in combination with other policies. This is due to the fact that a high proportion of the deadweight loss has come about as a result of the import ban on beans. Note that, while the deadweight loss of the import tariff policy on oil is relatively low as compared with those resulting from the ban on beans and surcharge on meal, the policy also generates relatively low tax revenue.

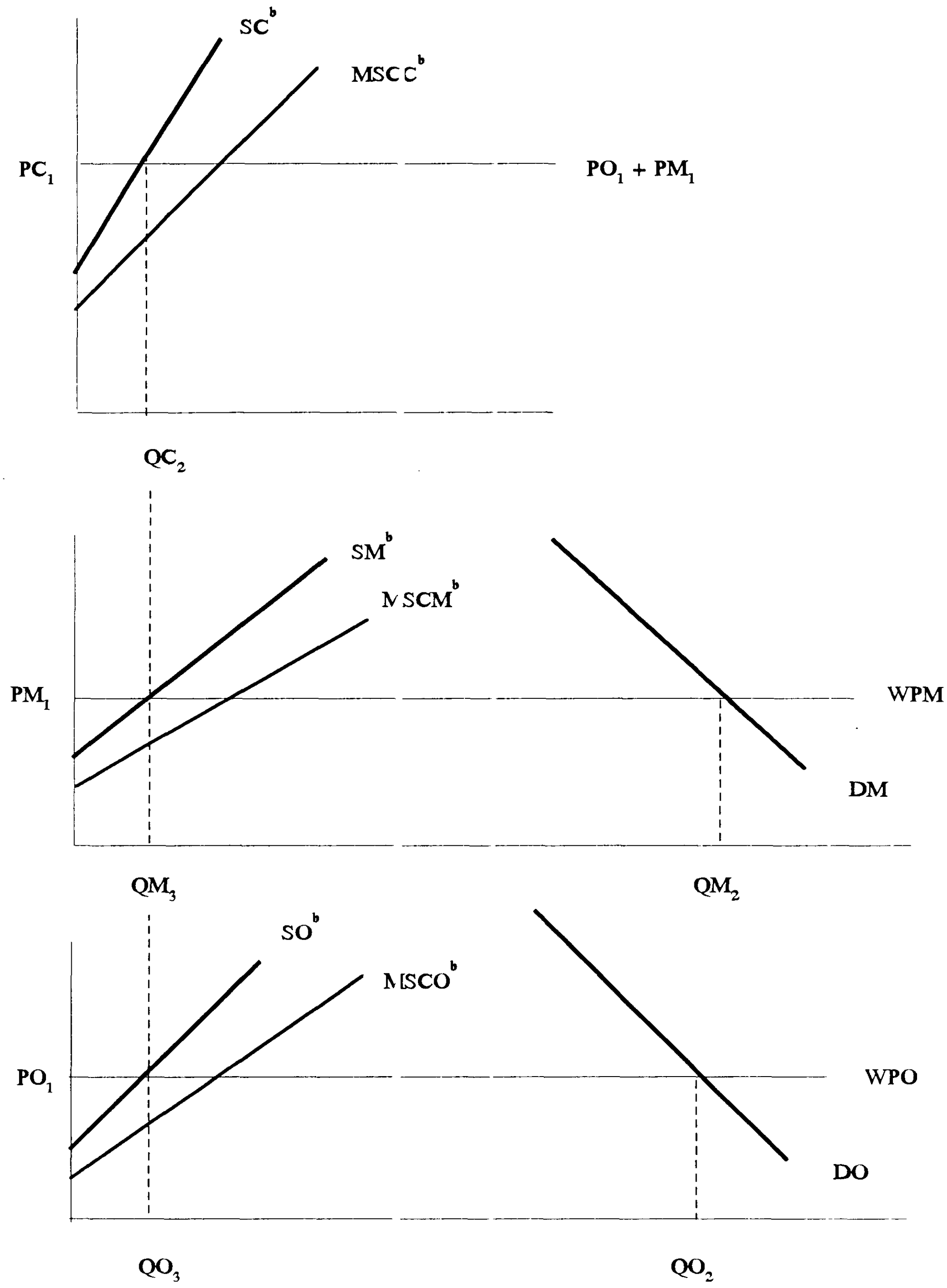
6.2.2 *The second-best policy assessment*

The second-best policy assessment consists mainly of the estimation of the relevant MSC curves and the use of these to re-estimate the various values of deadweight loss as a result of the policy interventions. The analyses are based on the various graphical models (as postulated in Chapter 3), the formulas and values for MRC and MSC (as defined in Chapter 4), and the empirical results of the econometric models (as listed in Chapter 5). A few points need to be clarified, however.

Before the various MSC curves can be derived and used for policy analysis several additional remarks need to be made. First, the demand curve for meal (DM), the demand curve for oil (DO) and the demand curve of the food industry (DF) are assumed to equal their respective marginal social benefit (MSB) curves. This is due to the fact that there is no evidence in Thailand that there is significant distortion in the consumption of these commodities. Second, with only a small divergence between the MSC and MPC, as evident from the empirical finding in the previous paragraphs, the supply curve for beans (SB) is also assumed to approximate its MSC curve. The contention is that the divergence can be as well caused by statistical discrepancy rather than being a real difference between the two curves. What remains is to estimate the MSC curve for soybean meal and the MSC curve for soybean oil, given that they are different from the respective marginal private cost curves of these commodities.

Given that the cost structure presented in Table A.4.19 is, in fact, a cost structure for oil crushing (i.e. in the production of meal and oil), all the statistics obtained so far for the social private cost factor (SPCF), MSC, MRC and so forth as presented in Table 4.4, are in fact for the combined production of meal and oil (in a with ban situation). This has posed no problems in so far as the quantity of meal produced (QM) and oil provided (QO) are proportional to each other. Since the SPCF has been developed as a factor for expressing the divergence between the MSC curve and the market supply curve in terms of a percentage, the same factor can be used for the combined supply curve of oil and meal (SC) and the two separate supply curves (SM and SO). The above argument is best clarified graphically Figure 6.1 (extracted from sections D, E and F of Figure 3.13) presents the relationship among the supply curves of the combined outputs of oil and meal (SC^b) of meal (SM^b) and oil (SO^b) in a with ban situation. With an assumed value of SPCF all the MSC curves can be derived.

Figure 6.1 : Derivation of Mar;;inal Social Cost Curves for Soybean Meal and Oil.



Since a graphical description has been given in Chapter 3, the description given here is brief, focusing on only the points of direct concern. Just as the relationship among the marginal private cost (MPC) curves ensures that SO and SM add up vertically to SC, the relationship among the MSC curves is that MSCO and MSCM add up vertically to MSCC.

Thus far the use of the SPCF in the derivation of MSC curves from the market supply curves seems to pose no problems. However, there is an inherent limitation of the device resulting from invoking the underlying assumptions, particularly assumptions (M.3) and (M.4). When the social costs incurred in the domestic production and importation of soybeans are much different, the direct DRC estimation using imported soybeans as input material in oil crushing would produce values different from those generated from a total DRC estimation using domestically produced soybeans as input. Given the fact that the social and private cost components used in the derivation of SPCF for oil processing were obtained from a policy-laden environment including an import ban policy on soybeans, there is a need to adjust the value of SPCF to reflect the difference in the values of MSC between the with-ban situation and the without-ban situation.

In the without-ban situation, both locally produced and imported soybeans will be used as raw material in oil processing. A weighted average of the social private conversion factor (WSPCF) of oil extraction using domestic soybeans (SPCF) and using imported soybeans (SPCF*) would be an appropriate factor to convert MPC to MSC.

Using the statistics in Table 4.4 and Table A.4.10, $SPCF^*$ can be estimated with the formula:

$$SPCF^* = \left[\frac{TI^*}{PTI^*}\right]\left(\frac{a}{a+b}\right) + \frac{DC^*}{PDC^*}\left(\frac{b}{a+b}\right),$$

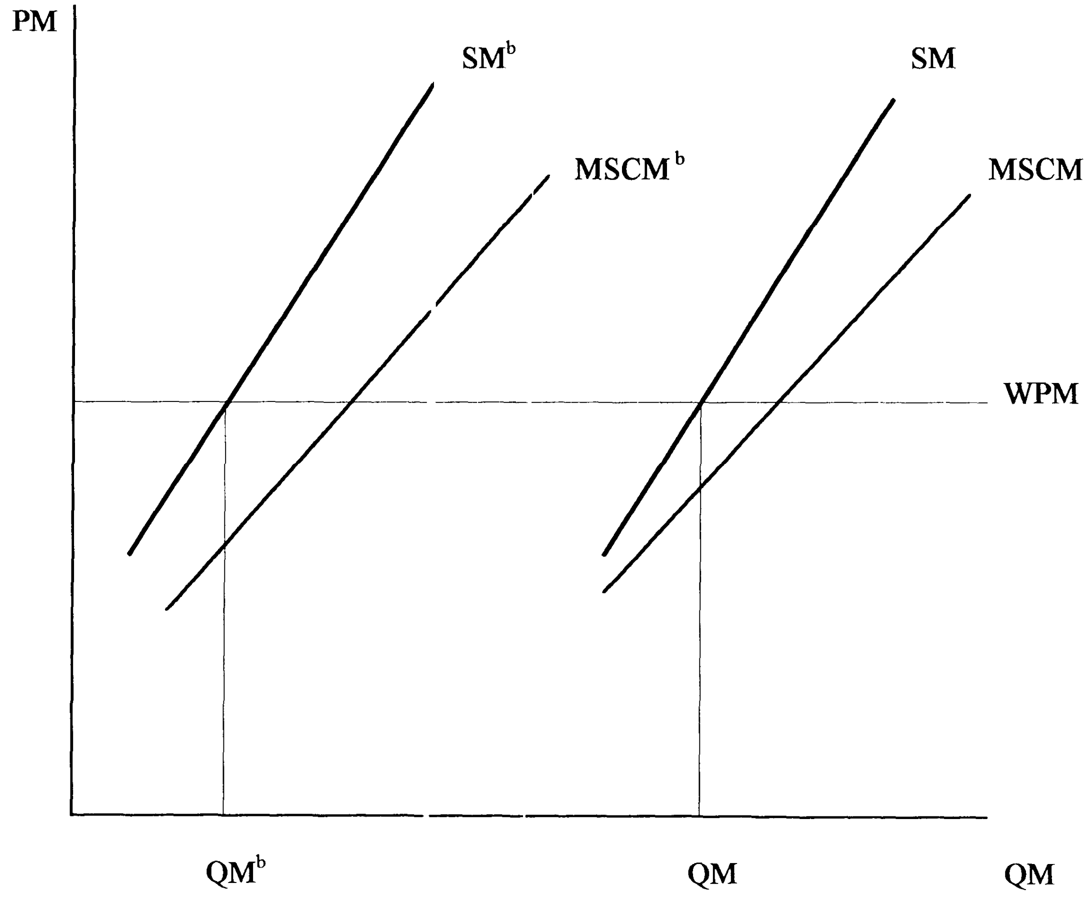
Where TI* is the social TI cost in oil processing plus the CIF value of soybeans plus the social TI cost in transporting soybeans from border to factory. Estimation of PTI* follows the same device but using private values instead of social values. By the same token, DC* is the social DC in oil processing (NTI) plus the social DC in transporting soybeans from border to factory plus marketing cost. Lastly, for PDC*, apart from using private values in estimation, all DCs are equal to NTI cost plus tax. It is noted, however, that the import duty on soybeans is not included in DPC*. This is merely a matter of choice to start policy analysis (for the without-ban situation) with a complete free trade scenario so tha. policy assessment can be consistent with the graphical model as depicted in Figure 3.12. With all the statistical values thus far :

TI*	=	(28.59 + 52.27) + 7028.93 + 23.5	= 7133.29
PTI*	=	(26.58 + 54.65) + 6533.672 + 21.9	= 6636.802
DC*	=	(98.86 + 726.03) + 57.1 + 238.007	= 1119.997
PDC*	=	(139.13 + 737.62 + 1.35 + 186.95) + (58.5 + 19.6) + 268.328	
	=	1411.478	

With a = PTI* and b = PDC*, SPCF* is found to be 1.025. Refering back to Figure 3.13 and Table A.6.3, with a free trade scenario domestic supply of beans would decrease from 658,690 tonnes to 585,510 tonnes while importation increases by 107,160 tonnes. Thus, the proportion of domestic to imported beans consumed would be 0.845 : 0.155. Assuming that both the oil processing and the food industry utilized domestic and imported soybeans as raw material approximately with the proportion, the WSPCF turns out to be 0.812 (i.e., = 0.773*0.845 + 1.025*0.155).

The outcomes of SPCF and WSPCF estimation for the oil crushing industry disclose that, without an import ban policy on soybeans, divergence between the MSC curve and the market supply curve would be lessened. This is understandable, since the cost of soybeans used as input material in oil crushing captures a large percentage of the total production cost. The hypothetical abolishing of the ban policy would result in an influx of soybean imports, causing the market price and shadow price of soybeans to approximate each other. This greatly bridges the gap between the private cost and social cost of oil processing. The smaller divergence of the two curves also indicates an imrpoved pattern of resource allocation among the various activities. With all this information, the MSC curves for soybean meal can be depicted as shown in Figure 6.2. The curves denoted by SM and SM^b are the supply curves of soybean meal with and without the import ban on soybeans, respectively. As described in Chapter 3, with world price WPM, the production level would be QM with a free-trade regime. When an import ban policy is imposed on soybeans, the oil crushing industry faces a higher input cost. This would result in a leftward shift of the supply schedule from SM to SM^b, which results in a lower level of output at QM^b. In this regard, the attached MSC curve would shift along with the supply curve. However, due to the change in the value of the social-private cost factor from WSPCF to SPCF, the divergence in values between SM^b and $MSCM^b$ is greater than between SM and MSCM, as depicted.

Figure 6.2 : The Supply Curve and Marginal Social Cost Curve of Soybean Meal With and Without an Import Ban Policy on Soybeans.



To simplify the discussion, only the most relevant portions of the graphical model will be used in the analysis, with the contention that the bird's eye view has been given in Chapter 3. Moreover for the second-best policy analysis which follows, all agents are assumed to respond to private rather than social supply and demand schedules, because they only observe market prices in their private decision making. Hence, except for the various values of deadweight loss (DL), the impacts on price, production, consumption, import, etc. are identical to those of the first-best one. Thus, the second-best policy analysis mainly focuses on the re-estimation of the various DL values and the determination of an optimal level of intervention.

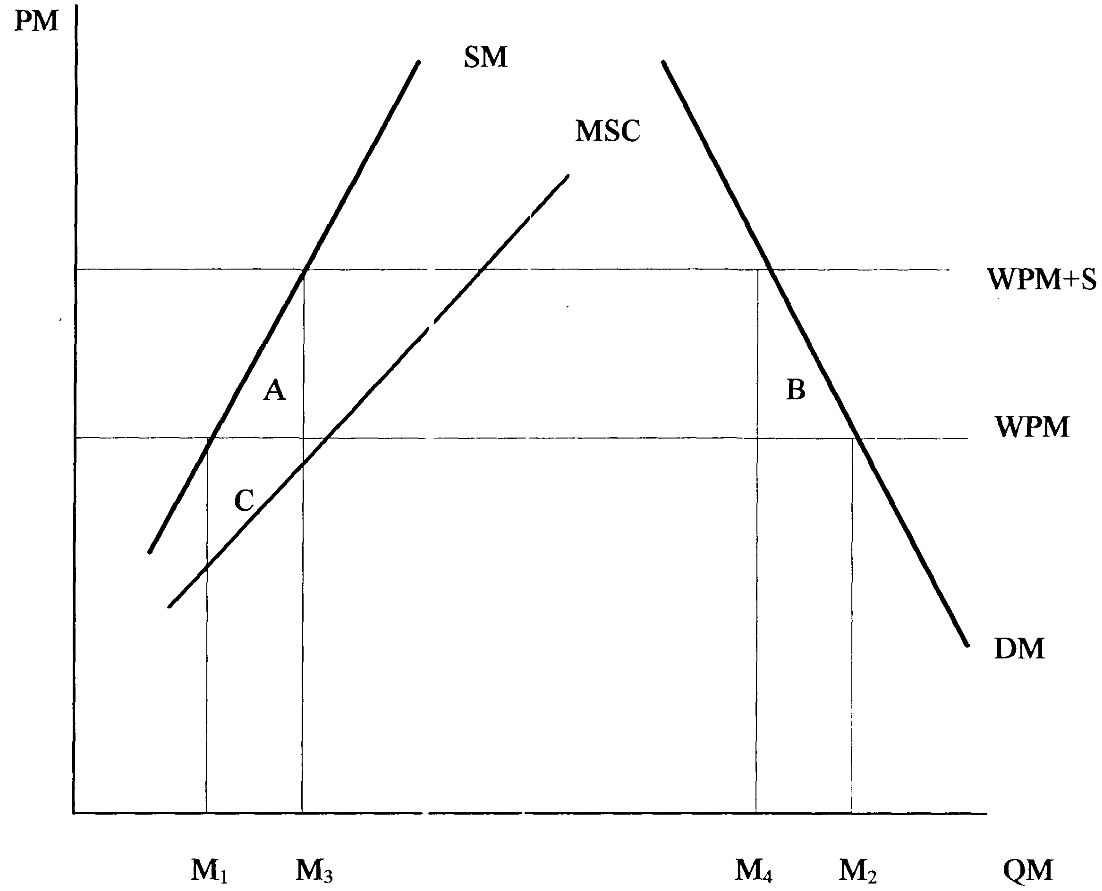
To demonstrate how the social private cost factor is used in (a) the derivation of the MSC curve from the private supply curve, (b) the reestimation of DL, and (c) the determination of the optimal level of intervention, the supply curve of meal is again chosen for demonstration. Figure 5.3 portrays a scenario where a single import surcharge policy is imposed on soybean meal.

The scenario assumes no other intervention (i.e. no ban and no tariff) in the soybean industry but presumes a situation in which unremovable distortions elsewhere in the economy have caused the MSC curve to lie below the market supply curve by a factor of WSPCF. In this regard, as mentioned in Chapter 4, a second-best analysis suggests that the change in DL resulting from an average surcharge rate of S would consist of a gain in efficiency on the production side of area C (above MSCM and below WPM) and a loss on the consumption side of area B. Thus, the change in efficiency can be positive or negative rather than a definite loss as in the first-best assessment.

In empirical analysis, the measurement of the triangle A or B, is straightforward. The area C, however, can be readily measured with the use of WSPCF. For instance, with a surcharge rate of S the area C can be measured by the following formula:

$$(6.4) \qquad C = WPM(M_3 - M_1) - WSPCF(WPM + \frac{S}{2})(M_3 - M_1).$$

Figure 6.3 : The Marginal Social Cost of Soybean Meal, the Second-Best Measurement of Deadweight Loss, and the Optimal Surcharge Rate.



Before estimating these values, it is worthwhile to look at one more policy scenario in detail, namely, the marginal impact of an import surcharge on soybean meal with the import tariff on oil and import ban on beans already in existence. Inspection of this scenario will provide different insights as to how the movement of the market supply curve would react to policy intervention compared with the former one. This leads to more sophisticated analyses. Thus, for the second-best analysis, the model necessarily calls for detailed theoretical inspection before the empirical analyses can commence.

The model presented in Figure 6.4 has been extracted from part of section (E) of Figure 3.18. The three marginal social cost curves MSC^{bt}, MSC^{bts} and MSC^{*} are derived from their corresponding market supply curves (SM^{bt} and SM^{bts}) and the equilibrium market supply curve (SM^{*}) by applying SPCF. The hypothetical analysis discloses similar findings to that of the previous analysis: a surcharge of rate S would result in an efficiency gain on the production side of area Z (rather than an efficiency loss of Y as described in the previous first-best analysis). The over-all change in DL cannot be determined without knowledge of the demand curve, which has been dropped from the figure to simplify model presentation. However, the impact on the demand side is identical to that of the previous analysis. With the same surcharge rate (S) one may refer to the previous analysis and conclude that the net efficiency gain or loss is area Z in Figure 6.4 minus area B in Figure 6.3. Complicated as it seems, a close inspection of the positions of each of the curves in Figure 6.4 discloses the fact that the same method used in the estimation of changes in DL, as well as in the determination of an optimal surcharge rate, can as well be applied here with the tariff and ban operative. However care must be taken to select the right position of the price-quantity combination points along the equilibrium market supply curve and the equilibrium marginal social cost curve.

With the methods developed so far, the various components of gain or loss in efficiency comprising deadweight loss as a result of the seven policy scenarios can be re-estimated with the second-best criteria. The re-estimation of DL in the oil and meal markets has just been explained. What is left is the estimation of the change in DL due to an import ban in the soybean market Figure 6.5 reproduce sections (B), (C) and (E) of Figure 3.13 with the attached MSC curves as depicted in Figure 6.2 superimposed on section (E). The relationship among the graphical models give rise to two marginal social

Figure 6.4 : The Marginal Social Cost of Soybean Meal, and the Second-Best Analysis of the Import Surcharge on Soybean Meal with an Import Tariff on Soybean Oil and an Import Ban on Soybeans.

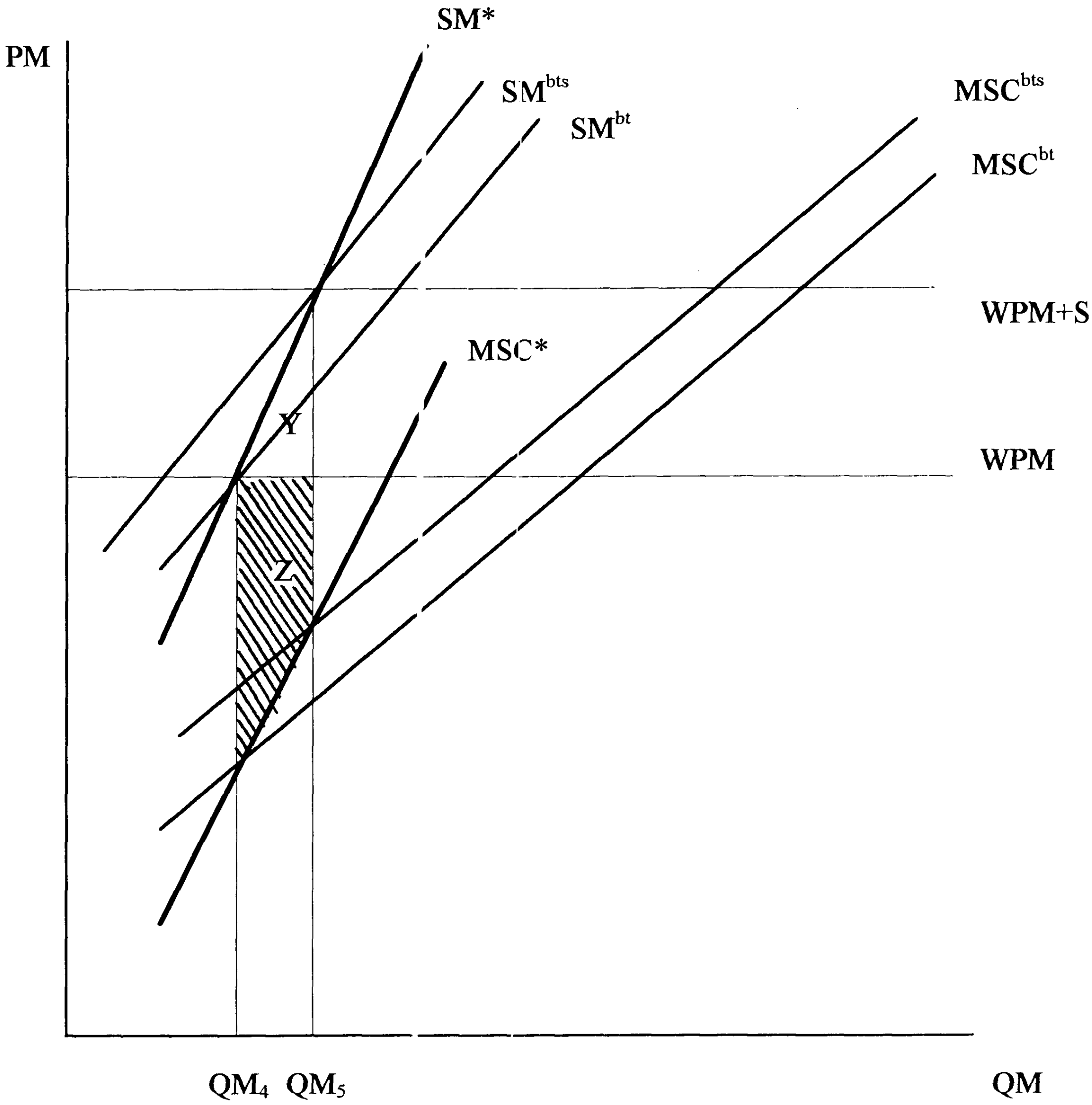
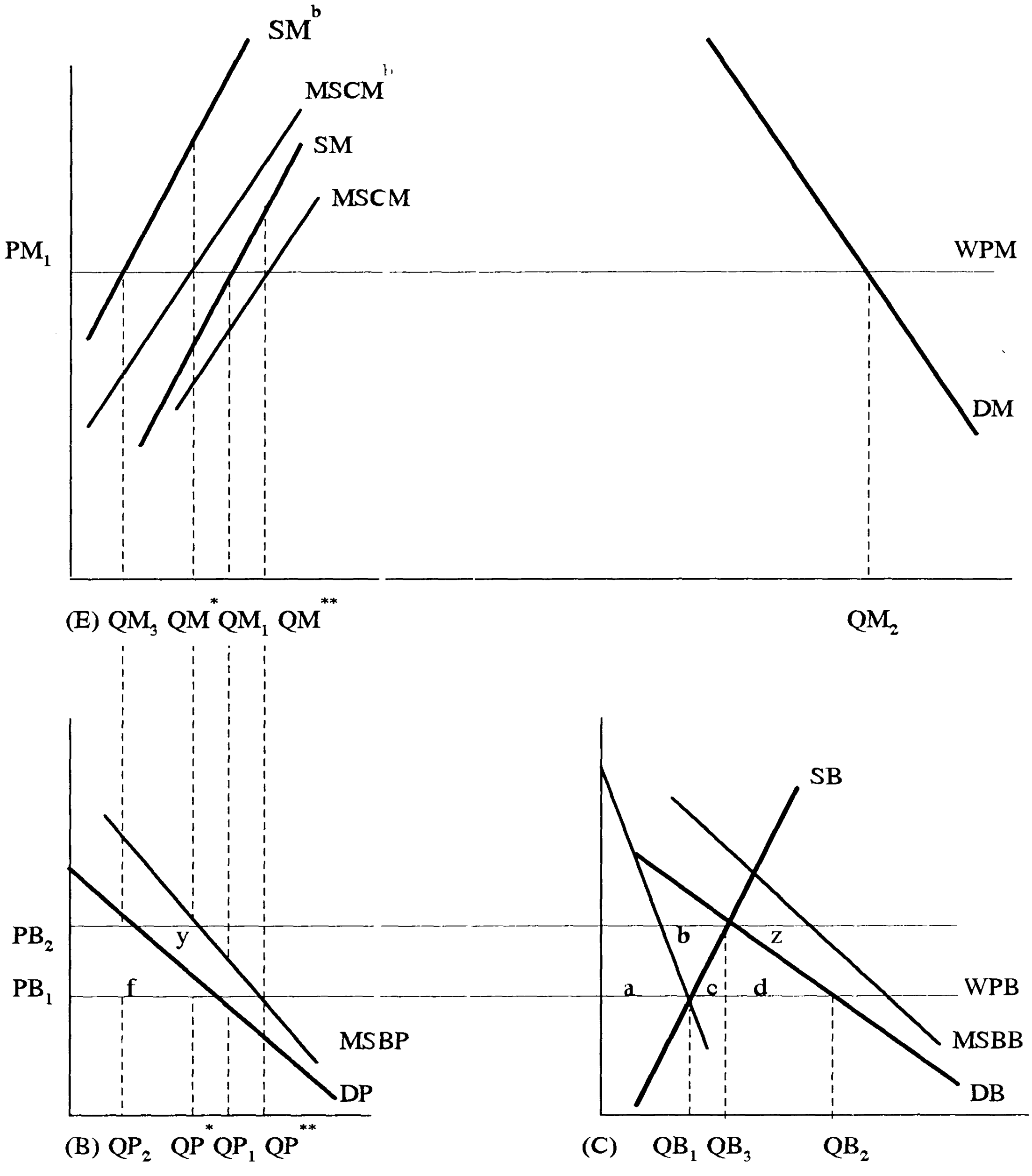


Figure 6.5 : The Added (Second-Best) Deadweight Loss Due to an Import Ban on Soybeans.



benefit curves; one for oil processing (MSBP) and one for soybeans (MSBB). The added DL due to import ban policy can either be determined by area Y in section (B) or area Z in section (C). The mentioned area can be measured by

$$((QP^* - QP_2 + QP^{**} - QP_1)/2)(PB_2 - PB_1)$$

where, $(QP^* - QP_2) = (PM_1)(1/SPCF - 1)(\text{slope of } SM^b / 0.77)$ and
$(QP^{**} - QP_1) = (PM_1)(1/WSPCF - 1)(\text{slope of } SM / 0.77)$

With a pre-import-ban SPCF of 0.812 and a post-import-ban SPCF of 0.773, and with the statistics listed in Table 6.2, Table A.6.1 and Table A.6.2 ($PM_1 = 6.46$, slope of SM^b = slope of SM = 6.11, $PB_2 - PB_1 = 0.88$), the area is calculated to be 11.85. Adding this to the DL of the first-best estimation, the second-best DL turns out to be 59 million *baht*. The second-best values of NELP, NELC AND DL were estimated and are presented in Table 6.5.

Inspection of the outcome of deadweight loss estimation based on the second-best criteria reveals some interesting points. The values of NELP of scenarios T, S, T/B, and S/(B+T) turn out to have negative values of –3.48, –5.52, –3.59 and –6.52, respectively. This implies that the policy in question has resulted in welfare improvement on the production side by decreasing the NELP by the mentioned values. However, since all policies result in higher prices for the commodities, and since the demand curves of oil and meal are assumed to be equivalent to their MSB curves, the NELC are all positive. The negative values of NELP have brought about the possibility of enhancing the total welfare of the country by exerting a system of optimal tariffs and/or optimal surcharges on the importation of the commodities.

Table 6.5

Annual Deadweight Loss of Policy Interventions Assessed with Second-Best Criteria.

Unit : million *Baht.*

	B	T	S	T/B	B+T	S/(B+T)	B+T+S
Beans:							
NELP	32.20				32.20		32.20
NELC	26.80				26.80		26.80
DL	59.00				59.00		59.00
Oil:							
NELP		-3.48		-3.59	-3.59		-3.59
NELC		2.85		2.85	2.85		2.85
DL		-0.63		-0.74	-0.74		-0.74
Meal:							
NELP			-5.52			-6.52	-6.52
NELC			12.38			12.38	12.38
DL			6.86			5.86	5.86
Total:							
DL	59.00	-0.63	6.86	-0.74	58.26	5.86	64.12

Source: Estimation based on Table A.6.1, Table A.6.2, Figure 6.3 and Figure 6.4.

6.2.3 An optimal surcharge rate

When the MSC of a particular product lies below its corresponding market supply curve, as in the case of the oil processing industry in Thailand, it is conceivable to administer an appropriate degree of intervention in the form of an optimal tariff or surcharge to enhance welfare. Using soybean meal production as a case in point, the present study attempts to show how an optimal surcharge rate can enhance welfare with scenario S/(B+T). Optimal intervention rates for other scenarios are also estimated. Model S/(B+T) is chosen due to the fact that it represents the current real-world situation in the Thai soybean industry and that the desirability of the surcharge intervention has been criticized widely in economic policy discussion. In general, the import ban on soybeans receives relatively less attention, while the tariff policy on oil seems to capture no attention at all. The ignorance of the impact of the tariff on oil is justified by the fact that the tariff is a non-discriminating one, since the same tariff rate is imposed on other oils as well. The negligence towards the impacts of the ban policy on soybeans is also justified, but purely in the political sense that it seems reasonable to increase farm income, improve the balance of trade and be self-sufficient in bean production. While most criticisms of the surcharge policy convey negative opinions about its imposition, the present study attempts to demonstrate that, given the divergence between its market supply curve and the corresponding MSC curve, the imposition of an optimal surcharge rate can duly enhance welfare.

With the statistics accrued thus far (dPBR/dPMAR = 0.065, dSB/dPBR = 83.16, dDF/dPBR = -17.95, dDM/dPMAR = -12.82); with a surcharge rate of S, bean price would increase by (0.065)S *baht*/kg bean output would increase by (83.16)(0.065)S thousand tonnes, and the demand for beans in the food industry would decrease by (17.95)(0.065)S thousand tonnes, thus there is an increase in the quantity of beans used in oil processing of (83.16 + 17.95)(0.065)S thousand tonnes. As a consequence, meal output would increase by (83.16 + 17.95)(0.065)(0.77)S = (5.06)S thousand tonnes. On the demand side, meal consumption would decrease by (12.82)S thousand tonnes.

With the use of formula (6.4) and the mentioned statistics the values of NELP, NELC and DL can be determined as follows :

$$\begin{aligned}
NELP &= -[(WPM)(5.06S) - SPCF(WPM + \tfrac{S}{2})(5.06S)] \\
&= -[(6.46)(5.06S) - 0.773(6.46 + \tfrac{S}{2})(5.06S)] \\
&= -[7.42S - 1.96S^2],
\end{aligned}$$

$$NELC = (S)(12.82S)/2 = 6.41S^2 \quad \text{and}$$

$$DL = 6.41S^2 - 7.42S + 1.96S^2 = 8.37S^2 - 7.42S$$

To minimize deadweight loss is to equate the derivative of DL with respect to S with zero and solve for S, namely :

$$\frac{\partial DL}{\partial S} = 16.74S - 7.42 = 0$$

This gives an optimal surcharge rate (OS) of 0.4432 *baht*/kg.

With the same device, equations for DLs, values of optimal tariff (OT) and surcharge are estimated for policy scenarios T, S, T/B and S/T+B and presented in Table A.6.10. Policy simulations are carried out with various tariffs and surcharge rates to confirm that optimal results have been attained.

Summary of the analytical results on optimal tariffs and surcharges as well as the resultant values of minimum DL are presented in Table 6.6. Deadweight loss of the existing tariffs and surcharge rates assessed with both first-best and second-best criteria are also presented in the same table for purposes of comparison. The welfare impact on various agents as given in Table 6.4 are also reproduced to facilitate diacussion on the issue of trade-off between the efficiency objective and the equity objective in the later part of the chapter.

The empirical results reveal that the imposition of optimal taxation in scenarios T, S, T/B and S/(B+T) would lead to certain level of gain in efficiency. Comparing to the first-best existing DL the gain in efficiency are 5.05, 19.83, 4.86 and 18.89 million *baht* for the four scenarios respectively, while comparing to the second-best existing DL the gain in efficiency are 0.62, 8.41, 0.54 and 7.5 million *baht* respectively. For scenarios with the ban element, namely B+T and B+T+S imposition of optimal taxation would also result in some gain in efficiency when compared with the second-best existing DLs. In general, except for scenario S and S/(B+T) the gains are trivial when compared with the much larger DLs in all scenarios with a ban element.

The optimal tax rate for scenario T, S, T/B and S/(B+T) are 0.7985, 0.4173, 0.8279 and 0.4432 *baht*/kg respectively. Inspection of these optimal rates of intervention discloses an interesting point. The optimal surcharge (or tariff) rates are higher in cases where an import ban policy has already been imposed. The economic implication is clear

Table 6.6

Comparison of Deadweight Loss with Various Policy Scenarios and the Income Distribution Effects

Unit : million *Baht*, unless otherwise specified.

	B	T	S	T/B	B+T	S/(B+T)	B+T+S
Optimal Intervention							
Tariff (B/kg)	-	0.7985	-	0.8279	0.8279	-	0.8279
Surcharge (B/kg)	-	-	0.4173	-	-	0.4432	0.4432
Second-Best DL	59.00	-1.250	-1.548	-1.275	57.725	-1.644	56.081
Existing Intervention							
Tariff (B/kg)	-	1.36	-	1.36	1.36	-	1.36
Surcharge (B/kg)	-	-	1.39	-	-	1.39	1.39
First-Best DL	47.15	3.80	18.28	3.59	50.74	17.25	67.99
Second-Best DL	59.00	-0.63	6.86	-0.74	58.26	5.86	64.12
Welfare Change							
Farmer	547.45	-	-	46.31	593.76	60.14	653.90
Food Industry	-122.21	-	-	-9.12	-131.32	-11.60	-142.92
Oil Processing	-472.39	116.02	590.17	74.80	-397.60	528.74	131.14
Meal User	-	-	-855.59	-	-	-855.60	-855.60
Oil Consumer	-	-125.26	-	-125.26	-125.26	-	-125.26

Source: Table 6.4, Table 6.5 and Table A.6.10.

in the sense that, without an import ban policy, the soybean industry is already confronted by some degree of distortion, so that a corrective tariff or surcharge can be imposed to increase welfare. However, with an import ban policy the degree of distortion has been aggravated, so that a higher degree of corrective measure is called for. Thus, though one might not be willing to discredit an import ban policy due to normative justification by policymakers, one should recognize its negative effects on the economy or its hidden role in aggravating other distorting policies. By the same token, it is well noted that, in a distorted economy such as the soybean industry in Thailand, optimization should be concerned with the determination of marginal degrees of intervention rather than the choice of whether to use or not to use a certain policy measure. With the knowledge of optimal tariff and surcharge rates as presented in Table 6.6, and with the existing tariff rate of 1.36 *baht* per kg for oil and a surcharge rate of 1.39 *baht* per kg for meal, the policy implication is to decrease the rate rather than abolish the interventions all together.

6.2.4 The income distribution effects

The effects on income distribution are complicated by the number of policy scenarios and the number of agents involved. Complicated as it seems, the various policies have established certain patterns of influence on the income distribution of the related groups. The analysis in the present study investigates how each policy scenario would affect the five major groups. Then the overall impact of the seven policies on the pattern of income distribution is investigated by considering trade-offs between the efficiency effects and the equity effects of the policies.

Based on the policy options presented in Table 6.6, policy option B would benefit the farmers and simultaneously hurt the food industry and the oil processing industry. Policy T and S, on the other hand, would benefit the oil processing industry and exert negative impacts on oil consumers and meal users.

The tariff with ban (T/B) policy has an impact on oil consumers which is negative and identical to the tariff-only option. The marginal impact of the tariff adds to the positive impact on farmers of a ban and the negative impact on the food industry of a ban. It partly offsets the negative impact of the ban for the oil processing industry.

As far as the S/(B + T) scenario is concerned, the marginal impact of a surcharge enhances the positive impact of the ban in increasing farm income, and adds to the negative impact of the B + T policy on the food industry slightly. It greatly enhances the welfare of the oil processing industry but exerts the same negative impact on the meal users as policy S.

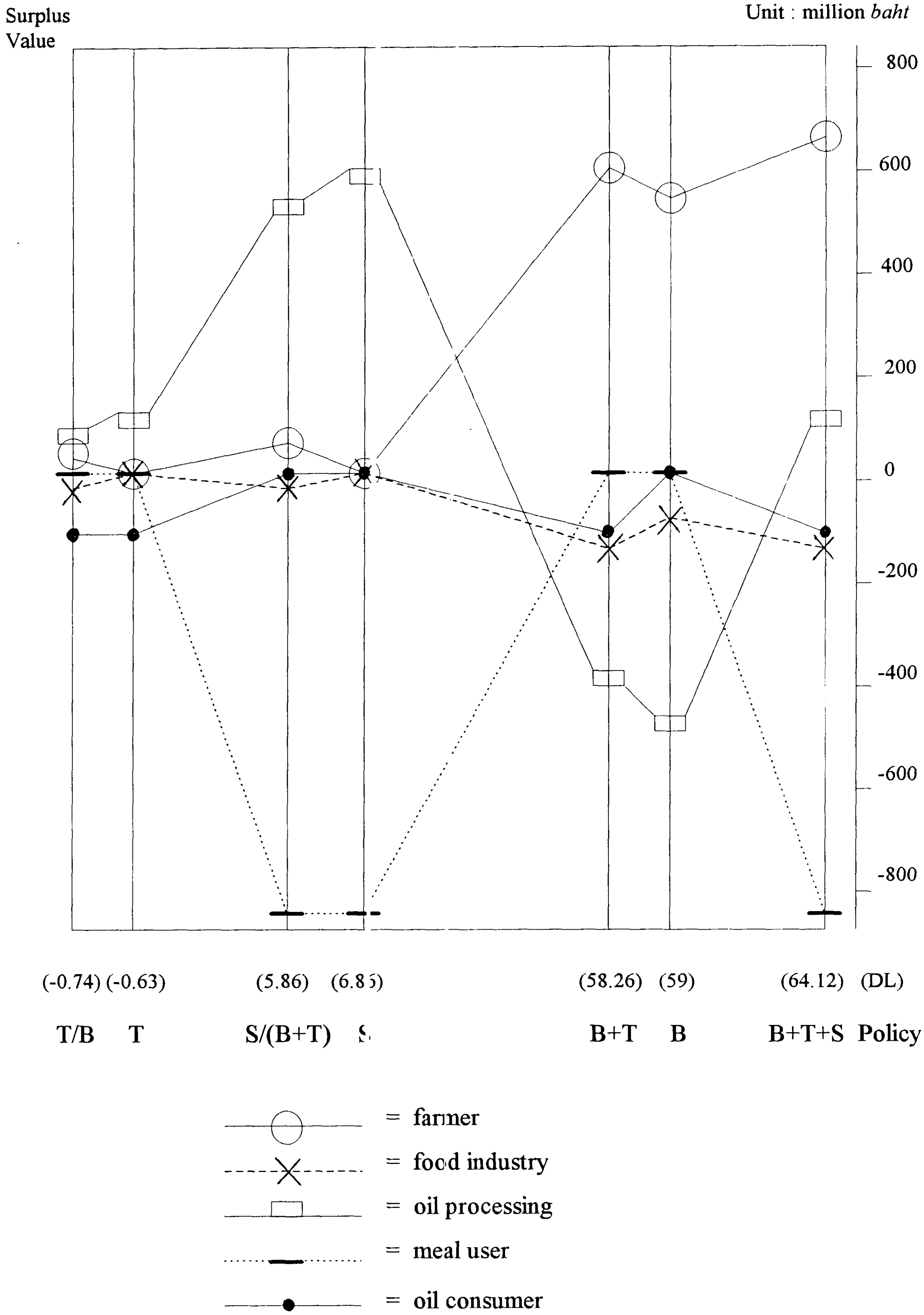
Impacts of the B + T + S scenario, being the combined effect of S/(B + T) and (B + T), provides the highest positive impact on farmers and highest negative impact on the food industry. The positive effect of S/(B + T) offsets the negative impact of the existing B + T and thus results in a moderate overall welfare gain to the oil processing industry.

Consequently, the farmers clearly benefit from all policies, with a ban policy as a major element. The food industry and the oil consumers are the clear losers in this arena. While all policies except the single T and S would affect the food industry negatively, the oil consumers are hurt only by the imposition of the tariff policy. Similarly, the meal users are (greatly) negatively affected by the surcharge policy, either as a surcharge alone or in combination with other measures while T and B alone or in combination would not affect the meal users unless there was a surcharge.

In general, inspection of Figure 6.6 provides useful insights into policy options that otherwise might appear to be obscure in some respects. For instance it can be inferred from the graphs that a policy to enhance farm income must necessarily bare a high DL, while a relatively low-cost policy (e.g., S/(B + T) or S) can enhance the welfare of the oil processors with the cost borne substantially by the meal users. If farmers are not the cause of concern, policy B + T + S can be considered inferior to S in that it results in the same cost to the meal users but enhances the welfare of the oil processing industry to a much lower degree.

The graphs have also made explicit some other aspects of policy options. For example, if a policy option must be chosen to increase merely the welfare of the oil processing industry, policy option S would be much superior to policy B + T + S in that the policy target can be approached and with less cost. In addition, the graphs also make explicit the dependence of some policy targets on some policy component. It is obvious from the graphs that farm income cannot increase substantially without the ban element, and the welfare of the oil processing sector cannot be enhanced without the surcharge element. Moreover, the graph discloses that, while oil consumers seem to be hurt by the tariff policy, the effects can be considered as relatively trivial when compared with other, more aggressive, measures of protection. Finally, it is interesting to note that the consumers in the food industry are negatively affected by most policies, and the negative welfare impacts increase simultaneously with the increase in deadweight loss. However, as with the case of oil consumers, the negative impacts are relatively low.

Figure 6.6 : Impacts of Seven Policy Scenarios on Income Distribution.



Chapter 7

SUMMARY, RECOMMENDATIONS AND FUTURE RESEARCH

7.1 Summary

The production of soybeans in Thailand has been increasing rapidly during the last decade. As cited in the literature (Virakul 1990; Sriplung 1987) the growth is due mainly to the government's intervention in the industry. The intervention consists of production policy, price policy and trade policy, and the rapid increase in output comes as a result of the combined effects of the three policies. The impacts of the production policy are demonstrated by the increase in yield and by the increase in area planted to soybeans.

The price policy (to augment the production policy) in the form of a minimum price scheme for soybeans was introduced in 1978. The scheme was said to be ineffective (Sopitkul 1990; Busbongton 1989) without the simultaneous imposition of the trade policy. The trade policy was introduced in 1982 and consists mainly of an import ban on soybeans, an import tariff on soybean oil and an import quota on soybean meal. With this policy combination, soybean output has increased with fairly high annual growth rates of 19.25 per cent and 22.26 per cent during 1980-85 and 1986-90, respectively. The import quota policy was replaced by a system of variable import surcharges in March 1990.

The policy package has been criticised for favouring soybean farmers and the oil processing industry while disfavouring the feed industry, livestock production and meat consumers (Setboonsarng 1990; Wattanakul 1987; Virakul 1987). This is a problem of income distribution. However, no study has attempted to measure the size of the distributional effects objectively and, furthermore, little attention has been given to the economic efficiency loss as a result of the intervention. Moreover it is possible that with some existing distorting policies already present, an additional policy measure can be a corrective policy which decreases the size of the efficiency loss. There has been a lack of objective assessment of the soybean policy package. The present study attempts to correct this deficiency.

In this study various theoretical multi-market models were postulated to help determine the impacts of the policy interventions. The impacts of each single policy and policy combinations were determined in terms of the deadweight loss generated through transfers in economic surplus under a first-best criterion. Then, the theoretical aspects of a second-best policy were explored. To determine the efficiency of resource allocation on the production side, domestic resource cost coefficients for the soybean industry are estimated. With the values of DRC equal 0.791 for soybean farming and 0.816 for oil processing, following the conventional approach would imply a certain degree of comparative advantage in the Thai soybean industry. Thus, on efficiency grounds, both soybean farming and processing should be expanded. However, the development of methods to measure the marginal resource cost ratio and the derivation of a marginal social cost curve to be used in the second-best assessment of policy results in somewhat different view. With the values of MRC equal 1.111 for soybean farming and 0.885 for oil processing, the policy implication is to restrain soybean farming while encouraging the oil processing industry.

An econometric model of the soybean industry was estimated. Reasonably satisfactory statistical results were obtained. The estimated coefficients of the demand and supply schedules for the multi-market model were consistent with economic theory, with high statistical significance for most of the coefficients. The models were used in the analysis of seven policy scenarios based on 1989/90 data. The policy assessment was conducted with three given government objectives in mind, namely: increasing farm income and output, improving the balance of trade and generating government revenue.

The first-best policy analysis disclosed that, for the objective of increasing farm income and output, the most effective policy is the import ban on soybeans (whether in isolation or combined with other policies). However, the ban also results in a high level of deadweight loss. As for the objective of improving the balance of trade, the most effective policy is also the import ban on soybeans, while the import tariff on oil and import surcharge on meal result in a moderate improvement of the trade balance. For the objective of generating government revenue, the high-revenue generating scenarios are those with a surcharge element which result in only a moderate loss in economic efficiency.

The second-best policy analysis provided additional information. With a first-best analysis the deadweight losses for policy scenarios involving the ban, the tariff, the surcharge, the addition of a tariff given an already existing ban, the ban and the tariff together, the surcharge given the existence of the ban and the tariff, and all the policies together are 47.15, 3.80, 18.28, 3.59, 50.74, 17.25 and 67.99 million *baht*, while with a second best analysis their values change to 59, –0.63 6.86, –0.74, 58.26, 5.86 and 64.12 million *baht*, respectively. Thus, compared with the first-best analysis, the values of second-best deadweight losses are higher in scenarios B and B+T and lower in other scenarios. This has come about because some policy scenarios result in negative values of NELP while the ban results in higher value of NELC. This, in turn, gives rise to the possibility of enhanced welfare through optimal levels of intervention. In addition it should be noted that, because private individuals respond to price movements along unadjusted demand and supply schedules in both the first and second-best cases, the values of consumer and producer surpluses are the same in both instances.

The optimal tariff and surcharge rates were estimated. The optimal tariff rate is approximated to be 0.7985 *baht* per kg for scenario T and 0.8279 *baht* per kg for scenarios T/B, T+B and B+T+S; the optimal surcharge rate is 0.4173 *baht* per kg for scenario S and 0.4432 *baht*/per kg for scenarios S/(B+T) and B+T+S. In general, the optimal tariff and surcharge rates are higher with the imposition of an import ban policy. The implication is that a higher corrective tax rate is normally needed for situations with higher levels of distortion introduced by the import ban.

Finally, the analysis of policy impacts on income distribution reveals some interesting points. First, for single policies, scenario B would benefit farmers but harm the food and the oil processing industries, while scenarios T or S would benefit the oil processing industry but harm the oil consumers and meal users. As for policy combinations, scenario T/B adds to the positive impact on farmers from the ban and the negative impact on the food industry from the ban, but offsets the negative impact on the oil processing industry from the ban. Scenario S/(B+T) enhances the positive impact on farmers from the ban and worsens the negative impact of the B+T policy on the food industry. It reinforces the positive impacts on the oil processing industry and the negative impacts on meal users. Scenario B+T+S has the highest positive impact on farmers and the highest negative impact on the food industry. It results in a moderate gain of welfare to the oil processing industry.

As far as the trade-offs between equity and efficiency are concerned, a graphical analysis reveals that farm income cannot increase substantially without an import ban element which incurs relatively high deadweight losses. While the surcharge element enhances the welfare of the oil processing plants with relative low deadweight losses, there is a much higher cost borne by the meal users. With a given objective, say to promote the oil processing industry, policy S can be considered superior to policy B+T+S in that the policy target can be better served with less cost. Moreover, the results reveal that, while the welfare of the oil processing sector, the meal users and the farmers can vary widely with different policy scenarios, policy impacts on the food industry and the oil consumers are relatively low.

7.2 Policy Recommendations

Based on the available information and the empirical findings, several policy recommendations are proposed. However, since the soybean industry involves a multi-market, multi-policy situation, and since there are other distortions facing the industry, policy recommendations are conditional. In this regard, a general, unconditional recommendation would contemplate complete free trade for the whole economy, which is impractical at present and unlikely for the near future. The practical interventions are thus second–best measures, based on optimal levels of interventions conditional on the existing policy domain and/or distortions. A number of policy options are proposed for the immediate and for the longer-run situations.

In the immediate term where no other measures can effectively replace the import ban on soybeans in raising farm income, and if the government's objective of increasing farm income and output is still justified (with the knowledge that there must be some efficiency loss as well as some problems in income distribution), the combined optimal import surcharge rate for soybean meal and the optimal import tariff rate for soybean oil should be 0.4432 *baht* per kg and 0.8279 *baht* per kg, respectively. However, if the import ban on soybeans was no longer justified and was abolished, then the optimal surcharge and tariff rates should be 0.4173 *baht*, and 0.7985 *baht*, respectively.

From a longer-run perspective, it is advisable to replace the import ban policy on soybeans with a package of trade-cum-production policies. For instance, farm income and output could as well be enhanced by fostering production technologies to improve product yield and by promoting farm management skills to decrease unit cost of soybean production. These measures have already been attempted by the Thai authorities. What is recommended here is to give more emphasis to the production policies and less to the price and trade policies. Changes from trade/price policies to production policies can be done gradually or quickly. One option is to retain the import ban on soybeans in the short term while improving the domestic production efficiency, and then to abolish the ban policy when appropriate. Another option is to abolish the ban now, replacing it with, say, an import tariff or surcharge on soybeans and using the tax revenue to help promote soybean production, and then to gradually decrease the degree of trade intervention. Still another, more radical, option is to abolish the ban now without using other trade interventions (i.e., complete free-trade for the importation of soybeans) and gradually promote soybean production through production policies.

A version of the first option is being used (though according to the present study more emphasis should be given to the production policies). While the third option is preferred in terms of economic efficiency (in a comparative static sense), it may cause disruptions to resource allocation within the agricultural sector, especially with high fluctuations in the world price of soybeans. The second option seems appropriate for the moment. What remains is to determine an appropriate tax rate. If the objective is to gradually decrease the intensity of the trade policy, the after tax (import parity) price should be less than the closed-economy domestic equilibrium price. Since private marginal cost approximates social marginal cost in soybean production, any taxation would result in some efficiency loss. The estimated value of MRC greater than one implies over-protection of soybean farming and a cost of protection. Thus, the option necessarily involves trade-offs between the present cost of protection and the present level of farm income and output, as well as the favourable effects on production growth of soybeans in the future.

Though the above proposed policy options would, in the end, result in greater production efficiency and lower unit cost of soybeans, (thus narrowing the gap between the private marginal costs and social marginal costs in the production of soybean oil and meal), for a long-run plan it is advisable to further investigate other sources of distortion facing the oil processing industry and to try wherever possible to remove (or lessen) the existing distortions. Within the context of policy intervention in the soybean industry, this can result in a lower level of corrective policy (i.e., lower optimal surcharge and tariff rates), making it possible for the government to attain some existing objectives (e.g., raising farm income and output and improving the balance of trade) with less cost. As far as the objective of raising government revenue is concerned, the administration of a less-discriminating tax system (say, by moving toward a more uniform tax system for all commodities or simply raising revenue from a poll tax rather than from trade protection), would better enhance welfare.

7.3 Suggestions for Future Research

There are a number of areas worth-considering for future research. These include model updating and extension as well as research into related areas to answer some subtle policy questions which were outside of the domain of the present study.

The model design for the present study is highly dependent on the nature of the available data. For example, some data (e.g., prices of soybean oil) had to be generated from existing shorter series of data. Moreover, some variables (e.g., prices of palm oil) had to be omitted from the model due to data shortages. There is a need to develop richer and longer series of data.

When more detailed and longer series of data are available, the present model can be extended and modified to allow a more sophisticated and/or wider investigation. For instance, a fruitful extension would be to classify the supplies of soybeans by the two major (wet and dry) seasons. A more detailed extension would be to further classify them by specific locations. If adequate data are available to allow this disaggregation, one possible model extension would be to introduce dynamic elements into model construction. The use of simulation techniques may help answer questions regarding the dynamic efficiency of intervention.

When models of soybean supply are seasonal and location specific, more detailed investigation of how farmers switch their crops in response to incentives can be conducted. Moreover, with more data, the present model can be extended to provide more detailed analyses of the related markets. For instance, additional supply and demand schedules for the feed industry could be incorporated.

One aspect of policy analysis that seems invaluable is the detailed investigation of the variable import surcharge (or quota) policy as a device for price stabilisation. With the added potential merit of this policy measure in lessening domestic price fluctuations, some additional policy implications may be revealed. For instance, the optimal surcharge rate might be different from what is mentioned in the present study once a stabilisation objective is also included in the policy set. Finally, for the production policies to be more efficient, more research should be conducted on the administrative costs of their implementation.