Agricultural Price Policies and the Developing Countries

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Vinod Thomas
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A World Bank Publication
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### Currency Equivalents

US$1.00 = won (W) 484 (1978-79)
US$1.00 = taka (Tk) 15.5 (1978-79)
US$1.00 = baht (B) 20 (1978-79)
US$1.00 = bolivars (Bs) 4.3 (1977-78)

(These exchange rates correspond roughly to the time of preparation of the studies.)

### Fiscal Years (FY)

<table>
<thead>
<tr>
<th>Country</th>
<th>Fiscal Year</th>
</tr>
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<td>Korea</td>
<td>January 1–December 31</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>July 1–June 30</td>
</tr>
<tr>
<td>Thailand</td>
<td>October 1–September 30</td>
</tr>
<tr>
<td>Venezuela</td>
<td>January 1–December 31</td>
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</table>

### Units of Measure

<table>
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<th>Unit</th>
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<tbody>
<tr>
<td>1 seok</td>
<td>approximately 5 bushels</td>
</tr>
<tr>
<td>1 cheongbo</td>
<td>approximately 2.5 acres</td>
</tr>
<tr>
<td>1 acre</td>
<td>0.405 hectares</td>
</tr>
<tr>
<td>1 hectare</td>
<td>2.47 acres</td>
</tr>
<tr>
<td>1 maund</td>
<td>40 seers = 82.286 pounds = 37.326 kilograms</td>
</tr>
<tr>
<td>1 bale</td>
<td>400 pounds</td>
</tr>
<tr>
<td>1 long ton</td>
<td>2,240 pounds = 1,016.04 kilograms = 27.22 maunds</td>
</tr>
<tr>
<td>1 rai</td>
<td>0.16 hectare</td>
</tr>
</tbody>
</table>
Preface

Governments in developing countries have used agricultural price policies extensively in their developmental efforts, pursuing different goals with a variety of tools. It is widely agreed, however, that insufficient attention has been given to the effects of these policies. The results have been mixed, sometimes being viewed as generally satisfactory and sometimes not. In some cases the policies have been instituted in response to an immediate and pressing problem. Often the desired results have not been achieved, and there have been unanticipated side effects. Even in the most satisfactory cases, continuing analysis of design and change of programs is needed.

The purpose of the present book is to analyze the intended and unintended effects of agricultural price policies and to present methods for measuring their magnitudes as a contribution to the formulation of future policies. The book reviews contrasting country experiences and develops general methods that can be used by persons in or out of government in any country where agricultural price policies are a concern.

The study on Korea reviews the role of price policies—which include farm price supports and seasonal stabilization schemes—in the achievement of enunciated goals and sets out considerations affecting future policies with attention to tradeoffs among goals. In the case of Bangladesh, price policies—which include price supports and input subsidies—are viewed in the context of the nation's goals to attain food self-sufficiency and in conjunction with other policies for achieving this objective. The work on Thailand sets out the experience of the country as a major rice exporter and traces the effects of its export tax on rice, recognizing the government's objectives of raising revenue and insulating the economy from fluctuations in international prices. The chapter on Venezuela reviews the country's need to import increasing amounts of food in volatile world markets. The study stresses the effects of government interventions in the grain and livestock sector—the most important part of Venezuelan agriculture—and the need to take account of relations between inputs and outputs, and supply and demand substitutions in a dynamic context.
The main purpose of the chapters dealing with country experiences is to show how goals have been affected by price policies. The analysis is carried out in quantified terms where feasible. It attempts to show what the major effects are, and not primarily to make policy recommendations. It also shows how the effects may differ, depending on a country's agricultural situation and stage of development.

The second part of the book provides tools for the analysis of price policies in any country. Basic considerations in measuring effects on producers, consumers, and government costs are first presented. These are then applied to interventions of distinctly different types, which are encountered partly because the countries are at very different levels of development. Analyses are given of differences between price supports and agricultural input subsidies, seasonal stabilization, effects on adoption of new varieties, and how to handle interrelated commodities.

The book originated from the authors' economic work on the different countries, in the course of which a common methodology evolved, which is presented in Part Two of the book. We believe that more analyses are needed to help improve understanding of the wide range of implications of price policies. Developing and applying basic tools of analysis to country experiences can help establish better estimates of the effects of policies.

Parts of the book grew out of country studies carried out at the World Bank. The views expressed in the book, however, are those of the authors alone and should not be attributed to the World Bank.

We wish to acknowledge the valuable contributions of Eui Gak Hwang and Götz Schreiber. The development of the study owes a great deal to Manuel Carao, David Dunn, Cornelis Jansen, Fletcher Riggs, John Holsen, W. David Hopper, Jonathan Smulian, and Michael Wiehen. The work benefited from comments by Rangopal Agarwala, Robert Armstrong, Gilbert Brown, Henry Gassner, Carl Jayarajah, D. Gale Johnson, Bruce Johnston, Fred King, Om Nijhawan and Theodore W. Schultz. We would also like to thank the people—too numerous to mention by name—in the countries studied, for their help and cooperation at various stages.

Jane H. Carroll edited the final manuscript for publication. Harry Einhorn read and corrected proof, Raphael Blow prepared the charts, Joyce C. Eisen designed the case binding, James Silvan and Ralph Ward indexed the text, and Christine Houle coordinated production of the book.

Despite the assistance of so many, we alone are responsible for any remaining errors and for all views expressed.
Overview

The prices of many agricultural commodities and inputs are influenced in a variety of ways by governments of developing countries. Government intervention can and does take place at the stages of production, marketing, consumption, and trade. Agricultural price policy almost invariably involves the taxation or subsidization of one or more commodities. For example, production of an agricultural commodity can be subsidized through farm price support or by an input subsidy. Consumers may be subsidized by retail price control or by an import subsidy if the commodity is imported. Taxation of agricultural commodities occurs most often at the exporting stage with such devices as export taxes, less favorable exchange rates, or forced procurement at low prices by monopolistic exporting agencies. These taxes generally discourage growth in agricultural production. Other forms of government intervention do not tax or subsidize any commodity explicitly; reserve stocks to moderate year-to-year price fluctuations and seasonal stabilization schemes are examples. Even these apparently neutral devices, however, may have the unintended effect of favoring or disfavoring the production or consumption of certain commodities.

Because the commodities under government intervention are often of great importance in the country's income, consumption, and trade, the effect of agricultural price policies on the economy can be very great. Other than government revenue and cost directly associated with the program, the welfare of farmers and consumers, national income and its

distribution, as well as the country's balance of payments position and rate of economic growth can be affected by government price policies. The present study elucidates some of these effects. The experiences of countries in quite different circumstances are reviewed and their price policies are analyzed for a better understanding of their options.

Objectives of Price Policy

The objectives of agricultural price policy vary greatly among countries. One often stated purpose is to help bring about a certain income distribution deemed desirable by policymakers. The support of high farm prices, for example, has often been viewed as an instrument for raising farm income. Similarly, the price to consumers of an important staple such as rice has been held down in some developing countries on the assumption that rises in cereal prices harm mostly poor people who spend a large portion of their income on food. In contrast, farm price supports are said to improve rural welfare because farmers are believed to constitute the poorer section of the economy. In the short term, however, farm price supports benefit mostly those who market a large part of their crop—mostly large-scale farmers—while subsistence farmers receive little benefit. This is not to minimize the possible inducement under a price support program for subsistence farmers to produce for the market. As the Bangladesh study (chapter 3) points out, even those with little marketable surplus or even no net surplus at all make distress sales; these small farmers could potentially benefit from price support if it were effective in providing better farm-gate prices. Similarly, the poorest people in urban areas may not be reached by the government's low food-price policy if they cannot afford to buy much cereal in any case. Thus, there are serious limits to which a government can use price policy to transfer income to poor people.

Another rationale for farm price support is to provide the incentive to farmers to increase production. This objective is particularly important for importing countries striving toward self-sufficiency. Both Korea and Bangladesh have supported or raised the farm price of rice to encourage production and reduce imports. Production can also be encouraged by reducing the price of inputs. Thus, in Bangladesh, along with a support for the farm price of rice, there are also subsidies on fertilizer and other modern inputs. Some observers have questioned whether price policy is the best means to encourage production, or whether other methods, such as direct government investment in irrigation and water control facilities, are more effective and efficient. This question is of particular relevance in an economy such as Bangladesh, which is severely constrained by
OVERVIEW

physical, institutional, and other bottlenecks. There is little doubt, however, that farmers do respond to price changes, although the magnitude of their production response depends on the availability of inputs, social and economic institutions, and many other factors. Over time, price incentives can speed up the adoption of modern inputs and thus provide long-term benefits. That Korea has achieved self-sufficiency in rice is at least partly due to government price policy. In the case of Bangladesh, the history of rice price policy is short and the degree of its success is only beginning to be observed.

Some countries have viewed price policy as an instrument of stabilization. In this case, government policy is more concerned with the extent of price fluctuation than with the average level of prices. Of the two main types of price stabilization programs, one aims at moderating the seasonal price pattern and the other at reducing year-to-year price fluctuations. The seasonal stabilization program for rice in Korea (chapter 2) belongs to the former group, and in Bangladesh (chapter 3) price policy may have the potential of reducing seasonal price variation through government purchases and open market sales of rice. Year-to-year price fluctuations can be caused by weather or shifts in international prices if the commodity is traded. Since world prices of agricultural commodities have experienced rather wide variations, most countries have interfered with trade to some extent to insulate the domestic economy from instability generated in the international market. In fact, some traditionally importing countries now seek to become self-sufficient in food to avoid sudden increases in food import bills owing to international price fluctuations. Countries exporting food may also want to control the volume of export to maintain a relatively stable domestic price in the face of international price fluctuations. As shown in chapter 4, Thailand has tried to control its export through an export tax and other instruments at least partly with this objective in mind.

Stable domestic food prices are desired for various reasons. It has often been argued that high international prices, if allowed to be transmitted to the domestic economy, can cause inflation. It is true that because of the importance of food in the consumer's budget in many developing countries, rising food prices would immediately be reflected in the cost of living index. The belief that food prices alone could cause inflation through a cost-push mechanism, in which rising food prices lead to wage increases, which in turn push up other prices, is, however, probably unjustified. Price stability at the farm level was thought at one time to stabilize farm income. It is now fairly well known, however, that price stabilization alone does not necessarily stabilize farm income. Nevertheless, if farmers are risk-averse and farming remains as dependent on the
weather and as risky as in Bangladesh, the stability of farm prices might be of value in production planning.

Some developing countries have chosen to tax rather than subsidize their major agricultural commodities. For these countries, government revenue is often an important consideration. The most common way to tax agriculture is through export taxation. But this raises the objection that the tax burden is easily passed back to farmers and that the taxation of agricultural exports is therefore regressive in its effects on income distribution and will reduce the farmers’ incentive to increase production. It should be recognized, though, that for many of these countries greater reliance on alternative forms of taxation (for example income taxes) may not be administratively feasible in the near future. Moreover, monopolistic intentions are often present when developing countries tax their exports. Commodities such as jute, coffee, and cocoa come readily to mind. In the long run the monopoly power exercised by any country on a commodity is probably insignificant, but the influence of large exporters on the international price could be considerable in the short run. Export taxation is sometimes defended on the ground that funds are urgently needed to finance development and other projects. This issue is examined in greater detail in chapters 4 and 8 when we discuss the rice export tax of Thailand. Just as governments of countries exporting agricultural products want to extract revenue, countries which subsidize their agricultural activities aim at keeping down the costs of government programs. Program costs will receive attention in the studies on Korea, Bangladesh, and Venezuela.

Price policy has also been viewed as an instrument to speed up the process of economic development. The arguments are varied, depending on the policies in question. Some proponents, for example, view diversification of the economy and industrialization as important features of economic development. According to this view, taxation of the agricultural sector would encourage diversification into other activities and facilitate rural-urban migration. It should be recognized, however, that a lagging agricultural sector can cause a deficiency in the food supply that can in turn hold back the processes of industrialization and economic development. As another example, many countries hold down food prices for consumers in the belief that this leads to low urban wages which help to attract inflows of foreign capital contributing to the country’s balance of payments and growth. The balance of payments argument has also been used by traditionally importing countries to justify high farm prices to induce extra production in the drive toward self-sufficiency. It will later become apparent in the discussion on Korea (chapter 2) and Thailand (chapter 4) that many of the links implied in these arguments are at best tenuous. One of the main difficulties in linking price policy with economic
The previous paragraphs described the major objectives of agricultural price policy.\(^2\) These objectives need not be (and often are not) consistent with one another. For example, a policy of low domestic prices may benefit consumers and hold down the cost of living, but it is likely to lower farm income and may have undesirable effects on farmers' incentives to increase production, which may lead to more imports and increasing foreign dependence. If farm prices are raised at the same time consumer prices are lowered, however, program costs would rise sharply, other things remaining unchanged. Thus in policy formulation, it is necessary to determine whether various objectives are consistent. If they are not, policymakers are faced with the difficult task of balancing among objectives, a task which will be aided by the best understanding possible of the effects of alternative price policies.

### Effects of Price Policy

The most obvious effect of agricultural price policy is on the production of the affected crops. As long as farmers are responsive to price changes, greater production may be induced by either a farm price support of the commodity or by the reduction of the price of an input such as fertilizer. As shown in chapters 3 and 7, however, the implications of the two policies on program cost and other magnitudes may be quite different.

Since agricultural price policy usually involves the taxation or subsidization of one or more commodities, the government either receives revenue or suffers a loss in its operations. Since the commodities under government intervention are often of great importance in the economy, the effect on government revenue or program cost is often considerable.

As noted earlier, price policy may affect income distribution through changing the farm price, the consumer price, or farm income. Thus, a high farm-price policy redistributes income to farmers while government release at low prices leads to an increase in the real income of consumers. An export tax depresses the domestic price of the commodity, which tends to lower farm income but raises the real income of consumers. Whether price policy is regressive in its effect on income distribution depends mainly on whether farmers or consumers who benefit from the policy

\(^2\) Although price policies have often been part of development programs, this surely is not the sole context of their use. They sometimes are used for evident political purposes.
represent the poorer section of the economy. There is also the question of whether any increased agricultural income goes to the agricultural laborers or the landowners.

An important effect of price policy which has not yet been mentioned is on resource allocation. Price policy can distort the relative price structure among various commodities and very often among inputs as well, leading to inefficiencies in production and consumption. A recent study of several countries indicates that they incurred large welfare losses because of the misallocation of resources as a result of agricultural price distortions. This work shows that in relation to economic output, distortions are generally more costly in the developing countries than in the industrialized nations.

Fixing a low price to consumers encourages excessive consumption of the commodity in relation to other commodities and may lead to inefficiencies in production. A subsidy on fertilizer, for instance, encourages the disproportionate use of it, and the resulting inefficiencies will raise production costs. Welfare losses owing to the inefficient allocation of resources will be measured in some detail in the studies on Korea (chapter 6), Bangladesh (chapter 7), and Thailand (chapter 8). In the above discussion it is assumed that market product prices and input prices would represent social values and costs. If this is not true, then appropriate government intervention could lead to a gain in the social product. Thus, if farmers have come to accept farming as a way of life and would not normally shift to potentially more profitable activities, a tax on agriculture might encourage such shifts and raise the value of output for the society. Similarly, if farmers are reluctant to experiment with modern inputs, or simply unaware of the advantages of modern technology, an input subsidy might be appropriate to encourage adoption of the input in the early stages, after which it would be phased out. To take another example, if a country has some monopoly power in the export market, it could manipulate prices to a certain extent, and exporting as much as possible at world prices might not be the best policy. Raising the price to foreigners through an export tax would transfer income, at least in the short run, from the rest of the world and increase the welfare of the home country. In analyzing the major effects of agricultural price policy, one should be aware of several distinctions. First, there is the distinction between short-run and long-run effects. For example, when the farm price is raised, the production response of farmers is likely to be much greater in the long run than in the short run. In any year, production can be regarded as

more or less given, and the only effect of an increase in farm price is an increase in farm income. Farmers, however, will increase their production if high prices are expected to continue. In the long run, as indicated earlier, they may modify their technology in response to the new set of price relations (see chapter 8), and the effect on production would be even greater.

Second, one should distinguish between intended and unintended effects. As an illustration, the government may impose an export tax with only the revenue objective in mind. The tax, however, will depress the domestic price of the commodity, discourage production, and lead to a fall in farm income—effects which may not be desired or even foreseen by the government.

Third, there is the distinction between direct and indirect (induced) effects. When the government intervenes in a certain sector, substitutions in production and consumption or input-output relations may affect other sectors. To draw an example from the study on Venezuela (chapter 5), a subsidy on feed used in pork and poultry production reduces costs, and the benefits are passed on to consumers through lower pork and poultry prices. This leads to a substitution in consumption away from beef into pork and poultry, which reduces prices and income in the beef sector. As shown in chapter 10, the neglect of such indirect effects could result in a substantial underestimation of the program costs of price policy.

Purpose and Outline of Study

While governments in developing countries have extensively used agricultural price policies in their development efforts, the effects of these policies have received insufficient attention. Country studies on this subject provide a basis for evaluating the full range of implications of the price policies currently followed or under consideration. Such studies are essential to give policymakers an adequate understanding of the direction and broad order of magnitude of the effects—intended and unintended—of price policies.

Many observers believe that historically the prices of farm products in many developing countries have been kept low and that this has been one reason for their low agricultural productivity. Where domestic prices are

4. Several studies on the effects of various government disincentives to agriculture in developing countries can be found in *Distortions of Agricultural Incentives*, Theodore W. Schultz, ed. (Bloomington, Ind.: Indiana University Press, 1978). See, for instance, papers
kept well below world prices, the country is likely to pay a high price for meeting its objectives (if, indeed, the objectives are being met). In such situations, other means of achieving the objectives ought to be explored and pursued. Fully consistent with such a broad conclusion, this study is also intended to point out that each country circumstance is different, and policy recommendations ought to be based on analysis that is country specific. For instance, the tendency to keep farm prices low is by no means universal. Some countries have maintained prices of some farm commodities well above the world price. Some of these intercountry differences are brought out in the discussions on Korea, Bangladesh, Thailand, and Venezuela.

In analyzing the effects of price policy, we focus on government cost and revenue, farm income, and producer and consumer welfare, although other effects—on agricultural diversification, inflation, economic growth, and balance of payments—are also taken into consideration. For Korea, Bangladesh, and Thailand, we concentrate on rice, by far the most important agricultural commodity in those countries. Korea was self-sufficient in rice in some recent years, and in line with its seasonal stabilization scheme the government purchases rice at harvesttime and releases it later to smooth the seasonal price pattern. While agriculture has contributed to the growth of the Korean economy, the main impetus to growth has been in other sectors. Growth has brought a rapidly rising demand for food and, more recently, an increasing labor scarcity in agriculture, which affect the outcome of price policy. Bangladesh is striving toward self-sufficiency, which it hopes to attain through various agricultural policies including increased provision of modern inputs, government support of farm prices, and some input subsidies. Price policies and other measures for food production and distribution are integrally related to its plans for development. Thailand is a major rice exporter experiencing moderate economic growth, and its export tax is viewed as an instrument to collect revenue from foreigners and to insulate the domestic economy from fluctuations in international prices. Venezuela, which has experienced a relatively slow growth of agricultural output and a rapid growth of demand,

by W. David Hopper, Gilbert T. Brown, Reed Herrford, Randolph Barker, and Martin E. Abel in the section, Distortions of Incentives (Part 3, pp. 69-191).

must import increasing amounts of food in volatile world markets. We examine the effects of government intervention in the grain-livestock sector, which is the most important part of Venezuelan agriculture. The experience of Venezuelan agricultural development brings out the need to take account of the relation between inputs and outputs and between production and demand substitutions in a dynamic context to avoid serious problems.

An introduction to the agricultural economy and the main features of price policies for each of the countries—Korea, Bangladesh, Thailand, and Venezuela—are presented in chapters 2 through 5. These chapters contain discussions of the objectives and effects of price policies in individual countries. The broad conclusions of each country study draw on analyses presented in chapters 6 through 10. These chapters provide tools that can be used by policymakers concerned with establishing reliable estimates of the effects of policies in other countries.
Part One

Country Experiences
Price Policy under Rapid Development: Korea

Agriculture has made many direct and indirect contributions to the economic growth of Korea. These accomplishments are especially impressive because the people remaining in agriculture have been able to share in the fruits of development more fully than in many developing countries. Today agriculture and agricultural policy are at a crossroads. There has been great success in increasing rice production and improving rural levels of living. Rice self-sufficiency has been attained in recent years, and the countryside is prosperous in many—though not all—ways. Meanwhile demands for nonrice agricultural products are increasing rapidly as per capita income continues to rise, and supply problems are being encountered for the nonrice commodities. A basic problem is to find a set of agricultural policies which will contribute to Korea’s goals at a time when old problems have been solved and new ones are emerging.

In spite of the rapid growth of nonagricultural production, rice is still a commodity of great importance in the Korean economy. In 1977 it accounted for 62 percent of agricultural receipts. It is also a predominant user of agricultural land—of the 2.2 million hectares of land under cultivation in 1977, 1.2 million hectares (about 55 percent) were paddy land. Rice has therefore received most government attention in the formulation of agricultural policies.

1. The Republic of Korea, also known as South Korea, is referred to in this book as Korea.
Table 2-1. Korea: Production and Imports of Polished Rice
(thousand metric tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th>Imports</th>
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<tbody>
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<td>3,939</td>
<td>770</td>
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<tr>
<td>1971</td>
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<td>1976</td>
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<td>1977</td>
<td>6,006</td>
<td>65</td>
</tr>
<tr>
<td>1978</td>
<td>5,797</td>
<td>n.a.</td>
</tr>
<tr>
<td>1979a</td>
<td>6,047</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

n.a. Not available.

a. Estimate

Note: Production figures are for the rice year beginning in October of the preceding year. Imports are for the calendar year.

Sources: Production figures from National Agricultural Cooperative Federation, Agricultural Cooperative Yearbook and Rice Situation various issues; import figures from (Seoul), Bank of Korea, Economic Statistics Yearbook, 1978.

Table 2-1 documents the success in raising rice production, which increased some 50 percent from 1970 to 1978 by raising yields with a relatively stable land base. Rice yields per hectare have increased to the point of surpassing Japan's to become the highest in the world (table 3-1). Several factors have been responsible for this rapid increase in production during the 1970s. First, land development measures have improved the quality of land. Of particular importance to rice have been irrigation schemes and the paddy rearrangement program of leveling and consolidation. Thus, while the area of paddy land remained about constant from 1970 to 1978, the area of irrigated paddy land increased from 1.02 to 1.13 million hectares, and the area of consolidated land increased from 0.13 to 0.31 million hectares. Second, there has been a rapid introduction of nontraditional rice varieties. It can be seen from table 2-2 that the area devoted to new varieties as a percentage of total rice acreage increased from 15 to 70 percent during 1974–78. The government reports that the average yield in 1977 from land planted with old varieties was 4.1 metric tons per hectare as compared with 5.3 metric tons per hectare from land planted with new varieties, a 30 percent yield advantage for new varieties. Third, there has been an increase over time of the government farm purchase

4. Ibid.

price of rice. Table 2-3 indicates that the farm purchase price rose a little more than fivefold between 1970 and 1978, and since the consumer price index rose approximately threefold during the same period, the farm purchase price in 1978 was about 70 percent higher in real terms than in 1970. With an assumed price elasticity of supply of 0.3, the effect on rice production is 21 percent.

Among the objectives of Korean rice price policy in the 1970s were to increase rural welfare by raising the real price of rice received by farmers

### Table 2-2. Korea: Total Rice Paddy Area and Area in New Varieties

<table>
<thead>
<tr>
<th>Year</th>
<th>Total rice paddy area</th>
<th>Area in new varieties</th>
<th>New varieties as percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>1,189</td>
<td>181</td>
<td>15.2</td>
</tr>
<tr>
<td>1975</td>
<td>1,198</td>
<td>274</td>
<td>22.9</td>
</tr>
<tr>
<td>1976</td>
<td>1,196</td>
<td>533</td>
<td>44.6</td>
</tr>
<tr>
<td>1977</td>
<td>1,208</td>
<td>660</td>
<td>54.6</td>
</tr>
<tr>
<td>1978</td>
<td>1,208</td>
<td>850</td>
<td>70.4</td>
</tr>
</tbody>
</table>


### Table 2-3. Korea: Rice Prices

<table>
<thead>
<tr>
<th>Crop year</th>
<th>Government purchase price</th>
<th>Government release price</th>
<th>Wholesale price (average quality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>6,319</td>
<td>6,500</td>
<td>7,784</td>
</tr>
<tr>
<td>1971</td>
<td>8,150</td>
<td>9,500</td>
<td>7,153</td>
</tr>
<tr>
<td>1972</td>
<td>9,888</td>
<td>9,500</td>
<td>9,544</td>
</tr>
<tr>
<td>1973</td>
<td>11,377</td>
<td>11,264</td>
<td>9,728</td>
</tr>
<tr>
<td>1974</td>
<td>15,760</td>
<td>13,000</td>
<td>12,175</td>
</tr>
<tr>
<td>1975</td>
<td>19,500</td>
<td>16,730</td>
<td>17,213</td>
</tr>
<tr>
<td>1976</td>
<td>23,200</td>
<td>18,400</td>
<td>22,235</td>
</tr>
<tr>
<td>1977</td>
<td>26,000</td>
<td>18,400</td>
<td>24,196</td>
</tr>
<tr>
<td>1978</td>
<td>26,000</td>
<td>18,400</td>
<td>28,211</td>
</tr>
</tbody>
</table>

*Note: Column (3) is for calendar years while other columns are for rice years beginning in November prior to year shown.

a. The government purchase price differs somewhat from the price received by farmers. One reason is that the government deals only in new-varietv rice. Furthermore, there are quantity purchase targets, and rice in excess of these targets may have to be sold to private buyers at lower prices. Conversely, in case of a short crop, the government may be unable to reach its targets and rice may be sold to private buyers at higher prices. In general, however, purchase prices and prices received by farmers show similar movements.

*Source: Korea, Ministry of Agriculture, Food Grain Division; Bank of Korea, General Price Report; and Economic Planning Board, Monthly Statistics of Korea, various issues.*
and to reduce the country's dependence on imports. As table 2-1 indicates, the self-sufficiency objective was more or less achieved by 1977. If the trends of the 1970s continue, Korea could become an exporter of rice.

The two main decisions in government price policy are the determination of a purchase price to farmers and a selling price to wholesalers and consumers. Typically the government acquires stocks in the harvest season to raise the farm harvest price, and releases stocks to hold down urban prices and protect consumer welfare. As long as the purchase price plus cost of storage and processing is greater than the release price, the government suffers a loss in its operations. In the 1960s attention was given to moderating, but not completely eliminating, the seasonal rise in prices. As late as 1970 and 1971, the farm purchase prices were lower than the government release prices shown in column (2) of table 2-3, and government losses in handling rice were small compared with those that have been encountered subsequently. In recent years, with a high farm price policy, the government has maintained a flat release price through the year, selling rice in urban areas at all times below farm purchase price. Moreover, government purchases of rice have increased considerably. As a result of these developments, the contribution of rice to the Grain Management Fund (GMF) deficit has increased greatly (table 2-4).

The program costs of other commodities are also shown in table 2-4. Barley, the second most important crop in Korea, is used principally for human consumption, and since it is generally considered an inferior good, its importance is expected to decline as per capita income rises. As in the case of rice, the purchase price has been raised substantially above the release price (table 2-5). Table 2-4 indicates that the contribution of barley to the GMF deficit has been greater than that of rice. Since the total value

<table>
<thead>
<tr>
<th>Year</th>
<th>Rice</th>
<th>Barley</th>
<th>Other</th>
<th>Wheat flour</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>0.4</td>
<td>-2.8</td>
<td>-0.4</td>
<td>0</td>
<td>-2.8</td>
</tr>
<tr>
<td>1971</td>
<td>5.1</td>
<td>-4.5</td>
<td>-0.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1972</td>
<td>4.9</td>
<td>-6.1</td>
<td>-0.4</td>
<td>-0.6</td>
<td>-2.2</td>
</tr>
<tr>
<td>1973</td>
<td>0.9</td>
<td>-8.8</td>
<td>-1.0</td>
<td>-16.3</td>
<td>-25.4</td>
</tr>
<tr>
<td>1974</td>
<td>-32.7</td>
<td>-35.6</td>
<td>-1.9</td>
<td>-54.8</td>
<td>-125.0</td>
</tr>
<tr>
<td>1975</td>
<td>-16.3</td>
<td>-22.0</td>
<td>-0.7</td>
<td>-54.6</td>
<td>-93.6</td>
</tr>
<tr>
<td>1976</td>
<td>-19.7</td>
<td>-28.6</td>
<td>-0.5</td>
<td>-1.5</td>
<td>-50.3</td>
</tr>
<tr>
<td>1977</td>
<td>-21.9</td>
<td>-43.3</td>
<td>2.1</td>
<td>0</td>
<td>-63.1</td>
</tr>
</tbody>
</table>

*Note: In all tables "billion" refers to a thousand million.*

*Source: World Bank data.*
Table 2-5. Korea: Barley Prices  
(won per 78.5-kilogram bag)

<table>
<thead>
<tr>
<th>Year</th>
<th>Government purchase price</th>
<th>Release price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969</td>
<td>3,348</td>
<td>2,750</td>
</tr>
<tr>
<td>1970</td>
<td>3,850</td>
<td>3,100</td>
</tr>
<tr>
<td>1975</td>
<td>9,091</td>
<td>8,320</td>
</tr>
<tr>
<td>1976</td>
<td>11,100</td>
<td>9,200</td>
</tr>
<tr>
<td>1977</td>
<td>13,000</td>
<td>9,200</td>
</tr>
<tr>
<td>1978</td>
<td>15,500</td>
<td>9,200</td>
</tr>
</tbody>
</table>

Source: Same as table 2-3.

of rice production is much greater than that of barley, this implies that the loss per bag is greater in the case of barley, or that a larger fraction of the crop is acquired by the government, or both.

Extremely small quantities of wheat and corn are produced. Table 2-4 shows that in 1973–75 wheat flour was the chief source of the deficit. This was due to a policy of maintaining a fixed selling price in Korea while world prices escalated and U.S. Public Law 480 assistance was phased down. Since then the policy of maintaining a fixed selling price below the world price has been changed, and wheat is now handled through the Wheat Flour Price Stabilization Fund.

Program Costs

The widening spread between farm purchase price and urban release price can easily be understood as a factor contributing to the rise in program costs, since the loss on each bag of rice handled by the government is increased. The importance of this factor has already been pointed out; other costs are discussed below.

Volume of Rice Marketed

Government costs have also increased because the volume of rice handled under the program has grown ever larger for less easily understood reasons. One factor tending to increase the volume is that the percentage of the population which is urban has increased from one-third in the 1950s to about two-thirds at present. With more of the population in urban

6. U.S. Public Law 480 provides surplus agricultural commodities to other countries on concessional terms, with repayment in local currency.
areas, more of the rice tends to be consumed there rather than on farms. It is likely that the percentage of the population which is urban will continue to increase.

Another factor tending to increase program costs is self-sufficiency in rice. Until 1975 a significant portion of urban demand for rice was met through imports, not purchased locally. With self-sufficiency, however, all the rice for urban consumption is obtained from farmers in Korea, which means that government purchases from farmers have increased. Rice in excess of that required for self-sufficiency must either be added to yearly carry-over stocks or be exported. In either case, the rice moves off farms into government channels and adds to government program costs. Any rise in the self-sufficiency ratio above recent levels of about 110 percent will tend to make program costs even greater than they have been.\(^7\)

*Proportion of Rice Purchased by the Government*

Even more significant than the rise in the volume of rice marketed as a contributor to program costs has been the increasing proportion of rice that must be purchased by the government to accomplish its price objectives. As shown in table 2-6, government purchases as a fraction of production have risen fairly continuously from 8.9 percent in 1971 to 23.4 percent in 1978. This is still far less than the total amount of rice marketed which, when the total value of rice production is compared with cash receipts, was 52 percent of production in 1977. Since the government stands ready to sell rice for urban consumption at a price below that being paid to farmers, no rice would be expected to pass from farms to urban consumption except through government channels. With farm price above urban price, there would be a loss on any marketing through private channels. Yet, since the fraction of the crop handled under the government program is far less than that required to supply all urban consumption, a substantial amount of rice does, in fact, pass from farm to urban consumers through private channels.

Explaining the amount of rice handled by the government is made more difficult because of the cost of storing rice seasonally. For example, if the cost of processing and transporting rice to urban areas were 10 percent of the farm purchase price—in 1978 won (W) 26,000 per bag (table 2-3)—the cost of delivering rice to the urban market would be W26,000 plus W2,600 or W28,600 per bag at harvesttime. With the 1978 government release price of W18,400 (table 2-3), the loss per bag at harvesttime would

---

Table 2-6. Korea: Government Purchases of Rice from Farmers as Percentage of Rice Production

<table>
<thead>
<tr>
<th>Crop year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>9.2</td>
</tr>
<tr>
<td>1964</td>
<td>6.0</td>
</tr>
<tr>
<td>1965</td>
<td>6.1</td>
</tr>
<tr>
<td>1966</td>
<td>8.6</td>
</tr>
<tr>
<td>1967</td>
<td>9.1</td>
</tr>
<tr>
<td>1968</td>
<td>7.9</td>
</tr>
<tr>
<td>1969</td>
<td>4.8</td>
</tr>
<tr>
<td>1970</td>
<td>8.0</td>
</tr>
<tr>
<td>1971</td>
<td>8.9</td>
</tr>
<tr>
<td>1972</td>
<td>12.3</td>
</tr>
<tr>
<td>1973</td>
<td>12.8</td>
</tr>
<tr>
<td>1974</td>
<td>11.4</td>
</tr>
<tr>
<td>1975</td>
<td>16.5</td>
</tr>
<tr>
<td>1976</td>
<td>16.9</td>
</tr>
<tr>
<td>1977</td>
<td>20.0</td>
</tr>
<tr>
<td>1978</td>
<td>23.4</td>
</tr>
</tbody>
</table>

Source: Prepared by George S. Tolley and Eui Gak Hwang.

be W12,300. For rice held to supply consumption later in the season, the loss is greater. Storage costs including deterioration and payment of a market rate of interest can easily come to 40 percent of the farm purchase price for rice held until the end of the season. Seasonal price rises on the order of 40 percent were typical in the years before there were extensive government rice price operations. A government program that flattens the seasonal price pattern in urban areas also eliminates any private incentives to hold rice to meet demand during the remainder of the year after harvest. A 40 percent storage charge adds another W11,400 to the cost of supplying urban consumers at the end of the season, so that the loss at the end of the season would be W23,700 per bag. The government program thus discourages the private shipment of rice to urban areas, with a disincentive that grows as the season progresses because of the necessity to bear storage costs in the face of the fixed release price governing the price of rice in urban areas. In the years before 1972, when the farm purchase price was below the urban release price, a seasonally flat release price meant there was no incentive to hold rice seasonally, but it did not mean a great loss if the rice was held for a month or two. In those years the government may have been able to acquire a smaller fraction of the crop because many well-to-do farmers habitually held rice for marketing later in the year. Although the program deprived them of the return on investment previously earned from their seasonal holdings, they may not have fully
believed the government would maintain a flat seasonal price in the early years of the program, and they would have had to bear transaction costs to liquidate their annual holdings early and find alternative seasonal investments. They thus continued to hold significant stocks seasonally, though the figures suggest the holdings were diminishing over time as old habits gradually gave way to incentives to sell early. Since 1973, as the farm purchase price has been raised farther and farther above the urban release price, the cost of marketing directly to urban areas, even at harvest-time, has risen greatly. Thus, today as opposed to the past, it would appear that seasonality considerations alone are not sufficient to explain the low fraction of the crop acquired by the government.

If all urban rice failed to pass through government hands because the amount of rice offered by farmers to the government at harvest time exceeded the permissible government quantity targets, one would expect the farm harvest price to fall below the government release price of W18,400 in urban areas by an amount sufficient to cover processing, transportation, and storage for the number of months which the privately sold rice would supply the urban market. Nothing of this extreme nature appears to happen. Apparently, the government is able to purchase close to the amount of rice offered at the support price, so that the support price is essentially an effective price.

A more adequate explanation of the low fraction of the crop acquired may be that the government purchases only the new varieties of rice. It thus does not acquire all the rice destined for urban areas because part of the rice sold there is the old variety. This explanation leads one to expect that there is a free market for old-variety rice, with a traditional seasonal price rise. This seasonal pattern would not necessarily lead to a noticeably low average farm price at harvest time because the old-variety rice sells at a premium on the order of 20 percent. Old-variety rice can be viewed as a substitute, the price of which is influenced but not completely governed by new-variety rice prices. It may then be that the government purchases essentially all new-variety rice marketed, which maintains the price of new-variety rice and helps to keep up the price of old-variety rice through a substitution effect, and that there is a seasonal price rise in old-variety rice sufficient to cover private storage costs.

The seasonal rise in wholesale rice price, in spite of a seasonally flat release price, suggests that there is in fact a pronounced seasonal price rise in old-variety rice, with the observed wholesale price being an average of a constant new-variety price and a seasonally rising old-variety price. With traditional varieties relatively low in price at the beginning of the crop year, most of the urban demand has apparently been satisfied from traditional varieties in these months. The rise in price of traditional-variety
rice late in the crop year accompanied by the fixed release price of new-
variety rice has induced consumers to substitute toward new-variety rice,
accounting for the heavy government releases during the later months of
the crop year.

A category of rice not yet discussed is rice consumed off the farm where
grown, other than in the urban areas where the government program
operates. The existence of this marketed rice falling outside the govern-
ment program further explains why the government does not acquire all
the marketed rice. This rice, along with old-variety rice, is not held down
in price seasonally by government releases. One would expect that the
price of rice would rise seasonally in rural areas according to the cost of
storage, a factor which could increase living costs for those in rural areas
who buy rice, especially when they do so late in the year.

The fraction of the crop acquired by the government may rise in the
future, and further increase program costs, for two reasons. First, the
government's intent to increase the proportion of the crop planted to new
varieties will also increase the proportion of the crop with which govern-
ment operations deal. Second, as new varieties are developed which are
closer to the old varieties in the qualities desired by consumers, new- and
old-variety rice will tend to become more perfect substitutes. Old-variety
rice will sell at little or no premium over new-variety rice. The result
could be that the government refusal to deal in old-variety rice would
make its price fall substantially at harvesttime. Both reasons suggest that
to achieve price objectives in the future, more—and possibly nearly all—
rice destined for urban areas will need to be handled through the govern-
ment program.

Measuring Program Costs

The foregoing discussion of the price spread, the amount of marketed
rice, and the proportion of the marketed rice acquired by government
provides a basis for obtaining some idea of what could happen to program
costs in the future. The commonly used indicator of government price
policy program costs, and the only indicator available, is the deficit in the
GMF. Table 2-4, showing government figures on the contributions of
various commodities to the GMF deficit, indicates the general tendency
toward rising costs of rice operations from 1971, when there was actually
a small profit, to 1977, when the reported deficit due to rice was W21.9
billion.8 Much of the variation in program costs during the early 1970s
was associated with changing prices paid for imported rice.

8. In this book “billion” refers to a thousand million.
Table 2-7 shows an early plan for GMF operations for 1978, including a projected deficit. Because the reported GMF revenues and costs are heavily influenced by the purchase and release prices and the quantities moving through government hands, the GMF deficit provides a rough measure of program costs, but the details of the plan in table 2-7 indicate that the accounting procedures used make the reported deficit a rather imperfect measure of true costs.

The GMF does not provide a profit and loss picture on current operations because additions to carry-over are counted as current costs and depletions of stocks are counted as current revenues. Thus, in years when stocks are building up, as they have been recently, the present GMF procedures for stocks contribute to an overstatement of program costs. Another problem is the treatment of loan repayment. The repayment of grain bonds and repayment of loans are treated as expenses in arriving at the GMF deficit. The inclusion of loan repayment as a cost overstates the deficit on current operations.

The reporting of interest paid on obligations incurred in the past is incorrect if a picture of current operations is desired. Thus interest and fees on grain bonds should not be included. It is not clear what the unexplained additional small item for interest is. To obtain the true cost to Korea of holding stocks, the interest amount that should be carried is the opportunity return on the investment in the stocks. If the alternative return on investment is 25 percent, then the interest charge would be 25 percent of the value of stocks held during the current year. Aside from the problem already noted that the current GMF procedure is to include interest on past obligations rather than on current value of stocks, there is the further problem that the interest paid on GMF obligations apparently does not correspond to the opportunity return on investment. A part of the deficit in recent years has been financed from grain bonds, on which it has been reported that the interest rate is 18 percent. As can be seen from the 1978 plan in table 2-7, less than half the expected deficit is to be covered by a short-term loan or grain bond. On net, it appears that the true interest component of storage costs has been greatly understated in the GMF accounts. A painstaking investigation would be required to reach more definite conclusions.

The difference in table 2-7 between expenditures of W771 billion and revenues of W431 billion gives a projected GMF deficit of W340 billion in the 1978 plan. The plan was based on the assumption that stocks would be acquired at a purchase price of W26,000 per bag. To conform to the announcement in the fall of 1978 that the purchase price would be W29,000, however, the cost should be raised by 29/26 of its value, increasing the projected deficit to W370 billion (at W480 to the U.S. dollar,
Table 2-7. Korea: Plan for the Grain Management Fund, 1978

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity (thousand seok)</th>
<th>Price (won per bag)</th>
<th>Amount (billion won)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expenditures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain purchases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice of FY1977</td>
<td>2,000</td>
<td>26,000</td>
<td>97.8</td>
</tr>
<tr>
<td>Rice of FY1978</td>
<td>6,000</td>
<td>26,000</td>
<td>293.3</td>
</tr>
<tr>
<td>Barley of FY1978</td>
<td>4,500</td>
<td>15,500</td>
<td>132.0</td>
</tr>
<tr>
<td>Other grain of FY1978</td>
<td>100</td>
<td>19,300</td>
<td>4.4</td>
</tr>
<tr>
<td>Imported wheat</td>
<td>750</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Other imported grain</td>
<td>222</td>
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<td></td>
</tr>
<tr>
<td>Other grain purchases</td>
<td>348</td>
<td>4.8</td>
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</tr>
<tr>
<td>Contingency</td>
<td></td>
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<td>18.7</td>
</tr>
<tr>
<td><strong>Other expenditures</strong></td>
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<td></td>
</tr>
<tr>
<td>Amortization</td>
<td></td>
<td>8.8</td>
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</tr>
<tr>
<td>Interest</td>
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<td></td>
</tr>
<tr>
<td>Repayment of grain bonds</td>
<td></td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Interest and fees on grain bonds</td>
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<td>17.2</td>
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<tr>
<td>Repayment of loans</td>
<td></td>
<td>20.0</td>
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</tr>
<tr>
<td>Warehousing costs</td>
<td></td>
<td>58.3</td>
<td></td>
</tr>
<tr>
<td>Other expenses</td>
<td></td>
<td>6.7</td>
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</tr>
<tr>
<td><strong>Total expenditures</strong></td>
<td></td>
<td>771.4</td>
<td></td>
</tr>
<tr>
<td><strong>Revenues</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice selling</td>
<td>6,000</td>
<td>10,120</td>
<td>226.6</td>
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<tr>
<td>Barley selling</td>
<td>4,500</td>
<td>82.1</td>
<td></td>
</tr>
<tr>
<td>Grain for military and government use</td>
<td>72.8</td>
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</tr>
<tr>
<td>Other grains</td>
<td></td>
<td>12.2</td>
<td></td>
</tr>
<tr>
<td>By-products</td>
<td></td>
<td>23.2</td>
<td></td>
</tr>
<tr>
<td>Contingency</td>
<td></td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td><strong>Total revenues</strong></td>
<td></td>
<td>431.4</td>
<td></td>
</tr>
<tr>
<td><strong>Deficit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term loan</td>
<td></td>
<td>200.0</td>
<td></td>
</tr>
<tr>
<td>Short-term loan or grain bond</td>
<td></td>
<td>140.0</td>
<td></td>
</tr>
<tr>
<td><strong>Total deficit</strong></td>
<td></td>
<td>340.0</td>
<td></td>
</tr>
</tbody>
</table>

* Source: Economic Planning Board.

about $770 million. Based on the difference between buying and selling costs per bag, the deficit attributable to rice alone would be about 250 billion.

To obtain an idea of the true costs to Korea of rice operations, the following round numbers for the 1979 rice crop year may be considered. If the farm purchase price is 29,000 per bag and the release price is 24,000, the difference between the buying and selling cost will contribute 5,000 per bag to the deficit. At 12.5 bags to the ton, this is a
difference of W62,500 per ton. In addition, storage costs must be considered. Given the pattern of late release in the season by the government, suppose each bag is held eight months. If the yearly carrying cost is 24 percent interest plus 12 percent for warehousing and deterioration, the cost of storage for a full year is 36 percent of the value of the rice—or 24 percent for eight months. Multiplying W29,000 per bag times 12.5 to arrive at value per metric ton and taking 24 percent to arrive at storage cost for eight months, gives storage cost for a ton for eight months of W87,000. The storage cost plus the loss on the difference between the buying and selling price comes to a total cost per ton of about W150,000. If the rice harvest is 6 million tons and if 25 percent is handled by the government, the W150,000 cost per ton just derived will be borne on 1.5 million tons. Multiplying W150,000 times 1.5 million tons gives W225 billion for the yearly cost of rice operations, which is not too far from the rough estimate of W250 billion mentioned above as attributable to rice under current accounting procedures.

The true costs considered so far do not include costs of carrying the nation's stockpile of rice from year to year. The figure of 36 percent of value estimated to be the cost of storage for a full year gives a W130,000 storage cost per ton. Suppose the amount carried into the 1979 rice crop year was 1.5 million tons, then multiplying the W130,000 cost per ton by 1.5 million tons gives a cost of carrying the stockpile for a year of about W200 billion. Since most of these costs are interest costs, the practice in the GMF accounts of charging little interest on long-term loans will mean that the cost of carrying the stockpile will largely not appear in the GMF deficit, even though this cost is nearly as great as the costs of the rice buying and selling operations within the year.

Possible Future Costs

The costs of carrying a stockpile from year to year may be dropped from further consideration, and attention confined to the cost of the government's rice buying and selling operations within the year, which the above discussion has suggested may be on the order of W225 billion under recent conditions. The question then is: How may this cost be affected by future events?

MEDIUM COST PROJECTION. For a medium projection, suppose that the farm purchase price of W29,000 per bag is continued in real terms and that the release price is W24,000 per bag in real terms. Under these conditions, it is not unreasonable to expect that production will rise at

9. All tons are metric.
something like 2 percent a year from its present normal level of somewhat more than 6 million tons, reaching 7 million tons in 1985. This implies a growth rate of production of one-third that experienced during most of the recent years of the 1970s, which were more heavily influenced by the introduction of new varieties and the rise of rice prices than is likely in the future. While future production growth may be slower than in the recent past, there are several reasons for expecting further growth. These include the ongoing land development programs, plans to extend the acreage of new varieties, and the continued response to the rising rice price which has not yet run its course. That is, the short-run response to higher rice prices has taken place, but the long-run response may continue for many years as production habits of more and more farmers change and as technological improvements and cultural practices are developed and introduced in response to the price incentive.

In view of the expectation that the fraction of the crop which is marketed will continue to increase and that the fraction of these marketings passing through government hands will continue to rise because of the factors discussed earlier, suppose that rice handled under the government program rises from its present level of about 25 percent of production to 30 percent in 1985. The government will then be purchasing about 2 million tons of rice from farmers. Assuming a continuation of the present cost per ton of about W150,000, the cost of the rice operations would be W300 billion.

This calculation assumes that all the rice can be disposed of at a domestic selling price of W24,000 per bag. It is unlikely, however, that demand will increase sufficiently for this volume of domestic disposal to be possible. Allowing for 1.6 percent annual population growth and some slight further increase in per capita consumption, rice disappearance might reach 6.5 million tons by 1985. Compared with the 7 million ton projection of production, the implication is that 0.5 million tons of rice would have to be exported—any possible demands for adding to carry-over having long since been met by that time. The calculation of program costs would not be affected if rice could be disposed of on the international market for the assumed selling price of W24,000 per bag. At 12.5 bags to the ton this would be a selling price of W300,000 per ton, which comes to $625 per ton. Realistically, the exported rice might be disposed of on the international market at one-third the domestic selling price or W100,000 per ton, leading to an additional loss of W200,000 on each of the 0.5 million tons exported for an additional cost of W100 billion. The total cost of yearly rice operations in 1985 under the medium projection is then W400 billion or nearly double the present cost.

HIGH COST PROJECTION. If the government were to continue to increase the spread between the purchase and selling price, raising the
purchase price in real terms, production would increase more rapidly and the loss per bag would increase. Cost would be raised still further if the percentage of the crop handled by the government were to rise faster than assumed in the medium projection. With an increase in the spread between purchase and selling price of an additional W5,000 per bag, the loss per ton if all rice were sold in the domestic market would be W212,500 per ton as compared with W150,000 per ton in the medium projection. Production would rise to 8 million tons by 1985, of which the government might acquire 35 percent or 2.8 million tons. The cost, if all rice were sold in the domestic market, would be W420 billion as compared with W300 billion obtained in the medium projection.

If per capita consumption went down slightly, disappearance of rice in Korea in 1985 could not be much greater than its present level, or as a round number 6 million tons. Exports would then be 2 million tons. With a less favorable international market, the loss on international sales could be W250,000 per ton. The addition to costs from disposing of exported rice in the international market would then be W500 billion, bringing the total cost of yearly rice operations in 1985 under the high cost projection to W920 billion, or more than four times their present level.

LOW COST PROJECTION. If the supply performance is poorer than in the medium projection and 6.5 million tons of rice are produced in 1985, if the proportion of the crop handled by the government is held to 25 percent, and if the loss per unit of sales of the rice is held to W150,000 per ton, the cost of disposing of rice acquired from farmers would be 1.4 million tons times W150,000, or W220 billion.

More rapid demand growth than expected could raise disappearance of rice in Korea to 7 million tons by 1985, making it necessary to import 0.5 million tons. With a low international price of $175 or W85,000 per ton and revenues in the domestic market of W24,000 per bag or W300,000 per ton, there would be a profit to the government of W215,000 on each ton of rice imported. The total profit on the international sales would be W215,000 per ton times 0.5 million tons or W107.5 billion. The profit on imports would partially offset the loss borne on acquisitions from farmers, leaving a net cost on yearly operations in 1985 under the low cost projection of somewhat more than W100 billion, or about half of present costs.

IMPLICATIONS OF THE PROJECTIONS. The projections indicate that with the continuation of recent policies the Korean government should be prepared for a substantial rise in costs of yearly rice operations. At the high end, a quadrupling of costs is within the realm of possibility. Only
with the "luck" of a loss in self-sufficiency, enabling a profit on imports partially to offset losses on domestic production, would program costs be reduced below present levels.

Seasonal Stabilization

This section examines the effects of varying degrees of seasonal price stabilization by the government. First, the case of complete seasonal price stabilization is considered, followed by the case of partial seasonal stabilization. The technical materials underlying the discussion are contained in chapter 9.

For simplicity, the distinction between new and traditional rice varieties is neglected in the following discussion. In the absence of any program, the wholesale price will rise from a low at harvesttime through the crop year, peaking just before the next harvest. In this way private storers cover storage costs—the seasonal price rise may be regarded as a payment by consumers to storers for their services. If, however, the wholesale price is completely flattened throughout the year by government stabilization policy, there is no longer any incentive for farmers and private storers to acquire rice and sell it later in the season, and the government will theoretically have to buy the entire amount consumed in urban areas as discussed earlier.

The degree of seasonal price stabilization that the government can achieve depends on the amount of stocks available for release during the crop year—that is, the quantity of government purchase at harvesttime. The amount the government is able to acquire from the farmers for later distribution is in turn dependent on the farm purchase price. For example, if the government decides on a policy of complete seasonal price stabilization but fixes a purchase price that is too low, it will be unable to acquire sufficient quantities to maintain a stable wholesale price through the year.

The objective of complete seasonal stabilization would then be defeated, and prices would begin rising after government stocks ran out. The stabilization objective may be stated in three equivalent ways—as a given degree of seasonal price stabilization, a given quantity of purchase from farmers, or a given farm purchase price. Thus, in considering the effects of varying degrees of seasonal stabilization on program cost, it is possible simply to look at different levels of purchase price.

Complete Seasonal Price Stabilization

To estimate government program costs under complete seasonal stabilization, it is necessary to determine the farm purchase price that enables
the government to acquire just sufficient quantities from the farmers for this purpose. In the absence of any stabilization program, the wholesale price would typically be low in December following a new harvest and would rise to a seasonal high in September, just before the next harvest, reflecting the private cost of storage. This cost consists of two main components. The first, warehousing and losses during storage, is assumed to be 1 percent of the value of the rice held per month, or 9 percent over nine months. The second consists of interest costs, representing the revenue forgone by storing rice instead of selling immediately and lending out what is received at the going rate of interest. The interest rate for private storers is assumed to be 3 percent per month, or 27 percent for nine months. Thus, the total (interest plus noninterest) costs of storage for nine months will be 36 percent of the value of the rice held. In the absence of any stabilization program, prices will rise 36 percent over the season to cover the cost of storage, or the average wholesale price during the season will exceed by about 18 percent the wholesale price at harvesttime. The wholesale price at harvest is assumed to be 10 percent more than the price actually received by farmers to allow for costs of transport and processing. This implies a difference between farm harvest price and average wholesale price of 28 percent in the absence of any government program.

With complete seasonal price stabilization, by definition, government purchases and sales will be made until the wholesale price becomes completely flat throughout the year. In other words, the wholesale price at harvesttime will be about 18 percent higher, and at the end of the season about 18 percent lower, than without seasonal stabilization. Under complete seasonal stabilization there is a difference of only 10 percent between the farm harvest price and the (flat) season average wholesale price to cover processing and transport costs. There is an added cost to the government because the farm harvest price is higher than it would be without seasonal stabilization.

Seasonal stabilization has both a direct and an indirect effect on program cost. The direct effect is the government's loss on the quantity which would be marketed in the absence of any program. The major indirect effect arises from marketed supply response. Since government purchases in the beginning of the season raise the farm harvest price, if farmers market more at a higher price, the quantity handled by the government and therefore its costs would increase. The larger amount released for urban consumption lowers average wholesale prices, which also contributes to program costs.

On the one hand, the higher the elasticity of marketed supply, the greater will be the increase in quantity handled by the government as a
result of the increase in the farm purchase price, and the higher will be program costs. On the other hand, the less responsive (or more inelastic) demand is to price, the higher program costs will be. This is because the fall in the average wholesale price owing to the larger volume of marketings will be greater, reducing government revenue from sales of rice stocks acquired earlier from farmers. Of course, costs will also be higher if the farm purchase price is raised to levels beyond that required for complete seasonal stabilization. Assume that the elasticities of supply and demand for rice in Korea are 0.3 and 1 respectively. It may be further assumed that the elasticity of marketed supply is equal to the elasticity of supply (0.3), which is a reasonable estimate based on analysis of marketed supply. Under these assumptions, complete seasonal stabilization would result in a 4 percent fall in the average wholesale price and a 14 percent increase in the farm harvest price. In other words, if exports or imports are ruled out, to acquire sufficient stocks for complete seasonal stabilization, the government must raise its farm purchase price about 14 percent above the self-sufficiency price, defined as that farm price which would prevail in a normal year in the absence of imports and in the absence of any government program. Assume that the self-sufficiency price is W28,500 per 80-kilogram bag for the 1979–80 crop year. The example can easily be changed if a different self-sufficiency price is assumed. The farm purchase price required for complete seasonal stabilization would be about W32,450 per bag. Under our elasticity assumption, government program costs are estimated to be W255 billion (see chapter 9). With a high government purchase price of W35,000 per bag, about 10 percent higher than that required for complete seasonal stabilization, program costs will be W422 billion.

The above estimates assume that government and private storage costs are the same. If, for example, the government borrows at a lower interest rate, program costs will be lower. If the government interest rate is one-third that of the private interest rate (1 percent a month instead of 3 percent a month), and if noninterest costs of holding rice are the same 1 percent a month, in both cases program costs will be W141 billion with a W32,450 per bag purchase price and W295 billion with a W35,000 per bag purchase price.

**Effect of Rice Exports**

The above estimates show that as long as government stocks have to be released in the domestic market, higher farm purchase prices are likely to result in rising program costs. The reason is that the quantity handled by the government increases because of supply response. Under the as-
sumption that the elasticity of demand for rice is unity, a reduction in the average wholesale price through seasonal stabilization would leave total revenue unchanged. If the elasticity of demand is less than unity, as may be likely in the case of rice, total revenue from sales would even decrease. One way to avoid the increase in net program cost as the purchase price is raised is to sell the extra rice in the world market. Then instead of remaining constant or declining, as would happen when all sales are made in the domestic market, revenue would increase through foreign exchange earnings, and this might help reduce net program costs.

Specifically, it may be assumed that once the farm purchase price has been raised sufficiently to allow complete seasonal stabilization, the supplies forthcoming from further increases in the farm purchase price are sold in the world market. To estimate program costs in such a situation, it is necessary to predict what price Korean exporters are likely to receive in the international market. In table 2-8 the export price of rice from Thailand, in U.S. dollars per metric ton, is shown in column (2). Column (3) shows the same figures converted into won per 80-kilogram bag using the exchange rates in column (1). It can be seen that the world price of rice has shown very wide fluctuations. Since the years 1973–74 are rather atypical, it does not seem likely that the export price can be much above $300 per metric ton (or about W11,600 per 80-kilogram bag) in the near future. In fact Korean exporters are likely to receive a lower price than this because Thailand is a well-established exporter, and Korea would

Table 2-8. Korea: Export Price of Rice

<table>
<thead>
<tr>
<th>Year</th>
<th>Exchange rate (won per U.S. dollar)</th>
<th>U.S. dollars per metric ton</th>
<th>Won per 80-kilogram bag</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>316</td>
<td>143.9</td>
<td>3,638</td>
</tr>
<tr>
<td>1971</td>
<td>373</td>
<td>131.3</td>
<td>3,918</td>
</tr>
<tr>
<td>1972</td>
<td>399</td>
<td>143.6</td>
<td>4,584</td>
</tr>
<tr>
<td>1973</td>
<td>398</td>
<td>368.1</td>
<td>11,720</td>
</tr>
<tr>
<td>1974</td>
<td>484</td>
<td>546.4</td>
<td>21,157</td>
</tr>
<tr>
<td>1975</td>
<td>484</td>
<td>364.2</td>
<td>14,102</td>
</tr>
<tr>
<td>1976</td>
<td>484</td>
<td>241.8</td>
<td>9,362</td>
</tr>
<tr>
<td>1977</td>
<td>484</td>
<td>272.3</td>
<td>10,543</td>
</tr>
<tr>
<td>1978</td>
<td>484</td>
<td>368.2</td>
<td>14,257</td>
</tr>
<tr>
<td>1979 January</td>
<td>484</td>
<td>299.0</td>
<td>11,577</td>
</tr>
<tr>
<td>February</td>
<td>484</td>
<td>300.0</td>
<td>11,616</td>
</tr>
</tbody>
</table>

probably be unable to export the grades of rice desired by most customers of Thailand. Thus an export price of W9,500 per 80-kilogram bag might well represent the maximum Korean exporters could expect in 1979-80. Under this assumption, with a farm purchase price of W35,000 per bag, program costs will be W384 billion if government and private costs of storage are equal, and will be W265 billion if government storage costs are half of private storage costs. Thus, allowing export sales would reduce program costs by approximately 10 percent with the same purchase price of W35,000 per bag. This reduction is rather small because rice prices in Korea have been supported above world prices. This can be verified by comparing the Thai export price in column (3) of table 2-8 with the Korean wholesale price in column (6) of table 2-3. As usual, international comparison of prices is subject to many difficulties. But adjusting for loading and other costs and possible difference in quality, it appears that the domestic price of Korea is at least twice as high as the international price. Thus, barring unexpected changes in the export market, it is likely that prices received for rice exported from Korea would be much lower than domestic cost.

Related Commodities: Barley and Wheat

Rice price policy affects program costs in substitute crops such as barley and wheat by cross-elasticity supply and demand effects. Rice program costs are in turn affected by policies for these other grains. Attention should be given to the effects of policies not only on the average level of prices but also on their seasonal pattern. The case of barley serves as an example. Without seasonal stabilization programs, the price of barley is seasonally low in the summertime just after its harvest, when the price of rice is reaching its peak, encouraging barley consumption. When rice and barley prices are stabilized seasonally, however, maintaining the price of barley at harvesttime discourages barley consumption, and the lack of a seasonal rise in the rice price further diminishes the incentive to substitute barley for rice. By allowing some seasonal rise in the rice price, the demand for barley would increase, driving up the urban barley price at which government acquisition could be liquidated and thereby lowering program costs on barley.

Wheat, almost all of which is imported, is sold in Korea at a controlled price. The difference between the world price and the domestic price is made up by payments in and out of the Wheat Flour Stabilization Fund.

10. The Thai export price is for white rice 5 percent broken, which is among the highest grades, while the Korean wholesale price is for rice of average quality.
In 1973–75, however, the selling price in Korea was kept low as world prices escalated, and there were large losses on imports. During this period, the lower price of wheat reduced the demand for rice, the wholesale price of which was therefore lower than it would have been. Thus, government program costs on rice were higher for any given purchase price of rice.

**Partial Seasonal Price Stabilization**

More modest policies would attempt a less than complete flattening of the seasonal price pattern. The rise in the farm harvest price would then be smaller, but farm income would still increase somewhat. The price of rice would show some seasonal rise, but the extreme heights reached in the absence of any seasonal stabilization could be avoided.

It was earlier estimated that the farm purchase price required to acquire sufficient quantities for complete seasonal stabilization is W32,450 per bag. Thus for any lower farm purchase price, only part of the amount sold in urban areas would be bought by the government and the rest would be marketed out of private storage. Government stocks are held off the market for a time during which prices are determined by private market behavior. If private storers have accurate knowledge about government intentions, the price paid at harvesttime for the remainder of the crop above government acquisitions will tend to be such that private storers can just cover storage costs up to the time when government releases begin. Prices begin rising after harvest at a rate determined by the cost of storage until the time government releases begin, after which the release price is maintained for the rest of the year. Thus under partial seasonal stabilization the seasonal price pattern is determined by rather complex interactions between the government and private storers. The farm harvest price, and therefore the level of the price pattern, is determined by the condition that total consumption for the year add up to the total amount marketed. This condition is brought about by the actions of private storers in their demand for seasonal stocks. Harvest prices would tend to be such that private storers run out of stocks just as government releases begin. If prices at harvesttime were too low, private storers would run out of stocks before the time the government is able to supply the market for the rest of the year at the price prevailing at the beginning of releases. Private storers can expect prices to jump after they run out of stocks, and they could make money by holding additional stocks and selling after the price jump. Their attempts to hold additional stocks will bid up prices at harvesttime until there is no longer any prospect of a price jump. Similarly, if prices at harvesttime were too high for private storers to have prospects
of selling their seasonal stocks at prices covering costs of storage before government releases begin, their attempts to hold less stocks will lower harvest prices.

Compared with complete seasonal stabilization, partial seasonal stabilization raises the farm harvest price by less, reducing government purchase requirements and therefore program costs. Costs are also reduced because the government can release stocks at higher prices when some seasonal price rise is allowed. It is therefore not surprising that program costs are reduced when seasonal stabilization is partial. A question to be considered is whether program costs would rise more or less than proportionally with the degree of seasonal stabilization. Chapter 9 will show that program costs would rise much more than in proportion to the degree of seasonal stabilization. In other words, program costs could be greatly reduced if partial rather than complete seasonal stabilization were attempted. Under our elasticity assumptions (elasticity of marketing equal to 0.3 and elasticity of demand equal to unity), the farm harvest price need be raised merely by 2.6 percent (from W28,500 per bag to W29,240 per bag) to eliminate half the seasonal price rise. To eliminate two-thirds of the seasonal price rise, the required increase in purchase price is 4.5 percent—to W29,780 per bag. In the latter case, net program costs are W91 billion, assuming government and private storage costs are equal, compared with the earlier estimate of W255 billion under complete seasonal stabilization.

If the interest rate paid by the government is lower than the private interest rate, there is the interesting possibility that net program costs can be negative under partial seasonal price stabilization. The reason is that the revenue from sales of government stocks depends on the wholesale price at the time of government release, and the seasonal rise in the wholesale price is determined by private (interest plus noninterest) storage costs. The cost to the government, however, is determined by storage costs that are lower than those of the private sector because government pays a lower interest rate. As long as government storage costs are lower, the government can stabilize prices to a certain extent without incurring positive net program costs—the degree of seasonal stabilization possible would be higher, the lower are government storage costs in relation to those of private. Thus if government storage costs are half as much as private costs, under our elasticity assumptions, a stabilization program which

11. If the private interest rate is 3 percent a month and noninterest storage costs are 1 percent a month, government storage costs will be half as much as private costs if the government interest rate is one-third that of private storers (or 1 percent a month) and noninterest storage costs are the same for both private storers and the government.
eliminates two-thirds of the seasonal price rise would result in zero net program cost. As shown in the previous paragraph, this requires a purchase price of W29,780 per bag. With a lower purchase price the government would make a profit.

**Effects of Rice Price Policy on Goals**

The preceding sections have been concerned with the effects of rice price policy on government program costs. Because of the many competing demands for government expenditure, reducing the cost of any government program is indeed important. Several other goals are affected by rice price policy, however, and they are considered in the following sections.

**Rural Welfare and Income Distribution**

The importance of rice in urban consumption implies that raising the purchase price of rice will increase farm income more effectively than, say, raising the purchase price of barley, in the sense that the program costs of achieving a given percentage increase in farm income will be lower. In 1977 the value of urban consumption of barley was only about one-sixth that of rice. Thus the purchase price of barley would have to rise approximately six times more than the purchase price of rice to have the same effect on farm income. Assuming the elasticities of supply and demand for rice and barley are similar, however, the increase in government program costs will be much greater in the case of barley since its marketing costs would increase much more owing to the greater rise in price.

About one-third of the rice produced is consumed on farms. An increase in the purchase price of rice would contribute to an increase in farm income on the portion of the rice crop that is sold. Since larger farms market a greater amount of rice, they would benefit more from an increase in the purchase price. Rural households which are purchasers of rice and nonfarm households outside urban areas do not benefit from rice sales in urban areas below the cost of acquisition, and they must presumably pay the price received by farmers allowing for the cost of storage.

Since the stabilization program lowers somewhat the average wholesale price paid, urban consumers pay a lower price than they would in a situation of no government program and no imports. They are, of course, paying a higher price than they would pay under free trade (import), as

noted earlier. (Despite government programs, the price of cereals rose 28 percent in relation to all consumer goods from 1970 to 1978. Such price increases hurt the low-income households relatively more than others since the former devote a higher fraction of their expenditures to cereals. 13) Another distribution effect concerns taxpayers and money holders. If the government expenditures on the rice program are financed by increasing taxes, then the incidence of the costs is according to the incidence of the increased taxes. But if expenditures are financed by an increase in the money supply, inflation results. This is equivalent to a tax on money holders and may also have complicated redistribution effects.

Resource Allocation Efficiency

Resource allocation effects can be illustrated by the example of raising the price received by farmers and lowering the seasonal average wholesale price paid by urban consumers, with effects just sufficient to eliminate any seasonal price rise. With a purchase price of W35,000 per bag, under the assumptions that the elasticity of marketing is 0.3 and the elasticity of demand is unity, welfare of producers (farmers) will increase by W253 billion and welfare of consumers will increase by W85 billion. The sum of these two gains is less than the government program cost estimated earlier of W422 billion. The difference, equal to W84 billion, is a loss owing to resource allocation inefficiencies caused by the program. In the absence of any government intervention, producers decide how much to produce and consumers decide how much to consume of a certain commodity on the basis of market prices. The government program, by distorting the structure of market prices, leads to inefficiencies in production and consumption. By raising the farm price, the seasonal stabilization program encourages excessive production, while by lowering the average wholesale price it encourages excessive consumption of rice in relation to other commodities. This gives rise to the resource allocation cost of W84 billion.

If exports were allowed under the W35,000 per bag purchase price, program costs would be lowered from W422 billion to W384 billion, but consumers would not have any gain in welfare because extra supplies would be sold in the world market. The welfare loss in this case is a program cost of W384 billion less W253 billion gain in producer welfare (surplus), or W131 billion. Since Korea is a relatively high-cost producer

of rice, and Korean exporters are likely to receive a price much lower than the domestic price, it is not surprising that increasing production for the purpose of export would lead to further resource misallocations and larger welfare losses.

Self-sufficiency

In the late 1960s and early 1970s, one of the objectives of rice price policy was to reduce dependence on imports, which were quite high at the time. Korea is now more or less self-sufficient in rice, but as a result consumers have to pay more than the world price. Domestic production as a percentage of total disappearance remains low for wheat and corn—about 3 and 10 percent respectively. Substitution of wheat for rice in consumption is still taking place as older people in the population are replaced by younger people with a more westernized diet. Corn has become the fastest growing import owing to the rapid increase in demand for livestock feed of which corn is the main component. Attempts have been made to introduce high-yielding new varieties of wheat and corn, but foreign dependence on these two crops is expected to remain substantial.

Inflation

There appears to be little empirical support for the once popular idea that rising grain prices raise wages, which in turn raise prices through some kind of cost-push mechanism. Several studies have indicated that the quantity of money explains much of the inflation experienced in Korea, while cost-push factors, including the price of rice, have little explanatory power.

The rice price program may, however, have inflationary consequences through the money supply. If the government expenditures on the rice program are not financed by increasing taxes or by borrowing from the nonbank public, and are not accompanied by reduced expenditures on other programs, direct or indirect borrowing from the banking system is necessary and is likely to lead to increases in the money supply. The money supply (M₄) was W2,295 billion at the end of June 1978. At rates of growth of the money supply of recent years in the vicinity of 30 percent, the annual growth of the money supply is on the order of W600 billion, of which the projection of the reported deficit in the GMF account of W370 billion is more than half. This is not to claim that the GMF deficit is responsible for the greater part of the inflation in Korea. But if a great part of program cost is financed in ways that increase the reserve base of
the money supply, the government grain programs could contribute materially to inflation.

Economic Growth

Rice price policy can affect economic growth in more than one way. It is sometimes claimed that grain price policies are not economically efficient because they distort the relative price structure of various commodities in Korea as well as the relation of prices in Korea to world prices; the resulting real resource costs detract from national income and therefore fewer funds are available for investment contributing to growth.

Another widespread belief, however, is that grain price policies contribute to economic growth through their effect on urban wages. According to this view, Korea's spectacular rate of economic growth can be attributed to conditions attracting massive inflows of capital. It is believed that Korea's relatively low urban wages are a key consideration in attracting capital to the nation. This argument is open to question. If urban labor is a price taker, it will receive a wage equal to its marginal productivity, which in turn is determined by the amount of labor in urban areas and the capital available in any given year. Although grain prices can affect the welfare of urban consumers by affecting the amount which can be purchased with their wage, they cannot affect the amount an employer will pay a worker. It is even possible to argue that grain price policies can raise urban wages by slowing down the rate of migration from rural areas to cities by raising farm prices and incomes, thereby keeping labor on farms.

Rice price policy can also affect growth through a redistribution of government expenditure. Given the fixity of government revenue sources, government outlay on the rice program is likely to be at the expense of other expenditures, some or all of which might contribute to growth.

Last, it has been claimed that rice price policy eases a foreign exchange constraint to growth. The large imports of foreign capital, which have been associated with Korea's postwar growth, are subject to control with a view to the prospects for repayment and the supply of foreign exchange. Reducing food imports through increasing domestic production may therefore be viewed as a way of avoiding a balance of payments crisis which might necessitate corrective measures (such as restricting further foreign borrowing and investments by foreign firms) deemed undesirable in view of the desire for growth. This line of argument would appear to assume, among other things, that exchange rates are kept out of equilibrium, but in any case the argument is conjectural.

From the foregoing discussion it appears that the effect on producers,
consumers, and government costs can be quantified in a rather rigorous manner, while effects on other goals can be traced only qualitatively at present. Clearly, there is much room for further analysis to determine these effects.

Looking to the Future

The rapid growth of the Korean economy in the 1970s became widely distributed as real wages rose, and the growth of demand for food products picked up considerably. Meanwhile, as labor was drawn increasingly out of agriculture to make possible the industrial growth of the country, costs of agricultural production rose and contributed to the press of demand against Korea's limited agricultural base. The introduction of high-yielding varieties, high farm rice prices, and paddy land development led to more than satisfactory increases in rice production, and urban rice prices were held down by large government losses on price operations.

There were no such mitigating events for noncereal agricultural products. Their prices rose more or less continuously at a greater rate than other prices. In 1978 increases in demand were even more rapid than expected, so that growers were not prepared, and weather for some crops was poor. These developments added to the underlying long-run price rises. The difficulties in 1978 accentuated and brought to public consciousness the agricultural problems that had been developing for some time. As a result, the fundamental thrusts of agricultural policies are being reconsidered to a greater extent than at any time since the country embarked on its policy of high rice prices during the 1970s.

To meet the problems that have been developing and have recently become accentuated, a three-pronged approach could be useful. First, it is appropriate to reconsider the continued role of price as an instrument to encourage grain production and redistribute income to rural areas. As Korea enters the ranks of the developed nations, the country can learn not only from its successes in economic development but also from its problems. One problem is the sometimes irreversible nature of expansion in price policies, which makes them endure even after they are no longer needed for achieving national goals. The benefits of income distribution, perhaps regressive among farmers in any case, tend to go to the initial recipients and then to be capitalized into agricultural land values where they are dispersed through inheritance. Later entrants, not blessed with the chance happening of inheritance, receive no benefits. Meanwhile, economic growth diverts demand away from rice to other commodities. Many nations, most notably Japan, find themselves producing rice in
excess of their needs and exporting at a loss on international markets. A large fraction of the government budget for agriculture remains devoted to price policies, precluding expenditures that could be used for agricultural development. One strategy at this stage, then, could be to shift emphasis away from agricultural price policy to other means of developing rural areas and improving income distribution.

Second, in view of the rising prices of noncereal agricultural products and the likelihood that problems will be aggravated as the demand for these products grows more rapidly than for cereals, measures to promote agricultural development could put more emphasis on these commodities than on rice. The historical importance of rice and its vital role at a low level of income are phenomena of the past. It would appear that agricultural policies have lagged in adjusting to new realities in which rice is now less important and other crops are increasing in importance.

Third, there is a need for more definite and defensible criteria in deciding on the degree of protection for Korean agriculture in relation to the world market. At present, importation of some commodities is completely prohibited, while some come in at world prices, and others are allowed in above the world price—a regulation amounting to a tariff. There are even some commodities for which prices in Korea are lower than world prices.

The following questions need to be addressed: What is the country trying to accomplish by agricultural protection? What are the costs and gains to the nation from protection? Is there a unified set of principles that can be applied to all commodities to arrive at a rationalized approach to the development of Korean agriculture in the world setting? A strategy chosen in view of the three major considerations discussed here could have positive consequences for decades to come as the Korean economy continues to grow and change.
3

The Effort
to Raise Food Production:
Bangladesh

Bangladesh is the fourth largest rice producer in the world. With a gross rice production of about 13.0 million metric tons in 1979 (roughly the equivalent of 19.4 million tons of paddy given in table 3-1), Bangladesh ranked below China, India, and Indonesia. Rice, however, constitutes about 95 percent of food-grain production in Bangladesh compared with about 40 percent in India. It dominates the Bangladeshi diet, accounting for an estimated 85 percent of the average caloric intake and about 75 percent of protein intake. In relation to the critical importance of rice in meeting the nutritional requirements of the people, domestic production has not been sufficient.

Rice production has also been low in relation to the land and labor devoted to its cultivation. About 80 percent of the 31 million acres of total cropped area (or 22 million acres of net cropped area) is under rice production, and about 80 percent of all irrigated acreage is used to grow rice. Average rice yields, however, are only about half a ton per acre (equivalently, about 1.9 tons of paddy per hectare given in table 3-1). The amount of labor engaged in rice production is also very large, as reflected by the estimate of about 0.41 hectare per worker in agriculture in table 3-1. While the current low yields reflect the difficulties of raising productivity, they also suggest the considerable potential for growth in the future.

Production of food grains, consisting of rice and wheat, has shown modest growth historically. From FY1961 to FY1979 rice production grew by only about 1.6 percent annually and food grains by about 1.7 percent (table 3-2). Total food-grain production reached 13.1 million tons in FY1978, compared with 11.8 million tons in FY1970 before the nation's
Table 3-1. Top Rice Producers in the World, 1977 and 1979

<table>
<thead>
<tr>
<th>Country</th>
<th>Paddy output (thousand metric tons)</th>
<th>Paddy yield&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Hectares per worker in agriculture&lt;sup&gt;bc&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>129,470</td>
<td>143,400</td>
<td>3.49</td>
</tr>
<tr>
<td>India</td>
<td>79,006</td>
<td>69,000&lt;sup&gt;de&lt;/sup&gt;</td>
<td>1.96</td>
</tr>
<tr>
<td>Indonesia</td>
<td>23,356</td>
<td>26,350</td>
<td>2.79</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>19,441</td>
<td>19,355</td>
<td>1.94</td>
</tr>
<tr>
<td>Thailand</td>
<td>13,921</td>
<td>15,640</td>
<td>1.75</td>
</tr>
<tr>
<td>Japan</td>
<td>17,000</td>
<td>15,600&lt;sup&gt;e&lt;/sup&gt;</td>
<td>6.17</td>
</tr>
<tr>
<td>Vietnam</td>
<td>10,885</td>
<td>10,500&lt;sup&gt;f&lt;/sup&gt;</td>
<td>2.01</td>
</tr>
<tr>
<td>Burma</td>
<td>9,462</td>
<td>10,000</td>
<td>1.95</td>
</tr>
<tr>
<td>Korea, Rep. of</td>
<td>8,291</td>
<td>8,051</td>
<td>6.86</td>
</tr>
<tr>
<td>Brazil</td>
<td>8,994</td>
<td>7,589</td>
<td>1.51</td>
</tr>
<tr>
<td>Philippines</td>
<td>6,895</td>
<td>7,000&lt;sup&gt;f&lt;/sup&gt;</td>
<td>1.97</td>
</tr>
<tr>
<td>United States</td>
<td>4,501</td>
<td>6,199</td>
<td>4.95</td>
</tr>
</tbody>
</table>

<sup>a</sup> Metric tons of paddy per hectare harvested.
<sup>b</sup> Total arable land (double-cropped area counted only once) divided by "economically active population in agriculture." These figures are probably indicative of the land-labor ratios in paddy production for most countries listed except perhaps the United States and Brazil.
<sup>c</sup> Figures for 1979 not readily available.
<sup>d</sup> FAO estimate.
<sup>e</sup> Unofficial figure.


independence. Output declined in FY1979, primarily because of bad weather, but it was estimated to have risen to an all-time high of 13.3 million tons in FY1980, and is projected to increase considerably more in FY1981.

Among the three rice crops—aman, aus, and boro (discussed later)—production of the irrigated winter crop of boro grew rapidly during the 1960s, but stagnated during the 1970s. During the latter decade, production of the other food grain, wheat, increased at a phenomenal rate—nearly fivefold between FY1970 and FY1979, as table 3-2 shows. Output was estimated to have nearly doubled in FY1980, and a continued sharp increase in wheat production is projected for the next few years. Aman, the largest crop, and aus are heavily weather-dependent; a breakthrough in their rate of growth is considered crucial.

1. When the fiscal year differs from the calendar year, the end year is cited. Thus, for Bangladesh, FY1970 refers to the fiscal year from July 1, 1969 to June 30, 1970. Including a projection of 14.6 million tons in FY1981, a growth rate for FY1970-FY1981 of about 2 percent is obtained.
Table 3-2. Bangladesh: Food-grain Acreage, Yields, and Production

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Aus Aman Boro</th>
<th>All rice</th>
<th>All Wheat grains</th>
<th>Aus Aman Boro</th>
<th>All rice</th>
<th>All Wheat grains</th>
<th>Aus Aman Boro</th>
<th>All rice</th>
<th>All Wheat grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>6,300 14,578 1,007</td>
<td>21,885</td>
<td>140 22,025</td>
<td>10.79 12.27 12.11</td>
<td>11.84 6.22 11.80</td>
<td>2,497 6,574 448</td>
<td>9,519 32</td>
<td>9,551</td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>5,874 14,082 1,007</td>
<td>20,963</td>
<td>145 21,108</td>
<td>10.79 12.86 13.11</td>
<td>12.29 7.32 12.26</td>
<td>2,328 6,652 485</td>
<td>9,465 39</td>
<td>9,504</td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td>6,192 14,221 1,071</td>
<td>21,484</td>
<td>182 21,666</td>
<td>9.68 11.57 12.25</td>
<td>11.06 6.58 11.02</td>
<td>2,202 6,046 482</td>
<td>8,730 44</td>
<td>8,774</td>
<td></td>
</tr>
<tr>
<td>1964</td>
<td>6,586 14,604 1,069</td>
<td>22,259</td>
<td>142 22,401</td>
<td>10.98 13.59 12.96</td>
<td>12.79 6.52 12.75</td>
<td>2,657 7,290 509</td>
<td>10,457 34</td>
<td>10,491</td>
<td></td>
</tr>
<tr>
<td>Five-year average</td>
<td>6,319 14,518 1,041</td>
<td>21,879</td>
<td>148 22,027</td>
<td>10.50 12.68 13.07</td>
<td>12.07 6.62 12.03</td>
<td>2,437 6,765 500</td>
<td>9,702 36</td>
<td>9,738</td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>7,321 14,672 1,137</td>
<td>23,130</td>
<td>136 23,266</td>
<td>10.85 12.61 14.80</td>
<td>12.16 7.01 12.13</td>
<td>2,918 6,799 618</td>
<td>10,335 35</td>
<td>10,370</td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>6,965 14,059 1,390</td>
<td>22,414</td>
<td>168 22,582</td>
<td>10.45 11.46 16.27</td>
<td>11.44 8.59 11.42</td>
<td>2,674 5,919 831</td>
<td>9,424 53</td>
<td>9,477</td>
<td></td>
</tr>
<tr>
<td>1968</td>
<td>8,221 14,672 1,534</td>
<td>24,427</td>
<td>192 24,619</td>
<td>10.16 12.64 19.77</td>
<td>12.25 8.22 12.22</td>
<td>3,069 6,812 1,114</td>
<td>10,995 58</td>
<td>11,053</td>
<td></td>
</tr>
<tr>
<td>1969</td>
<td>7,658 14,895 2,015</td>
<td>24,568</td>
<td>290 24,858</td>
<td>9.54 12.55 21.78</td>
<td>12.37 8.64 12.33</td>
<td>2,683 6,870 1,612</td>
<td>11,165 92</td>
<td>11,257</td>
<td></td>
</tr>
<tr>
<td>Five-year average</td>
<td>7,725 14,628 1,652</td>
<td>24,005</td>
<td>216 24,221</td>
<td>10.08 12.38 20.04</td>
<td>12.16 8.57 12.13</td>
<td>2,861 6,650 1,216</td>
<td>10,727 68</td>
<td>10,796</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
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<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Rice</td>
<td>7,885</td>
<td>7,418</td>
<td>7,241</td>
<td>7,681</td>
<td>7,857</td>
<td>8,452</td>
<td>7,952</td>
<td>7,995</td>
<td>7,995</td>
</tr>
<tr>
<td>Maunds</td>
<td>14,184</td>
<td>13,372</td>
<td>14,121</td>
<td>13,433</td>
<td>13,469</td>
<td>14,236</td>
<td>14,355</td>
<td>14,347</td>
<td>14,357</td>
</tr>
<tr>
<td>Gross Production</td>
<td>24,494</td>
<td>22,975</td>
<td>23,796</td>
<td>24,410</td>
<td>24,093</td>
<td>25,525</td>
<td>24,419</td>
<td>24,992</td>
<td>25,106</td>
</tr>
<tr>
<td>(Gross Production in Long Tons of Rice Equivalent)</td>
<td>311</td>
<td>314</td>
<td>297</td>
<td>305</td>
<td>311</td>
<td>371</td>
<td>395</td>
<td>654</td>
<td>1,071</td>
</tr>
<tr>
<td></td>
<td>24,805</td>
<td>23,289</td>
<td>24,093</td>
<td>24,715</td>
<td>24,508</td>
<td>25,875</td>
<td>24,814</td>
<td>25,646</td>
<td>26,177</td>
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<tr>
<td></td>
<td>2,863</td>
<td>2,341</td>
<td>2,273</td>
<td>2,802</td>
<td>2,389</td>
<td>3,230</td>
<td>3,011</td>
<td>3,104</td>
<td>2,809</td>
</tr>
<tr>
<td></td>
<td>5,912</td>
<td>5,695</td>
<td>5,587</td>
<td>6,699</td>
<td>6,000</td>
<td>7,045</td>
<td>7,046</td>
<td>7,126</td>
<td>7,303</td>
</tr>
<tr>
<td></td>
<td>2,192</td>
<td>2,220</td>
<td>2,250</td>
<td>2,286</td>
<td>2,106</td>
<td>2,242</td>
<td>2,106</td>
<td>2,129</td>
<td>2,427</td>
</tr>
<tr>
<td></td>
<td>10,967</td>
<td>9,774</td>
<td>9,932</td>
<td>9,774</td>
<td>10,110</td>
<td>12,561</td>
<td>12,416</td>
<td>12,765</td>
<td>12,543</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **1971**: 7,885 maunds of rice
- **1972**: 7,418 maunds of rice
- **1973**: 7,241 maunds of rice
- **1974**: 7,681 maunds of rice
- **1975**: 7,857 maunds of rice
- **1976**: 8,452 maunds of rice
- **1977**: 7,952 maunds of rice
- **1978**: 7,995 maunds of rice
- **1979**: 7,995 maunds of rice
- **1980**: 7,505 maunds of rice

**Five-Year Average**

- **1971-1975**: 7,616 maunds of rice
- **1976-1980**: 8,043 maunds of rice

**Gross Production, Expressed in Long Tons of Rice Equivalent**

- **1971**: 23,974 tons of rice equivalent
- **1972**: 22,975 tons of rice equivalent
- **1973**: 23,796 tons of rice equivalent
- **1974**: 24,410 tons of rice equivalent
- **1975**: 24,093 tons of rice equivalent
- **1976**: 25,525 tons of rice equivalent
- **1977**: 24,419 tons of rice equivalent
- **1978**: 24,992 tons of rice equivalent
- **1979**: 25,106 tons of rice equivalent
- **1980**: 28,399 tons of rice equivalent

**Five-Year Average**

- **1971-1975**: 23,974 tons of rice equivalent
- **1976-1980**: 25,106 tons of rice equivalent

---

*a. One long ton = 27.22 maunds.
*b. Gross production, expressed in long tons of rice equivalent.
c. Estimate.

*Source: Bangladesh Bureau of Statistics.*
In contrast to the growth rate of production, population is estimated to have been growing at about 2.7 percent a year during the past two decades. Consequently, a serious food shortage developed in the 1960s and 1970s. Food-grain imports averaging about 1.8 million tons, or about 15 percent of the total food grain available for consumption, have been necessary between FY1973 and FY1980 to bridge the production deficit (table 3-3). Most of the imports have been financed through aid, making Bangladesh the largest recipient of food aid at that time. In spite of the large quantities of imports, however, per capita availability is estimated to have declined during the last decade and has been below the government's target of 15.5 ounces a day per person in recent years. The estimated food-grain balance for recent years is given in table 3-3.

As implied earlier, the performance of the food-grain subsector is the primary determinant of the growth in crop production as well as in agriculture, and to a large extent the growth of the economy. Agriculture contributes roughly 55 percent of total gross domestic product (GDP), provides employment for 75 percent of the labor force, and directly or indirectly accounts for more than 90 percent of merchandise exports. Crop production—mostly rice, but increasingly wheat as well—constitutes about two-thirds of total agricultural value added. The livestock subsector contributes about 7 percent to GDP, while fisheries and forestry make up about 5 and 3.3 percent of GDP respectively. Crop production has failed to show any significant progress in recent years. During the 1970s the production of the major noncereal and nonfood crops essentially stagnated or declined as shown in table 3-4. The decline in the production of noncereal crops has had detrimental implications for the nutritional status of the people, and the poor performance of nonfood cash crops has hampered export promotion for the country. The value added in livestock, fisheries, and forestry as a whole has also been virtually stagnant. Considering the importance of these subsectors and their potential contribution to the economy, their disappointing performance has serious implications. The overall agricultural value added in FY1979 was less than 10 percent more than in FY1970. The modest improvements in food-grain production outlined earlier explain much of this sluggish growth in agriculture in recent times.

Future Needs and Constraints

One of the main developmental objectives of the government is to bring about a sharp departure from past trends in food-grain production. The goals are set much higher than historic trends because the potential for rapid growth is vast. Furthermore, growth in food-grain production will
contribute to the overall development of the economy and is certainly necessary to feed a fast-growing population. The government wishes to achieve food-grain self-sufficiency as soon as possible, but no later than FY1985. On the assumption of a population of 102 million in FY1985, meeting a minimum per capita daily requirement of food grain of 15.5 ounces implies the need for about 18 million tons of gross production allowing for a deduction for seed, feed, and waste. Compared with the estimated 13.3 million tons of production in FY1980, self-sufficiency, as defined above, by FY1985 requires an annual growth rate of about 6.0 percent.

Although food grains are central to self-sufficiency targets, the nongrain crops will have to reverse their past trends to help meet nutritional needs and targets. Improved performance of the cash crops and the noncrop subsectors will also be crucial for diversifying the economy, for achieving export goals, and for raising effective demand for more food grains.

The increase in food-grain production for self-sufficiency is considered feasible, particularly in light of recent advances in production, but obviously calls for further improvements on a variety of fronts. The government’s current strategy relies on expanding the use of modern agricultural inputs such as fertilizer, irrigation, and seeds of high-yielding varieties (HYV), and on providing production incentives to farmers. The difficulties of successfully executing such a production strategy are varied. The available administrative capacity is thinly spread. Transport and logistical constraints are overwhelming. Allocation of financial resources in the Annual Development Budget for agriculture has been insufficient to meet the requirements and generally low in view of the sector’s importance and potential, particularly if allowance is made for the substantial input subsidies included in these allocations. The present agrarian structure also presents impediments to raising farm productivity and sharing the benefits thereof. The policymakers are conscious of an increasing concentration of landholdings and a worsening of landlessness and rural unemployment. Plans to modernize agriculture and achieve a dramatic growth in food production are therefore to be viewed in the context of severe physical, financial, administrative, and institutional constraints. The following sections review some of the input requirements—particularly fertilizer and irrigation—and provide an overview of the agrarian structure in Bangladesh.

**Input Requirements**

**IRRIGATION.** Growth in food-grain output can be achieved through various combinations of inputs: HYV seeds, improved local seeds, fertilizer, irrigation, and flood control. Analyses of the prospects for output growth
### Table 3-3. Bangladesh: Food-grain Requirements and Supplies, FY1973–80

(Thousand long tons, unless indicated otherwise)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population, midyear (thousands)</td>
<td>74,266</td>
<td>76,055</td>
<td>78,105</td>
<td>80,366</td>
<td>82,755</td>
<td>85,207</td>
<td>87,668</td>
<td>90,199</td>
</tr>
<tr>
<td>Food-grain requirements</td>
<td>11,723</td>
<td>12,006</td>
<td>12,329</td>
<td>12,721</td>
<td>13,063</td>
<td>13,450</td>
<td>13,839</td>
<td>14,277</td>
</tr>
<tr>
<td>Domestic production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aus</td>
<td>2,273</td>
<td>2,802</td>
<td>2,859</td>
<td>3,230</td>
<td>3,011</td>
<td>3,104</td>
<td>3,288</td>
<td>2,809</td>
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<td>Aman</td>
<td>5,587</td>
<td>6,699</td>
<td>6,000</td>
<td>7,045</td>
<td>6,906</td>
<td>7,422</td>
<td>7,326</td>
<td>7,303</td>
</tr>
<tr>
<td>Boro</td>
<td>2,071</td>
<td>2,220</td>
<td>2,250</td>
<td>2,286</td>
<td>1,650</td>
<td>2,239</td>
<td>1,929</td>
<td>2,427</td>
</tr>
<tr>
<td>Wheat</td>
<td>90</td>
<td>199</td>
<td>115</td>
<td>215</td>
<td>255</td>
<td>343</td>
<td>486</td>
<td>810</td>
</tr>
<tr>
<td>Total, gross</td>
<td>10,022</td>
<td>11,830</td>
<td>11,224</td>
<td>12,776</td>
<td>11,822</td>
<td>13,029</td>
<td>13,349</td>
<td>13,449</td>
</tr>
<tr>
<td>Total, net</td>
<td>9,018</td>
<td>10,647</td>
<td>10,102</td>
<td>11,498</td>
<td>10,646</td>
<td>11,796</td>
<td>11,726</td>
<td>12,014</td>
</tr>
<tr>
<td>Minus government procurement</td>
<td>. . .</td>
<td>71</td>
<td>128</td>
<td>415</td>
<td>314</td>
<td>550</td>
<td>355</td>
<td>348</td>
</tr>
<tr>
<td>Plus government distribution</td>
<td>2,618</td>
<td>1,728</td>
<td>1,757</td>
<td>1,669</td>
<td>1,473</td>
<td>1,847</td>
<td>1,797</td>
<td>2,402</td>
</tr>
<tr>
<td>Food-grain availability</td>
<td>11,636</td>
<td>12,304</td>
<td>11,731</td>
<td>12,752</td>
<td>11,799</td>
<td>13,093</td>
<td>13,168</td>
<td>14,068</td>
</tr>
<tr>
<td>Apparent consumption per caput per day (ounces)</td>
<td>15.38</td>
<td>15.89</td>
<td>14.75</td>
<td>15.54</td>
<td>14.00</td>
<td>15.09</td>
<td>14.75</td>
<td>15.31</td>
</tr>
<tr>
<td>Availability gap/surplus</td>
<td>-87</td>
<td>+301</td>
<td>-598</td>
<td>+31</td>
<td>-1,264</td>
<td>-357</td>
<td>-671</td>
<td>-209</td>
</tr>
<tr>
<td>Government operations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Opening stocks</td>
<td>274</td>
<td>297</td>
<td>214</td>
<td>749</td>
<td>823</td>
<td>376</td>
<td>591</td>
<td>209</td>
</tr>
<tr>
<td>Plus domestic procurement</td>
<td>. . .</td>
<td>71</td>
<td>128</td>
<td>415</td>
<td>314</td>
<td>530</td>
<td>355</td>
<td>348</td>
</tr>
<tr>
<td>Plus imports</td>
<td>2,825</td>
<td>1,667</td>
<td>2,293</td>
<td>1,493</td>
<td>779</td>
<td>1,653</td>
<td>1,146</td>
<td>2,739</td>
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<tr>
<td>Minus distribution</td>
<td>2,618</td>
<td>1,728</td>
<td>1,757</td>
<td>1,669</td>
<td>1,473</td>
<td>1,847</td>
<td>1,797</td>
<td>2,402</td>
</tr>
<tr>
<td>Minus losses</td>
<td>184</td>
<td>93</td>
<td>129</td>
<td>165</td>
<td>66</td>
<td>141</td>
<td>87</td>
<td>115</td>
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<tr>
<td>Closing stocks</td>
<td>297</td>
<td>214</td>
<td>749</td>
<td>823</td>
<td>376</td>
<td>591</td>
<td>209</td>
<td>779</td>
</tr>
</tbody>
</table>

... Less than 500 long tons.

a. World Bank estimates, referring to January 1 of each year.
b. Corresponding to the government's target of 15.5 ounces per capita per day.
c. Gross production minus 10 percent for seed, feed, and waste.

Source: Ministry of Food; Bangladesh Bureau of Statistics; World Food Programme, Dacca; and World Bank estimates.
Table 3-4. Bangladesh: Production of Main Crops
(thousand long tons, unless indicated otherwise)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food crops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>11,718</td>
<td>12,561</td>
<td>11,567</td>
<td>12,765</td>
<td>12,543</td>
<td>12,539</td>
</tr>
<tr>
<td>Wheat</td>
<td>103</td>
<td>215</td>
<td>255</td>
<td>343</td>
<td>486</td>
<td>810</td>
</tr>
<tr>
<td>Gram and pulse</td>
<td>293</td>
<td>220</td>
<td>230</td>
<td>236</td>
<td>226</td>
<td>212</td>
</tr>
<tr>
<td>Edible oil seeds</td>
<td>290</td>
<td>238</td>
<td>235</td>
<td>188</td>
<td>190</td>
<td>240</td>
</tr>
<tr>
<td>Potato</td>
<td>857</td>
<td>889</td>
<td>724</td>
<td>849</td>
<td>895</td>
<td>903</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>7,417</td>
<td>5,886</td>
<td>6,401</td>
<td>6,670</td>
<td>6,828</td>
<td>6,571</td>
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<tr>
<td><strong>Cash crops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jute (thousand bales)</td>
<td>7,171</td>
<td>4,284</td>
<td>4,806</td>
<td>5,359</td>
<td>6,443</td>
<td>5,963</td>
</tr>
<tr>
<td>Mesta (thousand bales)</td>
<td>220</td>
<td>62</td>
<td>67</td>
<td>75</td>
<td>88</td>
<td>72</td>
</tr>
<tr>
<td>Tea (million pounds)</td>
<td>67</td>
<td>65</td>
<td>74</td>
<td>82</td>
<td>79</td>
<td>84</td>
</tr>
<tr>
<td>Tobacco</td>
<td>41</td>
<td>44</td>
<td>63</td>
<td>49</td>
<td>43</td>
<td>39</td>
</tr>
</tbody>
</table>

*a. Estimate.

Source: Bangladesh Bureau of Statistics.

indicate that increased irrigation and better water control would make an important contribution. At present 22 million acres, almost all the arable land, are being cultivated. According to available statistical evidence, which admittedly is not totally reliable, only 1.34 million acres are triple-cropped and 8.4 million acres double-cropped. This implies substantial potential for cultivating additional crops, particularly in the dry season (November-March), with irrigation. Herein lies the main prospect for increasing agricultural production in Bangladesh. Increased irrigation will permit both an increase in cropping intensity and an increase in the use of other modern inputs leading to higher yields.

The improvement which irrigation can make in productivity is well documented. For a shallow tubewells project in northwest Bangladesh, it was estimated, for example, that in the project area of approximately 150,000 acres (associated with 10,000 shallow tubewells) food-grain production would increase by about 150,000 tons (117 percent). The project envisions a threefold increase in fertilizer use, a twofold increase in the application of pesticides, and a tenfold increase in the use of HYV seeds. It also envisions an increase in cropping intensity from 144 to 176 percent. The projected increases in food-grain yields to one ton per acre (117

percent) and in cropping intensity (22 percent) indicate the significant influence of irrigation and associated inputs on crop production.

Flooding causes damage to crops and property at an estimated annual cost of taka (Tk) 650 million. About 14 million of the 15 million acres subject to flooding are now cultivated. Given the high risk in these areas, farmers minimize their potential losses by growing low-yielding varieties and reducing the use of other inputs. The provision of flood protection and drainage for such areas will be generally required if there is to be a significant increase in cropping intensity and planting of HYV. The economics of flood protection in Bangladesh need careful assessment, however, to determine the priority of flood protection and drainage for particular areas.

Meeting the FY1985 production target will require large increases in irrigated acreage. The achievement of the self-sufficiency target, according to the government’s Medium-term Food Production Plan, will require an increase from about 3.6 million acres irrigated in FY1978 to 7.2 million acres in FY1985.1 The government is faced with a major challenge. Irrigation is the main avenue to agricultural growth and food-grain self-sufficiency since it allows increased cropping intensity and guarantees higher yields.

Past development of irrigation has been slow. Only a million acres were newly irrigated from FY1970 to FY1979 (table 3-5). At just over 3.6 million acres, current acreage under irrigation represents only 15 percent of all cultivable land. About half this total is served by modern facilities (mainly tubewells and low-lift pumps), while the majority of farmers rely on traditional means (doons and swing baskets). This rather disappointing growth in irrigation, however, conceals the considerable potential for future development. First, a sizable expansion in irrigated acreage is expected in the coming years from the past investment in large-scale irrigation schemes. Second, there exists considerable scope for increasing the capacity utilization of existing facilities. Third, new investment—particularly in quick-yielding schemes—is being rapidly stepped up.

FERTILIZER. Chemical fertilizer was first introduced in Bangladesh in 1958, and its use spread rapidly, particularly after the establishment in 1962 of the East Pakistan Agricultural Development Corporation, which later became the Bangladesh Agricultural Development Corporation (BADC). The fertilizers used in Bangladesh are urea (46 percent nitrogen nutrient), TSP (46 percent phosphate nutrient), MP (60 percent potassium nutrient).
nutrient), and the recently introduced DAP (18 percent nitrogen and 46 percent phosphate nutrient). At present, urea accounts for 63 percent, TSP and DAP for 29 percent, and MP for 5 percent of the fertilizer used (see table 3-6).

Fertilizer is used by all types of farmers in Bangladesh. A recent survey indicates that fertilizer is now used by about 64 percent of the landowners and 63 percent of the tenants. Most tenants are responsible for its full cost but receive only about half the output. Although there are no national data on the quantity used by land tenure or farm size or on the frequency of use by farm size, regional surveys indicate that more fertilizer per acre is used on small and medium-size farms and that the frequency of use is about equal on varying sizes of farms.

Since 1966 fertilizer consumption has increased at an average annual rate of about 17 percent. Partly because of the disappointing performance of the domestic fertilizer industry, imports have increased from about 350,000 tons in FY1976 to about 640,000 tons in FY1979. The growth in consumption has been steady except for FY1972 (following the war of independence) and FY1975 (following an explosion at a domestic factory). Between FY1977 and FY1978 there was a 40 percent increase in offtake to 715,000 tons of commercial fertilizers. Factors that explain this growth include (a) the early announcement of adequate procurement prices for rice and paddy and sufficient purchases of rice and paddy to support those prices; and (b) increased government efforts to promote the use of fertilizer specifically by distributing mini-kits, liberalizing credit, and simplifying sales procedures. As a result, the effective demand was believed to be much greater than the available supply, which was low because of inadequate domestic production, difficulties in arranging imports, and marketing deficiencies. Sales during FY1979 were about 730,000 tons, however, an increase of only about 2 percent over FY1978.

Several published and unpublished studies (for instance, the Medium-term Food Production Plan) point out the substantial potential of fertilizer to sustain increases in productivity in Bangladesh. For more than half the rice and wheat crops, an increase in fertilizer use alone, without any other inputs or changes in practices, can bring about substantial initial increases in yields. Although very high ratios of output response to fertilizer use have been observed, actual responses in the field will depend on controlling water use, increasing the use of other modern inputs, and improving a variety of practices. It is estimated that the achievement of food-grain self-sufficiency by FY1985 depends on, among other things, an annual increase

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern methods</td>
<td>905,076</td>
<td>1,234,498</td>
<td>971,490</td>
<td>1,321,870</td>
<td>1,611,138</td>
<td>1,754,393</td>
<td>1,715,071</td>
<td>1,559,068</td>
<td>1,819,308</td>
<td>1,987,427</td>
</tr>
<tr>
<td>Power pumps</td>
<td>742,180</td>
<td>1,032,570</td>
<td>829,580</td>
<td>1,165,400</td>
<td>1,407,900</td>
<td>1,442,330</td>
<td>1,363,324</td>
<td>1,232,020</td>
<td>1,343,669</td>
<td>1,311,689</td>
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<tr>
<td>Tubewells</td>
<td>80,500</td>
<td>118,760</td>
<td>83,950</td>
<td>92,570</td>
<td>131,230</td>
<td>233,810</td>
<td>262,983</td>
<td>233,700</td>
<td>314,135</td>
<td>396,037</td>
</tr>
<tr>
<td>Gravity</td>
<td>82,396</td>
<td>83,168</td>
<td>57,960</td>
<td>63,900</td>
<td>72,008</td>
<td>78,453</td>
<td>88,764</td>
<td>93,348</td>
<td>135,063</td>
<td>157,068</td>
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<tr>
<td>Traditional methods^</td>
<td>1,708,974</td>
<td>1,649,452</td>
<td>1,615,810</td>
<td>1,670,630</td>
<td>1,591,112</td>
<td>1,806,879</td>
<td>1,742,207</td>
<td>1,443,852</td>
<td>1,769,657</td>
<td>1,674,351</td>
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<tr>
<td>Percentage modern</td>
<td>34.6</td>
<td>42.8</td>
<td>37.5</td>
<td>44.2</td>
<td>50.3</td>
<td>49.3</td>
<td>49.6</td>
<td>51.9</td>
<td>50.7</td>
<td>54.3</td>
</tr>
<tr>
<td>Percentage traditional</td>
<td>65.4</td>
<td>57.2</td>
<td>62.5</td>
<td>55.8</td>
<td>49.7</td>
<td>50.7</td>
<td>50.4</td>
<td>48.1</td>
<td>49.3</td>
<td>45.7</td>
</tr>
</tbody>
</table>

^a. Swing baskets, doons, canals, and other.
Source: Bangladesh Agricultural Development Corporation.
Table 3-6. *Bangladesh: Distribution of Commercial Fertilizer by Type, FY1963–80*  
(long tons of bulk weight)

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Urea</th>
<th>TSP</th>
<th>DAP</th>
<th>MP</th>
<th>HP</th>
<th>SP</th>
<th>AS/PS</th>
<th>NPK</th>
<th>TP</th>
<th>Total</th>
</tr>
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<tr>
<td>1963</td>
<td>41,122</td>
<td>3,081</td>
<td>—</td>
<td>1,405</td>
<td>—</td>
<td>1,021</td>
<td>3,531</td>
<td>—</td>
<td>—</td>
<td>50,160</td>
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<tr>
<td>1964</td>
<td>74,951</td>
<td>22,985</td>
<td>—</td>
<td>3,418</td>
<td>—</td>
<td>487</td>
<td>555</td>
<td>—</td>
<td>—</td>
<td>102,396</td>
</tr>
<tr>
<td>1965</td>
<td>71,007</td>
<td>18,975</td>
<td>—</td>
<td>3,316</td>
<td>—</td>
<td>343</td>
<td>190</td>
<td>—</td>
<td>—</td>
<td>93,831</td>
</tr>
<tr>
<td>1966</td>
<td>83,280</td>
<td>20,027</td>
<td>—</td>
<td>2,700</td>
<td>—</td>
<td>100</td>
<td>88</td>
<td>—</td>
<td>—</td>
<td>106,195</td>
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<td>1967</td>
<td>120,825</td>
<td>33,764</td>
<td>—</td>
<td>7,310</td>
<td>—</td>
<td>63</td>
<td>134</td>
<td>—</td>
<td>—</td>
<td>162,096</td>
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<td>1968</td>
<td>152,092</td>
<td>48,148</td>
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<td>10,816</td>
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<td>25</td>
<td>60</td>
<td>—</td>
<td>—</td>
<td>211,141</td>
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<tr>
<td>1969</td>
<td>159,937</td>
<td>52,938</td>
<td>—</td>
<td>12,433</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>225,308</td>
</tr>
<tr>
<td>1971</td>
<td>212,358</td>
<td>74,900</td>
<td>—</td>
<td>17,112</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>304,370</td>
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<tr>
<td>1972</td>
<td>169,771</td>
<td>60,139</td>
<td>—</td>
<td>13,932</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>243,842</td>
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<tr>
<td>1973</td>
<td>276,640</td>
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<td>18,470</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>384,023</td>
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<td>1974</td>
<td>267,673</td>
<td>93,820</td>
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<td>18,391</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>379,884</td>
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<tr>
<td>1975</td>
<td>174,195</td>
<td>75,175</td>
<td>—</td>
<td>17,509</td>
<td>11,455</td>
<td>—</td>
<td>1,235</td>
<td>—</td>
<td>—</td>
<td>279,569</td>
</tr>
<tr>
<td>1976</td>
<td>311,959</td>
<td>100,035</td>
<td>—</td>
<td>21,737</td>
<td>4,361</td>
<td>1,952</td>
<td>7,522</td>
<td>—</td>
<td>—</td>
<td>457,586</td>
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<tr>
<td>1977</td>
<td>349,258</td>
<td>125,215</td>
<td>—</td>
<td>22,156</td>
<td>4,066</td>
<td>1,486</td>
<td>13,877</td>
<td>—</td>
<td>—</td>
<td>516,038</td>
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<tr>
<td>1979</td>
<td>468,990</td>
<td>174,270</td>
<td>37,638</td>
<td>44,011</td>
<td>3,605</td>
<td>380</td>
<td>348</td>
<td>3,780</td>
<td>735</td>
<td>733,757</td>
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<tr>
<td>1980</td>
<td>535,985</td>
<td>206,187</td>
<td>42,010</td>
<td>46,235</td>
<td>3,110</td>
<td>85</td>
<td>100</td>
<td>8,019</td>
<td>256</td>
<td>841,986</td>
</tr>
</tbody>
</table>

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Zero or negligible.

Note: The fertilizers designated in the table are: TSP, triple superphosphate; DAP, diammonium phosphate; MP, muriate of potash; HP, hyperphosphate; SP, superphosphate; AS/PS, ammonium sulfate; NPK, nitrogen phosphate potassium; and TP, triple phosphate.

Source: Bangladesh Agricultural Development Corporation.
in fertilizer use of about 18 percent. This would imply the consumption of about 1.9 million tons of fertilizer in FY1985, compared with 840,000 tons in FY1980. Whether such levels can actually be sustained remains to be seen and will depend on improvements in the supply and distribution of fertilizer, accelerated progress in increasing irrigation and drainage, as well as improvements in supporting services. Given the pent-up demand evident in the past, the availability of additional fertilizer supplies will make other inputs more effective. The expected output response could be quick, since the fertilizer technology is simple and well known to Bangladesh farmers.

Agrarian Structure

The most striking feature of the agrarian structure is the growing pressure of the rural population on land. According to the Bangladesh Bureau of Statistics, the rural population grew by 35 percent between 1961 and 1974, making rural Bangladesh one of the most densely populated areas in the world. In 1974 rural areas contained an average of 2,030 persons per square mile, with some rural areas such as those in the Comilla district containing more than 3,000 people per square mile. Consequently, the size of landholdings has been declining, and about 60 percent are now estimated to be less than three acres.

Even with high population densities and small holdings, ownership of land has become increasingly concentrated in a small percentage of households. Evidence for 1977 indicates that 3 percent of households own more than 25 percent of all land, and 11 percent own more than 52 percent of the total. In contrast, one-third of rural households own no agricultural land and, together with those owning less than half an acre, the effectively landless constitute about 48 percent of the rural population.5

LAND TENURE. A disturbing consequence of population pressure is the land tenurial arrangements, which reflect the high value of land and therefore the economic strength of the landowners, particularly in relation to the functionally landless. An increasing percentage of farmers (30 to 35 percent) have sharecropping arrangements under which the tenants generally bear all the input costs, but usually receive only 50 percent of the output. Patron-client relations and the sharp unevenness of income distribution contribute to an inequitable access to crucial agricultural inputs and other services. These factors, combined with recurring adverse

5. Ibid.
weather, seriously impede the ability of small farmers to modernize agriculture.

It is widely believed that sharing of gross output with landlords leaves tenants insufficient incentives to invest in modern inputs. It might be argued that landlords could also benefit from investment, and if it were profitable to do so they would vary tenurial arrangements and invest jointly with the tenants. The 1977 Land Occupancy Survey indicates, however, that landlords did not act in this manner, and less than 1 percent of them provided agricultural inputs to tenants. There is also some evidence that in the northwest region of Bangladesh, where sharecropping is relatively more widespread, productivity is lower, particularly in comparison with the southeast region.

RURAL INCOME AND EMPLOYMENT. Whether or not productivity is independent of the tenurial arrangement, the present trend in landownership is symptomatic of a deeper problem: lack of productive employment opportunities for the rural population and the resulting pressure on land. With most of the land under the plow, virtually no possibility exists for further extending the cultivated acreage. The rural population has been growing by about 2.2 percent annually since 1960, while according to a recent estimate the annual rate of increase of labor requirements in crop production between 1960 and 1976 was 1.2 percent. The Ministry of Agriculture reports that the agricultural real wage, as a result, declined from about Tk2 per day in the mid-1960s to about Tk1.5 in the mid-1970s. There have been two published surveys of nutrition in rural Bangladesh, one made in 1962–64 and the other in 1975–76. The first survey indicated that 45 percent of all rural families had caloric intakes below the recommended daily minimum of 2,120 calories. According to the second survey this percentage had grown over the decade to 59 percent of rural families. According to the 1975–76 survey, the daily per capita intake of food in the rural areas declined from 2,224 calories in 1962–64 to 2,094 in 1975–76 (about 6 percent).

The above indicators of rural well-being do not extend to the period beyond 1975–76, when an upturn took place in the agricultural sector. Nevertheless, they serve to highlight the critical need to develop strategies to absorb the growing rural population in productive employment. In rural areas, ways and means need to be found to develop a large number of employment-oriented activities. These could include agriculture-related

schemes such as small-scale irrigation and drainage and nonagricultural activities such as cottage and small-scale industries and, to some extent, the development of the service sector.

Government Price Policies

The overview of the food-grain subsector indicated the potential for, and some of the constraints to, raising production and sharing the gains thereof. A successful agricultural strategy should facilitate greater productivity on the part of a majority of farmers, most of whom have small holdings, and would ensure not only that growth is significant but also that the resulting benefits are shared. Sustained and significant expansion in production in the long run will depend on improvements in the physical and institutional conditions faced by farmers. For these long-run measures to be fully rewarding, rational price policies are clearly essential to provide farmers adequate incentives to participate in programs aimed at raising farm productivity. If optimal farm incentives for food-grain production already exist, government price interventions are likely to result in the loss of efficiency. But if the existing output and input markets are not functioning optimally owing to a variety of circumstances, certain interventions may pay off. For example, if farm prices tend to be depressed, particularly at harvesttime, under existing circumstances, price support may help reduce price risks faced by farmers and encourage farm investment. Reasons for depressed harvest prices could be several—large aid imports and subsidized grain distribution, forced government procurement at below market prices, monopsony and other market imperfections, seasonality of production combined with storage, transport, and other physical and financial constraints faced by farmers. In the case of wide and systematic seasonal price variation, price stabilization may also be helpful. Expectation of a stable price level can help farmers in production planning while consumers could gain from a dampening of price peaks. Another instance in which a particular price policy may be beneficial is in the early stages of adoption of a modern input such as fertilizer. If it does not find wide acceptance among farmers because of ignorance, risk aversion, or other reasons, a fertilizer subsidy that stimulates increased application may be beneficial in the initial years.

The government has used a variety of price interventions which are detailed in subsequent sections. Some of these policies may be socially beneficial, given the prevailing constraints and market imperfections. Others may not be so, and may involve a net cost. There may be yet other policies which have not been adopted but which may be socially beneficial.
Table 3-7. Bangladesh: Average Wholesale Prices of Coarse Quality Rice
(taka per maund)

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<td>106</td>
<td>130</td>
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<td>190</td>
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a. Fairly stable prices in 1976 and 1978 coincided with “normal” crops and large government purchases from farmers following harvests.

Note: The country averages hide larger price variations across locations.

Source: Ministry of Agriculture.

Seasonality of Production

Price fluctuations arise from yearly variations in the output of various crops (table 3-7) and from the sharp seasonality of production. Bangladesh has three rice crops a year (figure 3-1). Aus, based on recent data, accounts for 31 percent of rice acreage and 23 percent of production. It is sown between March and May and harvested between July and September. Aman accounts for 58 percent of rice acreage and production. Sown after April, it is harvested between mid-November and mid-February. Thus, nearly 55 percent of the annual crop is harvested in about three months. Boro is 11 percent of acreage and 19 percent of production. It is transplanted from November to February and harvested from April to June. Wheat, a winter crop, now constitutes 6 percent of cereal production and output has been growing rapidly in recent years.

Production of these various crops is shown in table 3-2. The size of the aman crop in relation to the others implies that a sizable part of it must be stored for much of the year. Estimates of the size of the population not producing any food grains also indicate that marketing of food grains must be substantial—well over 50 percent according to some calculations. It is also observed that subsistence farmers with very little marketable surplus sell some of their crop to meet their financial obligations. Several micro studies indicate that small-scale farmers make distress sales during or immediately following harvests, but buy grains later in lean periods. Har-
Figure 3-1. Bangladesh: Crop Seasons for Major Food Grains and for Jute

<table>
<thead>
<tr>
<th>Crop season</th>
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<th>September</th>
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Source: Ministry of Agriculture and Bangladesh Bureau of Statistics.
THIE EFFORT TO RAISE FOOD PRODUCTION

Vest prices, particularly in the aman season—when most of these sales by small-scale farmers take place—tend to be depressed. Prices at the end of the boro and aus crop seasons—when small-scale farmers enter the market as buyers—tend to be higher. For instance, in FY1977 the average wholesale price of aman paddy at harvest (December) was Tk53 to Tk58 per maund in surplus districts and Tk58 per maund nationwide, compared with the government's procurement price of Tk74 per maund.7 By June of the same year, the national average wholesale price of paddy reached Tk93 per maund.

Table 3-7 indicates seasonal and year-to-year variation in rice prices, which reflect the seasonality of production and yearly variations in its level. Rice prices typically decline following the aman harvest (figure 3-1)—in some years by a large margin—and increase particularly in July, August, and September. Sharper seasonal price variations for a longer time series are shown in figure 3-2.

**Significance of Rice and Its Price**

**PRODUCERS AND CONSUMERS.** Implications of changes in rice prices for producers in Bangladesh can hardly be overstated. There are some 9 million farm households in Bangladesh operating farms of an average size of 2 to 2.5 acres. Because rice is the principal crop, its quantity and price are the main determinants of farm incomes. Small-scale and marginal farmers are generally most vulnerable to declines in output and price. In times of crop failure these farmers may not be able to sell anything; and to the extent that they sell during or immediately following the harvest in circumstances of distress before prices fully respond to the crop shortage, they gain relatively less from any price increases. Following good crops, prices decline—sometimes (for instance, at the 1975 and 1977 aman harvests) by large margins—drop that seriously affects the income position of farmers, particularly those who must sell their crop at harvest-time. In the face of such price declines, a good crop may even reduce the overall income of some farmers.

Price declines following good harvests may have a serious negative effect on investment for the next crop. A 1977 World Bank study analyzed the adverse effect on productivity of harvest prices' declining below incentive levels.8 During the 1970s farmers cut back acreage sown to rice, particularly to HYV rice, and reduced their investment in rentals of irrigation

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7. A maund equals about 82 pounds or 37 kilograms.
equipment and purchase of fertilizer partly in response to low harvest prices following good crops. The reported decline in overall farm investment in modern inputs in FY1977 following a record crop and low prices in FY1976 is a case in point.

Since rice accounts for nearly 60 percent of average household expenditure and almost 85 percent of total caloric intake, rice supply is a major determinant of overall consumption and nutritional levels. Crop failures and resulting food shortages cause acute deprivation, particularly to the small-scale and marginal farmers, the landless, the unemployed, and other poor consumers. Within the year, there is considerable seasonal variation in rice consumption. According to the 1975-76 Nutrition Survey, during the lean months, particularly August through October, rice consumption of the poorer sections of the population declines significantly. Thus seasonal and year-to-year declines in rice supply and the consequent price
Table 3-8. Bangladesh: Food-grain Imports by Month (thousand long tons)

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<td>779</td>
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<td>191</td>
<td>124</td>
<td>69</td>
<td>140</td>
<td>96</td>
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</table>

— Zero or negligible.

Source: World Food Programme, Dacca.

increases have serious implications for the real income position of consumers, particularly the low-income consumers.

COMPETING CROPS: JUTE. Changes in rice prices may have important implications for the area devoted to the production of alternative crops. Jute is such a crop. Half the 2 million acres devoted to jute is considered jute specific, but the remaining half is suitable for and competes with the aus rice, which usually occupies about 8 million acres. The planting and harvesting of jute roughly overlap with that of aus, although variations in these timings are possible for jute depending on the varieties in question. With its coverage of nearly 20 percent of the total cropped area during the aus and jute growing season and its high labor intensity (about 120 man-days per acre), jute cultivation is a major source of employment and cash income for cultivators and landless laborers. Jute is also the basic raw material—accounting for about 50 percent of production costs—for the country's most important manufacturing and export industry. Exports of jute fiber and jute goods together provide more than 70 percent of Bangladesh's foreign exchange earnings every year.

The output of jute has fluctuated considerably during the 1970s. One reason for these year-to-year changes has been that jute acreage has varied in response to changes in the ratio of jute price to aus paddy price. When, for example, this ratio fell to much below unity in FY1975, jute cultivators sowed aus on a record 8.45 million acres the next season. From FY1976
to FY1979 the jute–aus paddy price ratio improved in favor of jute, approaching 2 by FY1978. This was a major factor in the farmers' decision to increase jute acreage to about 2 million acres in that year. The relation between the prices and acreage of rice and jute underlines the need to consider the implications of rice production targets and accompanying price incentives on the prospects for jute cultivation.

In the past the government has considered a price ratio between rice and jute of about 1.3 as appropriate for balancing the incentives for farmers to allocate acreage to both jute and aus in the desired proportion. The paddy-jute price ratio implicit in this relation was thus roughly 0.87. While the continued acceptance of this particular ratio as a primary policy determinant may be questioned, any changes in the procurement prices for paddy and rice should be made after taking into account their potential reverberations on jute acreage and production and the desirability or need for the government effectively to support jute prices also.

In recent years the government has invested in the Intensive Jute Cultivation Scheme to expand yield-increasing and cost-lowering practices. This investment policy is intended to lower farmers' cost of production and hence the jute price incentive required by farmers. Given a tight land situation, the policy seeks to obtain the "optimal" level of jute output from as little jute acreage as possible. Unfortunately, no consensus exists on what level of jute output is optimal. In view of a declining trend in world demand for jute and responses in world prices to increases in supply, the desirability for some upper limit on jute output has been noted. These factors indicate the importance and limits of rice-jute competition. If rice price policy supports farm-gate harvest prices of aman (and even boro) and achieves some degree of seasonal stabilization in the remaining part of the year (particularly during and following the harvesting of jute), the profitability of jute cultivation—which competes mostly with aus—need not necessarily be affected.

Public Food-grain Distribution

A consequence of Bangladesh's chronic food shortage has been an extensive involvement by the government in the acquisition and distribution, particularly in the urban areas, of food grains and in the maintenance of some security food-grain stocks for crisis situations. Government distribution of imported (table 3-8) and domestic food grains has varied roughly between 1.5 million tons and 2.0 million tons of rice and wheat, or more than 15 percent of the annual food-grain consumption in recent years (tables 3-3 and 3-9). The government has carried out the public food-grain distribution at subsidized prices. A major part of imports—particularly
Table 3-9. Bangladesh: Total Monthly Offtake of Food Grains from the Ration System (thousand long tons)

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<td>Total</td>
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<td>1,669</td>
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<td>Monthly average</td>
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<td>146</td>
<td>139</td>
<td>123</td>
<td>154</td>
<td>150</td>
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Source: World Food Programme, Dacca.

The wheat component—is received on aid terms, and even at subsidized prices the sale of these imports represents some positive contribution to the government budget. On the whole, however, the government incurs a sizable loss in resources foregone on account of its overall food-grain operations. In so doing, the government tries to meet some of its distributional objectives. Most important, food-grain subsidies are intended to ensure that relatively low-cost food reaches certain segments of the population. Part of the subsidy under the current rationing system also stems from the domestic food-grain purchases at guaranteed minimum prices under the government's farm price support program.

Table 3-3 summarizes the food-grain operations of the government in recent years. Until FY1975 government procurement of domestic grain was limited and generally at prices 60 to 80 percent below market levels (see chapter 7 for details). Since FY1976 procurement prices have been attractive and the program has been entirely voluntary. Most of the procurement takes place during the aman season in the months of December and January (table 3-10). About 550,000 tons of food grains, or roughly 30 percent of the ration, were bought domestically in FY1978. That year's effort was meant not only to acquire grains for distribution but also to support harvest farm-gate prices, which traditionally fall below incentive levels following a good harvest. Rice (per maund) was bought at Tk132 (and paddy at Tk84) and sold in the ration system at Tk90 for half the
Table 3-10. Bangladesh: Procurement of Food Grains by Crop and Type

(maunds)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aus, total</td>
<td>—</td>
<td>1,698,730</td>
<td>1,103,594</td>
<td>41,104</td>
<td>630,967</td>
</tr>
<tr>
<td>Paddy</td>
<td>—</td>
<td>2,389,643</td>
<td>76,655</td>
<td>59,601</td>
<td>805,806</td>
</tr>
<tr>
<td>(Rice equivalent)</td>
<td>—</td>
<td>(1,594,095)</td>
<td>(51,110)</td>
<td>(39,734)</td>
<td>(537,264)</td>
</tr>
<tr>
<td>Rice</td>
<td>—</td>
<td>105,635</td>
<td>4,187</td>
<td>3,370</td>
<td>93,703</td>
</tr>
<tr>
<td>Aman, total</td>
<td>3,460,884</td>
<td>9,184,884</td>
<td>8,239,880</td>
<td>13,562,032</td>
<td>5,657,747</td>
</tr>
<tr>
<td>Paddy</td>
<td>4,861,027</td>
<td>11,511,127</td>
<td>8,704,043</td>
<td>14,244,458</td>
<td>6,643,882</td>
</tr>
<tr>
<td>(Rice equivalent)</td>
<td>(3,240,685)</td>
<td>(7,674,085)</td>
<td>(5,802,093)</td>
<td>(9,496,305)</td>
<td>(4,429,255)</td>
</tr>
<tr>
<td>Rice</td>
<td>220,199</td>
<td>1,510,799</td>
<td>2,457,183</td>
<td>4,065,727</td>
<td>1,228,492</td>
</tr>
<tr>
<td>Boro and IRRI total</td>
<td>291,222</td>
<td>157,722</td>
<td>144,721</td>
<td>1,000,798</td>
<td>2,262,385</td>
</tr>
<tr>
<td>Paddy</td>
<td>430,726</td>
<td>235,251</td>
<td>174,478</td>
<td>1,192,472</td>
<td>2,856,767</td>
</tr>
<tr>
<td>(Rice equivalent)</td>
<td>(287,151)</td>
<td>(156,834)</td>
<td>(116,319)</td>
<td>(928,135)</td>
<td>(1,904,511)</td>
</tr>
<tr>
<td>Rice</td>
<td>4,061</td>
<td>888</td>
<td>28,402</td>
<td>80,483</td>
<td>357,874</td>
</tr>
<tr>
<td>Rice, total</td>
<td>3,752,095</td>
<td>11,146,484</td>
<td>8,459,898</td>
<td>14,613,934</td>
<td>8,551,099</td>
</tr>
<tr>
<td>Paddy</td>
<td>5,291,753</td>
<td>14,213,743</td>
<td>8,955,186</td>
<td>15,696,531</td>
<td>10,306,545</td>
</tr>
<tr>
<td>(Rice equivalent)</td>
<td>(3,527,835)</td>
<td>(9,529,162)</td>
<td>(5,970,124)</td>
<td>(10,464,354)</td>
<td>(6,871,030)</td>
</tr>
<tr>
<td>Rice</td>
<td>224,260</td>
<td>1,617,322</td>
<td>2,489,774</td>
<td>4,149,580</td>
<td>1,680,069</td>
</tr>
<tr>
<td>Wheat</td>
<td>—</td>
<td>181,368</td>
<td>77,147</td>
<td>100,137</td>
<td>1,352,097</td>
</tr>
<tr>
<td>Food grains, total (rice equivalent)</td>
<td>3,752,095</td>
<td>11,327,842</td>
<td>8,537,045</td>
<td>14,914,271</td>
<td>9,904,096</td>
</tr>
<tr>
<td>Paddy (percent)</td>
<td>94.0</td>
<td>84.1</td>
<td>69.9</td>
<td>70.2</td>
<td>69.4</td>
</tr>
<tr>
<td>Milled rice (percent)</td>
<td>6.0</td>
<td>14.3</td>
<td>29.2</td>
<td>27.8</td>
<td>17.0</td>
</tr>
<tr>
<td>Wheat (percent)</td>
<td>—</td>
<td>1.6</td>
<td>0.9</td>
<td>2.0</td>
<td>13.7</td>
</tr>
<tr>
<td>Food grains, total (by weight)</td>
<td>5,516,013</td>
<td>16,092,423</td>
<td>11,522,107</td>
<td>20,146,448</td>
<td>13,339,611</td>
</tr>
<tr>
<td>Paddy (percent)</td>
<td>95.9</td>
<td>88.8</td>
<td>77.7</td>
<td>77.9</td>
<td>77.3</td>
</tr>
<tr>
<td>Milled rice (percent)</td>
<td>4.1</td>
<td>10.1</td>
<td>21.6</td>
<td>20.6</td>
<td>12.6</td>
</tr>
<tr>
<td>Wheat (percent)</td>
<td>—</td>
<td>1.1</td>
<td>0.7</td>
<td>1.3</td>
<td>10.1</td>
</tr>
</tbody>
</table>

— Zero or negligible.

a. A variety developed by the International Rice Research Institute.

Source: Ministry of Food.
year and Tk100 the rest of the year. Wheat (per maund) was bought at Tk84 and sold at Tk70 during part of the year and Tk80 in the remainder. In FY1979 purchases fell to about 355,000 tons of rice and wheat, primarily because of a poor crop. About 50,000 tons of wheat were domestically bought, however, out of a record wheat crop. The procurement prices in FY1979 were the same as the previous year's. At the end of FY1979 the ration prices were increased to Tk120 per maund for rice and Tk90 per maund for wheat. For FY1980 the government announced early in the aman season procurement prices for rice and paddy of Tk158 and Tk100 per maund respectively, which were later increased to Tk170 and Tk110 per maund respectively. The procurement price for wheat was raised to Tk110 per maund. Thus in FY1980 the rice and the wheat prices were raised by roughly 30 percent; at the official exchange rate these imply prices of roughly $300 a ton for rice and $200 a ton for wheat.

Domestic purchase of food grains at support prices and their sale at lower prices have meant a substantial cost to the government. The unit subsidies (that is, purchase cost plus all handling costs, minus sale price) on domestic rice and wheat in FY1979 were about Tk63 and Tk28 per maund respectively, or about Tk60 per maund on the average. Total subsidy on sales of domestically bought grains was more than Tk630 million in FY1978. The effect of the sharp increases in procurement prices for rice and wheat in FY1980 on the unit subsidy was expected to be partly offset by increases in the ration prices.

**Government Distribution of Fertilizer**

Because of the traditional nature of Bangladesh agriculture, the government has also propagated the use of modern inputs. The Bangladesh Agricultural Development Corporation handles almost all fertilizer purchases and sales. It sells fertilizer, as well as other modern agricultural inputs, at substantially subsidized prices, which averaged about Tk65 per maund below the world price in FY1979. Although the sale of aid imports of fertilizer represent a positive budgetary contribution, the subsidized sale of all fertilizers sometimes implies a net cash loss and always a sizable amount of forgone financial resources to the government. As in the case of food grains, however, the government tries to meet some of its economic and social goals through this subsidy program. Subsidized fertilizer distribution is intended to stimulate the use of this input and to raise food-grain production and perhaps also to redistribute some income to the farm sector.

The low unit subsidy on fertilizer sales in FY1975 (Tk20.5 per maund below world prices) increased rapidly to Tk65 per maund, or 50 percent
Table 3-11. **Bangladesh: Fertilizer Subsidy**

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Subsidy per unit of sales (taka per munda)*</th>
<th>Total (million taka)</th>
<th>Percentage of development expenditure for agricultural sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>n.a.</td>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>1975</td>
<td>20.5</td>
<td>150</td>
<td>9</td>
</tr>
<tr>
<td>1976</td>
<td>40.2</td>
<td>485</td>
<td>16</td>
</tr>
<tr>
<td>1977</td>
<td>46.5</td>
<td>644</td>
<td>19</td>
</tr>
<tr>
<td>1978</td>
<td>60.9</td>
<td>1,183</td>
<td>30</td>
</tr>
<tr>
<td>1979</td>
<td>65.2</td>
<td>1,301</td>
<td>25</td>
</tr>
</tbody>
</table>

n.a. Not available.

a. These subsidy rates indicate the differences between the sale price and the relevant world price.

*Source:* Bangladesh Agricultural Development Corporation.

of purchase cost, in FY1979 (table 3-11). The total subsidy increased even faster because of the increase in sales. In FY1978 and FY1979 the subsidy on fertilizer distribution was more than Tk1,000 million, or 25 to 30 percent of all development expenditures by the government in agriculture. In FY1979 the government planned to lower the unit subsidy by increasing the fertilizer sale price about 28 percent, but it was estimated to be offset by cost increases. The total subsidy was estimated to have increased in that year because of larger sales.⁹

**Government Objectives and Price Policies**

The social benefit of raising domestic food production is generally considered obvious. If this is so, policymakers can be best assisted by an evaluation of the government's program cost and the social cost of operating alternative policies to increase production. In chapter 7 alternative price policies are considered, with the benefit (a given increase in output) the same under each. Ways of measuring the cost of these policies are then illustrated.

Several factors govern the effectiveness of price policies in a country such as Bangladesh. First, the scope of price incentives is likely to be a function of the elasticity of input supplies. For example, the benefits from

price support depend on the ease with which farmers can obtain additional inputs in response to the price incentive. A fertilizer subsidy would have little effect on production if fertilizer supplies were limited. Clearly, direct investment to increase the supply of inputs is a requisite for deriving benefits from price incentives. To the extent that the access to new technology can be significantly improved by making modern inputs more available, price incentives may provide substantial long-term benefits by facilitating adoption of the new technology in a dynamic context. Second, price incentives to rice producers should be viewed in relation to growth in the rest of the economy. In a country where rice looms large in income and consumption, any incentive in the form of a potential increase in income from rice production would be beneficial and effective only if the production of other goods and services were increased. Growth in productive employment outside the rice subsector would itself serve to raise the effective demand for rice, thereby providing increased incentives for rice production. Thus both types of policies—raising direct investment in input-augmenting schemes and generating productive employment outside agriculture—deserve emphasis.

The government is clearly aware of the need for basic improvements in and outside agriculture. Consequently, it has been increasing direct investment to expand the supply of agricultural inputs, although the resources available have been far from adequate. Even fewer financial resources have been available for employment-generating schemes outside agriculture. In the case of many of these investments it is likely to take considerable time before benefits begin to accrue. In the meantime, price policies, which may be essentially second best, have been resorted to. The reliance on price interventions has grown, which calls attention to the cost attending them.

Among the price policies followed by the government, three important areas should be singled out for analysis: (a) food-grain procurement price and quantity; (b) food-grain ration price and quantity; and (c) fertilizer price and quantity. Discussed are the effects of these policies on food output and food prices and their program cost and resource cost.

Effects of Policies on Output and Price

PRICE SUPPORT. Price support through government acquisitions of grains is intended to complement input policies by assuring farmers that if they invest in modern inputs and raise production, farm-gate prices at harvest will not fall below minimum incentive levels. To the extent that price support is effective and investment opportunities are available and farmers respond to them, the policy will facilitate farm investment and
reduce production costs with the short-term and long-term benefits of higher output and lower prices. If ways can be found to reach the small-scale farmers, support of a *minimum* price at harvest can have the greatest benefit for those who sell part of the crop during or immediately after harvest.

The effectiveness of a price support program in raising output depends on a variety of factors. First, the output response depends on whether the support price is set at a level that provides farmers the incentive to invest in modern inputs. Second, a majority of farmers would respond to the potential benefit from the price support only if the price is announced well ahead of the season, if the farmers know it, and if the government buys all that is offered at the minimum price. In Bangladesh a variety of constraints have limited the program's effectiveness in providing a true price support at the farm-gate level to most small-scale farmers. The workings of the price support program must be improved if it is to help the majority of farmers. Third, and most important, the output response to an incentive price hinges on the price elasticity of supply, which depends critically on the timely availability of farm inputs in the proper mix. This elasticity is likely to be larger, the longer the length of time under consideration.

To have a positive effect on production, price support may not need to raise average prices during the year. According to a 1979 World Bank study, farm-gate prices following a good harvest have been more than 25 percent below government procurement prices in some surplus districts.\(^\text{10}\) Large divergences are also often reported between farm-gate and market prices. Whether these are due to market imperfections needs to be investigated. There may, however, be considerable scope for making a given purchase price effective to more farmers. Thus without raising prices, some positive effect on production may come simply from ensuring greater competition in grain purchases from farmers.

Chapter 7 gives some estimates of possible responses in marketed supply to price support, which should be considered only illustrative. A low short-run supply elasticity of 0.1 is assumed for the most part. The analysis focuses on market supply, which according to the earlier discussion refers to at least 50 percent of the crop. The illustrative scenarios adopt a more conservative assumption that only 30 percent of the crop is marketed.

RATIONED DISTRIBUTION. The distribution of government acquisitions influences price and output. The government can sell grains year-round at a subsidy (as done now) or use procurement out of a large crop

\(^{10}\) Ibid.
for market sales during lean seasons. Selective market sales would help lessen seasonal price variations, would perhaps lower the average market price during the year (which—rather than the ration price—is relevant for more consumers), and would certainly have lower program costs than rationed distribution (see chapter 7). Ahmed concludes that stabilizing seasonal fluctuations of food-grain prices may also improve the nutritional status of poor consumers. The 1979 World Bank study on food policy also indicates that market sales and price stabilization may have important nutritional benefits because of the grains acquired under a price support policy.12

The effect of sales of purchased grains on farm incentives also needs to be considered. In a strict one-period situation with no change in imports and stocks, to have an effect on production, the government would have to operate a two-tiered price system with a price support for producers and a lower price for consumers. (If imports were lowered or stocks built up, however, this would not be necessary.) In Bangladesh, which has more than one clearly defined season, price support and production incentives in the first season when supplies are relatively large need not always be affected by sales at market price—which could equal or even


Strictly from the point of view of economic principles, and assuming a declining marginal utility from consumption of foodgrains, the total utility derived from a given quantity of foodgrains will be higher if consumption is evenly distributed over the year than if more is consumed in the first half and less is consumed in the second half of the year. This may also be true of the technical relationship between nutrition and distribution of food intake within a consumption period. Seasonal variations in activity levels and energy requirements do not seem to be consistent with variations in seasonal supplies of foodgrains. For example, the harvesting and threshing of Aman rice constitute only about 30% of the total labor requirement for growing the crop; the other 70% of the total labor requirement falls within the period July—September, when price levels are generally high. See Raisuddin Ahmed, “Economic Analysis of Tubewell Irrigation in Bangladesh” (Ph.D. dissertation, Michigan State University, 1972). Energy requirements of the non-agricultural labor force are more evenly distributed over time than those of the agricultural labor force, because nonagricultural activities are less seasonal. This suggests that a reduction in seasonal fluctuations of foodgrain prices is desirable for improving the nutritional status of consumers (workers), and perhaps also for increasing the productivity of labor.

12. According to Nutrition Survey of Rural Bangladesh, 1975—76, total food intake is higher in the first six months of the year than in the last six months. In late October and early November, just before the aman harvest, food intake of all groups is at its lowest. Low consumption is observed also before the aus harvest. Thus most of the serious malnutrition occurs from late September to mid-November and June to mid-July.
exceed the support price—in the remainder of the year when supplies are small. (In comparison, rationed distribution in the first season of surplus would make the task of price support more difficult.) Harvest prices in the lean seasons may not be lowered if market sales are timed to affect end-of-season prices. How all these may affect private traders' behavior in the next year needs to be investigated. Under competitive conditions and starting with an equilibrium situation, traders might lower their purchases in the first period, given the possibility that the government would lower prices in the lean periods. If so, government acquisitions would have to increase more in the second year. The large seasonal price variations in Bangladesh suggest storage and other constraints.

It may be realistic to assume, therefore, that in the short run, government purchases from a large crop for sales in lean periods could have a positive effect on production without seriously reducing private trading activity which otherwise could reduce any government impact. Market sales, however, cannot provide food grains at prices low enough for the very poor. Therefore, part of the government stocks may need to be used to subsidize grain for the needy and vulnerable groups throughout the year. Use of the lower cost cereal (wheat), rather than rice, would enable the government to reach more people. Furthermore, the sale of wheat throughout the year at subsidized prices to the poor may not create much disincentive to rice production. First, rice and wheat in Bangladesh are not perfect substitutes in consumption. Second, if the subsidized sales are to people who have not been purchasing much food in the market, not much reduction in market demand is likely on account of their increased consumption of the ration.

FERTILIZER SUBSIDY. Incentives to raise output can also be provided by lowering the prices of farm inputs. A lower fertilizer price reduces farmers' incremental cost of production and increases farmers' demand for fertilizer and for other inputs depending on the elasticity of substitution, income effect, and elasticity of supply of other inputs. If sufficient quantities of fertilizer are available to meet the increased demand and if the additional fertilizer is properly applied, food production will increase. The extent of the response of output to a fertilizer subsidy depends on a variety of other factors. First, the output response relies on the farmers' incremental demand for fertilizer induced by the subsidy. Second, it depends on the contribution to output of fertilizer and the substitutability of fertilizer for other inputs. These factors are contained in the elasticity of food-grain output with respect to the fertilizer price. This supply elasticity of food grains with respect to the fertilizer price is more indirect and likely to be smaller than (or at best the same as) the direct supply
elasticty with respect to the output price (see chapter 7). A subsidy rate that is large enough, however, can obviously bring about the same output response as a price support program. As in the case of price support, the actual impact of a fertilizer subsidy on output depends critically on the timely availability of fertilizer and other inputs, particularly water.

A lower fertilizer price tends to reduce the market price of food grains in accordance with how much of a shift in output it facilitates. The long-term effect on market price will depend on the extent of the overall supply response that can be sustained through this policy.

Thus a fertilizer subsidy or price support may help raise output and stabilize food-grain prices. The effectiveness of these policies in so doing, however, is shown by the cost of operating them. The cost to the government and society of these policies could be different for a variety of reasons, some of which have already been mentioned. The following section discusses the government program cost and the resource cost of price support and fertilizer subsidy.

Cost of Price Policies

Chapter 7 discusses factors explaining the basic advantages and disadvantages of the two approaches and indicates circumstances under which one may be superior to the other. While the absolute merits of the two policies are important, it is also essential to determine the costs of attempting to achieve a certain additional output response by a change in policy, that is, by increasing the price support or the fertilizer subsidy. It will be clear from chapter 7 that the incremental cost of the two policies depends very much on how much of a price support or fertilizer subsidy already exists.

The government’s program cost of each policy is based on (a) the direct cost of a higher subsidy on all existing units of grain procurement or fertilizer and (b) the indirect cost of handling additional units—of grain procurement or fertilizer—induced by the policy. If both policies are simultaneously in effect, a change in one policy would lead to an additional indirect cost of operating the other policy; for instance, a higher price support might induce more fertilizer use and therefore raise the total fertilizer subsidy.

The direct cost to the government under each policy turns out to be a financial transfer to producers and consumers. If no distributional weights are attached, these transfers would not represent a resource cost. The indirect cost, however, represents a resource cost since it implies certain induced inefficiencies.
Chapter 7 considers the Bangladesh situation with both policies in effect and shows that in recent years the program cost of inducing higher production through either policy has been large. Netting out the financial transfer to producers, a much smaller resource cost is obtained under both policies. Whether this is a net resource cost to society depends on whether the output and input prices from which changes were considered fully represent social valuation.

When starting from the 1977-79 situation, price support is more cost efficient in inducing higher production than an input subsidy (previous section and chapter 7); the incremental cost of policies is also affected by assumptions relating to the initial situation. During 1977-79 the fertilizer price was already low (about 50 percent of world prices) under a much tried fertilizer subsidy program. In that period, while more than 4 kilograms of paddy were estimated to be required to buy 1 kilogram of nitrogen in India, the estimate for Bangladesh was less than 2. Hence, any reduction in fertilizer price is calculated to show a larger incremental resource cost than a price support which at that time was well below world prices. A different conclusion about the relative efficiency of an incremental change in either policy could result if the existing situation involves a “high” price support and “low” fertilizer subsidy. The government's program cost of these policies is also influenced by these considerations.

The incremental resource cost and program cost are also affected by the way in which the policies are operated. For instance, the incremental program cost of raising the support price would be very large in a strict one-period situation in which the government buys the whole crop for subsidized sale in the same period. If no expansion of subsidized sales is warranted, however, or if the potential exists for seasonal market sales, the incremental program cost could be reduced.

Both the price support and fertilizer subsidy have distributional implications. The policies usually imply sizable financial transfers from the government to producers. Under price support, farmers who produce for the market clearly benefit. Marginally subsistence farmers and those who sell early in the season but buy back grains later are also likely to gain. If harvest price support raises the average price of the commodity, the higher price could get capitalized in the value of land, thus providing a benefit to landowners. The benefit to consumers derives from any ex-

pansion in output and eventual long-term price reduction as well as any seasonal stabilization achieved through grain sales. Under the current government distribution, the majority of rural consumers are not reached.\textsuperscript{15} Thus producers with no marketed surplus and the landless and unemployed benefit from neither price support nor the public distribution as currently operated. The benefit from a fertilizer subsidy is not restricted to producers who market grain. Even those who produce well below subsistence levels could benefit from subsidized fertilizer purchases provided they earn sufficient income outside rice production to enable them to do so. Currently, however, with inelastic fertilizer supplies and reported excess demand at existing prices, the beneficiaries of the subsidies are believed to be predominantly large farmers and traders who have greater access to the input than do small and marginal farmers. The latter may be able to buy fertilizer from the former, but at higher (nonsubsidized) prices. Thus, at least as currently operated, neither the price support nor the fertilizer subsidy may be benefiting the very poor.

Policy Issues

For situations with no nonoptimalities in product and input markets, the discussion has indicated some degree of efficiency losses (measured by estimates of resource cost in chapter 7) from price interventions. Not analyzed fully—though discussed—and not quantified in chapter 7 are any dynamic effects of price policies in the adoption of new agricultural technology. It is possible that in the early years of adoption, price incentives can help propagate the new methods and thus provide longer term benefits, not fully accounted for in the present discussion.

In the discussion in this chapter (and in chapter 7) policies of both price support and fertilizer subsidy are shown to help raise production. If no suboptimality is assumed in the output level or in the input use under existing prices, the policies are also shown to involve resource costs. As currently operated, large program costs also result from the policies. Whether the resource costs represent net costs to society depends on how the additional food production is valued. For two reasons, both deserving further investigation, this cost might be justified, at least for some years. First, policymakers in Bangladesh foresee an increasing reliance on domestic food production to satisfy growing internal demand. It is unlikely that aid imports will grow indefinitely in response to the increasing food requirements. It is also unlikely that Bangladesh will in the short run be

\textsuperscript{15} See Ahmed, \textit{Foodgrain Supply, Distribution, and Consumption Policies}, chap. 5.
### Table 3-12. Bangladesh: Food-grain Procurement Prices, FY1970–80
(taka per maund)

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Effective date</th>
<th>Paddy</th>
<th>Rice</th>
<th>Paddy</th>
<th>Coarse rice</th>
<th>Medium rice</th>
<th>Paddy</th>
<th>Rice</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>Jan. 1, 1970</td>
<td>18.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>29.41</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
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<td>29.79</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>Jan. 15, 1972</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973</td>
<td>Dec. 14, 1972</td>
<td>33.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>53.00</td>
<td></td>
<td></td>
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<td>1974</td>
<td>Nov. 15, 1973</td>
<td>45.0</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>71.69</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1975</td>
<td>Jan. 2, 1974</td>
<td>45.0 + T</td>
<td>71.69 + T</td>
<td></td>
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<tr>
<td></td>
<td>Nov. 15, 1974</td>
<td>74.0 + 3.0</td>
<td>118.0 + 3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Apr. 21, 1975</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Apr. 1, 1976</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sept. 14, 1976</td>
<td>70.0 + 3.0</td>
<td>112.0 + 3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Feb. 19, 1977</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
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<tr>
<td></td>
<td>Apr. 1, 1977</td>
<td>n.c.</td>
<td>n.c.</td>
<td>74.0 + 4.0</td>
<td>118.0 + 4.0</td>
<td>120.0 + 4.0</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
</tr>
<tr>
<td></td>
<td>May 1, 1977</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1978</td>
<td>Aug. 1, 1977</td>
<td>70.0 + 4.0</td>
<td>112.0 + 4.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nov. 15, 1977</td>
<td>n.c.</td>
<td>n.c.</td>
<td>80.0 + 4.0</td>
<td>128.0 + 4.0</td>
<td>130.0 + 4.0</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
</tr>
<tr>
<td></td>
<td>May 1, 1978</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Regular</td>
<td>Medium</td>
<td>High</td>
<td>Dull</td>
<td>IRRI</td>
<td>Boro</td>
<td>Border Belt</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>---------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td>Aug. 1, 1978</td>
<td>80.0 + 4.0</td>
<td>128.0 + 4.0</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apr. 5, 1979</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>86.0 + 4.0</td>
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<tr>
<td></td>
<td>May 2, 1979</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>86.0 + 4.0</td>
<td>136.0 + 4.0</td>
<td>n.c.</td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>Nov. 15, 1979</td>
<td>n.c.</td>
<td>96.0 + 4.0</td>
<td>154.0 + 4.0</td>
<td>n.c.</td>
<td>n.c.</td>
<td>105.0 + 5.0</td>
<td>n.c.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nov. 15, 1979</td>
<td>105.0 + 5.0</td>
<td>165.0 + 5.0</td>
<td>105.0 + 5.0</td>
<td>165.0 + 5.0</td>
<td>105.0 + 5.0</td>
<td>n.c.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- No procurement.
- Not applicable.
- n.c. No price change.

a. The announcement of procurement prices is usually (although not always) made prior to sowing and planting, while the effective date generally denotes the date when government purchases at the announced prices will commence.

b. Prices for IRRI (a variety developed by the International Rice Research Institute) are set equal to those for boro.

c. Different procurement prices were set for the five-mile border belt than for the rest of the country to encourage procurement and discourage smuggling into India.

d. Regular.

e. Five-mile border belt.

f. The procurement price differences for the border belt were eliminated effective January 15, 1972.

g. Effective January 2, 1974, a transport bonus was paid to farmers and traders delivering grains to the purchasing centers. The amount of the bonus depended on the distance traveled to reach the center: 50 paisa for up to five miles, 75 paisa for five to ten miles, and Tk1 for more than ten miles.

h. The variable transport bonus was abolished and replaced by a single uniform transport bonus of Tk3, effective with the procurement price increase of November 15, 1974.

i. Effective February 19, 1977, the transport bonus was increased to Tk4.

j. The higher price quotation for medium quality rice was abolished effective November 15, 1979.

k. The government changed the previously announced procurement prices on November 11, before they became effective.

*Source: Ministry of Food.*
able to raise its exports sufficiently to meet the cost of increasing commercial food imports. Consequently, a premium—not fully reflected by existing domestic prices—may be placed on raising domestic food production, which may offset the resource cost of the policies. Second, domestic market prices of food grains—particularly following good harvests—have remained below world prices. On the one hand, in a country concerned with food self-sufficiency, the value of additional grain production may be indicated by the appropriate world prices. Thus the benefit of policies that raise domestic production may include a premium not fully reflected by domestic prices if they are below world prices. On the other hand, if domestic prices are raised above relevant world prices (at an appropriate exchange rate), the opportunity cost of not importing instead needs to be evaluated (see chapter 2). Both of these reasons indicate the need to consider seriously how agriculture will contribute to the long-term growth of the nation.

In the meantime, price interventions have assumed increasing importance in Bangladesh's development efforts, and the program cost of them has grown. Given the government's very limited resources, any expansion of these policies ought to be analyzed in conjunction with ways of rationalizing present policies and improving their effectiveness. Thus, for instance, more attention could be given to making appropriately chosen minimum support prices for rice and wheat effective for more farmers, rather than simply raising the level of purchase prices. Similarly, policymakers could consider any cost reduction under market sales and seasonal stabilization compared with the present year-round rationed distribution system. Given adequate output prices, the question of whether and how much input subsidies are needed to distribute the limited available supplies could be addressed.

In addition to moving toward more rational and cost-effective price policies, attention needs to be paid to reducing the various physical and socioeconomic constraints to raising production, some of which were mentioned in this chapter. Of utmost importance in Bangladesh are better water control and more irrigation facilities, which help reduce production risks to farmers and improve the worthwhileness of investing in other inputs such as fertilizer. Assured and timely water supply reduces the

16. A comparison of world prices and domestic prices for rice is difficult because of differences in the quality of rice and problems in using official exchange rates. In the past, domestic prices may have been below world prices. Before FY 1975 government procurement prices were below harvest prices, as shown by table 3-12 and argued by Ahmed. Since then, however, government purchase prices have been generally close to harvest prices, and in some recent years they may have helped raise domestic prices at harvesttime.
need for price incentives in the purchase of inputs. In general, there is the need, over time, simultaneously to find complementary or alternative ways of meeting the objectives currently pursued through price policies. One objective in Bangladesh is to provide production incentives to farmers through government purchase of domestic food grains. The need to do so could be reduced over time if storage and transport facilities were improved and credit were made more available to farmers. Furthermore, it would be desirable if price incentives were improved by raising the effective private demand for food. Programs designed to diversify the agricultural sector, and the economy in general, and to generate more productive employment, income, and purchasing power deserve serious attention.
Rice in an International Setting: Thailand

Since World War II, Thailand has been one of the few developing countries fortunate enough to have large surpluses of a food crop, rice, for export. Unlike many developing countries that incur large bills for food imports, Thailand has earned foreign exchange by exporting its rice. The dependence on rice exports, however, has also posed problems. The international market for rice is highly unstable, with widely fluctuating prices. Since rice constitutes a high percentage of the national income of Thailand and is also the main staple for consumption, the government has understandably tried to insulate the domestic economy from world price fluctuations. The taxation of rice exports has been an important means of generating government revenue, and it was believed that the export tax, when varied continuously, could also serve as an instrument for stabilizing the domestic price of rice in the face of world price fluctuations. The export tax proved to be inadequate for this purpose during the crises of the early 1970s, however, and other means of control had to be used.

Proponents of the taxation of rice exports argue that the burden is borne mainly by foreign buyers, while its critics assert that the burden is easily shifted to the farmers in the form of lower prices and is therefore a serious disincentive to increasing rice production. In this chapter we examine the various effects of rice export taxation on the Thai economy. At the outset, a brief discussion of the characteristics of the trade in Asia and of Thai rice policy is presented.

Characteristics of International Rice Trade

The international market for rice is a very thin one. Only about 5 percent of total world production is traded, and this percentage has grown even smaller in the 1970s. Most of the rice production and trade are concentrated in Asia, which accounts for about 90 percent of total world production and 70 percent of international trade. In general, the total rice production of the importing countries is greater than that of the exporting countries (excluding China), but imports are necessary because of high population pressure or unexpected shortfalls in production owing to weather. Rice is also the staple for consumption in the major Asian exporting countries, which usually assure domestic supply by curtailing exports in case of domestic shortage to prevent sharp rises in domestic prices. Because of the residual nature of the international rice trade, poor harvests in exporting or importing countries lead to rather sudden changes in export supply or import demand and wide fluctuations in international prices.

Another characteristic of the rice economy in Asia is the high degree of government intervention in rice production, internal distribution, and trade. About half of international trade is arranged through government-to-government contracts. Concessional sales, mainly by the United States, Japan, and Italy, have occupied about one-third of the international market. Even the commercial market is affected by various government policy instruments such as quotas, export taxes and subsidies, and export regulations. The important role of the government is best highlighted by the great differences in domestic prices of rice among countries. For example, while rice prices in Bangladesh have in recent years approached world levels, Japan and Korea have maintained domestic prices paid to producers at two to four times world levels. Prices paid to producers in Thailand,

however, have traditionally been below world levels. Many other examples could be cited. Differences as great as these would not occur if there were free trade in rice. As Timmer and Falcon have remarked, it is possible that national prices, reflecting national rice policies, could be an ultimate determinant of international prices and the volume of international trade.¹

Rice Policy of Thailand, 1950–79

In the post–World War II period Thailand has ranked as one of the world’s largest rice exporters. In the 1960s it replaced Burma as the largest exporter, and was surpassed in only a few years by the United States and China. The share of Thai rice exports in the international market is usually 20 to 25 percent, although in some years (such as 1972) it reached more than one-third. Paddy accounted for about 60 percent of the planted area in 1978. Rice made up more than 20 percent of the value of Thai agricultural exports, and 13 to 14 percent of total exports in recent years. These percentages have been falling during the past decade as the nation diversifies into the production and export of other commodities (table 4-1). Rubber, corn (maize), kenaf, and tapioca are produced mainly for the foreign market. Their importance in production and export is growing in relation to that of rice, although fluctuations around trends are considerable because of instability in foreign demand (see tables 4-2 and 4-3).

From 1950 to 1955 a multiple exchange rate system was in operation in Thailand and the export of rice was under government monopoly.⁴ This monopoly was abolished in 1955, and the export premium, a fee to be paid as a price for obtaining an export license and in effect an export tax, became the major tool for government intervention. Government-to-government rice exports, suspended in 1955 but later restored, average about 30 to 40 percent of total exports (table 4-1).⁵ Other than the rice premium and the occasional use of quotas, the rice economy of Thailand

⁵. In the case of government-to-government exports, the government negotiates the terms with foreign governments and procures rice at official prices which are lower, thus generating a profit analogous to the rice premium. This is paid by the government to the government agency collecting the premium.
Table 4-1. Thailand: Rice Export

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume (thousand metric tons)</th>
<th>Value (million baht)</th>
<th>Share of rice in total value of Thai export (f.o.b.) (percent)</th>
<th>Volume of government-to-government export as percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962</td>
<td>1,271</td>
<td>3,240</td>
<td>34.0</td>
<td>32</td>
</tr>
<tr>
<td>1963</td>
<td>1,418</td>
<td>3,424</td>
<td>35.4</td>
<td>42</td>
</tr>
<tr>
<td>1964</td>
<td>1,896</td>
<td>4,389</td>
<td>35.6</td>
<td>43</td>
</tr>
<tr>
<td>1965</td>
<td>1,895</td>
<td>4,334</td>
<td>33.5</td>
<td>38</td>
</tr>
<tr>
<td>1966</td>
<td>1,508</td>
<td>4,001</td>
<td>28.4</td>
<td>45</td>
</tr>
<tr>
<td>1967</td>
<td>1,482</td>
<td>4,653</td>
<td>32.8</td>
<td>45</td>
</tr>
<tr>
<td>1968</td>
<td>1,068</td>
<td>3,775</td>
<td>27.6</td>
<td>34</td>
</tr>
<tr>
<td>1969</td>
<td>1,023</td>
<td>2,945</td>
<td>20.0</td>
<td>33</td>
</tr>
<tr>
<td>1970</td>
<td>1,064</td>
<td>2,316</td>
<td>17.0</td>
<td>32</td>
</tr>
<tr>
<td>1971</td>
<td>1,576</td>
<td>2,909</td>
<td>16.8</td>
<td>39</td>
</tr>
<tr>
<td>1972</td>
<td>2,112</td>
<td>4,437</td>
<td>19.7</td>
<td>26</td>
</tr>
<tr>
<td>1973</td>
<td>849</td>
<td>3,594</td>
<td>11.1</td>
<td>37</td>
</tr>
<tr>
<td>1974</td>
<td>1,029</td>
<td>9,778</td>
<td>19.6</td>
<td>29</td>
</tr>
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<td>1975</td>
<td>951</td>
<td>5,852</td>
<td>13.0</td>
<td>38</td>
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<td>1,973</td>
<td>8,603</td>
<td>14.2</td>
<td>50</td>
</tr>
<tr>
<td>1977</td>
<td>2,046</td>
<td>13,183</td>
<td>18.8</td>
<td>n.a.</td>
</tr>
<tr>
<td>1978</td>
<td>1,607</td>
<td>10,425</td>
<td>12.6</td>
<td>n.a.</td>
</tr>
<tr>
<td>1979</td>
<td>2,797</td>
<td>15,555</td>
<td>14.6</td>
<td>n.a.</td>
</tr>
<tr>
<td>1980</td>
<td>2,880</td>
<td>19,253</td>
<td>14.9</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

n.a. Not available.
a. Preliminary figures.

Sources: Bangkok Bank Ltd., Bangkok Bank Monthly Review, various issues; and Sri-on Somboonsup and Delane E. Welsch, “Comparison of Government to Government with Private Sales of Thai Rice Exports, 1959–75” (Kasetsart University, Department of Agricultural Economics Research Report no. 17, February 1976).

was comparatively free from government intervention until the crises of 1973–74.

In April 1971, to encourage rice exports, premiums on most grades of rice were removed, but they were restored in 1972. Prices rose very rapidly in 1973 as a result of worldwide production shortfalls in the previous crop year and the international monetary crisis. To ensure adequate supplies for domestic consumption, export premium rates were raised to very high levels.6 This proved insufficient to halt the sharp rises in domestic rice prices (table 4-4), and in mid-1973 the government banned all rice exports

6. For example, the export premium on 100 percent white rice was raised from 750 to 5,000 baht (B) per metric ton on September 18, 1973.
Table 4-2. Thailand: Production of Major Agricultural Commodities
(Thousand metric tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Paddy</th>
<th>Rubber</th>
<th>Maize</th>
<th>Kenaf</th>
<th>Tapioca</th>
</tr>
</thead>
<tbody>
<tr>
<td>1959</td>
<td>7,186</td>
<td>174</td>
<td>317</td>
<td>50</td>
<td>1,083</td>
</tr>
<tr>
<td>1960</td>
<td>7,035</td>
<td>171</td>
<td>544</td>
<td>181</td>
<td>1,222</td>
</tr>
<tr>
<td>1961</td>
<td>7,788</td>
<td>186</td>
<td>598</td>
<td>339</td>
<td>1,726</td>
</tr>
<tr>
<td>1962</td>
<td>8,246</td>
<td>195</td>
<td>650</td>
<td>136</td>
<td>2,250</td>
</tr>
<tr>
<td>1963</td>
<td>10,029</td>
<td>198</td>
<td>858</td>
<td>212</td>
<td>2,110</td>
</tr>
<tr>
<td>1964</td>
<td>9,558</td>
<td>211</td>
<td>935</td>
<td>303</td>
<td>1,557</td>
</tr>
<tr>
<td>1965</td>
<td>9,199</td>
<td>217</td>
<td>1,021</td>
<td>529</td>
<td>1,475</td>
</tr>
<tr>
<td>1966</td>
<td>13,500</td>
<td>220</td>
<td>1,122</td>
<td>661</td>
<td>1,892</td>
</tr>
<tr>
<td>1967</td>
<td>11,200</td>
<td>219</td>
<td>1,250</td>
<td>250</td>
<td>1,871</td>
</tr>
<tr>
<td>1968</td>
<td>12,400</td>
<td>234</td>
<td>1,500</td>
<td>174</td>
<td>2,200</td>
</tr>
<tr>
<td>1969</td>
<td>13,410</td>
<td>282</td>
<td>1,700</td>
<td>350</td>
<td>2,600</td>
</tr>
<tr>
<td>1970</td>
<td>13,270</td>
<td>287</td>
<td>1,950</td>
<td>300</td>
<td>3,000</td>
</tr>
<tr>
<td>1971</td>
<td>13,570</td>
<td>316</td>
<td>2,300</td>
<td>370</td>
<td>3,400</td>
</tr>
<tr>
<td>1972</td>
<td>12,317</td>
<td>326</td>
<td>1,300</td>
<td>432</td>
<td>3,800</td>
</tr>
<tr>
<td>1973</td>
<td>14,898</td>
<td>382</td>
<td>2,339</td>
<td>489</td>
<td>6,416</td>
</tr>
<tr>
<td>1974</td>
<td>13,386</td>
<td>380</td>
<td>2,500</td>
<td>394</td>
<td>7,053</td>
</tr>
<tr>
<td>1975</td>
<td>15,299</td>
<td>349</td>
<td>2,863</td>
<td>259</td>
<td>8,100</td>
</tr>
<tr>
<td>1976</td>
<td>15,067</td>
<td>387</td>
<td>2,675</td>
<td>183</td>
<td>10,138</td>
</tr>
<tr>
<td>1977</td>
<td>13,920</td>
<td>431</td>
<td>1,850</td>
<td>240</td>
<td>12,372</td>
</tr>
<tr>
<td>1978</td>
<td>17,473</td>
<td>467</td>
<td>3,030</td>
<td>310</td>
<td>16,000</td>
</tr>
</tbody>
</table>


and imposed retail price control on those types of rice consumed locally. 7

Since 1973 there has also been greater use of the reserve requirement on rice export—a mandatory sale by exporters to the government of a fixed proportion of rice of particular grades for every ton exported, which is then sold by the government in urban areas below market prices. Since the reserve rice is acquired by the government at a price below the market price, like the export premium it implies a tax on rice export; the tax burden is heavier, the greater the difference between the market price and the government purchase price and the higher the reserve ratio. The reserve requirement was first introduced in the late 1960s, but it did not interfere much with the market at that time because the ratio was low and the difference between the market price and the concessionary sales price was rather small. In September 1973 the reserve ratio was raised dramatically to 200 percent. Government reserve rice constituted 39 percent

7. For a good description of Thai government policy changes during this period (as well as the earlier period) see Ammar Siamwalla, "A History of Rice Policies in Thailand," Stanford University Food Research Institute Studies, vol. 14, no. 3 (1975), pp. 233-49.
Table 4-3. Thailand: Export of Principal Agricultural Commodities Other Than Rice

<table>
<thead>
<tr>
<th>Year</th>
<th>Rubber Volume</th>
<th>Rubber Value</th>
<th>Maize Volume</th>
<th>Maize Value</th>
<th>Kenaf and jute Volume</th>
<th>Kenaf and jute Value</th>
<th>Tapioca products Volume</th>
<th>Tapioca products Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962</td>
<td>194</td>
<td>2,111</td>
<td>472</td>
<td>502</td>
<td>238</td>
<td>579</td>
<td>401</td>
<td>423</td>
</tr>
<tr>
<td>1963</td>
<td>187</td>
<td>1,903</td>
<td>744</td>
<td>828</td>
<td>126</td>
<td>358</td>
<td>427</td>
<td>439</td>
</tr>
<tr>
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*Note: Volume in thousand metric tons, value in million baht.
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n.a. Not available.
a. White rice, 100–5 percent for 1955–59; 100 percent for 1960–79.
b. Baht per kwien (average weight = 1 metric ton).

of export in 1973 and 59 percent of rice export in 1974.8 Thailand (as well as the world as a whole) had a record rice crop in 1973, but international prices remained high in 1974 because stocks had been greatly diminished the previous year. The situation eased by 1975, and in 1976, as export prices continued to fall (see table 4-4), the reserve requirement was abolished. Later reimposed, the reserve requirement and the export premium now represent the major forms of government intervention. The volume of Thai rice export reached a new record of 3 million metric tons in 1977—45 percent more than the previous peak in 1972. Exports fell to 1.6 million metric tons in 1978 but rose again to 2.8 million metric tons in 1979.

Taxation of Rice Exports and National Welfare

In this section the effects of Thai rice policy on various groups and on the nation as a whole are discussed. It is assumed at first that the choice of technology in paddy production is not affected by the tax but later this assumption is relaxed. The discussion concentrates on the export premium, which is in effect an export tax. Instruments such as the rice reserve ratio, quotas, and direct price controls are considered under the topic of domestic price stabilization. The first two of these policies are also instruments of export restriction, but for the purpose of analysis, it is assumed that there is a single export tax on rice.

An Optimal Export Tax

A tax on a commodity generates revenue to the government, but its burden has to be borne by the buyer in the form of a higher price paid for the commodity or by the producer in the form of a lower price received. Thus an export tax gives rise to an increase in the price paid by foreign buyers or a fall in the domestic price of the commodity in the country imposing the tax. The fall in the domestic price implies a burden on the producers of the commodity,9 but it benefits consumers and generates revenue for the government. There is a net welfare loss generated in the domestic economy as a whole, however, because the tax distorts relative prices of commodities and thus causes allocation inefficiencies in produc-


9. When there are no direct controls in the domestic market, the price paid by consumers, after various marketing margins are deducted, would be equal to the price received by producers.
tion and consumption. Thus by depressing the domestic price of rice in relation to other commodities in production and consumption, the export tax results in too little rice production and too much rice consumption.

Part of the export tax is borne by foreigners in the form of higher prices paid by them, and from the national point of view this represents a gain. Thus whether the export tax generates an overall benefit to the country imposing the tax depends on whether the gain at the expense of foreigners is greater or less than the losses owing to resource allocation inefficiencies in the domestic economy. The various gains and losses are quantifiable and in fact are estimated in chapter 8. One very important determinant of the size of the net gain or loss is the extent to which the tax is passed on to foreign buyers, which in turn depends on how responsive foreign demand is to changes in the price charged by the exporting country. In an extreme case, if the exporting country is only one among many competitive suppliers in the world market, it may not be able to influence the world price to any extent. The export tax would then be reflected entirely by a fall in the domestic price in the exporting country and a net loss in welfare must result. As long as a country has some influence on price (which implies that the foreign demand curve facing the exporting country is not infinitely elastic), there is an optimal export tax which maximizes the net gain to the exporting country. This is far from saying that any rate of export tax would generate a net gain. It can be proved (see chapter 8) that if the tax is imposed at a rate much higher than is optimal (if exports are restricted too much) it may generate a net loss to the exporting country. The optimal rate of export tax depends crucially on how responsive foreign demand is to price changes; the less responsive it is, the higher would be the optimal rate of tax.

The optimal export tax rate for Thailand depends on whether the country is able to influence the international price to any extent. If it is unable to do so at all, then the optimal export tax is zero. Many people have in fact argued that Thailand cannot exert any influence on international prices. They visualize the world rice market as perfectly competitive with free trade so that “the” world price is determined by world supply and demand conditions. Since Thailand produces only about 4 percent of the world's total rice output, it follows that the volume of Thai export has little influence on world prices. The assumptions of perfect competition and free trade are, however, highly unrealistic in the case of rice; on the contrary, the great differences in national rice prices shown in table 4-4 are indicative of a highly imperfect market. Because national prices have been heavily manipulated by government policies, the international rice trade is, as noted earlier, residual in nature. Under such a situation, changes in small components of world supply and demand—in exportable
surpluses or levels of stocks—could be reflected in international prices. Since Thailand is one of the world’s largest rice exporters, it does exert some influence on international prices.

Other considerations reinforce the belief that Thailand is able to influence international prices. There is considerable regional segmentation of the international rice market. Most of the Asian exports go to importers in the same region. Conversely, with the major exception of the United States, most of the imports into the Far East come from Far Eastern exporters. Thus, in general, Thailand is competing more closely with other Asian exporters and the United States than with exporters (such as Italy, Egypt, Australia, and Latin America) which do not sell in the same market. Even in Asia, there is a certain division of the market between Thailand and other Far Eastern exporters. For example, in the 1960s most of the lower grades of rice required by Sri Lanka, India, Indonesia, and Pakistan were provided by Burma, while Thailand provided the higher grades of long-grain rice to the commercial markets of Hong Kong, Malaysia, and Singapore, which together accounted for 35 percent of Thai rice exports. In these markets there have been close commercial and often family connections between merchants of Chinese origin in Bangkok and the main importing centers.

A considerable proportion of Thai rice export is arranged under government-to-government contracts, some of which are long term in nature. Since the government is under some obligation to fulfill these contracts after they have been made, this tends to lessen the effect of price changes.

Some may wonder why buyer-seller relations, bilateral trading, and long-term agreements are so common in the case of rice. The reason is not difficult to find. Since rice is the main staple in many importing countries, a significant decline in its availability in any year could mean great hardship. From the point of view of importing countries, it is better to be assured of a stable long-term source of supply from certain exporters than to take advantage of low prices offered in particular years by nontraditional suppliers. Exporters may also find it in their own interest to be assured of regular buyers. This probably accounts for the fact that nontraditional suppliers often have difficulty breaking into the market to take advantage of high prices in particular years.

10. This could best be seen in the events of 1973–74. Although the world had a record rice crop in crop year 1973–74, the export price (5 percent white rice) continued to shoot up long after the new crop entered the market. In fact, the price reached a height of US$635 per metric ton in April 1974 because of attempts by countries to replenish stocks depleted in the previous year.

The quality and taste of rice are very important. Different varieties are easily identified by the buyer, who usually has a preference for a particular grade or variety, such as round-grain or long-grain, glutinous or nonglutinous, and so on. The product is also distinguishable by the place of origin, and Thai rice has often been noted for its high quality. In view of this, Thai rice may be regarded as a close but imperfect substitute for rice sold by other exporters.

The preceding discussion implies that, at least in the short run, Thailand is able to influence international prices to some extent. According to the estimate in chapter 8, the foreign elasticity of demand for Thai rice is $-4$. This estimate is based on the assumption that the present characteristics of the world rice market do not change. According to a formula derived in chapter 8, the optimal export tax would then be around one-fourth of the export price. In 1961–70 the export premium had been approximately one-third of the export price, which is somewhat higher than the optimal export tax. According to the estimate in chapter 8, it would still result in a net gain in welfare for Thailand of 323 million baht (B) over the period. This sum is arrived at by deducting losses owing to inefficiencies in production and consumption of B99.5 million and B39.8 million respectively from the gain of B462.3 million from passing on the tax burden to foreign consumers. The above estimates require that producers and consumers have sufficient time to adjust fully to price changes resulting from the export premium. But the present restrictive institutional characteristics of the rice trade are assumed not to change. Under these assumptions, it is not surprising that the removal of the export premium would not benefit Thailand. This is because under the present restrictive arrangements, the large exportable surpluses resulting from the removal of the export premium could not be sold in the international market without causing a drastic fall in price.

It then follows that if the international market in rice were completely liberalized, there would be a much stronger case for the elimination of the premium. Under free trade, Thailand could not to any great extent pass on the tax burden to foreign buyers by raising prices since it is a relatively small producer. The greater part or all of the tax would then be reflected in a fall in the domestic price, resulting in losses owing to inefficiencies in production and consumption described above. Under free treatment, Thailand would not benefit from the export premium.

12. In a study by Hiroshi Tsujii, the foreign elasticity of demand for Thai rice has been estimated to be somewhat less than unity. This estimate is cited in Hiroshi Tsujii, "An Economic and Institutional Analysis of the Rice Export Policy of Thailand: With Special Reference to the Rice Premium Policy," The Developing Economies, vol. 15, no. 2 (June 1977), pp. 202–20.
trade conditions, it appears reasonable to assume that the export price would rise by not more than 5 percent of the export premium. Under this assumption the export premium would result in a large net loss for Thailand of B1,227.7 million because welfare losses on domestic production and consumption (B1,272.4 million) far exceed the tax burden on foreigners (B44.7 million). If the world price did not rise at all, the tax would be entirely borne by domestic citizens, and there would be a net welfare loss of B1,551.5 million, which is about 2.3 percent of national income.

Except under the highly unrealistic assumption that all the burden is borne by foreigners, the tax must to some extent be reflected in a fall in the domestic price, and farmers would suffer accordingly. In this discussion, which concerns national welfare, it is assumed that the government would adopt optimal internal income redistribution policies so that farmers would share in the gain in national welfare. Losses borne by rice farmers are heaviest when there is no change in the world price and the whole of the tax burden is borne domestically. Under this assumption, the transfer from farmers is as high as B5,565.4 million (approximately 8.3 percent of national income). A large part of this loss is in an imputed sense only, since a reduction in cash income is borne only on the part of the crop that is marketed. Thus, if 60 percent of the rice crop is marketed, losses in cash income to rice farmers will be about B3,340 million.

The estimate of the foreign elasticity of demand (-4) is for the short run. In the long run it could conceivably be higher as substitution takes place and as present market relations and buyers’ preferences break down, though it would still not approach infinity unless international trade were fully liberalized. Moreover, even if Thailand could have no influence on price in the truly long run, it does not mean that no tax should be imposed at present. The optimal export tax in this case would depend on the magnitude of the long- and short-run foreign demand elasticities, the length of time before the true long run is reached, and the government’s rate of time discount. In the case of Thai rice, the difference between short- and long-run foreign elasticities of demand can be considerable for reasons mentioned earlier. But there is little indication that the rice trade will be liberalized, and the adjustment period toward the truly long run could therefore be very long. For a typical developing country, the rate of time discount is often considered by policymakers to be quite high because of the need for funds to speed up the process of economic de-

velopment, and alternative means of finance may be limited. Thus some rate of tax on rice export could certainly be justified.

Rice Export Tax and Adoption of New Technology

Nevertheless, the long-run effects of price policy on agriculture should be kept in mind, and some of the most important are with respect to the choice of technology. The rice premium, by depressing domestic rice prices, may hinder the adoption of new inputs in rice production. A farmer tends to use an input—say, fertilizer—until the last unit employed contributes to the value of output an amount just equal to its cost. For a single farmer the price he pays for fertilizer and the price he receives for paddy sold can be taken as given. The contribution of fertilizer to paddy output is expected to fall, however, as more and more of it is used. Thus, when the paddy price is made artificially low, farmers would tend to cut down their fertilizer consumption; if in addition the fertilizer price is kept high its use would be curtailed further. This is precisely what happened in the late 1960s. The paddy price had been kept low by the export premium, while imports of urea and ammonium sulphate had been restricted to give protection to an obsolete domestic plant which had costs of production 50 percent higher than the c.i.f. prices of similar fertilizers. Such price distortions led to inefficiencies in production and higher costs, and they should be counted as part of the welfare effect of government price policy.

Even more serious, however, is the effect on the direction of research. It has been asserted, for example, that new technologies in agriculture are developed in response to (product and factor) price signals reflecting relative scarcities. There is little incentive to develop fertilizer-responsive, high-yielding rice varieties when paddy prices are kept artificially low and fertilizer prices are kept artificially high. In the long run, a slowdown in the development of new technology can cause a loss in potential agricultural output (or in potential cost savings). Such losses are difficult to measure but could be quite significant.

It is difficult to determine how far the export premium has been responsible for slowing down the development and adoption of new technology in rice farming. Rice yields in Thailand are low, however, even in comparison with those of other developing economies (table 3-1) and in fact were falling in the early 1970s. Between 1960 and 1977 rice production grew at an annual rate of about 30 percent, but yields increased

by only 0.6 percent. Low paddy prices and high fertilizer prices are probably part of the explanation.  

In chapter 8 the welfare effects of the export premium are estimated, with its possible impact on the adoption of new technology taken into account. A numerical example in that chapter indicates that even when rather modest changes in the cost per unit of production are assumed, removal of the rice premium could lead to substantial production gains if it encouraged more farmers to adopt the new technology. With no change in the international price and a reduction of the cost per unit of output owing to the adoption of the new technology of about 10 percent, welfare gains in production from the removal of the premium would increase from B1,007 million (in the absence of changes in technology) to B2,013 million, or approximately double. The above estimates assume free trade and therefore exaggerate the production gain. In practice, the extra production resulting from the adoption of new technology probably cannot be sold in the international market without causing some price decline, which in turn might slow down the rate of adoption by farmers. Yet, such dynamic effects of the taxation of the rice-producing sector can be important, and the export premium may be more difficult to justify when they are taken into account.  

The adoption of high-yielding varieties (HYV) of rice has been a relatively recent phenomenon in Thailand, and the rate of adoption is considerably slower than in many other Asian countries. As late as the 1972–73 crop year, the area under HYV was less than 5 percent of the total area planted in rice. Whether this slow rate of adoption can be attributed to low paddy prices or to some other factors is a moot question. Other reasons often cited include the lack of water control and accompanying inputs which increase the profitability of HYV, the quality-oriented nature of rice research in Thailand to meet standards in the export market, and the heavy indebtedness of farmers in the Central Plains, which prevents the adoption of a technology requiring capital and credit. While not downplaying the importance of these other factors, the output (paddy) price is clearly an important variable since it directly affects the profitability of increasing production. Chapter 8 examines how removal of the export premium would affect the benefit-cost ratio of shifting from traditional varieties (TV) to HYV. The data on yields and costs are drawn from an unpublished International Rice Research Institute (IRRI) study.  

15. Timmer and Falcon, "Political Economy of Rice Production," have argued that differences in the ratio of fertilizer and rice prices explain much of the international difference in rice yields.
in the Central Plains in 1971. Unfortunately, the evidence there is inconclusive: the increase in the benefit-cost ratio after the removal of the premium is rather small and may not be sufficient to compensate for the extra risk involved in shifting to an unfamiliar technology. Moreover, the IRRI study appears to indicate that adopting HYV brings a rather insignificant cost saving per unit of output. Of course no firm conclusions could be drawn from a single study, and further investigations would certainly help.

Other Effects of the Export Premium

While the argument that the export premium is an optimal export tax has some validity, at least in the short run, it is not the argument most often advanced by its proponents. Instead, apart from its use to collect revenue, the export premium has been viewed by the Thai government as an instrument for regulating the volume of export to ensure adequate domestic supplies and for preventing fluctuations in world prices from affecting domestic prices. In other words, as world prices fluctuate, the export premium would be adjusted continuously so as to keep domestic prices stable.

Domestic Price Stabilization

To see how far the government has been successful in this objective, it is useful to look at figures 4-1 and 4-2. Figure 4-1 shows the relation between the export price, the export premium, and the domestic wholesale price in the 1955–72 period (the basic data plotted are from the first three columns of table 4-4). The net export price is simply the export price minus the export premium. The relation between the net export price and the domestic wholesale price indicates the extent to which instruments other than the rice premium—quotas, changes in the rice-reserve ratio, and direct price controls—have influenced the domestic price. This is because in the absence of these instruments the domestic wholesale price should be equal to the export price net of export premium after marketing margins are deducted. In figure 4-1 there is indeed evidence that domestic wholesale prices and export prices net of the premium moved closely together in 1955–72, and the differences between the two are what might be expected to cover exporters’ profits and transport and other costs. This suggests that in this period government intervention on the rice economy other than the export premium had been insignificant. This was indeed the case, as noted earlier in this chapter. Quite a different picture is presented in figure 4-2. The extent of export price fluctuations after 1972
is many times greater than in the previous period (note that figures 4-1 and 4-2 are drawn on different scales). The domestic wholesale price followed a different pattern from that of the net export price, and differences between the two were very large in 1973–75. This need not and, in our opinion, does not indicate that exporters were making huge profits during these years. Rather, figure 4-2 suggests that the export and domestic price controls as well as large changes in the rice reserve requirement for local consumption, not the export premium, were the effective instruments of export restriction in the later period.

Overall, the evidence appears to be that in the earlier period of 1955–72 the export premium was an important determinant of the domestic price and indeed could have been used to stabilize it. In practice, the premium
Figure 4-2. Thailand: Relation between the Export Price, Domestic Price, and the Export Premium, 1972–1977

Note: Export price and premium rate are for white rice, 5 percent broken; domestic price is for 100 percent white rice.
Source: Table 4-5.
was not adjusted frequently or sufficiently for this purpose (table 4-4), and the domestic price tended to follow the export price during this period, though at a much lower level because of the premium. One argument sometimes advanced for the stabilization of the domestic price is that farmers are risk-adverse and prefer stable prices which also facilitate their production planning. Behrman has indeed found that Thai farmers respond positively to the level of rice price but negatively to its variation (as measured by its standard deviation). Thus, if the export premium had stabilized domestic prices, part of its adverse effect on domestic supply would have been offset. But figure 4-1 suggests that the rice premium had not stabilized domestic prices to any great extent during the 1955–72 period. In the more recent period (1973 and later), the domestic wholesale price was kept reasonably stable in the face of wide swings in international prices, but other instruments were mainly responsible. As a matter of fact, in truly emergency situations, the government tended to rely on direct controls rather than the export premium to control the volume of export. The reason is fairly simple. The exportable surplus is determined by the quantity supplied and the quantity demanded domestically at a given price. The elasticity of domestic demand for rice is very low, and in the short run production may be regarded as given, implying that export supply is not very responsive to price changes. Thus, even very high rates of export tax may not succeed in checking the outflow of rice, and other means of control will then be necessary.

At this point it might be asked whether it is really desirable for a country to achieve domestic price stability by trade restrictions. As already indicated, national policy and interference with trade are themselves responsible for the wide price fluctuations in the international market, and if international trade were fully liberalized world prices of commodities would be much more stable. But trade liberalization cannot be achieved by a single country, and in the case of a commodity that contributes a high percentage of national income, if the domestic price were allowed to follow the international price—which may fluctuate as widely as that shown, for example, in figure 4-2—the domestic economy would become highly unstable. It is therefore at least understandable that a developing country might want to insulate the domestic economy to some degree by trade restrictions. Whether it succeeds in doing so and whether the best instruments are chosen for this purpose are, of course, quite separate matters.

17. In chapter 8 the elasticity of demand for rice is estimated to be $-0.43$ in the short run and $-0.47$ in the long run.
Urban Cost of Living and Inflation

The export premium keeps down domestic rice prices and, through substitution in consumption, the prices of other commodities. Van Roy has estimated its deflationary impact on the urban cost of living to be about 16 percent. According to a more recent estimate by Lam, the removal of the export premium in 1962–70 would have raised the urban cost of living by an average of about 11 percent.

Whether increases in rice prices "cause" inflation by raising wages, which in turn raise prices, is an issue discussed in connection with Korean rice policy (chapter 2). As in the case of Korea, the link between rice prices and inflation is difficult to establish and even more difficult to refute. That many people hold this belief, however, is clearly a factor to be reckoned with. According to Siamwalla, the rice crisis of 1973–74 was directly responsible for the change in government at that time.

Government Revenue and Income Distribution

Table 4-5 shows that revenue from rice premiums was an important component of total government revenue (tax revenue plus other charges and income from government enterprises) in the 1960s, although its importance has declined recently. Thailand has relied heavily on indirect taxes, especially sales taxes and import duties. It was not until 1966 that receipts from income taxes accounted for more government revenue than did receipts from rice premiums.

The burden of the export premium rests mainly on rice farmers, and to the extent that they represent the poorer section of the population the tax is regressive. But it falls mainly on farmers with large marketable surpluses—presumably richer farmers. Farmers growing rice for their own subsistence are not affected by the premium, and those who are net purchasers of rice would even benefit from lower domestic prices.

In the 1950s and early 1960s one popular argument against the elimination of the rice premium was that the benefit would accrue not to farmers through higher farm prices but rather as extra profits to middlemen. Thus, the export premium was regarded as an instrument transfer-
Table 4-5. Thailand: Export Premium and Its Percentage Share in Total Government Revenue

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Revenue from rice premium (million baht)</th>
<th>Percentage share in government revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>798</td>
<td>9.3</td>
</tr>
<tr>
<td>1964</td>
<td>1,090</td>
<td>11.4</td>
</tr>
<tr>
<td>1965</td>
<td>1,249</td>
<td>11.3</td>
</tr>
<tr>
<td>1966</td>
<td>1,068</td>
<td>8.5</td>
</tr>
<tr>
<td>1967</td>
<td>929</td>
<td>6.4</td>
</tr>
<tr>
<td>1968</td>
<td>1,116</td>
<td>6.7</td>
</tr>
<tr>
<td>1969</td>
<td>1,236</td>
<td>6.8</td>
</tr>
<tr>
<td>1970</td>
<td>654</td>
<td>3.5</td>
</tr>
<tr>
<td>1971</td>
<td>262</td>
<td>1.4</td>
</tr>
<tr>
<td>1972</td>
<td>163</td>
<td>0.8</td>
</tr>
<tr>
<td>1973</td>
<td>276</td>
<td>1.1</td>
</tr>
<tr>
<td>1974</td>
<td>2,751</td>
<td>7.3</td>
</tr>
<tr>
<td>1975</td>
<td>795</td>
<td>2.1</td>
</tr>
<tr>
<td>1976</td>
<td>42</td>
<td>0.1</td>
</tr>
</tbody>
</table>

a. The rice premium ceased to be transferred to the Ministry of Finance after 1976.


ring income away from monopolistic middlemen (and through government expenditure) to the rest of the population. Today this argument is seldom taken seriously. The general view is either that rice marketing in Thailand is competitive so that marketing margins are close to the cost of services performed, or that although some monopsonistic or monopolistic elements may be present they do not in general prevent changes in rice prices from being passed on to farmers.

It has often been argued that greater reliance on direct taxes (especially through strengthening the income tax system) would make for greater equity. The administrative feasibility of such proposals remains to be investigated.

Agricultural Diversification and Trade

Since World War II, expansion of other crops has taken place very rapidly. Some crops such as corn, rubber, kenaf, and cassava have been

grown mainly in response to foreign demand and most of their outputs are exported (tables 4-2 and 4-3), while others (for example, cotton and sugar) are mainly for domestic consumption. It has sometimes been claimed that the export premium, which causes the undervaluation of rice and therefore indirectly subsidizes other farming activities, encourages Thailand to diversify its agricultural activities and reduce the risk of dependence on a single commodity. But, if it is profitable to diversify into other crops, farmers would presumably do so on their own initiative, and there would be little need for the government to distort the price relation between rice and other crops. It is possible, however, that rice farming has gone on for so long that it has become a way of life. Farmers may be tradition-bound or excessively risk-adverse, and many might not shift into these new crops even though they are more profitable. Then the export premium might help overcome these rigidities and immobilities and move the economy in the right direction.

Another version of the diversification argument is that exporting a larger variety of commodities can reduce fluctuations in export earnings, since below-trend export earnings from one commodity in any year may be compensated by above-trend export earnings from another. Export instability need not be reduced, however, if such negative correlations among export earnings of various commodities are negligible. Major alternative exports such as rubber, maize, tin, kenaf, and jute also face rather uncertain foreign demand conditions. From 1976 to 1977, for example, the value of maize exports plummeted by more than 40 percent while the value of kenaf and jute exports declined by almost 30 percent. There is thus far little evidence that fluctuations in export earnings have been reduced through diversification.

While the effect of the export premium on the stability of export earnings is uncertain, it is almost certain that the average level of foreign exchange earnings on rice exports is reduced. This is true as long as the foreign elasticity of demand is higher than unity. Thus the export premium might have been partly responsible for the widening balance of trade deficits in recent years, which might soon result in balance of payments problems if not offset by rising capital inflows.

**Summary and Conclusions**

Thailand is in the rather peculiar position of being one of the world's largest rice exporters but not among the largest producers. Although under free trade Thailand could not be expected to have any appreciable influ-
ence on world prices, it does exercise some monopoly power under existing conditions in the international market. The export premium could therefore be justified as an optimal export tax on rice. Although it is likely that the export premium has generated a net gain in welfare for Thailand as a whole, it results in a substantial transfer of income from the farmers. Moreover, the extent to which Thailand could continue to manipulate the export price depends on the future characteristics of the international market, over which Thailand has little control. In the event of drastic changes in international trading arrangements—say, owing to significant moves toward liberalization—the failure of Thailand to modify its rice export policy could entail high welfare losses.

The paddy yield in Thailand is low when compared with most other countries. It is quite possible that by keeping the domestic price of rice low, the export premium reduces the farmers' incentive to improve yield by adopting modern inputs (such as fertilizer and high-yielding varieties of rice) and thus keeps technology in paddy production at a low level. If this is so, this loss in potential agricultural output (or unexploited potential cost reduction) has to be taken into account. Unfortunately, the evidence is not very clear in the case of Thailand. It appears that nonprice factors, such as lack of water control and expansion into areas less suitable for rice, might have been equally important in accounting for low yields.

Since rice is the most important crop in the economy as well as the main staple for consumption, attempts to insulate the domestic rice economy from the wide swings in international prices in the early 1970s were quite legitimate. Fluctuations in domestic rice prices to some extent affect the whole economy, and it is conceivable that the export premium, if adjusted continuously, could act as a tool for stabilizing them. While this is one of the often stated objectives of the export premium, in practice it has not been varied frequently or sufficiently for this purpose. In the event of really sharp rises in prices, as in 1973–74, the government has tended to rely instead on direct restrictions on exports and price controls.

Since rice is an important part of the consumer's budget, increases in rice prices are immediately reflected in the urban cost of living index. There does not appear to be evidence, however, that rises in rice prices could themselves cause inflation through a cost-push mechanism.

The export premium has been viewed by some as an instrument of economic development—providing government funds for development plans and encouraging the intersectoral movements of resources and diversification of the economy. The real issues are whether such intersectoral effects are indeed significant or desirable for development, and whether alternative means of government finance, which may be more justifiable on other grounds (such as equity), are administratively feasible.
AGRICULTURAL PRODUCTION in Venezuela has lagged far behind demand. While agricultural imports accounted for only 12 percent of the value of agricultural products used in 1970, the figure has increased to more than 20 percent in recent years. In typical years in the 1970s, agricultural output rose at an annual rate of about 4 percent, while national output of all goods and services rose annually at 6 percent.

In the face of increasing concern about the performance of agriculture, various policies have been adopted to spur production as well as to ensure availability of adequate amounts of food at reasonable prices in urban areas. Among the more important policies have been subsidization of powdered milk consumption, retail price controls on livestock products, importation of feed grains at a loss, and price supports on domestic feed marketings sold at a loss by the government. Significant management problems have been encountered in carrying out the policies. Government costs have mounted. Urban shortages have occasionally developed. Inadequate storage facilities have hampered marketings.

Many of the management problems are related to the unique features of Venezuelan agriculture. One feature is diversity: many crops vie for attention. The highest value crop, maize, accounts for only 3 to 4 percent of the value of agricultural output. Thirteen crops had a value of 1 percent or more of total agricultural output during the 1970s. Together, these crops contributed only 25 percent of total value of agricultural output. As another feature, production is subject to large variations. In one year alone (1976), rains and flooding caused cereal production to fall 10 percent, while cotton production fell 25 percent and coffee production fell 23 percent. Changes are occurring in the composition of output. Livestock
production has continued to gain in prominence, and, most dramatically, sorghum production has within a few years come to contribute significantly to meeting demands for feed. In 1973 sorghum production was nil in Venezuela. It was estimated that by 1980 production would be 425,000 metric tons and could account for as much as a third of the tonnage of cereal production.

The growth of the Venezuelan economy has created problems for agriculture. Farm costs are rising, and people are leaving agriculture. Food intake has surged upward faster than population. Beef, pork, and poultry consumption increased 6 to 7 percent annually in the mid-1970s.

International uncertainties contribute to the problems of food and agriculture policy. The markets for Venezuelan imports and exports are subject to unexpected swings in prices and availabilities. World price changes for food and feed grains have had particularly pronounced effects on the costs of government purchase and price programs.

Management problems have been made more difficult by price policies for related commodities that influence one another. A major hindrance is the difficulty of predicting government costs for related commodities in the face of unexpected changes in food demand and supply within the country and international fluctuations. The problems are most complex in the grain and livestock sector, which is especially subject to mixed, rapid, related, and unforeseen changes. Policies for the grain and livestock sector—the subject of this chapter—confront sometimes competing goals and must be formulated and carried out under conditions of great uncertainty about the future. The task is made more difficult by the complexity of relations within the sector and the task of distinguishing the important from the less important effects of the policies.

Basic objectives of policies toward the grain and livestock sector are threefold: to encourage Venezuelan production and provide adequate farm incomes, to hold down urban prices, and to hold down government costs. For many programs, including those in credit, extension, and research, the first two objectives are complementary. If production costs are lowered, both farmers and consumers benefit. A problem of balancing objectives arises particularly in determining the amount of government funds to devote to these programs. In the case of price policy, there is a problem of balancing all three objectives. High producer prices encourage production and help farm income; but if higher prices are achieved at the expense of raising urban prices, as can be done by insulating the market from foreign prices, then the problem is to balance farmer and consumer objectives. Through sales of price-supported commodities below cost, the government can simultaneously subsidize the farmer and the consumer, but only by raising subsidy payments and thereby government costs.
Many of the problems of implementing price policies have to do with the logistics of acquisitions from farmers, storage, and arrangements for imports. In the past, partly because of unexpected events, these problems have not been adequately met. Shortages of storage facilities and shortages of food have been among the undesired consequences. Occasionally an emergency has forced imports of commodities for which nonimport policies were originally planned. Government costs have in some years shot up unexpectedly both because of the need to arrange special imports and because of an increase in world prices of imports in the face of policy commitments not to exceed prespecified maximum consumer prices.

The Approach

The chapters on Korea, Bangladesh, and Thailand were concerned mainly with rice price policy in view of the overwhelming importance of rice in those countries. While the effects of rice policy on other crops were mentioned in passing, they were not actually estimated. And, although input-output relations were considered in the chapters on Bangladesh and Thailand, they were restricted to rice production, and the interrelations with other agricultural subsectors were set aside.

This study on Venezuela is intended to provide a broader perspective on the effects of government price policy in one agricultural subsector on others. The discussion focuses on the effect of policies in the grain and livestock sector on government program costs. Most governments regard the program cost as an important criterion for the choice of a particular policy because of competing demands for government funds.

The impact of price policy on program cost can be broken down into a direct effect and various indirect effects. The direct effect is estimated by multiplying the existing quantity of the commodity by the proposed price changes. This does not tell the whole story because the quantities of other commodities handled by the government are likely to change as the proposed price change leads to further changes in program costs. The Bangladesh study on rice price policy showed that even in the context of a single commodity, at least two major indirect effects have to be taken into account: first, the supply response to the increase in a farm support price increases the government cost of the price support program; and second, additional purchases of fertilizer, induced by the rise in rice price, increases fertilizer subsidy payments. In the case of many interrelated commodities, a large number of effects on the cross-elasticity of supply and demand also have to be considered. If the price of a certain commodity is changed by government policy, the supply of and demand for other commodities that are close substitutes or complements in production or
consumption are likely to shift, causing changes in program costs on these commodities. Thus, if the lowering of the price to consumers of commodity A leads to a reduction in demand for commodity B, which is a close substitute in consumption, and if B is originally subsidized, the result is a reduction of government program cost in B partially offsetting the increase in government cost in A. If B is originally taxed, however, the result would be a loss in tax revenue on B that further augments the loss on government operations. Even if no government program exists for B to begin with, the changes in price and quantity traded of that commodity would still rebound on sector A, causing second-order changes in prices and quantities—and therefore program costs—of commodity A.

The issue becomes even more complicated when the input side is also considered. Price policy changes in sector A could affect the use in that sector of input X, which may also be used in the production of many other commodities. Since agriculture involves the production of many commodities using many different inputs, it is difficult enough to list, let alone quantify, the relevant indirect and induced effects of alternative price policies.

Another problem in predicting the effects of price policy is in determining its important features. It might be thought that government legislation and decrees would specify completely what is to be done, but in some cases they may not, leaving some flexibility in implementation. It may also be difficult to decide whether certain policies are effective. For instance, the presence of an extensive list of maximum and minimum prices may lead one to conclude that government intervention is pervasive. But if maximum prices are higher (and minimum prices lower) than market prices, they are merely policies on paper and have little real effect. If these decreed prices differ markedly from market prices, however, and if enforcement is weak, violations in various forms (such as quality changes and illegal transactions) are possible. Moreover, government decrees often apply only to part of the market or make fine distinctions in quality within the same commodity. Some of these details are unimportant, while others may affect program outcomes significantly.

It might be thought that large-scale econometric models are indispensable to take account of all forms of government interventions in agriculture and to consider the numerous interrelations among commodities. The lack of accurate data in developing countries, however, often makes it difficult to obtain reliable estimates of coefficients for the model. Also, the relations estimated on the basis of historical data may not accurately reflect future possibilities owing to technical progress or structural change. Furthermore, if the interaction mechanism of the model is very complicated, it may be difficult to explain why certain results are obtained. There is thus a role for smaller models that attempt to capture major effects.
In chapter 10 we present an attempt to quantify the direct and major indirect effects of alternative price policies. The appraisal has the advantage that each of the component (direct and indirect) effects of government policy can be estimated and given an easy interpretation. The grain and livestock sector of Venezuela is used as an illustration. The full mathematical models and numerical estimates of effects of policy changes are presented in chapter 10; the present discussion is limited to the essence of the approach and some results.

The analysis attempts to take into account major economic effects, but in a simple and readily understandable way. First, to reduce the problem to manageable dimensions, essentially similar inputs and outputs are aggregated. Thus, while corn, sorghum, and other feed concentrates are not strictly the same, they are all sources of animal nutrients and are therefore grouped together as one commodity. Second, indirect evidence is used to infer which policies are effective. It is assumed that in the absence of shortages, queues, or large-scale government transactions, the price of a commodity is approximated by the market price. For the purpose of analysis, the price of such a commodity is regarded as determined by market demand and supply rather than by government decree. Such an approach permits us to concentrate on other commodities in which government operations are really significant.

The next section examines the characteristics of the grain and livestock sector of Venezuela. The milk subsidies and the feed program are identified as the major instruments of government intervention using the above criteria. The major economic effects—especially in relation to program costs—are then described.¹

Price Policy and the Grain and Livestock Sector

The grain and livestock sector—which includes food and feed grains (wheat, corn, rice, and sorghum), other feeds, meat products (beef, pork, and poultry), milk, cheese, and eggs—accounts for about 67 percent of the value of agricultural production in Venezuela.² The quantities pro-

¹. Parts of this chapter draw on results from a project by Planar, Inc., undertaken for the government of Venezuela on agricultural information needs. No views expressed here are official.
². This figure comes from adding the value of grain crop production in Venezuela to the net value of output of livestock products, where the latter is the total value of output of livestock products less the value of grains and other feeds grown in Venezuela used in livestock production. This avoids double counting of the feed grown in Venezuela and then used in livestock production.
Table 5-1, Venezuela: Production and Imports of Grains and Livestock Products, 1977
(1,000 metric tons)

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Production</th>
<th>Imports</th>
<th>Total</th>
<th>Imports as percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grains and other feeds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>1</td>
<td>658</td>
<td>659</td>
<td>100</td>
</tr>
<tr>
<td>Rice</td>
<td>330</td>
<td>0</td>
<td>330</td>
<td>0</td>
</tr>
<tr>
<td>Corn</td>
<td>799</td>
<td>568</td>
<td>1,367</td>
<td>42</td>
</tr>
<tr>
<td>Sorghum</td>
<td>326</td>
<td>395</td>
<td>721</td>
<td>55</td>
</tr>
<tr>
<td>Other feeds</td>
<td>127</td>
<td>188</td>
<td>315</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,583</td>
<td>1,809</td>
<td>3,392</td>
<td>53</td>
</tr>
<tr>
<td><strong>Livestock products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td>274</td>
<td>22</td>
<td>296</td>
<td>8</td>
</tr>
<tr>
<td>Pork</td>
<td>85</td>
<td>5</td>
<td>90</td>
<td>6</td>
</tr>
<tr>
<td>Poultry meat</td>
<td>152</td>
<td>15</td>
<td>167</td>
<td>9</td>
</tr>
<tr>
<td>Pasteurized milk</td>
<td>43</td>
<td>0</td>
<td>43</td>
<td>0</td>
</tr>
<tr>
<td>Powdered milk</td>
<td>60</td>
<td>65</td>
<td>125</td>
<td>52</td>
</tr>
<tr>
<td>Cheese</td>
<td>31</td>
<td>16</td>
<td>47</td>
<td>34</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>645</td>
<td>123</td>
<td>768</td>
<td>16</td>
</tr>
</tbody>
</table>

Source: Ministry of Agriculture.

Produced of these commodities in 1977 are shown in Table 5-1. The heavy dependence of the grain and livestock sector on imports can also be seen from the same table. For grains and other feeds, the overall dependence of Venezuela on imports is about 50 percent. Self-sufficiency ratios, however, differ widely among individual grains. There is self-sufficiency in rice, and wheat is almost entirely imported, while the self-sufficiency ratios for corn, sorghum, and other feeds were respectively 42, 55, and 60 percent in 1977. The foreign dependence for grain as animal feed is greater than for human consumption, although imports are important for both types of consumption.1

Among livestock products, foreign dependence is most important for powdered milk, for which imports were 52 percent of production plus imports in 1977. Fluid milk is not imported, however. There is little foreign dependence for pork, poultry, and beef, although there are unofficial imports of beef cattle from Colombia which are treated as part of domestic production. Under this assumption, the self-sufficiency ratios for all three commodities are well over 90 percent, as indicated in Table

3. In 1977, of the 2,076 thousand metric tons of grains and other feeds that went to nonanimal uses (mainly human food), 48 percent was imported. About 62 percent of the 1,315 thousand tons fed to animals was imported.
5-1. Imports of these commodities are mainly to meet emergencies resulting from a short-term upsurge in demand.

Thus imports are important for grains and powdered milk. World prices to a great extent determine the domestic prices of these commodities in Venezuela after adjustment for various subsidies. In contrast, fluid milk, beef, pork, and poultry are largely nontraded commodities. In the absence of government intervention, their prices are determined mainly by domestic supply and demand.

In Venezuela there are maximum or minimum prices, or both, for almost all commodities, and the question is which decreed prices are effective and which are not. The degree of government intervention on the market for a certain commodity is to a great extent reflected by the volume of government transaction of that commodity to maintain the decreed price, or (what is essentially the same thing) the cost of the government program. In this regard, table 5-2 shows the components of the loss in operations of the Corporación de Mercado Agrícola (CMA), the agency that buys and sells the commodities in question.

The grain and livestock sector accounts for 85 percent of program costs. Subsidies on milk (327.4 million bolivares, Bs) represent the largest single component of CMA cost and a major area of government intervention. CMA costs on meat, poultry, and eggs total only about Bs7 million. The government operations on beef, pork, and poultry appear to be small, and, as noted earlier, imports are arranged only under emergency situations. This suggests that although there are controlled prices for pork and poultry they in fact approximate market clearing levels. In the case of beef, prices of low-grade cuts are controlled while prices of high-grade cuts are not. Shortages and queues thus tend to develop for inexpensive cuts, and people shift their expenditure to uncontrolled cuts, raising prices. On the average, the price paid by the consumer is likely to be close to the free market price. The government's main channel for influencing pork and poultry prices is by subsidizing inputs (such as grain) used to produce feeds; these subsidies lower the costs of production and in turn benefit consumers through lower prices. There have been large CMA purchases of grain in some years, indicating that the government is taking effective action. Table 5-2 indicates that program costs on grains represent the second largest component of CMA costs, totaling Bs350 million in 1977.

The above discussion indicates that milk subsidies and government feed policy represent the major effective forms of intervention in Venezuelan agriculture. In the following sections, first milk subsidies are analyzed, then the effects of government feed policy on program costs and on pork and poultry producers. As an example of the effect of policy in one subsector on another, the effect of the poultry-pork-feed program on the
Table 5-2. Venezuela: Summary of CMA Costs, 1976

<table>
<thead>
<tr>
<th>Item</th>
<th>Million bolivares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess of costs of acquiring commodities over revenue from selling them</td>
<td>146.6</td>
</tr>
<tr>
<td>Grain and livestock products</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>99.1</td>
</tr>
<tr>
<td>Other grains</td>
<td>42.0</td>
</tr>
<tr>
<td>Meat and eggs</td>
<td>5.5</td>
</tr>
<tr>
<td>Other products</td>
<td>36.6</td>
</tr>
<tr>
<td>Subsidy</td>
<td></td>
</tr>
<tr>
<td>Grain and livestock products</td>
<td>547.9</td>
</tr>
<tr>
<td>Milk</td>
<td>327.4</td>
</tr>
<tr>
<td>Grains</td>
<td>208.5</td>
</tr>
<tr>
<td>Feed mixes</td>
<td>10.4</td>
</tr>
<tr>
<td>Poultry</td>
<td>1.6</td>
</tr>
<tr>
<td>Other products</td>
<td>44.9</td>
</tr>
<tr>
<td>Other CMA expenses</td>
<td>24.1</td>
</tr>
<tr>
<td>Total CMA loss</td>
<td>799.7</td>
</tr>
</tbody>
</table>


The milk industry is considered. The mathematically inclined reader may refer to the tables of chapter 10 on which the following discussion is based.

**Milk Subsidies**

As noted earlier, Venezuela's dependence on foreign powdered milk is about 50 percent, and an import subsidy exists on it. In the case of domestic powdered milk, there are subsidies for both the unmarked and the brand-name types. Fluid milk is not imported nor is its price controlled, although a subsidy has been considered. (For analytical purposes, a subsidy on fluid milk of 3.3 percent of the industry's price is assumed.) For convenience, the subsidies on unmarked and brand-name powdered milk are treated as a single weighted average subsidy.

Powdered milk and fluid milk are close substitutes in consumption. Thus the demand for powdered milk or fluid milk depends negatively on its own price but positively on the price of the other. That is, the own-price elasticities of demand for powdered milk and fluid milk are negative, but the cross-elasticity of demand for powdered milk with respect to the price of fluid milk and the cross-elasticity of demand for fluid milk with respect to the price of powdered milk is positive.
Producers can market milk in the form of either fluid or powder, which are therefore close substitutes in production. The supply of powdered milk or fluid milk responds positively to increases in its own price but negatively to increases in the price of the other commodity. Thus own-elasticities of supply are positive while cross-elasticities of supply are negative. The numerical values of the various elasticities on which the present analysis is based have been drawn from previous studies and are presented at the end of table 10-1.

In the case of fluid milk, there are no imports and the market clears domestically. In the absence of government intervention there is a single price for both producers and consumers after allowance for normal marketing and margins. A domestic subsidy on fluid milk would, however, make the price received by producers higher than that paid by consumers, the difference being the loss per unit of the commodity handled by the government. 4

Since Venezuela is a price taker in the international market in the case of powdered milk, it cannot effectively influence the import price. Consequently, the import price sets the domestic price of powdered milk. On the assumption that domestic and imported powdered milk are more or less perfect substitutes in consumption, the price paid by Venezuelan consumers for powdered milk is equal to the world price less the import subsidy. The price received by producers of powdered milk is raised above the price paid by consumers by the amount of the production subsidy on powdered milk. It is therefore equal to the world price less import subsidy plus producer subsidy. As the producer subsidy is greater than the import subsidy, the price received by producers of powdered milk is above the world price.

The cost to the government of the milk program consists of three components: domestic subsidy payments on fluid milk; subsidy payments on domestic production of powdered milk; and import subsidy payments on powdered milk. In examining the various effects of policy changes on program costs, the important point is that because powdered milk and fluid milk are closely related commodities, and because consumption of powdered milk must be met by either domestic production or imports, a change in any one of the three subsidies invariably affects the other two subsidy payments.

4. The same analysis can be carried out with a fixed price to consumers and a fixed price to producers, with the latter higher than the former. The difference is then the domestic subsidy which also represents the loss per unit of government operation on the commodity.
Subsidy on Fluid Milk

Suppose the subsidy on fluid milk is doubled from its original 3.3 percent of the industry's price. The implication is that on the existing quantity of fluid milk handled by the government, the cost per unit is raised by the same amount as the increase in subsidy. This direct effect raises program costs by 6 percent. The increased subsidy on fluid milk, however, increases the wedge between the price received by producers and that paid by consumers by raising the former and depressing the latter. The higher price to producers of fluid milk induces a supply response, and since subsidy has to be paid on this extra production, program costs increase further by 0.018 percent. This rather small effect of supply response assumes a rather low elasticity of supply of 0.1.

In respect to cross-supply effects, the higher price received by producers for fluid milk shifts them away from the production of powdered milk; as a result, domestic subsidy payments on powdered milk decline by about 0.23 percent of program costs. This is partially offset by an increase in import subsidy payments of about 0.04 percent of program costs, owing to the fact that for a given level of consumption, any decrease in domestic production must be compensated by an equal increase in imports. There is still a net saving of about 0.19 percent, owing to the assumption that the domestic subsidy is greater than the import subsidy.

As for cross-demand effects, the lower price of fluid milk to consumers because of the higher subsidy shifts demand away from powdered milk. The decrease in total consumption of powdered milk reduces import subsidy costs by about 0.02 percent of milk program costs. Since the cross-supply effect tends to increase imports of powdered milk while the cross-demand effect tends to reduce them, import subsidy payments may either increase or decrease; under the present assumptions they increase by roughly 0.02 percent of milk program costs.

Under the assumption that the world price of powdered milk is given, policy changes in the fluid milk sector cannot affect the producer and consumer prices of powdered milk (since the domestic and import subsidies on powdered milk are unchanged). Hence, the only effect is on the production and consumption of powdered milk (and therefore on imports). All indirect effects together result in an offsetting decline of about 0.2 percent of total program cost (that is, 3.3 percent of the direct effect of a 6 percent increase in program cost). The net increase in program cost is therefore about 5.8 percent.
Domestic Subsidy on Powdered Milk

If the domestic subsidy on powdered milk is doubled from its original level of 50 percent of the industry's price, the direct effect on the existing quantity causes program costs to rise by 78 percent. This strong direct effect is due to the originally high rate of domestic subsidy and the importance of subsidy payments on powdered milk in the total milk program cost.

An increase in the domestic subsidy on powdered milk would not affect the price to Venezuelan consumers of powdered milk, which remains equal to the world price less the (unchanged) import subsidy. The price received by producers, however, is now the (unchanged) consumer price plus the higher production subsidy. This leads to higher production of powdered milk. If cross-elasticity effects with the fluid milk sector are ignored, program costs increase by a further 7.8 percent because of the need to pay domestic subsidy on the extra production induced by the higher price. This is partially offset by a decline in import subsidy payments by roughly 1.47 percent (again with cross-effects ignored) since imports are reduced by the same amount as the increase in domestic production. The net effect is an increase of program costs by 6.3232 percent.

The second-round effects are that the increase in the price received for powdered milk discourages fluid milk production, leading to a decline in domestic subsidy payments on fluid milk by 0.3 percent if the price of fluid milk remains unchanged. Since the fluid milk market clears internally, however, the reduction in supply causes fluid milk (producer and consumer) prices to rise. The decline in quantity of fluid milk produced (and consumed) is therefore less than it would have been had fluid milk prices remained constant. As a result, fluid milk subsidy payments decline by a little less than 0.3 percent.

The changes in prices in the fluid milk subsector in turn react upon the powdered milk subsector. On the one hand, the increase in the producer price of fluid milk makes production of powdered milk somewhat less attractive, and the original increase in production of powdered milk is modified, so that the net increase in milk program cost owing to supply response is only 6.03 percent, instead of 6.32 percent. On the other hand, the rise in the price to consumers of fluid milk increases consumption of powdered milk, resulting in an increase in program cost by 0.3496 percent because of higher import subsidy payments.

Since both production and consumption of powdered milk increase, imports and import subsidy payments on powdered milk may either in-
crease or decrease. Under the assumed elasticities, import subsidy payments decline by about 1.06 percent.

**Import Subsidy on Powdered Milk**

A doubling of the original import subsidy on powdered milk of one-fourth of the industry's price leads to increased subsidy payments on the existing level of imports by 16 percent of milk program cost. With the world price given, an increase in the import subsidy lowers the price of powdered milk to consumers, and with the producer subsidy unchanged, the producer price is lowered as well. The fall in the producer price of powdered milk encourages more fluid milk production, while the reduction of the price of powdered milk to consumers reduces the demand for fluid milk. Since the demand for fluid milk is decreased while its supply is increased, the quantity of fluid milk traded and subsidy payments on fluid milk may increase or decrease; under present assumptions, subsidy payments increase by about 0.1 percent.

The price to both producers and consumers of fluid milk is now lower. The reduction in the price of fluid milk to consumers shifts demand away from powdered milk, offsetting part of the original increase in consumption induced by the higher import subsidy. The reduction in the producer price of fluid milk shifts resources toward powdered milk production, offsetting part of the original decline. After adjusting for these cross-elasticity effects, however, there is still a net increase in consumption and a net decline in production of powdered milk. The reduction in domestic production of powdered milk leads to a decline in domestic subsidy payments, partly offsetting the increase in import subsidy payments, so that the net effect is about a 2.7 percent reduction in program cost. The increase in domestic consumption leads to an increase in import subsidy payments of about 3.2 percent. These two indirect effects are individually very strong—in absolute terms about 20 percent of the direct effect, although they happen to offset each other almost exactly. All indirect effects taken together add about 0.7 percent of program cost to the direct effect of 16 percent. Thus, overall, indirect effects add about 4 percent to the direct effect.

**Feed Programs**

The price for feed paid by livestock producers is, as mentioned, partly controlled by the government through subsidies on inputs—mostly grain—used in the production of feed. For the purpose of analysis it is assumed that different types of grain can be treated as a single commodity.
Grain used by livestock producers comes from either imports or domestic production. To encourage the latter, the price received by farmers for domestically produced feed is fixed by the government above the world price, which in turn is higher than the price of feed paid by livestock producers. As in the case of powdered milk, the influence of Venezuela on the world price of feed is minimal. The government incurs a loss on both domestically produced and imported feed, since in both cases the price at which it acquires feed is higher than the price at which it sells to livestock producers. The loss on domestically produced feed is greater than the loss on imported feed.

Farm Price of Feed

Consider a 1 percent increase in the price paid by the government to domestic producers of feed. If the original value of feed is Bs400 million, the direct effect on the existing quantity acquired by the government raises program cost by Bs4 million. Farmers, however, will respond to the higher price by producing more feed, and the government loss on this extra production increases program cost by about Bs0.42 million owing to the difference between the price paid to domestic feed producers and the price of feed sold to livestock producers. The amount of feed used in livestock production remains unchanged since the price of feed sold to livestock producers is independently fixed by the government. Thus any increase in domestic feed production displaces imports by the same amount. As a result, government losses on feed imports, which are caused by the difference between the cost of acquiring feed in the international market and the price paid by livestock producers, are reduced by about Bs4.3 million when both direct and indirect effects are taken into account. The indirect effects in this example are fairly strong: the supply response effect is more than 10 percent of the direct effect, and all indirect effects together add about 8 percent to the direct effect on program cost.

Feed Price Paid by Pork and Poultry Producers

As noted earlier, government operations on beef, pork, and poultry are rather insignificant, and prices in these sectors approximate free market levels. Pork and poultry are close substitutes in consumption, and more or less the same feed materials are used in production. For convenience, in the following discussion pork and poultry are treated as if they were a single commodity. Since cattle are fed primarily with grass, the cost of beef production is not affected by feed policy—except indirectly through interactions with the pork and poultry sectors, as shown below.
Consider a 1 percent reduction in the price paid by pork and poultry producers for feed. If the value of the feed used is originally Bs750 million, the direct effect of a decrease in government revenue from sales of the existing quantity of feed will be Bs7.50 million.

An individual livestock producer aiming at profit maximization would be expected to use feed until the contribution of the last unit of feed to pork and poultry output is equal to the price of feed. Now the producer would find it profitable to use more feed to increase pork and poultry production, since the price of an input (feed) has fallen while the price of output (pork and poultry) would presumably be unaffected by the actions of a single producer. The actions by all producers to increase pork and poultry output, however, would reduce price, diminishing the original incentive to increase feed use.

There is nevertheless a net increase in feed use because of the policy change. Since the price received by feed producers is unchanged, there is no change in domestic production, and all the increase in demand must be met by imports. If there were no interactions with the beef sector, government losses on feed imports would increase by Bs0.625 million. The reduction in pork and poultry price, however, shifts demand away from beef since they are close substitutes in consumption, and the resulting decline in the price of beef in turn reduces the demand for pork and poultry. The price of pork and poultry is lowered further and the increase in feed use (and import) will be less. When interactions with the beef sector are taken into account, the increase in losses on imports is Bs0.6 million (instead of Bs0.625 million). This adds about 8 percent to the direct effect on government cost.

**Effect of Feed Policy on Beef Prices**

An increase in the price paid by the government for feed produced by farmers would lead to an increase in domestic production which directly displaces imports. But the total amount of feed used by livestock producers (from either domestic production or imports) depends only on the price charged by the government, which is independently fixed. Thus an increase in the price of feed received by farmers would not affect the amount used by pork and poultry producers. Pork and poultry prices, as well as the price of beef, will also be unaffected.

A lowering of the price paid for feed by pork and poultry producers would, through lowering the cost of production, reduce pork and poultry prices. Since beef is a close substitute for pork and poultry in consumption, lower pork and poultry prices reduce the demand for beef, thereby lowering beef prices. According to the estimate given in chapter 10, this cross-
effect on the beef industry is significant. If the price of feed paid is reduced by 10 percent, beef prices are reduced by 1.3 percent. This in turn would discourage beef production, causing it to drop by 0.7 percent.

Since the beef industry is relatively free from government intervention, the cost of the beef program is little affected. The induced change in the price of beef would, however, shift the supply and demand for pork and poultry, inducing further changes in program costs in the latter sectors.

Summary and Conclusions

In evaluating the effects of government price policy changes, the various indirect and induced effects—including those arising from interactions with other sectors—should be taken into account. Not all these effects can be easily estimated. Nevertheless, the most important ones should be included along with the direct effect to give more reliable predictions than those currently available of the effects of policy changes on program costs.

At least two types of induced effects are potentially important: the supply and demand response effects when the price of a commodity is affected by government policy, and induced effects arising from input-output relations. Usually these effects are stronger, the more responsive are supply and demand for the commodity to price changes and the stronger are the input-output relations. In addition, there are cross-supply and demand effects on program costs for other commodities. These effects are stronger, the more responsive are supply and demand for these commodities to a change in price of the commodity affected by government policy; they are also stronger the more significant are government interventions in these other sectors.

The case of the milk subsidies illustrates the kinds of indirect effect to be considered when close substitutes exist in production and consumption. If the subsidy on fluid milk is doubled, under present assumptions the most important indirect effect is the change in domestic subsidy payment on powdered milk that causes program costs to decline 0.2 percent, offsetting partially the direct effect of a 6 percent increase. Other indirect effects are relatively insignificant. If the domestic subsidy on powdered milk is doubled, the most important indirect effect is the increase in domestic subsidy payment on powdered milk owing to the supply response of producers of powdered milk. This adds 7.8 percent to total milk program costs in contrast to the direct effect of 78 percent. The increase in production displaces imports, reducing import subsidy payments by 1.5 percent. Other indirect effects are relatively insignificant, so that all indirect effects taken together add about 6 percent to the total program cost.
With a doubling of the import subsidy on powdered milk, there are two very strong indirect effects, although they almost exactly offset each other. The reduction in production of powdered milk owing to the lower producer price lowers domestic subsidy payments by approximately 4 percent of program cost, while the increase in consumption of powdered milk owing to the lower consumer price raises import subsidy payments also by about 4 percent of program cost. All indirect effects, including interactions with the fluid milk market, add about 0.7 percent of program cost to the direct effect of 16 percent (or about 4 percent of the direct effect).

In the two examples on government feed policy, indirect effects are important, overall adding about 8 percent to the direct effect in each case. When the price received by domestic feed producers is raised, the increase in government cost owing to the supply response adds about 11 percent to the direct effect, while the reduction of losses on imports subtracts about 3 percent. When the price paid for feed by pork and poultry producers is lowered, the increase in losses on imports because of higher feed consumption adds about 8 percent to the direct effect on program cost. Indirect effects arising from interactions with the beef sector are negligible.

Although in the previous examples indirect effects tend to offset one another, their overall impact on program costs is significant. The addition of some 10 percent to the direct effect could in practice imply thousands of dollars (or bolivares) of additional government outlays and should certainly be taken into account in making policy decisions. Moreover, although indirect effects tend to be offsetting in these examples, several are individually very strong, implying that our conclusion about the overall contribution of indirect effects may be very sensitive to our assumptions about the strengths of separate responses. The assumptions about elasticities and response coefficients on which the above estimates of indirect effects are based are rather conservative (see chapter 10). In practice the indirect effects are likely to be even stronger than outlined in this chapter, in which case it is all the more important to consider these effects in evaluating government program costs.
Part Two

Analysis of Policy Options
BECAUSE OF COMPETING DEMANDS for government expenditure, the cost of a government program is almost always important in the choice among policy options. Competing considerations that are also generally important, however, are the effects of price policy on producer and consumer welfare. In this chapter a basic framework is developed for considering these effects along with government costs.

In the first part of the chapter we examine the effects on national welfare and its components of changing the level of one or more agricultural commodity prices. In the second part the difference between total supply and marketed supply is analyzed because it is important to the estimation of price policy effects. After the discussion of income transfers among broad groups, in the third part of the chapter we consider how to estimate income distribution effects within groups.

Income Transfers and Resource Allocation

If amounts consumed and produced are not affected by a program, then the change in price paid or received times the amount of the commodity measures the income transfer to or from a group. A problem arises when amounts are affected because of production or consumption response to the price change. The additional consumption or output might be valued at either the price with the program or the price without it, but on reflection neither procedure is adequate. In the response of producers and consumers to a price change, the value they place on an additional unit changes with the amount of production or consumption. Each increment
of consumption or output must, to be precise, be valued differently, and the demand or supply schedule provides a way of valuing the increments. Much literature exists on this method, which has come to be known as the consumer and producer surplus method. Here the major assumptions required for its use are mentioned, followed by formulas and examples for computing the effects of a program on income transfers and resource allocation. The consumer and producer surplus analysis of the welfare effects of price policy rests on three basic assumptions. The first two are that the demand price for a good measures its value to the consumer, and that the supply price of a commodity measures its value to the supplier.

The first assumption appears quite plausible—if the consumer is willing to pay a certain price for a unit of the good, it is only reasonable that the amount he is willing to pay reflects the money value of the utility (or satisfaction) he obtains from that unit of the good. In figure 6-1, $S$ and $D$ represent respectively the supply and demand curves for a commodity, so that the competitive equilibrium price is $P_0$ and the quantity traded is $Q_0$. The highest value placed by a consumer on the good is $OB$. As more of the good becomes available its demand price becomes lower because new buyers entering the market value the good less, and because additional units bought by existing consumers generate less and less additional satisfaction to them. At the equilibrium quantity traded of $Q_0$, the total amount paid by consumers is $OQ_0AP_0$, and the total value placed by consumers on this quantity is given by the area under the demand curve, or $BAQ_0$. The excess of total value placed on the good by consumers above the amount paid, area $BAPO$, is known as consumer surplus. It arises because in a competitive market there is a single price for all units of the good consumed. Thus the last unit of the good bought in the market has a value to the consumer just equal to the market price, while previous units have values to the consumer above the market price.

The second assumption is in effect the assumption that the aggregate supply curve $S$ could be regarded as the sum of marginal cost curves by individual firms or farmers. It rises to the right both because the marginal costs of existing producers increase as more units are produced and because

higher-cost producers enter into the industry. The cost of producing $Q_0$ is given by the area under the supply curve up to $Q_0$, or area $COQ_0A$. The revenue obtained by selling $Q_0$ is given by area $OP_0AQ_0$. The excess of what producers receive over their cost of production, area $P_0AC$, is called producer surplus, and it arises for the same reason as the consumer surplus. In a competitive market equilibrium all sellers (producers) receive the price $P_0$, so that a profit (or "surplus") is yielded to those whose costs of production are lower than the market price.

The third assumption is that consumer and producer surpluses may be aggregated. It is then possible to estimate the effects of government policy alternatives on national welfare by summing the resulting changes in producer and consumer surpluses, plus the government program cost.

2. If marginal cost curves of producers reflect accurately the social opportunity cost of resources employed in the production of the good, area $COQ_0A$ also indicates the income the resources engaged in producing $Q_0$ of the good could have generated elsewhere in the economy.
Examined here are the welfare effects of a basic two-price policy in which the government buys rice from farmers at a price above the market clearing level and sells it to consumers at a lower price—as in the Korean seasonal rice price stabilization program described in chapter 2 and the Bangladesh study in chapter 3. The mechanics of seasonal price stabilization will be considered in much greater detail in chapter 9. In the absence of any government program, prices would rise through the year reflecting the interest and noninterest costs of holding rice. Under the assumptions about storage costs in chapter 9, prices will rise 36 percent seasonally during the year, implying that the seasonal average wholesale price is above that at harvesttime by 18 percent. With a difference of 10 percent assumed between the farm price and the wholesale price owing to transport and processing costs, the seasonal average wholesale price is higher than the farm harvest price by 28 percent. Seasonal stabilization consists essentially of the government's buying rice and raising prices at harvesttime, and releasing rice and lowering prices later in the season. The degree of seasonal stabilization which can be achieved depends on the amount of stocks available for release, which in turn depends on the government purchase price at harvesttime. The raising of the farm harvest price induces a marketed supply response by farmers, so that the quantity of rice marketed is greater than it would have been in the absence of government policy. This in turn implies that the seasonal average wholesale price would be lower. The effect of changes in average producer (farm) and consumer (wholesale) prices on producer welfare, consumer welfare, and government cost through this policy is analyzed here for the case in which the farm price is raised by as much as or more than required for complete seasonal stabilization. The case of partial seasonal stabilization is reserved for chapter 9.

In figure 6-2, $S$ and $D$ are respectively the supply and demand curves at the farm level. Their intersection, point $A$, gives the price that would prevail under normal supply and demand conditions and in the absence of trade and government policy. This price, referred to as the self-sufficiency price, is estimated to be W28,500 per bag in 1979–80. The wholesale demand curve $D'$ in the figure is higher than $D$ because of storage, transport, and processing costs. In accordance with the previous discussion, the seasonal average wholesale price in the absence of government policy, given by point $a$ in the figure, is $W28,500 \times 1.28 = W36,480$ per bag.

Let $p_f$ denote the farm price, $p_w$ the domestic wholesale price, and $Q$ the quantity of rice marketed. The supply function is $q = c_s p_f$, and the demand function is $q = c_d p_w^{-\beta}$ where $\gamma$ is the elasticity of supply and $\beta$ is the
elasticity of demand. Under the assumptions that $\gamma = 0.3$ and $\beta = 1$, it will be shown in chapter 9 that the government purchase price of W32,450 per bag is just sufficient to achieve complete seasonal stabilization.

The welfare effects of a government purchase price of W35,000 per bag, which is more than sufficient for complete seasonal price stabilization, are shown in figure 6-2. The government incurs costs of $MBCF$, which may also be regarded as taxpayer costs. But since the government purchase price of W35,000 is above the self-sufficiency price of W28,500, there is a gain in producer surplus of $EABM$. In addition, under our elasticity assumptions the seasonal average wholesale price to urban consumers is reduced from W36,480 to W33,985, causing a gain in consumer surplus (measured at prices at farm level) of area $EACF$. This leaves area $BAC$ ($= MBCF - EABM - EACF$) as the welfare cost owing to economic inefficiency—which exists because transfers have been accomplished
through measures affecting resource allocation instead of by direct payments outside the marketplace.¹

Mathematically, in the case with all extra rice sold domestically, the gain to farmers $G_f$ is

$$(P_f - P_f^0) Q^0 + \int_{Q^0}^{P_f} (P_f - \gamma q^{1/\gamma}) \, dq,$$

with the superscript $(s)$ denoting conditions of self-sufficiency, and at the point of self-sufficiency $q = c, (P_f^0)^n$, which gives $P_f^0 = c^{1/\gamma} q^{1/\gamma}$.

On integration and division by $P_f^0 Q^0$, after some rearrangement we have

$$G_f = \frac{1}{(1 + \gamma)} [(P_f/P_f^0)^{1+\gamma} - 1],$$

which gives the gain to farmers as a fraction of crop value under self-sufficiency.

The gain in consumer surplus $G_c$ is given by

$$G_c = 1.28 P_f^0 Q^0 - P_c Q + \int_{Q^0}^{P_f} (P_c - P_f) \, dq.$$

In this section the small letter $P_c$ refers to values as one moves along the demand curve while $P_c^0$ refers to a specific price, namely the wholesale price prevailing under government program. Rearranging the demand relation $q = c d p;«$ gives $p_c = c_d^d q^{1/\beta}$. Substituting into the expression for $G_c$ and carrying out the integration gives

$$G_c = 1.28 P_f^0 Q^0 - P_c Q + c_d [\ln Q - \ln Q^0], \quad \beta = 1.$$

as the expression for gain to consumers. The above expression can be simplified further. With all rice sold domestically, the demand and supply relations $q = c_d p_a$ and $q = c_d p_f$ can be equated to give $p_a = c_d^d p_f^{1/\beta}$. At the self-sufficient quantity, $p_f = P_f^0$ and $p_a = P_a^0 = 1.28 P_f^0$. Substituting these expressions into $p_c$ and rearranging gives $c_d^d = 1.28 P_f^0 [P_f^0]^{1/\beta}$, and substituting this result back into the expression for $p_c$ gives

$$p_c = 1.28 P_f^0 [P_f^0]^{1/\beta}.$$

³ For convenience, we have been comparing national welfare under the government stabilization program with point $A$ in figures 6-2 and 6-3, which indicates a situation without government intervention and without trade. Point $A$ is not the optimal point for national welfare, however. For example, since Korea's self-sufficiency price is above the world price, its national welfare can be improved by allowing imports at the latter price.
\[
p_{o}/P_{o}^{o} = 1.28 \left[ p/p_{o}^{o} \right]^{-\gamma \beta}.
\]

Finally, dividing \( Q \) by \( Q^{o} = c_{i} (P^{o}/P^{o})^{\gamma} \), gives \( Q/Q^{o} = (p/P^{o})^{\gamma} \).

Using the above results in the expression for \( G_{o} \), dividing by \( P_{o}/Q^{o} \), and simplifying further gives the following expression for gains to consumers as a fraction of self-sufficiency value:

\[
(6.2) \quad \frac{G_{o}}{P_{o}/Q^{o}} = -\left[ \frac{1.28}{(\beta - 1)} \right] \left[ 1 - (P/P^{o})^{\gamma - \gamma \beta} \right] \quad \text{if } \beta \neq 1
\]

and

\[
= 1.28 \gamma \ln \left[ P/P^{o} \right] \quad \text{if } \beta = 1.
\]

Under the assumptions elasticity of marketing \( \gamma = 0.3 \) and elasticity of demand \( \beta = 1 \), and a value of rice marketed at the self-sufficiency price \( P^{o}/Q^{o} \) of W1,075 billion, by applying equations (6.1) and (6.2) it is found that the gain in producer surplus with a W35,000 purchase price is W253 billion, and the gain in consumer surplus is W85 billion. It will be seen in chapter 9 that government program costs will be W422 billion if government and private storage costs are assumed equal. The welfare loss owing to allocation inefficiencies is therefore W84 billion.

The analysis of the preceding section continues by considering the relation between the response of total production and of marketed supplies to a change in price. The elasticity of supply of an agricultural commodity, which measures the responsiveness of the quantity produced to the price received by farmers, has often been estimated in econometric studies. In
price policy analysis, however, the elasticity of marketed supply is of interest because it measures the responsiveness of the quantity marketed to a change in price. For example, in analyzing the effect of price policy on farmers' cash income it is the quantity marketed rather than the quantity produced that is relevant. Similarly, the program cost of government price policy depends crucially on the quantity of the commodity handled by the government, which in turn depends on the responsiveness of the quantity sold by farmers in the market to price changes. The quantity marketed of a commodity is the difference between production and farm consumption. Thus, in analyzing the effect of price policy on marketed supply, one wishes to look at its effect on production and on-farm consumption.
The regressions for rice and barley marketings shown in table 6-1 are instructive for the analysis of marketed supply. As will be brought out, the first regression presented for each commodity is preferred. The first regression for rice indicates that rice marketings are positively and significantly related to rice production, and that the price of rice is not a significant explanatory variable while barley price is. Most of this section is devoted to the rice marketing results.

First, the coefficients of rice production and rice price are considered separately. Then a graphical interpretation combines results for both, followed by inferences about marketed supply elasticity, with estimates that allow for induced production response to a price rise. Finally, the effect of the price of barley on rice marketings is considered, and the barley marketing regressions are interpreted.

It can be seen from table 6-1 that the coefficients of rice production in the rice marketing regressions are about one, indicating that most of the extra production is marketed. With an income elasticity of demand for rice greater than zero, not all of an increase in rice production would be marketed. This is because an increase in rice production would result in a higher income, a part of which would be devoted to an increase in rice consumption. Thus, with a positive income elasticity of demand for rice, the coefficient of rice production is expected to be somewhat less than one. It can be seen that the coefficient of rice production in the first regression is less than one standard error above one. The second through the fourth regressions for rice marketings are the same as the first except that various variables are omitted. In these regressions, the rice production variable does have coefficients less than one.

The effect on farm household income of an increase in rice production depends on the importance of rice in total income and on the increase in expenses accompanying production. Net farm household income is the sum of net agricultural income and incomes from nonagricultural activities, or . The net income from agricultural activities is the sum of net receipts from rice production and net receipts from other agricultural activities (which include production of other crops as well as noncrop activities such as livestock and poultry production and handicrafts), or

where and represent respectively gross receipts and expenses from rice production and and represent gross receipts and expenses in other agricultural activities. Thus, if there were no expenses in producing rice, the increase in net income resulting from an increase in rice production would be the same as an increase in gross income from rice, or
### Table 6-1. Korea: Grain Marketing Regressions

<table>
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<th>Constant</th>
<th>Rice production</th>
<th>Deflated rice price</th>
<th>Barley production</th>
<th>Deflated barley price</th>
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</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1.73)</td>
<td>(3.73)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1039</td>
<td>151</td>
<td>0.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1.22)</td>
<td>(0.494)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dependent variable: rice marketings**

| -0.254   | 0.000214       | 0.062              | -0.110           | 0.56         |
| (0.903)  | (2.78)         | (0.796)            | (1.81)           |
| 0.089    | 0.000130       | -0.040             | 0.33             |
| (0.375)  | (1.84)         | (0.652)            |
| 0.039    | 0.000112       | 0.28               |
| (0.181)  | (0.179)        |
| 0.414    | 0.004          | 0.00               |
| (0.440)  | (0.624)        |

**Dependent variable: rice marketing ratio**

| -57.8    | -96.6          | 0.440              | 11.7             | 0.86        |
| (0.245)  | (7.18)         | (4.99)             | (0.130)          |
| -165     | 0.369          | -42.1              | 0.85             |
| (0.933)  | (5.58)         | (0.864)            |
| -282     | 0.386          | 0.83               |
| (2.54)   | (6.22)         |
| 644      | -124           | 0.16               |
| (2.93)   | (1.22)         |

**Dependent variable: barley marketings**

| 0.204    | -0.060         | 0.0000972          | 0.0046           | 0.59        |
| (1.63)   | (0.845)        | (2.29)             | (0.970)          |
| 0.137    | 0.0000788      | -0.0289            | 0.54             |
| (1.44)   | (2.21)         | (1.10)             |
| 0.056    | 0.0000906      | 0.46               |
| (0.294)  | (2.63)         |
| 0.301    | -0.046         | 0.22               |
| (0.468)  | (1.52)         |

**Dependent variable: barley marketing ratio**

*Note: Figures in parentheses are absolute values of t statistics.*
\[\frac{\delta T}{\delta Q_r} = G \left( \frac{G_r - E_r}{G_r} \right)\]

where \(G = G_r/(N+NA) = G_r/T\) is the ratio of gross income from rice to net household income and \((G_r - E_r)/G_r\) is the net income received per won of gross income from rice. If it is assumed that the share of rice in production expenses is the same as its share in gross agricultural income, or \(E_r/(E_r + E_a) = G_r/(G_r + G_a)\), which in turn implies \(E_r/G_r = E_r/G_a\), then it can be shown that the ratio \(F\) of net agricultural income to gross agricultural income is equal to the net income received per won of gross income from rice, or

\[F = \frac{(G_r + G_a) - (E_r + E_a)}{G_r + G_a} = \frac{G_r - E_r}{G_r}.\]

In other words, under this assumption, every won of gross income from rice yields \(F\) won of net income, where \(F\) is net agricultural income divided by gross agricultural income. Substituting the above expression into (6.3) gives

\[\frac{\delta T}{\delta Q_r} = GF = \left( \frac{G_r}{N + NA} \right) F.\]

From table 6-2, \(F\) is line 7 divided by line 1, while \(G\) is line 2 divided by line 9. Thus for all farms as a group, \(F = 0.77695\) and \(G = 0.4710\) so that \(F \times G\) is approximately 0.366. Thus a 1 percent increase in rice production will increase net farm income by about 0.366 percent.

The percentage increase in rice consumption of farm households from a 1 percent increase in production is the percentage increase in net income times the income elasticity of demand for rice, or

\[\frac{dT}{dG_r} = 1.\] Allowing for production expenses and assuming prices to be constant, the percentage change in net income \(T\) resulting from a 1 percent increase in rice production \(Q_r\) is

\[\frac{\delta T}{\delta Q_r} = G \left( \frac{G_r - E_r}{G_r} \right)\]

4. The change in net farm household income \(T\) with a change in rice production \(Q_r\) (and with levels of other agricultural and nonagricultural activities remaining unchanged) is \(dT = dG_r - dE_r\). With product and factor prices constant, \(dG_r = P_r dQ_r\) and \(dE_r = S_r dQ_r\), where \(P_r\) is the rice price and \(S_r\) is the per unit production expenditure and both \(P_r\) and \(S_r\) are constants. Substituting into the expression for \(dT\) and after some rearranging we obtain

\[\frac{dT}{dQ_r} = \left( P_r - S_r \right) \frac{Q_r}{T} = \frac{G_r - E_r}{T} = \frac{G_r}{T} - \frac{E_r}{T} G_r.\]

which is equation (6.3).
Table 6-2. Korea: Average Income and Expense Items per Farm, 1977

<table>
<thead>
<tr>
<th>Subject†</th>
<th>Average per household</th>
<th>Farm size in ch'ongbob</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;0.5</td>
<td>0.5–10</td>
</tr>
<tr>
<td>1. Gross receipts from agriculture</td>
<td>1,333,586</td>
<td>493,521</td>
</tr>
<tr>
<td>2. Value of rice produced</td>
<td>674,874</td>
<td>228,772</td>
</tr>
<tr>
<td>3. Quantity of rice (polished liters)</td>
<td>3,615.36</td>
<td>1,362.16</td>
</tr>
<tr>
<td>4. Price of rice (per 100 liters) [line 2 ÷ line 3] × 100</td>
<td>18,666.85</td>
<td>16,794.80</td>
</tr>
<tr>
<td>5. Value of other agricultural production [line 1 − line 2]</td>
<td>658,712</td>
<td>264,749</td>
</tr>
<tr>
<td>6. Agricultural expensesd</td>
<td>297,450</td>
<td>128,891</td>
</tr>
<tr>
<td>7. Net agricultural income [line 1 − line 6]</td>
<td>1,036,136</td>
<td>364,630</td>
</tr>
<tr>
<td>9. Farm household income [line 7 + line 8]</td>
<td>1,432,809</td>
<td>872,393</td>
</tr>
<tr>
<td>10. Rice sold (polished liters)</td>
<td>1,401.51</td>
<td>290.59</td>
</tr>
<tr>
<td>11. Rice sold (polished liters) plus “other”c</td>
<td>1,916.84</td>
<td>454.36</td>
</tr>
<tr>
<td>12. Rice cash income [line 10 × line 4] ÷ 100</td>
<td>261,618</td>
<td>48,804</td>
</tr>
<tr>
<td>13. Rice plus other cash income [line 11 × line 4] ÷ 100</td>
<td>357,814</td>
<td>76,342</td>
</tr>
<tr>
<td>14. Rice cash income as fraction of farm household income [line 12 ÷ line 9]</td>
<td>18.3</td>
<td>5.6</td>
</tr>
<tr>
<td>15. Rice plus other cash income as fraction of farm household income [line 13 ÷ line 9]</td>
<td>25.0</td>
<td>8.8</td>
</tr>
</tbody>
</table>

a. Current won values unless otherwise stated.
b. A ch'ongbo is approximately 2.5 acres.
c. Include crop receipts (rice, wheat, barley, miscellaneous grains, pulses, potatoes, vegetables, special crops, fruits, and by-products) and noncrop receipts (livestock, poultry, sericulture, and handicrafts).
d. Include expenditures for materials, animals, wages, rents, irrigation, milling, buildings, changes in inventories, and other charges.
e. Include in-kind farming expenditures for labor and materials as well as repayment for borrowed rice, lending rice to others, room and boarding charges, and other payments in kind, such as for schooling fees.

\[
\frac{\delta C_r}{\delta Q_r} = \frac{\delta C_r}{\delta T} \cdot \frac{T}{\delta Q_r} = 0.366 \eta
\]

where \( C_r \) is rice consumption of farm households and \( \eta = \frac{\delta C_r}{\delta T} \) is the income elasticity of demand for rice. Since rice consumption is about half of rice production, the absolute effect of production on consumption will be about half the percentage effect. This can be seen by rewriting the above equation as

\[
\frac{\delta C_r}{\delta Q_r} = 0.366 \eta \left( \frac{C_r}{Q_r} \right) = 0.183 \eta
\]

since \( C_r/Q_r = 1/2 \). Thus, for example, if production changes from \( Q_r = 100 \) to \( Q'_r = 101 \) so that \( \delta Q_r/Q_r = 0.01 \), the percentage change in consumption is \( \delta C_r/C_r = 0.366 \eta (\delta Q_r/Q_r) = 0.00366 \eta \). In absolute terms, however, consumption changes from \( C_r = 50 \) to \( C'_r = C_r (1 + 0.366 \eta \delta Q_r/Q_r) \), so that the absolute change in consumption is \( 0.366 \eta (\delta Q_r/Q_r)C_r = 0.183 \eta \). The increase in consumption will take away from marketings part of the increase in production. An estimate of the coefficient of rice production in the rice marketing regressions is \( 1 - 0.183 \eta \). This coefficient could be close to one (as in the reported regressions) even if the income elasticity of demand \( \eta \) is substantial.

The effect of the rice price on marketings depends on the relative importance of the income and substitution effects. In the usual type of demand analysis, where it is assumed that the entire amount of the commodity consumed by the household is purchased in the marketplace, the income effect of a change in price reinforces the substitution effect as long as the income elasticity of demand is positive. Thus a rise in the price of a commodity results in a fall in real income, which leads to a fall in consumption and reinforces the substitution away from the commodity induced by the price rise. In contrast, if the amount of a commodity owned by a household is greater than it wishes to consume, the household would be a net supplier, and in this case the income effect would work in the opposite direction from the substitution effect. In response to an increase in the rice price, the greater income of rice producers makes them wish to consume more rice, but the price rise also tends to encourage substitution away from rice. The volume of rice marketings will decrease if the income effect is dominant, and will increase if the substitution effect is dominant.

It can be seen in Table 6-1 that the coefficients for rice price are not significant. At first sight this appears to suggest that the substitution and
income effects approximately cancel each other. The elasticity of marketing $\varepsilon_M$ can be written as

$$\varepsilon_M = -\varepsilon' \frac{C_r}{M_r} - \xi \eta \frac{C_r}{M_r}$$

where $\varepsilon'$ is the compensated elasticity of demand with respect to price holding income constant, $\xi$ is the elasticity of net farm household income with respect to a change in the price of rice, $\eta$ is the income elasticity of demand, $M_r$ is rice marketing, and $C_r$ is farm household consumption.\(^5\)

In the next section, $\xi$ will be shown to be 0.183 if in-kind payments are excluded in estimating the effect of rice price on net farm household income and 0.250 if they are included. If $\varepsilon_M$ were zero, the substitution effect of a price change, represented by the first term in (6.5), is exactly offset by the income effect represented by the second term. This would imply that the income elasticity $\eta$ is 1/0.183 to 1/0.25 or approximately four to five times the pure substitution demand elasticity $\varepsilon'$. This does not seem too plausible for two reasons. First, the estimated coefficients for rice production of about one do not suggest an extremely high income elasticity. Second, even if the demand for grains as a whole is quite inelastic, the substitution effect could be fairly large because of possibilities of substituting one grain for another in consumption.

If the substitution effect outweighs the income effect, a rise in the rice price will increase rice marketings. While the coefficient for the rice price is not significant in any of the rice marketing regressions, it is of the "right" (positive) sign in four of the six regressions in which it is included, and the two negative coefficients are not significantly different from zero. The results are therefore consistent with the hypothesis that some increase in rice marketings out of a given quantity of production is expected in response to an increase in the rice price.

The relation between the quantity of rice produced, the rice price, and the rice farmers' marketing decisions can be clarified by looking at figure 6-4. $Q_r$ is the quantity of rice produced in an initial situation, and $Q_a$ is the amount of income left from other sources after paying rice production expenses to factors other than those owned by the farm household. The

\[5.\text{With production given at } Q_r = Q_a, \text{marketing of rice } M_r = Q_r - C_r = Q_a - C_r (P_r, T(P_r)). \text{Totally differentiating with respect to the price of rice } P_r \text{ gives } \]

$$\frac{dM_r}{dP_r} = \frac{8C_r P_r}{8P_r C_r} - \frac{8C_r 8T}{8T 8P_r}.$$ 

Multiplying both sides by $P_0/M_r$, and converting into elasticities gives (6.5). Note that $\varepsilon' = (8C_r/8P_r) (P_r/C_r)$, $\xi = (8T/8P_r) (P_r/T)$, $\eta = (8C_r/8T) (T/C_r)$, and $\varepsilon_M = (dM_r/dP_r) (P_r/M_r)$. 
Figure 6-4. Effects of Production and Price Changes on Consumption and Marketing

The point \((Q', Q'_r)\) is the production point as shifted by a change in rice production. The shift could be due to better weather or the farmers' decision to produce more. If net income from nonrice sources remains the same, \(Q'_r\) will be less than \(Q_r\) owing to harvesting and other expenses incurred in connection with the increased rice production. According to the estimate made earlier, if the percentage change in rice production is

\[(1 + 0.47f)Y\]
\[(1 + 0.366f)Y\]

\((C_r, C'_r)\) is the production point—it would also be the consumption point if the household desires to consume all the rice produced. The figure depicts a situation in which the household wishes to sell rice. The slope of the budget line for moving away from the production point is determined by the relative price of rice. The household chooses the consumption point \((C_r, C)\) at which the budget line is tangent to a consumption indifference curve. The quantity of rice marketed is the horizontally measurable distance \(C_r - Q_r\).
so that $Q' = (1 + f)Q$, the resulting percentage change in net income is $0.366f$. This is shown by the change from $Y$ to $(1 + 0.366f)Y$ of the intersection of the budget line with the vertical axis. Graphically, if there were no additional production expenses, the production point would shift exactly horizontally. Then by similar triangles, the value of total rice production would change from $Y - Q$ to $(1 + f)(Y - Q)$, giving an increase of $f(Y - Q)$. The value of $G$, the value of rice produced divided by farm household income, has been found earlier to be $0.471Y$. Thus $Y - Q = 0.471Y$. Thus with no increase in production expenses, the increase in income will be $0.471f$. As indicated by the dotted line between $(Q, Q)$ and $(Q', Q')$, however, there is a downward as well as horizontal movement in the production point owing to increases in production expenses. The vertical difference between the two points is determined by $F$, the ratio of rice receipts net of expenses to gross rice receipts, estimated earlier to be $0.77695$. The upward shift in the vertical intercept of the budget line is thus only $0.77695$ times $0.471f$, giving a proportionate increase of $0.366f$.

The change in consumption point in response to a change in production is from $(C_1, C_r)$ to $(C'_1, C'_r)$, which leads to a change in rice marketings from $M_1 = Q_1 - C_1$ to $M'_1 = Q'_1 - C'_1$. From our previous discussion, we know that the income elasticity of demand $\eta = \left[\frac{(C'_r - C_r)}{(C_r - C)}\right]0.366f$, implying that the change in consumption $(C'_r - C_r)$ is equal to $0.366f\eta C_r$. This must be subtracted from the change in production $(Q'_r - Q_r) = fQ_r$ to arrive at the change in marketings $M'_1 - M_1 = (Q'_r - Q_r) - (C'_r - C_r)$. After some rearranging we obtain

$$M'_1 - M_1 = (Q'_r - Q_r) [1 - 0.366 \eta R]$$

where $R = C_r/Q_r$ is the ratio of rice consumption to production. From table 6-2, the estimate of $R$ for all farms as a group is $0.39$ ($= 1401.51/3615.36$) to $0.53$ ($1916.84/3615.36$), depending on the definition of marketings. This is consistent with the fact that urban rice consumption accounts for about half of rice production. The average of the two estimates is in fact close to $0.5$, which may be used as our estimate of $R$. This gives

$$1 - 0.366 (0.5) \eta = 1 - 0.183 \eta$$

as the expected coefficient of rice production in the regressions with rice marketings as the dependent variable.

The above analysis of an increase in rice production by $f$ percent may be compared with that of an equivalent percentage increase in the rice price—that is, the proportionate increase in the rice price (with production unchanged) that would have led to the same increase in income received by the household as in the case of an $f$ percent increase in production, if
all rice were marketed. With a change in the rice price and production held constant, the consumption point is shifted from \((C_s, C_r)\) to \((C'_s, C'_r)\) on the new budget line intersecting the vertical axis at \((1 + 0.47f)Y\). To derive the new intercept, note that the change in the intercept gives the change in the money value of total rice production and is equal to \(f(Y - Q_s)\). Since \((Y - Q_s)Y\) is the ratio \(G\) estimated earlier to be 0.471, the increase in income measured in won is 0.471 times \(Y\). The increase in income received by the household would be the same as the increase in income measured in won only if all rice were marketed. The won income received from the sale of rice before the price change is \(C_s - Q_s\). The increase in income which would be received on the same quantity of marketings after the price change is the vertical distance from \((C_s, C_r)\) to the new price line. As a fraction of \(Y\), which is the original income measured in won, this distance is the proportionate change in the rice price times the fraction which rice marketings are of net household income. From the last two lines of table 6-2, this fraction is 0.183 to 0.250, depending on the definition of rice marketings. The income effect of the price change is therefore to increase consumption proportionally 0.183 \(f_n\) to 0.250 \(f_n\). Had there been no substitution effect, the household would choose the point at the intersection of the new price line with the income expansion path (point D). The movement from D to \((C'_s, C'_r)\) is due to substitution, and from the earlier discussion we know that \((C'_s, C'_r)\) must lie to the left of \((C_s, C_r)\), unless the income elasticity were four or five times higher than the substitution elasticity. The decline in consumption with leftward movement implies an increase of marketings in response to the price rise. With a given production, the response of marketings to price will be equal to but in opposite direction from the response of consumption.

A consistent interpretation has been given suggesting that an increase in rice production increases marketings by an amount somewhat less than the change in production, and that an increase in the rice price has an effect at least slightly greater than zero. These conclusions are now used to consider the elasticity of rice marketings with respect to a rise in the rice price, taking account of the fact that the price rise is likely to induce an increase in rice production. Rice marketings \(M_r\) may be written as a function of rice production \(Q_r\) and the rice price \(P_r\), and rice production itself is dependent on price. Thus we have

\begin{equation}
(6.6)
M_r = M_r[Q_r(P_r), P_r].
\end{equation}

Differentiating totally with respect to \(P_r\), gives

\[
\frac{dM_r}{dP_r} = \frac{\delta M_r}{\delta P_r} + \frac{\delta M_r}{\delta Q_r} \frac{\delta Q_r}{\delta P_r}.
\]
Multiplying by $P/M_t$ gives, after some manipulation, the elasticity of rice marketings with respect to price as

\[(6.7) \quad \frac{dM_t}{dP_t} = \left( \frac{\delta M_t}{\delta P_t} \right) \left( \frac{P_t}{M_t} \right) + \left( \frac{\delta Q_t}{\delta Q_t} \right) \left( \frac{dQ_t}{dP_t} \right).\]

The first term on the right-hand side is the elasticity of rice marketings with respect to price, with production held constant. It indicates the direct effect of a price rise on marketings out of a given amount of production. It has been noted above that this term is slightly greater than zero. The second term represents the indirect effect through which a price rise increases marketings by inducing a change in production. The term $\delta M_t/\delta Q_t$ is the response of rice marketings to production which we have argued to be slightly less than one. The ratio of rice production to marketings $Q_t/M_t$ is about 2. The elasticity of supply of rice $(dQ/dP) (P/Q)$ has been estimated to be about 0.3 for Korea, and estimates for other countries have typically ranged from 0.1 to 0.5. As a first approximation, suppose the elasticity of marketings with respect to price for a given quantity produced were in fact zero and $\delta M_t/\delta Q_t$ were one. When production response is taken into account, the elasticity of marketings with respect to price will be 0.6, or twice the production elasticity of 0.3. In other words, since all of the increased production is assumed to be marketed, and since production is twice marketings, the percentage increase in marketings in response to a given percentage change in price would be twice the percentage increase in production. Thus the marketing supply elasticity of 0.3 assumed in our study on Korea is likely to be the lower bound of the actual elasticity.

The second set of four regressions in table 6-1 takes the rice marketing ratio (rice marketings divided by rice production) as the dependent variable. It can be seen that the ratio of marketings to production tends to rise with increases in production. As a simplified explanation, a target level of rice consumption might be visualized with farmers marketing most of what they produce over this amount.

The coefficient of the price of barley in the first rice marketing regression is negative, which suggests that an increase in the barley price reduces rice marketings. This result is expected since farmers would then market barley and substitute rice for barley in their own consumption. A rise in the barley price also has an income effect, but it is less important that in the case of rice since the value of barley marketings is only about one-sixth the value of rice marketings.

The last eight regressions take barley marketings as the dependent variable, exactly replicating in a symmetrical fashion the analysis for rice. Barley marketing behavior is found to be essentially similar to rice mar-
marketing behavior. The coefficients for barley production are consistently positive and highly significant, the coefficients for barley price are generally negative, and the rice price has a negative effect which is highly significant in the preferred regression. The \( t \) statistics indicate that the coefficients for barley production are significantly below one. One reason suggested by the previous discussion would be a positive income elasticity. Since the income elasticity of demand for barley is likely to be below that of rice, this explanation does not account for the fact that the coefficients for barley production in the barley regressions are far below the coefficients for rice production in the rice regressions. Explanations might be pursued on the basis that on average a lower fraction of barley is marketed than of rice. Further analysis of grain marketings, possibly jointly with production responses, should be rewarding.

**Income Distribution within Groups**

Table 6-2 is useful in showing how policies affecting rice prices affect the income of farm households and, therefore, the welfare of farm people. Results are shown for 1977 for Korea for all farms as a group and for five size categories.

**Rice in Farm Income**

A change in the rice price would not have as great an effect on farm household income as might be expected from considering rice receipts given on line 2, since much rice is not marketed. For a given quantity of rice sold for cash (line 10), however, a change in the rice price would have a proportional effect on receipts. Line 10 is used in the minimum estimate of the effect of changes in the rice price on farm income. In addition to rice not leaving the farm and rice sold for cash, there are rice payments in kind. If the rate of exchange between rice received as payment in kind and other goods and services were not affected by changes in the rice price, then rice payments in kind may be neglected in estimating the effect of rice price on farm household income. If the rice price goes up, however, farmers might be able to obtain more goods and services for a given amount of rice in kind. If there were a full adjustment of payments in kind to the change in the rice price, both income from rice sold for cash and rice payments in kind would change proportionally to a change in price. A more likely situation is that not all payments in kind are adjusted fully to rice price changes. Thus rice sold for cash plus rice payments in kind shown in line 11 gives a maximum estimate of the effect of a change in the rice price on farm household income. Lines 12 and 13 convert physical
quantities on lines 10 and 11 to won amounts by multiplying the price of rice on line 4. Lines 14 and 15 express these won amounts as fractions of farm household income shown on line 9. Since under our assumptions the two rice magnitudes would change in proportion to a change in the rice price, lines 14 and 15 give estimates of the elasticity of farm household income with respect to the price of rice—that is, the percentage change in farm household income resulting from a 1 percent change in the price of rice. It can be seen from table 6-2 that for 1977 the minimum estimate is 18.3 while the maximum estimate is 25.0. The range is 5.6 percent to 8.8 percent for farms of less than 0.5 cheongbos, with increasing magnitudes up to a range of 33.2 to 49.3 percent for farms of 2.0 cheongbos or more.

Urban Consumers

Expenditures on cereals, but not rice separately, are available for Korea in the annual Family Income and Expenditure Survey. A major reason for the rise in prices of cereals from 1970 to 1978 was the increase in the real selling price of rice and barley under government programs. The price of cereals rose 28 percent in relation to all consumer goods from 1970 to 1978. If this percentage is multiplied by the percentage of expenditures on cereals, an estimate is obtained of the negative income effect of the real rise in cereal prices as a percentage of consumption expenditures. This is an estimate of the decrease in real consumption available to urban households because of the rise in cereal prices. As shown in table 6-3, the average negative income effect for all urban households is 5.6 percent. By income group, the range is from a negative income effect of 8.8 percent for households with monthly income of less than W29,999 down to 2.3 percent for households with monthly income in excess of W400,000. A larger percentage of the expenditures of low-income than of high-income households goes to pay for the real increase in cereal prices because low-income households devote a larger fraction of their expenditures to cereals. The effect is thus regressive.

Rural Consumers

Although farm households which are net sellers of rice are benefited by the rice program, households in rural areas which are net purchasers of rice must pay more because of the program. Rural households that are adversely affected include nonfarm households outside the urban areas where the government program operates and farm households for which purchases of rice are greater than sales. These households do not benefit from the sale of rice in urban areas for less than the cost of acquisition, nor do they benefit from urban seasonal price stabilization. They must
Table 6-3. Korea: Effect of Rise in Real Cereal Prices on Urban Families by Income Group
(won per month)

<table>
<thead>
<tr>
<th>Income group</th>
<th>Consumption expenditure</th>
<th>Expenditure on cereals</th>
<th>Percent</th>
<th>Won</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 29,999</td>
<td>82,050</td>
<td>16,530</td>
<td>5.6</td>
<td>4,595</td>
</tr>
<tr>
<td>30,000- 49,999</td>
<td>81,290</td>
<td>11,940</td>
<td>8.8</td>
<td>2,930</td>
</tr>
<tr>
<td>50,000- 69,999</td>
<td>54,310</td>
<td>16,740</td>
<td>7.6</td>
<td>4,128</td>
</tr>
<tr>
<td>70,000- 89,999</td>
<td>66,590</td>
<td>16,020</td>
<td>6.7</td>
<td>4,462</td>
</tr>
<tr>
<td>90,000-109,999</td>
<td>81,830</td>
<td>17,350</td>
<td>5.9</td>
<td>4,828</td>
</tr>
<tr>
<td>110,000-129,999</td>
<td>94,920</td>
<td>18,170</td>
<td>5.3</td>
<td>5,031</td>
</tr>
<tr>
<td>130,000-149,999</td>
<td>101,110</td>
<td>18,750</td>
<td>5.1</td>
<td>5,259</td>
</tr>
<tr>
<td>150,000-169,999</td>
<td>114,800</td>
<td>20,120</td>
<td>4.8</td>
<td>5,100</td>
</tr>
<tr>
<td>170,000-189,999</td>
<td>126,990</td>
<td>19,470</td>
<td>4.3</td>
<td>5,461</td>
</tr>
<tr>
<td>190,000-209,999</td>
<td>144,360</td>
<td>21,220</td>
<td>4.1</td>
<td>5,919</td>
</tr>
<tr>
<td>210,000-229,999</td>
<td>149,760</td>
<td>20,710</td>
<td>3.9</td>
<td>5,841</td>
</tr>
<tr>
<td>230,000-249,999</td>
<td>136,740</td>
<td>22,680</td>
<td>4.1</td>
<td>6,426</td>
</tr>
<tr>
<td>250,000-299,999</td>
<td>170,510</td>
<td>19,770</td>
<td>3.2</td>
<td>5,456</td>
</tr>
<tr>
<td>300,000-349,999</td>
<td>190,690</td>
<td>21,160</td>
<td>3.1</td>
<td>5,911</td>
</tr>
<tr>
<td>350,000-399,999</td>
<td>231,320</td>
<td>28,120</td>
<td>3.4</td>
<td>7,865</td>
</tr>
<tr>
<td>More than 400,000</td>
<td>287,730</td>
<td>23,580</td>
<td>2.3</td>
<td>6,616</td>
</tr>
</tbody>
</table>


pay the prevailing rural price of rice at harvesttime, which is presumably in the neighborhood of the price received by farmers, and in the absence of seasonal price stabilization in rural areas they must pay the higher prices connected with seasonal storage costs later in the crop year.

Information is not available to quantify effects on nonfarm rural households, and only indirect evidence is available on farm households which are net purchasers of rice. Table 6-4 shows cash expenditures on rice by farm households for the calendar year of 1977 and for January when prices are seasonally low and for September when they are high. The figures are for all farm households, including both net purchasers and net sellers of rice. If the amounts for households that are net purchasers were available separately, they would be much greater than those shown. The figures do suggest that there are substantial cash purchases of rice by farm households and that those making them are adversely affected by the seasonal price rise. Expenditures are more heavily concentrated late in the season for two reasons. First, the seasonal rise in price leads to increased rice expenditures if the demand for rice is relatively inelastic with respect to price. Second, many smaller farmers do not produce enough rice to meet their household needs for the year; they consume their own rice early in
Table 6-4. Korea: Cash Expenditures of Farm Households for Rice, 1977

<table>
<thead>
<tr>
<th>Farm size (cheongbo)*</th>
<th>Total for calendar year</th>
<th>January</th>
<th>September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>3,448</td>
<td>144</td>
<td>445</td>
</tr>
<tr>
<td>Less than 0.5</td>
<td>6,256</td>
<td>352</td>
<td>748</td>
</tr>
<tr>
<td>0.5-1.0</td>
<td>2,642</td>
<td>82</td>
<td>371</td>
</tr>
<tr>
<td>1.0-1.5</td>
<td>1,712</td>
<td>76</td>
<td>210</td>
</tr>
<tr>
<td>1.5-2.0</td>
<td>3,918</td>
<td>3</td>
<td>409</td>
</tr>
<tr>
<td>More than 2</td>
<td>1,196</td>
<td>n.a.</td>
<td>192</td>
</tr>
</tbody>
</table>

n.a. Not available.
a. A cheongbo is approximately 2.5 acres.


the crop year and later must purchase additional supplies. The importance of this second reason is suggested in table 6-2 by the fact that many farms of less than 0.5 cheongbo are the heaviest purchasers of rice and that their expenditures on rice more than double from January to September.

Taxpayers and Moneyholders

If the government expenditures on the rice program are financed by increasing taxes, then the incidence of the costs is according to the incidence of the increased taxes. If the expenditures are not financed by increased taxation, a presumption is that the program leads to increased inflation. The money supply (M1) was W2,295 billion at the end of June 1978. At rates of growth of the money supply of recent years in the vicinity of 30 percent, the annual growth of the money supply is on the order of W600 billion, of which the projected deficit in the Grain Management Fund (GMF) account of W370 billion (table 2-7) is more than half. This is not to suggest that the GMF deficit is necessarily responsible for half the inflation, but it does suggest that the contribution to inflation is probably substantial.

The distributional effects of the inflation caused by the GMF deficit include possible redistribution among private creditors and borrowers because of the divergence between expected and actual inflation not taken into account in arranging the terms of loans. They also include any loss on the real value of government obligations held by the public which do not pay interest sufficient to compensate for the rate of inflation. In particular, a 10 percent inflation rate implies the loss of W230 billion in the real value of the W2,295 billion money supply (M1) largely backed by reserve money; some fraction of this loss is probably due to the GMF deficit.
Price Supports and Input Subsidies

In many countries with agricultural price supports, prices of farm inputs, particularly fertilizer, are also subject to government intervention. There is a varying balance between influencing farm output prices on the one hand and farm input prices on the other to achieve production and income distribution goals. The question is which of the two measures is more effective according to the criteria of national welfare and government cost. This chapter presents methods of answering this question.

Harvest price support need not, and perhaps should not, necessarily mean raising the average consumer price of output (see chapter 9). In situations in which large divergences exist nationally and regionally between harvest prices and prices in lean periods on the one hand, and farmgate prices and open market prices on the other, government price support may simply ensure incentive prices at harvest for producers. Government sales of the purchased grains lower consumer prices; market sales in lean seasons could limit seasonal upswings in price for consumers. Over time, harvest price support—to the extent that it is effective—may facilitate farm investment in new technology, thereby limiting future price increases.

In pursuing these policies, a basic question is whether market prices for the output and the inputs adequately reflect social values. If they do, government interventions are likely to result in net social losses. Evidence is available, however, that in some countries at certain stages of development, existing output prices and consequently output levels may have been suboptimal. Similarly, the use of modern inputs such as fertilizer at existing prices may have been below optimal levels. In such situations governmental action to help reverse undervaluation of output or suboptimal input use could be beneficial. In the case of depressed product prices, the government could stand ready to buy products whenever their prices...
are at or below minimum levels and to store the products for sale when
prices begin to rise or when shortages develop. There could be net social
benefits from such a policy as long as the price support programs are
intended only to assure farmers of fair and stable prices and not to raise
product prices and producer incomes above long-term equilibrium market
levels. In the case of suboptimal demand for a modern input, the provision
of an input subsidy in the early stages of its adoption could stimulate its
use and lead to a net welfare gain to society, provided adequate supplies
of the input, along with other complementary inputs, were available.2

This section is intended not only to indicate the absolute merits of the
two policies but also to bring out the relative advantages of incremental
changes in the policies. Policymakers are often faced with decisions on
changes in subsidies rather than their overnight abolition. A model is
developed to consider an initial situation in which both policies are in
effect in varying degrees. The incremental cost of achieving a given in-
crease in output is evaluated for each policy. In the basic comparison of
incremental costs, market prices are assumed to reflect social values.
Hence, the results obtained for incremental costs of policies will need to
be modified according to judgments on the divergence between market
prices and social values.

Basic Considerations

The simplest cases of a price support scheme and a fertilizer subsidy
program are illustrated separately. It is assumed that there are no imports
and that all government purchases and sales take place in the same period.

1. Two World Bank studies ("Bangladesh: Food Policy Issues," Report no.2761-BD,
December 1979, and "Bangladesh: Food Policy Review," Report no.1764a-BD) contain
evidence of depressed output prices at the farm level seasonally and year to year in Bangladesh.
Until FY1975 most food-grain procurement by the government was on a compulsory basis
to facilitate public distribution, which probably contributed to undervaluation of output in
the past. (Data on volume of forced procurement and the divergence between procurement
price and market price since 1959–60 are given in Raisuddin Ahmed, Foodgrain Supply,
Distribution, and Consumption Policies within a Dual Pricing Mechanism: A Case Study of Bangladesh
ratio of procurement to market price for rice was roughly 60 to 80 percent.) Recently the
government has followed a policy of procurement for price support, presumably to reverse
some of the past disincentives. For FY1980 the procurement price for rice was raised by an
unprecedented 30 percent; the implied procurement price, according to some observers, was
above estimated incentive prices.

2. See Randolf Barker and Yujiro Hayami, "Price Support Versus Input Subsidy for
Food Self-sufficiency in Developing Countries," American Journal of Agricultural Economics,
It is also assumed that demand price measures the value of the commodity to consumers while the supply price measures its cost to suppliers.

Figure 7-1 depicts the logic of a price support designed to raise production. $S$ is the short-run supply curve and $D$ the demand curve for farm output. The supply curve slopes upward, reflecting increasing costs faced by farmers in raising production in the short run. With no government intervention and no imports, $OP_m$ and $OQ_m$ are the market price and quantity respectively. To increase output by $Q_1Q_1$, price may be supported at $P_1$. The expectation of a higher price leads farmers to increase supply, depending on the elasticity of supply. The increase in price, in principle, may also cause some farmers to reduce their own consumption, so that the increase in the marketed supply could conceivably exceed the increase in production. But there is also the possibility that an income effect of the price increase will raise farmers' own demand for rice, which may offset the effect of lowering farmers' own consumption. In the long run, the expectation of a higher price may also lead to investment in agriculture.
that could shift the supply curve to the right and eventually lower price in real terms.

The same increase in output \( Q_\text{a}Q_1 \) can alternatively be achieved by an input subsidy. In figure 7-2, \( D_F \) is the farmers' demand curve for fertilizer, \( P_F \) the world price, and \( P_F \) the subsidized price. \( S_F \), the supply of fertilizers, is assumed to be perfectly elastic at \( P_F \). The subsidy per unit of \( P_F \) encourages additional fertilizer demand of \( F_FF_1 \) from the free market level of \( OF_0 \). Viewed another way, the subsidy can lower the marginal private cost of production and shifts the supply curve to the right in figure 7-1 to give the same additional output of \( Q_\text{a}Q_1 \); thus the benefit in the case of both policies can be the same. The cost of the two policies in achieving the output increase may, however, differ.

**Government Cost and Resource Cost**

Figure 7-1 shows a one-period situation in which all grain purchases by the government are disposed of at the same time. For this case, the government has to buy the whole marketed crop. To raise output to \( OQ_1 \),
output has to be acquired at $OP_1$ and sold at $OP_0$ at a unit subsidy of $P_oP_1$. The total cost to the government is $P_oP_1CB$. A further increase in the support price to $OP_2$ will raise the program cost to $P_1P_2GF$. Clearly, starting from an already high price support, any further price increase will imply a higher incremental cost to the government and vice versa, other things remaining the same.

The program cost to the government could be lower if the purchases do not have to be sold at the same time. In a seasonal situation, it might be possible to acquire stock in a first period at low prices and sell it in a second period at higher prices. In such a case, the government need buy only $Q_0Q_1$ to support price at $OP_1$. The net cost to the government of the price support in the first season would depend on the storage cost and the sale price in the later season. The overall cost under a seasonal model should also consider price support objectives for crops in later seasons.

In the one-period case, the resource cost of supporting price at $OP$, and selling grains at $OP_0$ may be obtained by deducting changes in producer and consumer surpluses from the government cost. In figure 7-1, $P_0P_CR$ represents the gain to producers and $P_0P_BR$ the gain to consumers from the policy. Netting these out from the government cost gives $RBC$ as the resource cost. An increase in the support price to $OP_2$ will raise the resource cost by $BCGF$. The incremental resource cost is positively related to the level of existing price support, other things remaining the same.

The government cost of a fertilizer subsidy at the rate of $P_FP_F$ in figure 7-2 is given by $P_FP_BC$. An increase in the unit subsidy by $P_FP_FE$ increases cost by $P_FP_FEBC$. The higher the existing level of subsidy, the higher is the incremental cost to the government of a further increase in the subsidy, other things remaining the same.

At the subsidized price of $P_F$ in figure 7-2, $P_FP_AC$ is transferred to producers. Netting this transfer from the government cost gives $ABC$ as the resource cost. A further reduction in fertilizer price to $OP_F$ will raise the resource cost by $CBEF$, the size of which is positively related to the level of the already existing subsidy.

**Supply Elasticities**

It is clear from figure 7-1 that the effectiveness of a price support depends, among other things, on the price elasticity of output supply. The higher the supply elasticity (or the flatter the $S$), the greater the output response obtained from a given price support.

The price elasticity of product supply depends on the elasticities in input use with respect to product price weighted by their respective relative factor shares. The elasticities of input use with respect to product price are in turn related to the elasticity of input supplies and the elasticity of substitution between inputs. An intuitive implication is that the higher the input supply elasticities and the higher the elasticity of substitution between inputs, the greater the response of output to a price support is likely to be.

The effectiveness of a fertilizer subsidy depends, among other things, on the elasticity of output supply with respect to fertilizer price. Appendix A to this chapter presents a simplified two-input model to show that the overall price elasticity of supply of output is the sum of the output supply elasticities with respect to each of the inputs; that is, the output supply elasticity with respect to the fertilizer price is only a subset of output supply elasticity with respect to the own price.

A higher supply elasticity also implies a lower resource cost of achieving a given output response. For instance, in figure 7-1 a more elastic supply curve would give a larger output response and also a lower resource cost for a given target output increase.

A Model for Cost Calculation

The remaining sections illustrate more concretely how factors such as nonoptimality in the output and input markets, already existing government policies, seasonality of production, and supply elasticities affect the cost of policies. Presented in appendix B to this chapter is a simplified model which is quantified using Bangladesh data. The purpose is not to show all possibilities or to arrive at policy conclusions but to illustrate a procedure of cost calculation and to bring out some major effects.

Seasonality of production is explicitly taken into account. The model considers market demand for and market supply of food grains within a two-period situation in which the government may procure grains in the first season when supplies are plentiful. Competing crops are not considered, although chapter 3 discussed the issue of rice-jute substitution.

5. Wallace, "Measures of Social Costs of Agricultural Programs." When the target is to achieve a given price increase (as opposed to a given quantity increase), a higher supply elasticity implies a higher resource cost.
6. Ideally, a three-period model should be used to represent the three crop seasons of Bangladesh.
Chapter 3 also pointed out the limits of conflict with jute of a rice price support policy for aman and even boro, particularly if greater seasonal price stabilization is achieved. Nevertheless, in subsequent work, the model should be extended to include jute production. Similarly, wheat—which is not shown separately from rice in the present version—should be included as a separate crop.

The model considers the case in which price support and fertilizer subsidy are both in effect. Rationed distribution and imports are assumed throughout the year. Additional government purchases in the first or “surplus” season are assumed to be either sold at the same time at a subsidy or alternatively carried forward to the second or “deficit” season, with a certain amount of storage costs. Thus, although initially subsidized rations are sold throughout the year, the model recognizes the possibility that the government may increasingly resort to market sales.

The model helps to compute the government cost and resource cost of raising output through price support policy or fertilizer subsidy. First, expressions are derived that measure the changes in cost because of changes in the support price and in the fertilizer price. The cost expression in each case consists of (a) a direct cost of higher subsidy on all existing units of grain purchased or fertilizer distributed and (b) an indirect cost of handling additional units of food grains and fertilizers induced by the price changes. In addition, each expression includes an indirect element of cost of operating one program owing to a price change under the other program. Next, the above cost terms for each policy are expressed in terms of a change in government cost for a 1 percent change in the support price and a 1 percent change in the fertilizer price. Finally, the change in cost owing to a 1 percent change in price under each case is converted into a change in cost owing to a 1 percent (induced) change in output using appropriate expressions for supply elasticities.

Price Support

Equation (7.28) in appendix B gives an expression for government cost in the existing situation with a price support and fertilizer subsidy. To consider a simple case for Bangladesh, imports (mostly received through aid) and their prices may be treated as exogenous. The world price is not used to indicate the opportunity cost of raising the price support; the approach may be justified particularly if domestic prices are below the world price. Currently, the government sells only minimal quantities on the market. Most—and sometimes all—purchases from domestic and foreign sources are distributed under the ration program at fixed prices below market levels.
To analyze the effects on cost of an increase in the support price for the first period, equation (7.28) is differentiated with respect to $P_1$; the result of so doing is given in equation (7.29). On the basis of the premises given above, two possibilities may be considered. The additional procurement $dG_t$ may be assumed to be carried over, at a cost, for sale in the second period at market price $P_2$. In this scenario, any effect on output in the second period may also need to be considered, depending on the timing of sales, private traders' behavior, and so on (see chapter 3). Alternatively, the additional purchases may be assumed to be absorbed by ration sales in the same period. The increase in ration sales may not require any reduction in ration price if it is already "low enough." The next section indicates that in Bangladesh the government can probably sell the existing units and any additional purchases at higher than existing ration prices.

Under the first scenario given above—additional procurement in the aman season carried forward for market sales in the lean season—the main effects on cost of a higher price support in the first period are given in equation (7.1): (a) higher procurement cost for existing units, the net cost of carrying forward from the first to the second period the additional units of procurement, and a larger fertilizer subsidy owing to additional fertilizer use induced by the higher price support. Equations (7.31) and (7.32) in appendix B and equations (7.2) and (7.3) below relate the change in cost to a 1 percent change in the support price and to a 1 percent change in output supply respectively in the first period.

\[
\frac{dC_G}{dP_1} = G_1 + (P_1 + c_H + c_u - P_2) (a_i + b_i) + (P_F - \bar{P}_F) f\]

(7.1)

\[
\frac{P_1}{100} \frac{dC_G}{dP_1} = \frac{P_1 G_1}{100} + \frac{(P_1 + c_H + c_u - P_2) (S_I \gamma + D_i \beta)}{100} + \frac{(P_F - \bar{P}_F) F_i}{100} \beta_p
\]

(7.2)

\[
\frac{S_I}{100} \frac{dC_G}{dS_I} = \frac{P_1 G_1}{100 \gamma} + \frac{G_I (dP_1 / dP_1)}{100} + \frac{dG_I}{dS_I}
\]

(7.3)

7. The change in receipts from market sales of existing units in the second period owing to an increase in market sales in that period is assumed to be negligible for reasons given in the text. If this were not so, an additional term $G_I (dP_1 / dP_1)$ would appear in (7.1).

8. For equations (7.1), (7.2), and (7.3), the change in government cost is owing to a unit change in $P_i$, 1 percent change in $P_1$, and 1 percent change in $S_i$ respectively.
\[
\frac{(P_1 + c_H + c_u - P_2) (S_1 \gamma + D_1 \beta)}{100 \gamma} + \frac{(P_F - \bar{P}_F) F_1}{100 \gamma} \beta_p
\]

where \( C_G \) = Cost of government procurement  
\( P \) = Food-grain price  
\( G \) = Government procurement  
\( c_H \) = Unit handling cost  
\( c_u \) = Unit carryover cost  
\( S \) = Market supply of food grain  
\( D \) = Market demand for food grain  
\( F \) = Fertilizer  
\( P_F, \bar{P}_F \) = World price and subsidized price of fertilizer

Equation (7.3) is confined to the change in output in the aman season. Depending on the timing of sales, it is possible that the increase in market sales of grain by the government during the rest of the year could conceivably depress harvest prices and output somewhat in the boro and aus seasons (see chapter 3 for a discussion). The following equation for a change in government cost owing to a 1 percent change in total supply (that is, in both periods) takes into account that possibility:

\[
\frac{S}{100} \frac{dC_G}{dS} = \frac{S_1}{100} \frac{dC_G}{dS_1} \left( \frac{S}{S_1 + S_2} \right) \gamma_2 \gamma_1
\]

\[
\begin{bmatrix}
\text{Change in government cost owing to a 1 percent change in total supply} \\
\text{Change in government cost owing to a 1 percent change in aman supply}
\end{bmatrix}
\times
\begin{bmatrix}
\text{Ratio of total supply to aman supply, the latter adjusted for any fall in aus and boro supply owing to any fall in harvest prices because of increased government sales}
\end{bmatrix}
\]
where \( \rho \) is the absolute value of the percentage change in the second period's price \( (P_2) \) owing to a 1 percent change in the first period's price \( (P_1) \). Equation (7.4) divided by the volume of food grain corresponding to 1 percent of the annual production gives the change in government cost per unit (ton) of incremental production.

The change in resource cost may be obtained by netting out changes in producer and consumer surplus from the change in government cost. The change in producer surplus resulting from a price increase of one unit in the first period can be shown to be given by the supply, \( S_i \). Supply \( S_i \) consists of government consumption, \( G_i \), and private consumption, \( D_i \). \( D_i \) consists of transfers from consumers to producers; \( G_i \), the first term of equation (7.1), is a transfer from the government to producers. If no distributional weights are attached, these transfers do not represent changes in resource cost. Thus, from existing equilibrium, the change in resource cost is less than the government cost and consists of the cost of handling additional grain procurement and the indirect cost of the additional fertilizer subsidy.

The above analysis can be easily modified to represent the second scenario discussed, in which the additional procurement goes into subsidized rationed distribution in the same period. The main difference is that \( (P_1 + c_H + c_r - P_2) \)—the net unit cost of carryover—in the second term on the right-hand side of equation (7.1) would be replaced by \( (P_1 + c_H - P_R) \), the difference between purchase cost and ration price; only if a further reduction in ration price is needed to accommodate sale of the additional procurement in the same period, would an additional term, \( G_i dP_R \), be needed (see discussion earlier).

**Rationed Distribution**

The government cost of rationed distribution is the difference between the cost of purchases (from foreign and domestic sources) and receipts from the ration sales. If the additional purchase is sold in the ration system, the government cost simply increases by the product of the additional purchase and the subsidy rate. Alternatively, the additional procurement could go into market sales in lean periods. In this case the cost of the ration alone is unchanged. Another possibility is that, in addition to using the additional purchases for market sales, the government could raise the ration price if it is "low enough" in the existing situation. In this case the ration volume remains unchanged since any additional procurement is
used for market sales. Consequently, government cost would go down as given below:

\[
(7.5) \quad \frac{\text{d}C_g}{\text{d}P_r} = R
\]

\[
(7.6) \quad \frac{P_r \, \text{d}C_g}{100 \, \text{d}P_r} = \frac{P_r R}{100}
\]

\[
\text{\left[ \text{Decrease in government cost} \right]} = \text{\left[ \text{Savings in the ration subsidy} \right]}
\]

where \( P_r \) is the ration price, and \( R \) the ration quantity. Since \( R \) consists of both imported and domestically procured grains, the increase in the ration price would imply savings on the sale of imported grain as well.

**Fertilizer Subsidy**

The first element of change in government cost owing to a change in fertilizer subsidy is the change in the government outlay required to subsidize the existing fertilizer sales. The second element is the subsidy on the additional units of fertilizer demanded as a result of the price change. The third element of cost is the indirect effect on the cost of the price support program, the magnitude of which depends on what is assumed to be the purpose of the price support policy. If the government seeks to support a certain output price level, it would need to buy more (less) grain to raise (lower) the output price which would otherwise have decreased (increased) owing to the fertilizer price rise (fall). This is analogous to the indirect cost of additional fertilizer sales at an unchanged price owing to higher price support. Alternatively, the government may want to procure a given volume of grain. In that case, it would decrease (increase) the procurement price since the market price would have fallen (risen) owing to the decline (increase) in the fertilizer price. The indirect benefit (cost) would consist of the reduction (increase) in the procurement price required to buy the same volume of output. It is assumed in what follows that the procurement volume is changed to leave the support price in the aman

9. For equations (7.5) and (7.6), the change in government cost is owing to a unit increase and 1 percent increase in the ration price respectively.
period unchanged. The additional acquisition may be assumed to be carried forward for market sales in the next season or sold at subsidized prices in the same season.

Equations (7.34) through (7.37) in appendix B analyze the government cost under a fertilizer subsidy. Equations (7.7), (7.8), and (7.9) below show changes in the government cost owing respectively to a unit change in the fertilizer price, a 1 percent change in the fertilizer price, and a 1 percent change in food-grain supply.

\begin{align*}
\frac{dC_F}{dP_F} &= -F + (P_F - \bar{P}_F) \frac{dF}{dP_F} + \frac{dG_i}{dP_F} (P_i + c_H + c_s - P_i) \\
\frac{P_F}{100} \frac{dC_F}{dP_F} &= \frac{-\bar{P}_F F}{100} + \frac{(P_F - \bar{P}_F) \beta_F F}{100} + \frac{S_i \gamma_F (P_i + c_H + c_s - P_i)}{100} \\
\frac{S_i}{100} \frac{dC_F}{dS_i} &= \frac{-\bar{P}_F F}{100 \gamma_F} + \frac{(P_F - \bar{P}_F) \beta_F F}{100 \gamma_F} + \\
&\begin{bmatrix}
\text{Change in cost of selling existing volume of fertilizer} \\
\text{Cost of handling additional volume of fertilizer}
\end{bmatrix} + \\
\text{Indirect cost of change in procurement to maintain support price}
\end{align*}

where \( C_F \) = Government's cost of a fertilizer subsidy
\( \beta_F \) = elasticity of fertilizer demand
\( \gamma_F \) = elasticity of food-grain supply with respect to fertilizer price.

Equation (7.9) divided by the volume of output corresponding to 1 percent of production gives the change in cost per unit of incremental production.

To measure the change in resource cost or efficiency loss, the above expression for the government cost should be adjusted for any changes in producer and consumer surplus. The change in producer surplus resulting from a unit change in fertilizer price can be shown to be given by

10. For equations (7.7), (7.8), and (7.9), the change in government cost is owing to a unit change in \( P_F \), 1 percent change in \( P_F \), and 1 percent change in \( S \) respectively.
F. Thus the first term in equation (7.7) is a transfer from the government to producers. If no distributional weights are attached, only the second and third terms on the right-hand side of equation (7.9) are changes in resource cost resulting from the policy change from existing equilibrium.

Illustrative Cost Calculations

The model presented in the previous section is applied using parameters and data for the rice subsector in Bangladesh. Since wheat is a relatively small fraction of market supply and market demand, and elasticities of its supply and demand are not available, it is not included in the discussion. Future work, however, should do so.

Parameters and Data

One determinant of the cost of price support is the price elasticity of supply of food grains $\gamma$ (see equation [7.3]). Estimates of price elasticity of supply and demand for agricultural products in developing countries have been compiled by Scandizzo and Bruce.\(^{11}\) For Bangladesh, the supply elasticity estimates range from 0.13 to 0.23 in the short run to 0.19 to 1.28 in the long run.\(^{12}\) The low value of 0.1 is used as a central estimate, but a higher value of 0.2 is also referred to. The cost of price support is also influenced by the price elasticity of demand for food grains $\beta$. This parameter combined with $\gamma$ determines the amount of additional procurement required to achieve a certain price support (see the second term on the right-hand side of equation [7.3]). One estimate of the food-grain price elasticity of demand for Bangladesh is 0.28,\(^{13}\) while other micro studies in Bangladesh have indicated lower elasticities. A value of 0.2 is used in this section.

The price elasticity of demand for fertilizer with respect to the food-grain price $\beta_F$ is a factor in the indirect component of cost of price support (equation [7.3]). The own-price elasticity of demand for fertilizer $\beta_F$ de-


ANALYSIS OF POLICY OPTIONS

termines the incremental cost of the fertilizer subsidy (second term on the
right-hand side of equation [7.9]). An estimated short-run price elasticity
of demand for fertilizer is 0.34.14 This section uses 0.3 as one estimate
and also refers to a higher value of 0.50.15 For $\beta_p$, the indirect elasticity
of fertilizer demand with respect to output price, a value of 0.1 is adopted.16

According to equation (7.9), the incremental cost of fertilizer subsidy
depends on the food-grain supply elasticity with respect to fertilizer price
$\gamma$. In appendix A the direct price elasticity of supply ($\gamma$) is the sum of
two indirect price elasticities—of output with respect to price of fertilizer
($\beta_p$) and with respect to price of all other inputs ($\gamma_x$). In choosing a value
for $\gamma_x$, one consideration is that the elasticity of output with respect to
an input at equilibrium equals the share of that input in the value of
output. The share of fertilizer in the value of output may be assumed to
be about 10 percent.17 $\gamma_F$, which is the elasticity of output with respect
to fertilizer, multiplied by the elasticity of fertilizer with respect to its
price ($\beta_p$), could then be assumed to be 0.03.

Incremental cost calculations require base-level estimates of several vari-
ables. For the most part, averages for FY1978 (a good crop year) and
FY1979 (a poor crop year) are used. Estimates of the base levels of marketed
supply ($S_l$) and market demand ($D_l$) in equation (7.3) are required. Al-
though about half the supply is probably marketed (see chapter 3), a
conservative estimate of one-third is applied to a base-level aman supply
of 7.2 million tons to obtain an estimate of marketed supply in that season
($S_i$) of about 2.4 million tons. Market demand including ration in the same
period ($D_i$) may be assumed to be 1.4 million tons. As a base, government
purchase in the aman season ($G_i$) is assumed to be 400,000 tons.18 The
base purchase price for aman ($P_i$) from which changes are considered is
US$220 a ton (roughly what prevailed in FY1978 and FY1979. The ration
price of rice ($P_R$) in the initial situation is US$170 a ton, and the annual
ration quantity ($R$) is 1.8 million tons. The handling cost ($c_h$), excluding
carryover cost, is assumed to be US$18 a ton. The carryover cost ($c_c$), in

15. The short-run price elasticity of demand for fertilizer in five Asian countries was
estimated at between $-0.5$ and $-0.1$ by P. C. Timmer, “The Demand for Fertilizer in
16. A discussion of the elasticity of input price with respect to output price is given in
Floyd, “Effects of Farm Price Supports.”
17. The value of fertilizer at subsidized prices as a fraction of the value of marketed output
in Bangladesh is about 5 to 8 percent, which justifies this assumption.
18. Although aman procurement in FY1978 was 500,000 tons, it fell to 300,000 in FY1979.
addition to handling costs, for six months is assumed to be US$13 a ton.\textsuperscript{19} Alternative assumptions may be made for the rice price in the second period ($P_2$).

The base level of fertilizer use in the aman season ($F_1$) is about 200,000 tons. The subsidized price of fertilizer ($P_F$) in the initial situation is considered to be about US$105 a ton, which is about the weighted average of subsidized prices for various varieties in FY1978 and FY1979. The base-level unit subsidy on fertilizer ($P_F - F_F$) estimated by the government for these years is about US$110 a ton.\textsuperscript{20}

\textit{Price Support}

As discussed in earlier sections, the incremental government cost and resource cost of an increase in price support depend on the initial conditions and how the program is operated. We first evaluate cost under the scenario in equation (7.3) elaborated in appendix B. Additional purchase in the first or surplus season is carried forward for market sales in the second or lean period. In equation (7.3) the direct cost to the government on existing units for a 1 percent market supply increase is US$8.8 million if $\gamma = 0.1$ and US$4.4$ million if $\gamma = 0.2$. This part of government cost can be offset by an increase in ration price. An increase in ration price of about US$4.8$ and US$2.4$ a ton are needed respectively to offset the US$8.8$ million and US$4.4$ million cost increases. In addition to the above direct cost, the cost of handling the additional procurement needs to be estimated. To consider one case, if $P_2 = P_1$, the incremental cost is roughly US$1.6$ million for $\gamma = 0.1$ and US$1.2$ million for $\gamma = 0.2$. A gain could result from handling additional volume of grains if $P_2$ exceeds $P_1$ by more than $c_H$ plus $c_r$. The indirect cost owing to higher induced fertilizer subsidy is about US$0.2$ million for $\gamma = 0.1$ and about US$0.1$ million for $\gamma = 0.2$. Thus, in a case with no ration price increase and where $P_1 = P_2$, the government's program cost changes by a range of US$5.7$ million to US$10.6$ million for a 1 percent output increase. The change in resource cost is US$1.3$ million to US$1.8$ million. Depending on the possibility of increasing ration prices and on whether and by how


\textsuperscript{20} “Bangladesh: Food Policy Issues.”
much \( P_2 \) exceeds \( P_1 \) in actual situations, these costs can be lowered, eliminated, or even turned into a gain.

What is the effect on output of increased market sales in the second season facilitated by additional procurement in the first season? According to equation (7.4),\(^{21}\) if \( \gamma_1 \) and \( \gamma_2 \) are the same, the incremental government cost could be larger if the effect on annual supply (\( S \)) is considered rather than only the effect on \( S_1 \), depending on \( \rho \), which is the elasticity of \( P_2 \) with respect to \( P_1 \). If the incremental market sales by the government are restricted to the lean season and timed in a way not to affect harvest prices, the relevant \( \rho \) could be zero and no additional cost would need to be considered. While this could be the case temporarily or even for some years starting from a disequilibrium situation, private trader behavior should eventually be considered, as discussed in chapter 3. Even in that case, however, \( \rho \) for the Bangladesh case is probably small. The main reason for this is that increased sales in the second, long season (nine months) have a smaller effect on price in that season (\( P_2 \)) in relation to the increase in price in the first, short season (\( P_1 \)).\(^{22}\)

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21. Equation (7.4) is briefly derived below using the relation \( S = S_1 + S_2 \):

\[
\frac{S}{100} \frac{dC_g}{dS} = \frac{S_1}{100} \frac{dC_g}{dS_1} \left( \frac{1}{1 + \frac{dS}{dS_1}} \right)
\]

or

\[
\left( \frac{S_1}{100} \frac{dC_g}{dS_1} \right) \frac{S}{S_1 + S_2} \left[ \frac{1}{1 + \frac{dS_1}{dP_1} \frac{dP_2}{dP_1}} \right]
\]

which, after some manipulation, gives

\[
\frac{S_1}{100} \frac{dC_g}{dS_1} \left[ \frac{S}{S_1 + S_2} \left( \frac{\gamma_1}{\gamma_2} \right) \right]
\]

where \( \rho \) is the percentage change in \( P_2 \) with respect to \( P_1 \), and \( \gamma_1 \), \( \gamma_2 \) are price elasticities of supply in the two periods.

22. Using (7.21) and (7.26) in appendix B, \( \frac{dG_1}{dP_1} = a_1 + b_1 \), which may equate to

\[
\frac{dG_1}{dP_1} = (-b_1 - a_1) \frac{dP_2}{dP_1}
\]

or obtain

\[
\frac{P_1}{P_2} \frac{dP_1}{dP_1} = -\frac{P_1}{P_2} \left[ \frac{a_1 + b_1}{a_1 + b_2} \right]
\]

where \( a \) and \( b \) refer to the absolute values of slopes of supply and demand curves respectively. Since supply in the two periods is roughly the same, how small \( \rho \) depends on how small \( P_1 \) and \( b_1 \) are in relation to \( P_2 \) and \( b_2 \) respectively. While the difference between \( P_1 \) and \( P_2 \) varies, \( b_1 \) should be about one-third of \( b_2 \).
A second scenario is that additional procurement is added to the rationed distribution in the same period. It differs from the first scenario in that $(P_t + c_H - P_s)$ replaces $(P_t + c_H + c_s - P_s)$ in the second term of the right-hand side of equation (7.3), which will roughly double the resource cost of the program. If a reduction in the ration price is required to make possible the increased ration sales, government cost will increase further. Equation (7.1) for this case would include an additional term $G_i(dP_y/dP_t)$, and incremental government costs would grow, depending on $dP_y/dP_t$.

To conclude, under both scenarios given above, a large incremental program cost can result from an increase in price support from its base level. This cost increases almost directly with the base-level procurement price. It is also influenced by the type of price support program. Increased market sales as opposed to additional rationed distribution lowers the program cost. Furthermore, if ration price can be increased simultaneously, the incremental program cost can be reduced or eliminated. The incremental resource cost is relatively small, although it also depends on the existing base-level prices and the type of program under consideration. Going from a situation with a large output subsidy (in the form of rationed distribution) to a program of seasonal sales, the incremental resource cost could be roughly halved in the examples considered in this section.

**Fertilizer Subsidy**

The incremental cost of raising supply by 1 percent in the first season through a fertilizer subsidy is measured by equation (7.9). The direct incremental cost on existing units is US$7 million for $\gamma_F = 0.03$. The indirect cost of handling the additional volume of fertilizer sales is US$2.2 million, if $\gamma_F = 0.3$. Using an alternative value of $\gamma_F$ of 0.5 raises this cost. The indirect cost of additional rice procurement to maintain its support price in the first season is about US$0.7 million. Thus the incremental program cost to the government of engineering a 1 percent output increase is nearly US$10 million if $\gamma_F = 0.03$; the implied increase in resource cost, however, is only about US$3 million.

In the above examples, use of a higher fertilizer price (that is, a lower unit subsidy) for base levels would lower the incremental cost of expanding the subsidy policy. For instance, if the initial subsidy were US$55 a ton instead of the actual subsidy (US$110 a ton) used in this section, the resource cost would decline by US$1.1 million. The cost estimates also depend on the different parameters to varying degrees. In particular, the cost of the subsidy depends very much on the estimate of $\gamma_F$, which needs to be determined in subsequent work.
Summary and Conclusions

While both price supports and input subsidies can stimulate food production, the relative efficiency of these policies in doing so could differ. This chapter addressed the issue by analyzing the cost under each policy of achieving a given increase in output. Factors influencing the overall cost of policies and the incremental cost of changes in policies from existing situations were discussed. A model was presented to evaluate the incremental cost of attempting to increase food production by raising the price support or the input subsidy.

In the discussion on the cost of policies, the resource cost and the government cost were treated separately. Starting from the existing equilibrium, the incremental government cost is generally large under either policy, but the resource cost—obtained after accounting for the transfers contained in the government cost—is generally much smaller. Whether this resource cost represents a net social loss depends on how the additional food production is valued—a question not addressed in this chapter. Similarly, longer-term benefits from any dynamic effects of the price incentives on adoption of new technology were not quantified.

One determinant of the overall cost is the incentives inherent in the policies. A price support provides a direct form of incentive giving producers complete flexibility to choose the least-cost combination of inputs in raising production. A subsidy on an input, however, is a more indirect incentive that induces inefficiencies and a higher resource cost of achieving an equivalent increase in output. The overall cost and incremental cost are affected by the output response from these alternative incentives; appendix A shows that the output response from a subsidy on any one input must be smaller (or at best equal to) that from a price support.

A second consideration affecting overall cost, emphasized by Barker and Hayami, is that the use of certain inputs may not be in equilibrium. There could be a net gain from policies that stimulate the use of inputs not yet accepted by farmers at prevailing prices. In such a situation, the subsidization of an input such as fertilizer could yield an output response at a lower resource cost than a direct output price support. A price support raises the output-fertilizer price ratio, however, and gives added incentive to increase fertilizer use along with traditional inputs. Thus the gains from the subsidization of an underutilized input are not all net gains over those of subsidizing the output.

23. World Bank, “Bangladesh: Food Policy Issues,” provides discussion of issues in deriving net benefits from a price support policy in Bangladesh by making a minimum price effective for the majority of farmers.

In many practical situations in developing countries both price supports and input subsidies are in existence. Price supports may be provided in the face of historic trends of depressed and suboptimal farm prices and farm output. Input subsidies may have been initiated to help propagate the use of a modern input. (There could be a variety of other reasons for existing price supports and input subsidies.) Given the existence of both policies, quite different effects on incremental costs can result from changes in emphasis between them. These differences were brought out in the analysis presented in this section and are summarized below.

First, the incremental cost of a policy depends on the extent to which it is already being operated. Both the government cost and the resource cost are affected by this consideration. The additional cost of an increase in the price support, for instance, depends on the price at which the government currently buys grains from farmers. The higher the existing support price, the greater the cost to the government of handling current quantities and additional quantities (induced by the higher price support) of grains, and vice versa. If the domestic price support already is close to world price levels, decisionmakers would have to consider the opportunity cost of forgoing imports at world prices before further increasing the support price. Similarly, if there already exists a large subsidy on an input, any further increase in the subsidy would result in a higher cost than otherwise. One reason for the large incremental government cost and resource cost of any increase in the fertilizer subsidy as evaluated in this section was that in the situation considered, subsidized fertilizer prices are about 50 percent below world prices. The implication is that further increases in subsidy are costly and consideration of gains from a lowering of the subsidy becomes relevant instead. Countries often face constraints in the supply of these inputs, and divergences develop between the subsidized prices and prices actually paid by users if limited quantities of the inputs are being distributed. Furthermore, government price policies face more and more severe financial constraints and the increasing cost of subsidies itself begins to limit the expanded distribution of the input in question. Thus, a possibility is that input subsidies initiated in the face

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25. The two World Bank studies cited in note 1 above discuss the issue of gradual reduction of input subsidies as long as the product is not undervalued. In the case of fertilizer, one consideration is that while its supply is not very elastic, market demand for it has been relatively large at subsidized prices. Fertilizer prices for FY1980 have been raised by nearly 30 percent, perhaps in light of the above consideration, but the question has been raised as to how much and how quickly further increases should be made. On the merit of lowering fertilizer prices, see Raisuddin Ahmed, “Price Support versus Fertilizer Subsidy for Increasing Rice Production in Bangladesh,” Bangladesh Development Studies, vol. 6, no. 2 (Summer 1978).
of suboptimal input use would be progressively reduced over time, as long as minimum incentive prices for the product prevail and provision of complementary inputs is strengthened. In Bangladesh better water control and more irrigation are key factors that will govern the application of fertilizer and the adoption of other improved practices.

The existence of one of the policies also influences the incremental cost of expanding the other. One element of the incremental cost of a price support, for instance, is the inducement a higher output price gives to using more fertilizers, which in turn indirectly raises the cost of the existing fertilizer subsidy. Similarly, a higher fertilizer subsidy necessitates more grain purchases by the government to support a given price for farmers, which increases the cost of the existing price support program.

Finally, the way in which the policies are being operated affects both the overall cost and the incremental cost attending them. The resource cost and government cost of a price support, for example, are governed by the nature of sales of the purchased grains. The government cost in particular could vary substantially, depending on whether the purchased grains were disposed of at the same time at a subsidy or carried forward for sales at a later time when market prices typically rise.

The model developed in this chapter could be elaborated in the course of further work. For instance, substitution and complementarity in production and consumption could be considered, and tenancy could be incorporated. One constraint to using more elaborate models is the inadequacy of the data base in many developing countries. Consequently, further work would also need to estimate and verify the values of key parameters.

Starting from the 1977–79 Bangladesh situation, the discussion indicated a lower incremental resource cost under the price support but also pointed out how different conclusions regarding the relative merits of changing the support price or the input subsidy could be arrived at. Since there was a resource cost under both policies, a net social benefit could result from either policy only if suboptimality prevails in the product market or factor market or both when changes in the price interventions are adopted, and if the price changes are made effective in practice for farmers. Furthermore, any net benefits from price interventions usually accrue over a certain time and not indefinitely into the future. These are essentially country-specific issues. A continual evaluation of changing circumstances and constraints faced by countries would improve the accuracy of results such as those derived here using basic methods.
Appendix A: Price Support versus Input Subsidy

Output $S$ may be expressed as a function of inputs—fertilizer, $F$, and all other inputs, $A$. Given prices of the inputs $P_F$ and $P_A$, the equilibrium conditions are that prices of inputs equal their respective marginal products, $f_F$ and $f_A$, multiplied by the price of output $P$. Thus

(7.10) \[ S = f(F, A) \]
(7.11) \[ P_F = P \cdot f_F (F, A) \]
(7.12) \[ P_A = P \cdot f_A (F, A). \]

A change in $S$ with respect to a change in $P$ is given by $dS/dP$ derived by differentiating (7.10), (7.11), and (7.12) totally:

(7.13) \[ \frac{dS}{dP} = - \left[ \frac{f_A}{P_A} \frac{dS}{dP_A} + \frac{f_F}{P_F} \frac{dS}{dP_F} \right] \]

or

(7.14) \[ \frac{dS}{dP} = \frac{1}{M} \left[ f_A P_F f_{FA} - f_A P f_{FP} + f_F P f_{FP} f_{FA} \right] \]

where $M$ is the determinant of the matrix of (7.10), (7.11), and (7.12), and the subscripts denote derivatives. Similarly, an expression can be derived for the change in output with respect to a change in the price of fertilizer, $dS/dP_F$, which appears as a subset of $dS/dP$ in (7.13):

(7.15) \[ \frac{dS}{dP_F} = \frac{-1}{M} \left[ f_A P_F f_{FA} - f_A P f_{FP} \right]. \]

It is clear that $dS/dP_F$ in (7.15) is a subset of $dS/dP$ in (7.14).

Assuming linear homogeneity of the production function, and writing the expressions in elasticity forms, it can also be shown that the elasticity of output with respect to the fertilizer price, $\gamma_F$, is a subset of the elasticity of output with respect to the output price, $\gamma$. On the basis of equation (7.13),

\[ \frac{P}{S} \frac{dS}{dP} = - \left[ \frac{P}{P_A} \frac{f_A}{S} \frac{dS}{dP_A} + \frac{P}{P_F} \frac{f_F}{S} \frac{dS}{dP_F} \right]. \]

Using equations (7.11) and (7.12), the above can be rewritten as:

\[ \frac{P}{S} \frac{dS}{dP} = - \left[ \frac{P_A}{S} \frac{dS}{dP_A} + \frac{P_F}{S} \frac{dS}{dP_F} \right] \]

or

(7.16) \[ \gamma = -\gamma_A - \gamma_F. \]
Appendix B: A Two-period Seasonal Model

List of Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Market supply of food grain</td>
</tr>
<tr>
<td>D</td>
<td>Market demand for food grain ( \bar{P}_F )</td>
</tr>
<tr>
<td>G</td>
<td>Government procurement of food grain</td>
</tr>
<tr>
<td>I</td>
<td>Food-grain imports</td>
</tr>
<tr>
<td>R</td>
<td>Food-grain ration</td>
</tr>
<tr>
<td>U</td>
<td>Change in government stocks</td>
</tr>
<tr>
<td>P</td>
<td>Price of food grains</td>
</tr>
<tr>
<td>F</td>
<td>Quantity of fertilizers</td>
</tr>
<tr>
<td>A</td>
<td>Quantity of other inputs</td>
</tr>
<tr>
<td>P_i</td>
<td>Import price of food grains</td>
</tr>
<tr>
<td>P_R</td>
<td>Ration price of food grains</td>
</tr>
<tr>
<td>c_H</td>
<td>Unit handling cost</td>
</tr>
<tr>
<td>c_a</td>
<td>Unit carryover cost</td>
</tr>
</tbody>
</table>

Price Support

(7.17) \[ D_1 = D_1 (P_1, R_1) + R_1 \]
(7.18) \[ S_1 = S_1 (P_1) \]
(7.19) \[ I_1 = D_1 (P_1, R_1) + R_1 + U_1 - S_1 (P_1) \]
(7.20) \[ G_1 = R_1 + U_1 - I_1 \]

Substituting (7.19) into (7.20),

(7.21) \[ G_1 = S_1 (P_1) - D_1 (P_1, R_1) \]
(7.22) \[ D_2 = D_2 (P_2, R_2) + R_2 \]
(7.23) \[ S_2 = S_2 (P_2) \]
(7.24) \[ I_2 = D_2 (P_2, R_2) + R_2 + U_2 - S_2 (P_2) \]
(7.25) \[ G_2 = R_2 + U_2 - I_2 \]
Substituting (7.24) into (7.25),

(7.26) \[ G_2 = S_2 (P_2) - D_2 (P_2, R_2) \]

(7.27) \[ U_1 = -U_2 \]

(7.28) \[ C_G = P_1 G_1 + c_H G_1 + P_2 (U_1 + I_2) + c_s U_1 - P_R (R_1 + R_2) + P_2 G_2 - \alpha P_a U + (P_F - \bar{P}_F) (F_1 + F_2) \]

\[ \frac{dC_G}{dP_1} = G_1 + c_H \frac{dG_1}{dP_1} + P_1 \frac{dG_1}{dP_1} + P_2 \left( \frac{dI_1}{dP_1} + \frac{dI_2}{dP_1} \right) + c_s \frac{dU_1}{dP_1} - (R_1 + R_2) \frac{dP_{R_1}}{dP_1} - \left( \frac{dR_1}{dP_1} + \frac{dR_2}{dP_1} \right) P_R + G_2 \frac{dP_2}{dP_1} + P_2 \frac{dG_2}{dP_1} + \alpha P_a \frac{dU}{dP_1} \]

(7.29) \[ dCG = G_1 + c_H \frac{dG_1}{dP_1} + P_1 \frac{dG_1}{dP_1} + P_2 \left( \frac{dI_1}{dP_1} + \frac{dI_2}{dP_1} \right) + c_s \frac{dU_1}{dP_1} - (R_1 + R_2) \frac{dP_{R_1}}{dP_1} - \left( \frac{dR_1}{dP_1} + \frac{dR_2}{dP_1} \right) P_R + G_2 \frac{dP_2}{dP_1} + P_2 \frac{dG_2}{dP_1} + \alpha P_a \frac{dU}{dP_1} \]

Assuming that \( dI, \ dP_R, \) and \( dR \) are zero and \( G_2 \) negligible, \( dG_1 = dU_1 = -dG_1 \):

(7.30) \[ \frac{dC_G}{dP_1} = G_1 + (P_1 + c_H + c_s - P_2) \frac{dG_1}{dP_1} + (P_F - \bar{P}_F) \frac{dF_1}{dP_1} \]

(7.31) \[ \frac{P_1}{100} \frac{dC_G}{dP_1} = \frac{P_1 G_1}{100} + \frac{(P_1 + c_H + c_s - P_2) (S_1 \gamma + D_1 \beta)}{100} + \frac{(P_F - \bar{P}_F) F_1 \beta_p}{100} \]

(7.32) \[ \frac{S_1}{100} \frac{dC_G}{dS_1} = \frac{S_1 G_1}{100 \gamma} + \frac{(P_1 + c_H + c_s - P_2) (S_1 \gamma + D_1 \beta)}{100 \gamma} + \frac{(P_F - \bar{P}_F) F_1 \beta_p}{100 \gamma} \]

(7.33) \[ \frac{S}{100} \frac{dC_G}{dS} = \frac{S_1}{100} \frac{dC_G}{dS} \frac{S}{1 + (dS_2/dS_1)} = \frac{S_1}{100} \frac{dC_G}{dS} \left( \frac{S}{S_1 - S_2 \gamma_2} \right) \]

**Fertilizer Subsidy**

(7.34) \[ C_F = (P_F - \bar{P}_F) F + P_1 G_1 + P_2 (U_1 + I_2) + c_s U_1 - P_R (R_1 + R_2) + P_2 G_2 - \alpha P_a U \]

(7.35) \[ \frac{dC_F}{dP_F} = -F + (P_F - \bar{P}_F) \frac{dF}{dP_F} + \frac{dG_1}{dP_F} (P_1 + c_H + c_s - P_2) \]
\[
\frac{\bar{F}_F \, d\bar{F}_F}{100 \, d\bar{P}_F} = \left( \frac{-\bar{P}_F}{100} + \frac{(P_F - \bar{P}_F) \, \beta_F}{100} \right) + S_1 \gamma_F (P_1 + c_U + c_a - P_2) \frac{100}{100} \]

\[
\frac{S_1 \, d\bar{C}_F}{100 \, d\bar{S}_1} = \left( \frac{-\bar{P}_F}{100 \gamma_F} + \frac{(P_F - \bar{P}_F) \, \beta_F}{100 \gamma_F} \right) + S_1 (P_1 + c_U + c_a - P_2) \frac{100}{100} \]
Price Policy  
and the  
Adoption of New Varieties

NATIONAL PRICES OF AGRICULTURAL PRODUCTS often differ significantly from world prices owing to such devices as farm price supports and trade taxes. For a full analysis of the effects of agricultural price policy one should take into account its long-run implications for agricultural technology in addition to its short-term welfare effects. The purpose of this chapter is to develop a framework for considering both types of effects. The application is to an export tax, but the analysis readily generalizes to any policy affecting farm prices.

Agricultural exports of developing countries are often taxed by a variety of devices—a lower exchange rate for agricultural export, forced procurement from farmers at low prices by a monopolistic marketing board, and export taxes. The main objective is that of revenue collection, although others—such as maintaining a stable price to producers or encouraging a shift toward nontraditional exports—may also be present.

The imposition of an export tax on a commodity usually lowers its domestic price and may impair incentives to producers. But many countries believe, rightly or wrongly, that they have monopolistic positions in the world market for certain commodities so that the greater part of the tax burden will be borne by foreigners in the form of higher prices. National welfare could therefore be increased by export taxation.

The export premium of Thailand provides a typical example of the taxation of export of a key commodity (rice) in the economy. In this chapter its welfare effects are estimated using the technique of producer and consumer surpluses described in chapter 6. The effects on national welfare and its components are first estimated under the assumption that there is no change in technology. As noted in chapter 4, however, it is
quite conceivable that the rise in price received by the farmer after the removal of the export premium may encourage the adoption of modern inputs that will reduce the cost of production. The effects of such a shift of the production function on national welfare are estimated in a later section of this chapter.

Welfare Effects of an Export Premium

Whether the export premium increases or reduces national welfare depends on how much of it is passed on to foreign buyers and how much is borne by domestic producers. This in turn depends crucially on the foreign elasticity of demand for Thai rice. It is believed by some that since Thai rice exports represent only a small percentage of world production, changes in the volume of Thai exports would not affect world prices. The foreign elasticity of demand for Thai rice is very large or infinite. This argument, however, is based on the assumption of free trade among countries and a single price for rice. Chapter 4 showed, however, that this assumption has little validity, and that because of national rice policies the internal prices of rice in many countries bear little or no relation to international prices.

Because of the numerous manipulations of rice prices at the national level, the bargaining power of an exporting country may be better measured by its share in world trade. Thus countries such as Thailand and the United States, with large exportable surpluses, will have some influ-

1. Assuming there is a single world market for rice, the demand for export from Thailand $X_{18}$ is the difference between world demand $(D_w)$ and the quantity supplied by other countries $(S_o)$, or

$$X_{18} = D_w - S_o.$$

Differentiating with respect to price and converting into elasticity form give

$$\eta_f = \frac{D_w}{X_{18}} \frac{\eta_{1w}}{X_{18}} - \frac{S_o}{X_{18}} \eta_w$$

where $\eta_f$ is the foreign elasticity of demand for Thai rice, $\eta_{1w}$ is the price elasticity of world demand, and $\eta_w$ is the elasticity of supply of other countries. Since Thailand is a small producer, the ratio $D_w/X_{18}$ is very high—125 in 1971. Thus, even if the elasticity of world demand $\eta_{1w}$ is very low (say, equal to $-0.2$) and if the elasticity of supply of other countries is zero in the short run, $\eta_f$ would be about $-25$, which is operationally not much different from infinity. Most of the arguments that Thailand is unable to influence the international price are based on the above line of reasoning. See, for example, Sura Sanittanont, *Thailand's Rice Export Tax: Its Effects on the Rice Economy* (Bangkok: National Institute of Development Administration, 1967).
ence on international prices although they are not large rice producers.\textsuperscript{2}

It may be argued further that the relevant international market is one in which concessional exports are excluded, in which case Thailand's share would be even larger. It may also be claimed that because of buyers' preference, different grades or varieties of rice are not strictly speaking the same commodity. The possibility of substitution between wheat and rice, by contrast, tends to increase the foreign elasticity of demand for Thai rice. All things considered, it is still reasonable to assert that the latter is less than infinite.

The Thai rice market is illustrated in figure 8-1. With stock changes ignored, the export supply curve $S_e$ is the horizontal difference between the domestic supply curve $S_d$ and the domestic demand curve $D_d$. The foreign demand curve $D_f$ is the outcome of supply and demand conditions as well as national rice policies of all other countries. In line with the arguments in the previous paragraphs it is drawn as downward sloping. In the absence of the export premium, there is a single price $P_0$ to both foreign buyers and domestic producers and consumers, with marketing and other costs ignored. Rice producers produce $Q_0$, consumers consume $C_0$, and the volume of rice export is $X_0$. When the export premium $T$ is imposed, the export price rises to $P_2$ since foreign demand is imperfectly elastic, and the domestic price falls to $P_1$. Production is reduced to $Q_1$, consumption increases to $C_1$, and the volume of exports falls to $X_1$. Export tax revenue of $ADP_2P_2$ accrues to the Thai government. There is a reduction of the producer surplus of rice farmers by area $IJK$, only partially offset by a gain in consumer surplus of $KEGL$ and a gain in government revenue collected at the expense of domestic citizens of $FHJG$. This leaves areas $HIJ$ and $EFG$ (whose sum is equal to $CBD$) as deadweight losses, the

\textsuperscript{2} According to this approach, $X_{T2} = D_t - X_w$ where $D_t$ is the world demand for exports and $X_w$ is the quantity of export from other countries. Differentiating with respect to price and converting into elasticities give

\[ \eta_t = \frac{D_t}{X_{T2}} \eta_w - \frac{X_w}{X_{T2}} \varepsilon_w \]

where $\eta_t$ is the elasticity of world demand for exports and $\varepsilon_w$ is the elasticity of export supply of other countries. If Thailand's share in world export is 20 percent, $D_t/X_{T2} = 5$ and $X_w/X_{T2} = 4$. $\eta_t$ and $\varepsilon_w$ need not be high since both domestic supply and demand elasticities in most countries are likely to be low for an important staple such as rice. Thus the estimate for $\eta_t$ using this approach is often much lower than that described in note 1. A variant of this approach is used in Warren R. Grant, "A Model for Estimating Costs of Government Export Programs for Rice," Agricultural Economics Research, vol. 19, no. 3 (U.S. Department of Agriculture, July 1967), pp. 73-80. Grant first estimated the elasticity of world demand for rice export by an econometric model and then inferred the foreign elasticity of demand for U.S. rice exports from the country's export share.
former being the production loss and the latter being the consumption cost. Foreign exchange earnings change by area $ACP_2P_2$ minus area $CBX_0X_1$. Area $ABP_2P_2$ is the loss in the foreign consumer surplus, out of which $ACP_2P_2$ is collected by the Thai government and $ABC$ is a deadweight loss from an international point of view.

As long as the foreign demand for Thai rice is not perfectly elastic, there is an optimum export tax that maximizes the welfare of Thailand, or the gain in government tax revenue at the expense of foreigners minus welfare losses $(ACP_2P_2 - HIF - EFG)$. The issue of the optimal export tax is considered in greater detail later in this chapter. It will be seen that the gain is necessarily positive at low rates of export tax but may turn negative at high rates. The present task is to quantify the magnitude of this net gain or loss for Thailand.

**Measurement of Welfare Effects**

The various welfare and transfer effects of the export premium shown in figure 8-1 may easily be estimated using the following formulas:

(8.1) Production loss = $\frac{1}{2}AQAP_d$

(8.2) Consumption cost = $-\frac{1}{2}ACAP_d$

(8.3) Transfer from Thai farmers = $\frac{1}{2}AQAP_d - QAP_d$

(8.4) Transfer from foreigners = $X_{75}AP_w$

(8.5) Change in foreign exchange earnings

\[ \Delta P_wX_{75} + (\Delta Q - \Delta C)(P_w - \Delta P_w), \]

and applying linear approximation to the curves. $Q$, $X_{75}$, and $P_w$ refer respectively to production, export, and export price in the presence of the export premium. $\Delta Q$, $\Delta C$, $\Delta P_w$, and $\Delta P_d$ refer respectively to changes in production, consumption, export price, and domestic price resulting from the premium.3

Prediction of various changes in prices and quantities produced and consumed could be drawn from an earlier paper in which an econometric model of the Thai rice economy has been estimated.4 The regression results are summarized in table 8-1, and the various estimated elasticities

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3. Thus one would expect $\Delta Q<0$, $\Delta C>0$, $\Delta P_w<0$, and $\Delta P_d>0$.

Table 8-1. Thailand: Two-Stage Least Squares Estimates of Structural Equations of the Thai Rice Model, 1951–72

<table>
<thead>
<tr>
<th>Estimated equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Domestic supply equation&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>( Q_t = 3914.72 + 0.5538 Q_{t-1} + 1.5132 P_{w, t-1} - 16.4382 P_{w, t-1} - 209.2310 W_t )</td>
</tr>
<tr>
<td>( R^2 = 0.8863; ; b = 0.23^b )</td>
</tr>
<tr>
<td>2. Domestic consumption equation</td>
</tr>
<tr>
<td>( C_t = 4185.89 + 0.0814 C_{t-1} - 1.2458 P_{w, t} + 6.5629 P_{w, t} + 132.7350 t + 0.0087 Y_t )</td>
</tr>
<tr>
<td>3. Export price equation</td>
</tr>
<tr>
<td>( P_o = 433.72 - 0.1290 I_{o, t} - 8.0655 I_{o, t-1} + 10.1850 g_t + 340.2620 D_t - 0.5322 X_{Th} )</td>
</tr>
<tr>
<td>4. Price transmission equation</td>
</tr>
<tr>
<td>( P_t = 914.10 + 355.4730 D_t + 0.4233 P_o )</td>
</tr>
<tr>
<td>5. Market clearing identity</td>
</tr>
<tr>
<td>( X_{Th} = Q_{t-1} - C_t - \Delta S )</td>
</tr>
<tr>
<td>6. Export price net of rice premium (identity)</td>
</tr>
<tr>
<td>( P_o = P_{o, t} - T_t )</td>
</tr>
</tbody>
</table>

Note: The endogenous variables are: \( Q_t = \) domestic production of milled rice; \( P_o = \) domestic wholesale price of milled rice; \( C_t = \) domestic consumption of milled rice; \( X_{Th} = \) volume of milled rice export from Thailand; \( P_{o, s} = \) export price; \( P_{o, s} = \) export price minus export premium. The lagged endogenous variables \( Q_{t-1}, P_{w, t-1}, \) and \( C_{t-1} \) are \( Q_t, P_{w, t}, \) and \( C_t \) lagged one period respectively. The exogenous variables are: \( W_t = \) percentage of paddy area damaged in crop year \( t; \) \( P_{w, t} = \) lagged price index of all crops except rice; \( t = \) trend term (1951 = 1); \( Y_t = \) national income; \( I_{o, t} = \) sum of U.S. Public Law 480 rice exports and net rice export from Japan; \( I_{o, t-1} = \) index of per capita paddy production of six major importing countries, lagged one crop year; \( g_t = \) percentage of rice export from Thailand under government-to-government contracts; \( D_t = \) dummy variable, set equal to one for the period of multiple exchange rate system (1951–55) and zero for other years; \( \Delta S = \) addition to rice stocks during the year; \( T_t = \) export premium; and \( P_{o, s} = \) price index of substitute foods in consumption. The small letter \( t, \) when appearing as a subscript, denotes the time period—crop years for agricultural production statistics and calendar years for most other statistics. Rice prices and export premium rates are for white rice 5 percent broken. Prices, income, and export premium rates have been deflated by the wholesale price index with 1960 as base.

a. Estimated by ordinary least squares; standard errors in parentheses.
b. When a one-tail test is used, Durbin's \( h \) statistic has a probability value of 0.41, which implies that the null hypothesis of no positive serial correlation of residuals cannot be rejected under the usually accepted levels of significance. Durbin's method, however, is essentially a large sample test which may not be applicable here because there are only twenty-two observations. (See J. Durbin, "Testing for Serial Correlation in Least-Squares Regression When Some of the Regressors are Lagged Dependent Variables," *Econometrica*, vol 38, no. 3 (1970), pp. 410–21.)

Table 8-2. Thailand: Estimates of Elasticities at Means

<table>
<thead>
<tr>
<th>No.</th>
<th>Elasticities</th>
<th>Short run</th>
<th>Long run</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Price elasticity of supply</td>
<td>0.4065</td>
<td>0.9110</td>
</tr>
<tr>
<td>2.</td>
<td>Cross-price elasticity of supply</td>
<td>-0.2799</td>
<td>-0.6273</td>
</tr>
<tr>
<td>3.</td>
<td>Price elasticity of demand</td>
<td>-0.4285</td>
<td>-0.4665</td>
</tr>
<tr>
<td>4.</td>
<td>Cross-price elasticity of demand</td>
<td>0.1484</td>
<td>0.1616</td>
</tr>
<tr>
<td>5.</td>
<td>Income elasticity of demand</td>
<td>0.0935</td>
<td>0.1018</td>
</tr>
<tr>
<td>6.</td>
<td>Foreign elasticity of demand</td>
<td>-3.9994</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Elasticity of price transmission</td>
<td>0.4477</td>
<td></td>
</tr>
</tbody>
</table>

a. Inverse of price flexibility estimate.


are presented in table 8-2. Essentially the model consists of four equations—a domestic supply equation, a domestic demand equation, a (price dependent) foreign demand equation, and a price transmission equation—and two identities, one a market clearing identity and the other showing the net return to exporters as the export price minus the export premium. The values of $\Delta Q$ and $\Delta C$ we substituted into formulas (8.1) to (8.5) are the long-run changes in quantities produced and consumed predicted by the Nerlovian supply and demand equations with lagged adjustment mechanisms. Thus all $\Delta$'s in (8.1) to (8.5) refer to long-run changes. Since export premium rates, prices, and quantities vary considerably over time, the average values of these variables for 1961–70 are used in the formulas. As noted in table 8-1, prices and export premium rates in the model have been deflated by the wholesale price index with 1960 as the base; thus welfare changes and transfers can be estimated at 1960 prices, as presented in table 8-3.

According to the previous discussion, the crucial determinant of the net gain or loss to Thailand as a result of the tax is the relative burden borne by foreigners and by domestic citizens. This in turn depends on the extent foreign demand is more price elastic in the long run than in the short run. Although it would be possible for Thai exporters to raise their price in the short run without a significant loss of markets, buyers' preference and the present institutional arrangements of the international rice market may change over time and cause importers to shift to alternative suppliers or strengthen their self-sufficiency policies.

<table>
<thead>
<tr>
<th>Case</th>
<th>Rise in export price as percentage of premium (p)</th>
<th>Welfare effects</th>
<th>Transfers</th>
<th>Changes in foreign exchange earnings</th>
<th>Net loss for Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Production loss</td>
<td>Consumption cost</td>
<td>From foreigners</td>
<td>From farmers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>A</td>
<td>0</td>
<td>1007.0</td>
<td>544.5</td>
<td>0.0</td>
<td>5565.4</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>908.9</td>
<td>363.5</td>
<td>44.7</td>
<td>5239.3</td>
</tr>
<tr>
<td>C</td>
<td>15</td>
<td>727.6</td>
<td>291.0</td>
<td>134.2</td>
<td>4602.2</td>
</tr>
<tr>
<td>D</td>
<td>25</td>
<td>566.5</td>
<td>226.5</td>
<td>223.7</td>
<td>3985.2</td>
</tr>
<tr>
<td>E</td>
<td>-3</td>
<td>99.5</td>
<td>39.8</td>
<td>462.3</td>
<td>2302.6</td>
</tr>
</tbody>
</table>

Note: The average exchange rate for 1961-70 is 20.88 baht per U.S. dollar.

a. Col. (6) = col. (1) + col. (2) - col. (3).

b. Case E uses changes in prices and quantities predicted by total multipliers of the equation system.

Of even greater importance in determining the possible gains from removing the premium, however, is the degree of liberalization of the international rice market in the future. Cases A and B of table 8-3 represent hypothetical free-trade situations in which Thailand as a small producer is not expected to have a strong influence on world prices. It appears reasonable to assume that under such situations the change in the world price as a percentage of the export premium $\mu$ is not more than 5 percent. In Case E, which represents the other extreme, welfare effects and transfers are quantified by using directly the changes in prices and quantities predicted by the total multipliers of the dynamic equation system presented in table 8-1, which assume that the characteristics of the international market do not change in the long run.\footnote{For a good discussion of the derivation and interpretation of impact, interim, and total multipliers in a dynamic equation system see, for example, Henri Theil, Principles of Econometrics (New York: John Wiley & Sons, 1971), chap. 9. The dynamic multipliers of a one-unit change in the export premium given by the equation system in table 8-1 can be found in Wong, “A Model for Evaluating the Effects of Thai Government Taxation of Rice Exports.” The value of the rise in export price as a percentage of the premium $\mu$ implied by the total multipliers of the system is about 0.5—or in the long-run equilibrium as much as 50 percent of the tax may be passed on to foreigners. This high estimate of $\mu$ is due to the assumption that the characteristics of the international market do not change in the long run. This is because in the foreign demand equation in table 8-1 (unlike in the domestic supply and demand equations), we have not distinguished between short-run and long-run price responsiveness.} Cases C and D are intermediate, chosen arbitrarily for sensitivity tests, and may be looked upon as assuming different long-run elasticities of foreign demand associated with different degrees of trade liberalization and different extents to which the present institutional arrangements and buyer-seller relations would be modified in the future.

The welfare effects and transfers of Cases A to D of table 8-3 are estimated in the following manner. First, the export premium ($T$) over the period 1961–70 is divided between a rise in the export price ($\Delta P_e$) and a fall in the export price net of export premium ($\Delta P$) according to the assumed value of $\mu$. On the assumption that marketing margins are constant and that the government eliminates all other interventions on the rice economy, one would expect the domestic price to change eventually by the same amount as the export price net of export premium (or $\Delta P_e = \Delta P$). The long-run changes in the quantities produced and consumed, $\Delta Q$ and $\Delta C$, are then predicted using the estimates of the slope coefficients of the domestic supply and demand curves and the adjustment coefficients from table 8-1. Formulas (8.1) to (8.5) are then applied to compute the various welfare and transfer effects. Since the export premium and export...
price data used in fitting the model are for white rice 5 percent broken, a relatively high grade, and since in computing welfare losses and transfers it is more appropriate to use average prices and export premium rates for all grades, after applying formulas (8.1) to (8.5), the estimates are scaled down by a factor of 0.6685, which is the ratio of the average export premium for all grades of rice\(^7\) to the export premium for white rice 5 percent broken over the 1961–70 period.

From table 8-3 it can be seen that in Cases A to D the net losses from imposing the export premium at the levels of the 1960s are positive and fairly large. Under free-trade assumptions, for example, the net welfare loss is from 1.8 percent (Case B) to 2.3 percent (Case A) of national income. The transfer effect is even stronger, and the loss in producer surplus of the farmer is as high as 7.8 percent (Case B) to 8.3 percent (Case A) of national income. A large part of this loss to farmers in column (4) is only imputed, however, since rice grown by farmers for their own subsistence is not affected by the premium.\(^8\) The welfare losses computed are large partly because it was assumed that the export and domestic markets are perfectly integrated and that marketing margins are constant, so that \(\Delta P_d = \Delta P_p\). If the two markets are less than homogeneous or marketing margins rise when the export premium is removed, the welfare losses in columns (1) and (2) would have been overestimated in relation to the transfer from foreigners,\(^9\) and the net losses in column (6) would have to be scaled down considerably.

In contrast, the export premium results in a positive net gain for Thailand in Case E, in which it is assumed that the present characteristics of the rice trade do not change in the long run. This is because if the rice premium is removed, increases in outputs would be thrown continuously into the international market, which, under the existing restrictive arrangements, would result in substantial falls in export prices and actually reduce welfare.

In all five cases, the loss in foreign exchange earnings, shown in column (5), is quite large. Though not looked upon as a social cost, this may cause

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7. Estimated by dividing total export premium revenue by the volume of rice export.

8. Thus if 60 percent of the rice crop is marketed, the export premium will reduce producers’ profits by approximately 0.6 times the figures in column (4) of table 8-3. This is only approximately true since the higher price following a removal of the premium would encourage farmers to market a larger proportion of their crops.

9. This overestimation comes from two sources. First, if marketing margins increase when the export premium is removed, the increase in price to the farmer and the consumer is smaller. Second, because the change in the domestic price is smaller, the changes in production and consumption (\(\Delta Q\) and \(\Delta C\)), predicted on the basis of estimates of the slope coefficients of the supply and demand curves, are also smaller.
balance of payments difficulties in the future. The deficit in Thailand's merchandise trade has tended to widen, and factors that have caused an increase in receipts in the service account and a rise in the inflow of capital and transfers may soon disappear.

The Optimal Export Tax

As stated earlier, when the foreign demand curve is downward sloping, national welfare can be increased by imposing an optimal export tax. In figure 8-2 the curves $S_e$ and $D_f$ are the same export supply and foreign demand curves as those in the right-hand diagram of figure 8-1. Under free trade, exports would be $X_f$ and the international price, $P_w$. Point B, however, does not represent the optimum from the national point of view. Since the foreign demand curve is downward sloping, the country does well to act as a monopolist and restrict export to $X^*$ where the curve marginal to $D_f$ intersects $S_e$. This can be achieved by imposing an export tax of $AD$. Since $S_e$ is the horizontal difference between the domestic

10. Linear schedules are assumed throughout this section.
supply and demand curves, the move along $S_i$ indicates a reduction in domestic production or an increase in domestic consumption, or both. At the free-trade point B, the revenue generated by an extra unit of export is less than the marginal cost of increasing production and the marginal value of consumption to the domestic consumer by $BF$. If export is restricted to $X^*$, there is a social gain of area $b$ plus $c$. Any export tax less than $AD$ would also generate a social gain. Thus an export tax of $CG$, by reducing the divergence between marginal social cost and marginal social value of export from $BF$ to $GH$, leads to a welfare gain of area $c$. Too high an export tax, however, may reduce national welfare below its level under free trade. In figure 8-2 the export tax $KJ$ is such that $IJ = BF$ (so that $f + g = b + c$) and the export level $X_2$ results in the same national welfare as with free trade, $X_1$. An export tax higher than $KJ$ would, however, reduce national welfare below its level under free trade.

The relation between marginal revenue of export and the export price is given by $MR_f = P_w [1 + (1 / \eta_f)]$ where $\eta_f$ is the foreign elasticity of demand. If $t$ is the export tax rate expressed as a percentage of the gross export price, then $P_e (1 - t) = P_e \eta_f$, where $P_e$ is the net-of-tax export price given along $S_e$. Since at the optimal level of export $X^*$, $P_e = MR_f$, this gives

$$t^* = -\frac{1}{\eta_f}$$

as the optimal rate of export tax. Our estimate of the foreign elasticity of demand for Thai rice is about $-4$ (table 8-2), which implies an optimal rate of export tax of about 25 percent. During 1961–70 the export premium was about one-third of the export price, which is not too far from the optimal rate. It is therefore not surprising that under the assumption of unchanged conditions in the international market (Case E in table 8-3) a net social gain as a result of the tax is indicated.

In imposing the export tax the government may also be concerned about the resulting change in export earnings. In figure 8-2, with a linear demand curve, the absolute value of $\eta_f$ is unity at the export quantity where $MR_f$ intersects the horizontal axis. If the export supply curve intersects the inelastic portion of $D_f$ (at points such as $M$ to the right of $L$), raising the

1. The area $b + c$ could be proved to be the same as $(d + f + e) - a$, or in other words the difference between government revenue collected at the expense of foreigners and welfare losses. This is done by assuming the income effect of a price change to be negligible and then making use of the relation between average and marginal schedules. Thus in figure 8-2, $i = \epsilon + b$ and $i + d + f = b + a + b + \epsilon$. Solving for $b + \epsilon$ then gives $b + \epsilon = (i + d + f) - a - b = (d + f + e) - a$. 

11
export price would increase export earnings. Thus a properly chosen export tax can increase national welfare and export earnings at the same time. We have found foreign demand to be elastic, however, and therefore, as shown in table 8-3, an export tax would reduce foreign exchange earnings.

In figure 8-2 it is assumed that $S_r$ reflects accurately the marginal social cost of rice export and $MR_f$ reflects accurately the marginal social revenue of rice export. If either of the above does not hold then equation (8.6) does not give the correct formula. Thus in figure 8-3, if $S_r$ measures correctly the marginal social cost of rice export while marginal social revenue $MR^*$ is higher than $MR_f$, the optimal export tax is not $AD$ but $BC$ so that export is restricted to a level at which marginal social benefit and marginal social cost are equal. Similarly, if $MR_f$ reflects adequately the marginal social revenue of export, but the marginal social cost $MC^*$ is higher than marginal private cost, the optimal export tax is $EF > AD$.

To what extent are the above qualifications relevant in the case of Thailand? One situation in which social marginal revenue of export would be greater than marginal private revenue is when the baht is overvalued. This does not appear to have been the case. After the abolition of the multiple exchange rate system in 1955, the official and free-market ex-
change rates came together. The government has intervened only marginally in the foreign exchange market for purposes of short-term stabilization, and it does not appear that the baht had been significantly undervalued or overvalued during the period of our welfare analysis.

The marginal social cost of rice export would exceed the marginal private cost if the marginal social cost of resources engaged in rice production exceeds that of private. This would be true if, as some have suggested, resources tend to remain in rice production even though they could generate a higher value of output in other sectors of the economy. In this case, a tax rate higher than that given in equation (8.6) could be justified.

Adoption of High-yielding Varieties

As indicated in chapter 4, the export premium, by keeping rice prices low, may discourage farmers from adopting modern inputs and new technology and moving to a higher production function. The rest of this chapter is devoted to examining this issue. First, a method is presented to incorporate such effects in the measurement of welfare costs and to provide numerical examples of the probable magnitude of such effects. Then the Thai situation is examined to see if there is indeed evidence that farmers would adopt new technology—to be specific, high-yielding varieties (HYV)—if the export premium were removed.

Technological Change and Welfare Cost Measurement

Assume for convenience that foreign demand is perfectly elastic. The effect of a larger export volume on the international price may then be ignored. In figure 8-4 the world price \( P_w \) is assumed to be given, and with the export premium \( T \) imposed, the export volume would be \( CQ \) with the same production loss \( EFG \) and consumption cost \( HIJ \) as before. If the export premium were removed, the domestic price would rise from \( P_r \) to the level of the world price \( (P'_r = P_w) \). If this rise in price after the elimination of the premium would induce more farmers to adopt the new technology, the relevant supply curve would shift from \( S_j(P_r) \) to \( S_j(P'_r) \). For simplicity it is assumed that both supply curves pass through the origin and that the extent of the horizontal shift is \( b \times 100 \) percent. In this case the consumption cost of the export premium is still \( EFG \), but the production loss would now be \( OJHL \). The latter may be divided into two parts: \( Q/V \) is the extra cost involved in producing the quantity \( Q \) because the low prices resulting from the premium discourage the adoption of the new technology, and \( NHL \) arises because had the premium been removed the increase in production because of the change in technology would
Figure 8-4. The Welfare Effects of the Export Premium in the Presence of Technological Change with No Change in World Price as a Result of the Removal of the Premium

generate \( H \cdot L \cdot Q^* Q \) of export revenue but involves only \( Q \cdot N \cdot L \cdot Q^* \) of costs under the new technology.\(^{12}\)

The welfare changes under the export premium are now quantified, with various assumptions about \( b \), the extent of the horizontal shift of the supply curve. The factor \( b \) may be regarded as a function of the percentage reduction in cost per unit of output made possible by the new technology (HYV), the percentage of farmers finding it profitable to adopt the new technology after the removal of the premium, and other variables. \( S(P_d) \) in figure 8-4 may be regarded as the long-run equilibrium position of the supply curve after all those who find it profitable to adopt have done so; in the intermediate run the supply curve would be somewhere between \( S(P_d) \) and \( S(P_d') \).

12. Alternatively, the area \( O \cdot H \cdot I \cdot L \) may be broken down into \( H \cdot J \), the production loss in the absence of technological change, and \( O \cdot J \), the additional loss when technical change is considered.
Table 8-4. Thailand: Production Loss in Imposing the Export Premium When the Adoption of Modern Inputs in Paddy Production Is Discouraged, 1961–70 Average (million baht)

<table>
<thead>
<tr>
<th>Percentage shift of supply curve (b)</th>
<th>Production loss when long-run changes in technology are considereda</th>
<th>Total production lossb (area OJHL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area OIM (1)</td>
<td>Area IML (2)</td>
</tr>
<tr>
<td>5</td>
<td>479.03</td>
<td>23.95</td>
</tr>
<tr>
<td>10</td>
<td>914.51</td>
<td>91.45</td>
</tr>
<tr>
<td>15</td>
<td>1312.13</td>
<td>196.82</td>
</tr>
<tr>
<td>20</td>
<td>1676.61</td>
<td>335.32</td>
</tr>
<tr>
<td>25</td>
<td>2011.93</td>
<td>502.98</td>
</tr>
</tbody>
</table>

Note: Refer to figure 8-4 for the definitions of various areas.

a. No change in the international price as a result of the removal of the premium is assumed.
b. Col. (4) = col. (1) + col. (2) + col. (3).

The production losses arising from the export premium when changes in technology are considered are shown in table 8-4. The area $HJL$ under the assumption of no change in the export price after the removal of the tax has been estimated in Case A of table 8-3. From figure 8-4 it can be seen that area

$$OIM = \frac{1}{2}P_o (Q - (Q - Q'))$$

where $r$ is the extent of vertical shift of the supply curve with a change in technology, $Q$ is the quantity produced in the presence of the export premium, and $Q'$ is the quantity produced after the removal of the premium with no change in technology. Note that $Q - Q' = \Delta Q$, defined earlier as the change in quantity produced as a result of the premium. Also, it can be proved\(^4\) that $r = b/(1 + b)$. Substituting these expressions into $OIM$ gives

$$\text{(8.7)} \quad \text{Area } OIM = \frac{1}{2}P_o (Q - \Delta Q) \frac{b}{1 + b}.$$  

13. Thus $\Delta Q < 0$. No change in technology is assumed in $\Delta Q$.
14. From figure 8-4, the inverse of the slope of $S(P)$ is $Q'P_o$. It may alternatively be expressed as $IL/IM = bQ'(r P_o)$. On equating the two expressions and noting $Q' = (1 + b)Q'$, we get $r = b/(1 + b)$.\(^4\)
Similarly, area $IML = \frac{1}{2}(P \cdot b(Q - Q'))$, and on substitution

(8.8) \[ \text{Area } IML = \frac{1}{2} \left( \frac{b^2}{1 + b^2} \right) P_w(Q - \Delta Q). \]

Formulas (8.7) and (8.8) may be applied, assuming different values of $b$, to give the figures in columns (1) and (2) of table 8-4. It can be seen that fairly moderate shifts in the supply curve would lead to substantial production gains if the rice premium were removed. For example, welfare gains in production after the removal of the premium would approximately double if the supply curve were to shift to the right by about 10 percent. Thus if the heavy export premium hinders the adoption of modern inputs in paddy production, welfare losses would be much higher than those estimated in table 8-3.

The estimates in table 8-4 are based on two assumptions. First, it has been assumed that the world price does not change. If foreign demand is not perfectly elastic the additional output sold in the international market will depress the international price further, thus reducing the gain from removing the premium. Second, it has been assumed that all of the increase in production because of the change in technology will be exported at the prevailing international price, so that domestic consumers will not benefit from technological change. In practice, it is likely that domestic consumption would increase along with export, and consumers will also benefit from modern technology.

The Export Premium and Adoption of HYV

In general, factors other than price incentives influence the adoption of HYV. The yield of HYV can be greatly improved by the use of fertilizer, to which HYV respond much better than traditional varieties (TV). Also these dwarf varieties require a carefully controlled water level and drainage. Welsch and Tongpan speculated that only about 10 percent of the rice area at that time had the required degree of water control for the adoption of these varieties.

15. A 10 percent rightward shift in the aggregate supply curve is considered likely in the case of the Philippines. See Yujiro Hayami and Robert W. Herdt, "The Impact of Technological Change in Subsistence Agriculture on Income Distribution," paper presented to the Los Baños Social Science Workshop, International Rice Research Institute, December 16, 1974.

There have been very few studies on the cost of and return from the adoption of HYV in Thailand. The results of an International Rice Research Institute (IRRI) study of three villages are shown in table 8-5. The village in Rai Rot is well irrigated, that in Nong Sarai is less well irrigated, and that in Sa Krachom is totally rain-fed. A substantially higher proportion of farmers in the well-irrigated village has grown HYV (although they have grown TV at the same time). Table 8-5 clearly shows that labor and fertilizer costs are higher for HYV than for TV, and these costs rise with the degree of water control. The net return of HYV in comparison with TV is highest in the village in Sa Krachom. Table 8-6 shows that despite significant differences in net return and variable cost per hectare, variable cost per unit of output for HYV is not significantly different from that of TV. There is thus little gain in cost
Table 8-6. Thailand: Net Return from and Cost of HYV and Traditional Varieties in Three Villages, 1971 Wet Season

<table>
<thead>
<tr>
<th>Village Type</th>
<th>HYV Net Return/Variable Cost per Hectare</th>
<th>TV Net Return/Variable Cost per Hectare</th>
<th>HYV Net Return/Variable Cost per Ton</th>
<th>TV Net Return/Variable Cost per Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-irrigated village in Rai Rot</td>
<td>1,890/830</td>
<td>1,416/624</td>
<td>325</td>
<td>286</td>
</tr>
<tr>
<td>Difference</td>
<td>474&quot;</td>
<td>206&quot;</td>
<td>39&quot;</td>
<td></td>
</tr>
<tr>
<td>Less well-irrigated village in Nong Sarai</td>
<td>1,469/571</td>
<td>1,010/350</td>
<td>268</td>
<td>282</td>
</tr>
<tr>
<td>Difference</td>
<td>459&quot;</td>
<td>221&quot;</td>
<td>14&quot;</td>
<td></td>
</tr>
<tr>
<td>Rain-fed village in Sa Krachom</td>
<td>1,273/257</td>
<td>689/246</td>
<td>239</td>
<td>327</td>
</tr>
<tr>
<td>Difference</td>
<td>584&quot;</td>
<td>11&quot;</td>
<td>88&quot;</td>
<td></td>
</tr>
</tbody>
</table>

a. Not significant at 10 percent level.
b. Significant at 10 percent level.
c. Significant at 5 percent level.
d. Significant at 1 percent level.


Efficiency with the new technology. If costs associated with family labor and land are included, however, the cost per ton would be less for HYV.17

The effect of eliminating the rice premium on the benefit-cost ratio of shifting from TV to HYV for the villages in Rai Rot and Nong Sarai is shown in tables 8-7 and 8-8. It is assumed that because of floods, totally rain-fed areas are not suited to the adoption of these dwarf varieties. In 1971 the export price was B1,210 per metric ton of paddy equivalent, and rice taxes (export premium plus export duty18) were about B200 per ton. The paddy price was B850 per ton, which means that various marketing margins and transport costs summed up to about B160 per ton. If the premium were eliminated the upper limit to which the paddy price would


18. Throughout the period, an ad valorem export duty of 4 to 5 percent was imposed on all agricultural exports, in addition to the rice premium.
Table 8-7. Thailand: Benefit-Cost Ratios of Shifting from TV to HYV in the Well-Irrigated Village in Rai Rot, 1971, before and after Elimination of the Export Premium

<table>
<thead>
<tr>
<th>Item</th>
<th>With rice premium</th>
<th>After elimination of premium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HYV</td>
<td>TV</td>
</tr>
<tr>
<td>Total cost (baht per metric ton)</td>
<td>830</td>
<td>624</td>
</tr>
<tr>
<td>Yield (metric ton per hectare)</td>
<td>3.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Gross return</td>
<td>2,720</td>
<td>2,040</td>
</tr>
<tr>
<td>Net return</td>
<td>1,890</td>
<td>1,416</td>
</tr>
<tr>
<td>Benefit-cost ratio of shifting to HYV</td>
<td>3.30</td>
<td>4.04</td>
</tr>
</tbody>
</table>

a. It is assumed that the paddy price is B1,040 per metric ton after elimination of the premium.

Source: Tables 8-5 and 8-6.

The rise would be about B1,040.19 The effect of the rise in paddy price on the benefit-cost ratio of shifting from TV to HYV is rather small in all cases, and only in the well-irrigated village does the ratio exceed 4. A benefit-cost ratio considerably higher than 1 is essential because of the risks involved in adopting a new technology.

In droughts or floods, HYV tend to fare worse than TV. Thus in the absence of good water control the incentive to shift to HYV will be reduced. In table 8-8 a hypothetical case has been drawn up for the less well-irrigated village on the assumption that one out of three years is “bad,” in which the yields of both TV and HYV are reduced to 1.4 metric tons per hectare. In this case the expected yields of HYV and TV will be 2.07 and 1.53 metric tons per hectare respectively. Table 8-8 shows that under poor conditions of irrigation the incentive to shift to HYV is substantially reduced.

The performance of HYV in the area under investigation is certainly not as impressive as in many other countries. In particular, the extra expenses are high in relation to the increase in yield. Of course, the evidence is far from being decisive, and studies in other areas are clearly desirable. The area is at a relatively low level of management,20 and this probably accounts for the disappointing performance of HYV.

19. On the assumption of no change in marketing margins and a fall in export price by 5 percent of the tax.
Table 8-8. Thailand: Benefit-Cost Ratios of Shifting from TV to HYV in the Less Well Irrigated Village in Nong Sarai, 1971, before and after Elimination of the Export Premium

<table>
<thead>
<tr>
<th>Item</th>
<th>1971 wet season</th>
<th>Hypothetical case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With rice</td>
<td>After elimination</td>
</tr>
<tr>
<td></td>
<td>premium</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td>571 350</td>
<td>571 350</td>
</tr>
<tr>
<td>Yield</td>
<td>2.4 1.6</td>
<td>2.4 1.6</td>
</tr>
<tr>
<td>Gross return</td>
<td>2,040 1,360</td>
<td>2,490a 1,664a</td>
</tr>
<tr>
<td>Net return</td>
<td>1,469 1,010</td>
<td>1,925 1,314</td>
</tr>
<tr>
<td>Benefit-cost ratio of shifting to HYV</td>
<td>3.08 3.76</td>
<td></td>
</tr>
</tbody>
</table>

a. Expected yield with one bad harvest every three years.
b. The paddy price is assumed to rise to B1,040 per metric ton after elimination of the export premium.
Source: Tables 8-5 and 8-6.
If HYV are regarded as land-saving innovations, the use of price incentives such as the elimination of the premium will increase the net return per unit of land and thus make the adoption of HYV more profitable. In tables 8-7 and 8-8 the shift to HYV after elimination of the premium caused a rather small increase in the cost-benefit ratio because in 1971 the export price, domestic price, and average premium rate were all lower than in most other years. This suggests that the profitability of adopting modern inputs depends as much on the future of world prices as on the price incentive used.

Although HYV, fertilizer, and water control have been treated separately, the complementarity among the three should not be neglected. HYV could be profitably adopted only if there is good water control, and they are more responsive than TV to large applications of fertilizer. Thus government irrigation and water control projects, for example, would enhance the profitability of using fertilizer and also the adoption of HYV. In general, further studies on the cost of and return from various modern inputs and their complementary relations in increasing yield would be required for reliable predictions regarding the possible shift in the production function after the removal of the premium.

Summary and Conclusions

Estimates of the effects of the export premium on national welfare have been presented, based on producer and consumer surplus techniques. This was first done in a static framework in which technology is assumed not to change after the removal of the premium. In this case the conclusions regarding the desirability of retaining the premium depend crucially on assumptions about future characteristics of the international rice market. If world trade in rice were liberalized, Thailand would do best to remove restrictions and export at the world price. Under the existing restrictive arrangements in the world market, however, foreign demand for Thai rice is not perfectly elastic. Under such conditions, an export tax of about one-third (which Thailand imposed in the 1960s) could probably be justified by the optimal export tax argument. The export premium, however, represents a heavy burden on farmers.

The possible dynamic effects of the export premium on the rice-producing subsector were also examined. In general, the case for the export premium becomes weaker if it reduces the incentive to adopt new technology, although even in this case assumptions about conditions in the foreign market remain important. In the case of Thailand, few studies on the cost of and return from adopting new technology have been made, and more research is needed to give some idea about the probable magnitude of these dynamic effects.
The importance of relations between seasonality and price policies is often overlooked. Government operations affecting prices received by farmers will ordinarily require purchases only at harvesttime, but interventions affecting urban consumer prices will ordinarily involve sales of commodities throughout the year. These sales could conceivably be made at progressively higher prices during the year to reflect the normal seasonal price rise and to cover seasonal storage costs that occur in the absence of price policies. Government procedure in many cases, however, is to dampen and sometimes eliminate any seasonal price rise. The relation between policies of seasonal stabilization and policies that affect yearly values is discussed here, together with the effect of price policies on incentives of private storers to hold seasonal stocks.

In the first part of this chapter the case of complete seasonal price stabilization is examined. At the outset, a purchase price just sufficient to achieve complete seasonal stabilization is considered, followed by a discussion of higher support levels. The possibility of exporting rice is included as a relevant alternative. In the second part of this chapter, a model for partial seasonal price stabilization is developed to examine how government cost is affected by varying degrees of seasonal stabilization given the quantity of rice marketed. As illustration, calculations are presented for government purchase prices below that required for complete seasonal stabilization. The effect of changes in seasonal price patterns on consumer and producer welfare is also considered.

Complete Seasonal Stabilization

Under complete seasonal stabilization, the price of rice is flat throughout the year, and farmers and private storers have no incentive to acquire rice and sell it later in the season. The implication is that the government must
Figure 9-1. *Market Price Determination*

An additional 10 percent difference between farm and wholesale price has been assumed to allow for transport and processing, making a total difference of 28 percent between farm harvest price and average wholesale price.
With complete seasonal price stabilization, purchases and sales are made until price is flat—in the example given, this would raise the harvest price by 18 percent and lower the price peak at the end of the season by about the same amount. As shown in figure 9-2, adjustments take place until the quantities supplied and demanded are equal when there is a difference of only 10 percent between the harvest price and the seasonal average wholesale price covering processing and transport costs. The farm-level demand schedule may in this case be interpreted as the government break-even purchase price, since there will be a net cost to the government if the price is raised above this level by seasonal purchases. The shaded area measures government cost if government storage costs are the same as private storage costs. If the government borrows at a lower interest rate, then government cost is some fraction of the shaded area.

The amount of rice marketed in figure 9-2 is greater than that in figure 9-1 because government purchases in the beginning of the season raise the harvest price, which causes a marketed supply response. There are in addition two effects which operate against each other. On the one hand,
the higher farm price results in an income effect on consumption that reduces the amount marketed. On the other hand, the increase in price raises the amount of other goods that must be forgone when rice consumption is increased, and this substitution effect tends to increase marketed supply.

The increase in yearly rice marketings depends on the elasticity of marketed surplus and the elasticity of demand. Let \( Q \) stand for rice marketings, \( P_w \) the wholesale price, and \( P_f \) the farm harvest price. Then the wholesale price elasticity of demand \( \beta = \frac{\Delta Q/Q}{(\Delta P/P_w)} \) and the price elasticity of marketing \( \gamma = \frac{\Delta Q/Q}{(\Delta P_f/P_f)} \). From the previous discussion, under the seasonal stabilization program

\[
- \frac{\Delta P}{P_w} + \frac{\Delta P_f}{P_f} = \frac{\Delta Q}{Q} \left( \frac{1}{\beta} + \frac{1}{\gamma} \right) = 0.18,
\]

and the percentage change in rice marketings is thus

\[
\frac{\Delta Q}{Q} = 0.18 \left( \frac{1}{\beta} + \frac{1}{\gamma} \right).
\]

The elasticities of supply and demand for rice have been estimated as 0.3 and 1 respectively in the case of Korea. The elasticity of marketed supply \( \gamma \), could be higher than the elasticity of supply; in this section \( \gamma \) is taken to be 0.3, but it is likely to be a conservative estimate. When \( \beta = 1 \) and \( \gamma = 0.3 \) are substituted into the above expression, the conclusion is that the program increases marketed supply by about 4 percent. There is a reduction of the spread between the seasonal average wholesale price and farm harvest price by 18 percent accomplished by a 4 percent fall in wholesale price and a 14 percent rise in farm harvest price.

A W32,450 Purchase Price

The effect of complete seasonal price stabilization on government costs is depicted in figure 9-2. To estimate this effect, however, the purchase price that is just sufficient to achieve seasonal stabilization needs to be estimated. This analysis pertains to a normal year—in any given year sudden changes in supply and demand could give rise to unforeseen fluctuations in price and quantity. The self-sufficiency price of rice (point A in figures 9-1 and 9-2) is defined as the price that would prevail in a normal year if rice is neither exported nor imported and the government does not attempt to influence price.

For the five harvests preceding the 1977–78 season, the average rice production was 4.538 million metric tons. If this is the average under normal weather conditions and if a growth rate of 6 percent (the average
growth rate over the same five-year period) is assumed, 5.405 million metric tons is the estimated normal crop for 1977–78. The farmer in making his decisions pays attention to the price of the previous crop (in 1976–77). As shown in Table 2-3, data on farm harvest prices are unavailable for recent years, and the farm purchase price is an unsatisfactory indicator since the government deals only in new varieties. The index number of harvest price in column (4) could be used, however, to estimate the harvest price in 1976–77 (3.544 × 6,569), and allowing for an inflationary adjustment of 8 percent from 1976–77 to 1977–78 gives a price of W25,140 per bag. Thus it is reasonable to assume that in the 1977–78 crop year, farmers expected to harvest a crop of 5.405 million tons and receive a price at harvesttime of W25,140.

The self-sufficiency price must be between the W25,140 farmers expected to receive for a normal crop and the price they actually would have received for the normal crop of 4.538 million tons if there had been no imports and no government program. The point is that if there is a difference between demand and supply price for a given quantity, supply will adjust until demand and supply are equated at some intermediate price. Thus, if farmers would have received more than W25,140 per bag for a crop of 4.538 million tons, demand would exceed normal supply and self-sufficiency would be achieved only at a higher price, and conversely.

The harvest in 1977–78 was 6.006 – 5.405 = 0.6 million tons above the normal level. As stocks had already accumulated to 1.29 million tons the previous year, it was unlikely that they would accumulate at any faster rate. Imports in 1978 fell further from the already low level in 1977 and may be considered negligible. Preliminary figures indicate that the value of rice imports in the first ten months of 1978 was only about 5 percent of that in the same period in 1977. Thus Korea was essentially self-sufficient in rice at that time. If an extra 0.6 million tons (about 12 percent of total consumption in 1978) entered consumption, prices would have been 12 percent lower (with unitary demand elasticity). In other words, had 0.6 million tons been removed from consumption, the average wholesale price would have been about W31,596 per bag instead of W28,211 per bag in 1978. A 36 percent rise in the wholesale price during a season implies a rise from W26,776 per bag at harvesttime to W37,283 at the end of the season. With a 10 percent difference between the wholesale price and the farm price to cover transport and processing, the price at harvesttime would be W24,098 per bag, which is the price received by farmers under normal weather with no imports and no government intervention. It is somewhat below the price of W25,140 farmers expected to receive when they planted their crop.
If an alternative assumption that the seasonal price rise is 20 percent rather than 36 percent is used, however, the estimated farm harvest price would be W25,851 per bag. If $\beta$ is equal to 0.5 instead of unity, then a 12 percent decrease in consumption availability would have caused a 24 percent rise in price. The average wholesale price would then be W28,211 × 1.24 = W34,982. The farm harvest price would be W26,681 per bag with a 36 percent seasonal price rise, and W28,622 with a 20 percent seasonal price rise. Other alternatives may be tried, but in general the price range of W24,098 to W28,622 appears fairly realistic. Taking the average and adjusting for one year's inflation (8 percent) gives W28,500 per bag which is the estimated self-sufficiency price for 1979–80.

The total value of rice marketed was 52 percent of production in 1977. Assuming the same percentage for the 1979–80 crop year implies about 3 million tons being marketed, or about W1.075 billion when valued at the self-sufficiency price. This value, intended to be applicable to the harvest in the fall of 1979 under normal conditions, is used throughout this chapter.

Since the price paid to farmers at harvest time has to be raised 14 percent above the self-sufficiency level, the required purchase price is about W32,450 per bag. This purchase price has the effect of reducing the seasonal average price in a normal year from W28,500 × 1.28 = W36,480 (point a in figure 9-2) to W32,450 × 1.1 = W35,695 (point b), or by W785 per bag.

To estimate government costs, the gross cost of each bag marketed can be written as $P_f + (0.10 + 0.18k)P_f = (1.10 + 0.18k)P_f$ or the farm purchase price $P_f$ plus 10 percent for transport and processing and 18 percent for seasonal storage cost estimated earlier for private storers. The factor $k$ is the ratio of government seasonal storage cost per bag to those of private storers. The net cost to the government is

$$C = [(1.10 + 0.18k)P_f - P_w]Q$$

where $P_w$ is the wholesale price and $Q$ is the quantity marketed.

Assume a constant elasticity farm supply curve $Q = c_s(P_f)^\eta$ and a constant elasticity demand curve $Q = c_d(P_w)^{-\delta}$. If the quantity marketed

2. Thus $k = 1$ if government and private costs are equal. If the private interest rate is 3 percent a month while the government interest rate is 1 percent a month (and noninterest costs of holding rice are 1 percent a month in both cases), $k$ will be 1/2.
is all sold domestically in the year harvested, the following relation between wholesale and farm price is obtained:

\[ P_w = (c/c_d)^{-\gamma}P_f^{-\gamma} \]

The ratio \( c/c_d \) may be found by noting that at point A, with self-sufficiency, \( P_f = P_f(s) \) and \( P_w = 1.28 P_f(s) \), which gives

\[ c/c_d = 1.28^{\gamma}P_f^{-\gamma} \]

Expressing program costs as a fraction of the value of crop under self-sufficiency \( V(s) = P_f(s)Q(s) \) (previously estimated to be \( W1,075 \) billion) gives

\[ C/V(s) = \frac{1}{P_f(s)} \left( (1.10 + 0.18k) (P/P_f(s)) - 1.28 \left[ P_f(s)^{1-\gamma} \right)^{(1.10 + 0.18k)} \right) \]

which holds for all values of \( P_f \) high enough to achieve complete seasonal price stabilization. Since with \( P_f \) just high enough to achieve complete seasonal stabilization, \( P_w = 1.10 P_f \), it can easily be shown that to achieve complete seasonal stabilization, the condition

\[ P/P_f(s) \geq (1.28/1.10)^{\gamma \beta + \beta} \]

must hold.

Equation (9.2) can be used to calculate program costs under complete seasonal stabilization through a purchase price of \( W32,450 \) per bag, since in this case \( P/P_f(s) = 1.14 \). If \( \gamma = 0.3 \) and \( \beta = 1 \), program costs will be about \( W255 \) billion for \( k = 1 \), and about \( W141 \) billion for \( k = 1/2 \).

**A W35,000 Purchase Price**

In this section a farm purchase price of \( W35,000 \) per bag—one higher than required for complete seasonal price stabilization—is considered. This farm purchase price is about 22.8 percent above the self-sufficiency price (see figure 6-2). With \( \gamma = 0.3 \), this results in a 6.84 percent increase in marketing. With \( \beta = 1 \), the wholesale price is reduced from \( W36,480 \) per bag at point a to \( W33,985 \) at point f in figure 6-2. With a purchase price of \( W35,000 \), neither seasonal costs nor transport and processing costs will be covered, and there is an additional loss of \( W1,015 \) on each bag marketed.

Program costs may be evaluated as before using equation (9.2). With \( \gamma = 0.3, \beta = 1, \) and \( P/P_f(s) = 1.228 \), government program costs are \( W422 \) billion for \( k = 1 \) and \( W295 \) billion for \( k = 1/2 \). The difference between \( W422 \) billion and \( W295 \) billion may be viewed as a transfer from savers who would have earned higher interest without government intervention to taxpayers if lower program costs lower taxes.
Program Cost of Exporting Rice

Program costs increase greatly as the farm purchase price is raised because the quantity purchased increases owing to supply response, while the sale of extra rice in the domestic market cannot increase revenue so long as the elasticity of demand is less than unity. If it is possible to sell extra rice in the international market, however, revenue can increase in the form of exchange earnings which will offset some rise in gross costs.

Suppose that once the farm price has been raised sufficiently for complete seasonal stabilization, the extra supplies from further rises in the farm purchase price are sold in the world market. Program costs are not changed in the case of the W32,450 purchase price, since it is just sufficient for complete seasonal stabilization. With a W35,000 purchase price (figure 6-2), the self-sufficient quantity is sold at the seasonal average wholesale price of W36,480, while net revenue per bag sold in the domestic market is only W28,500. The remainder of the rice \( Q_e \) is sold at the world market price \( P_e \).

It can be shown that allowing exports would almost certainly reduce program costs.

With exports, equation (9.1) is replaced by

\[
C = 1.10 P_e Q_e - (P_u - 0.18k P) Q_d - P_e Q_e,
\]

as the expression for program costs; the processing and transport cost of 10 percent is borne on all rice produced \( Q \), while seasonal storage costs equal to 0.18k percent of farm price are borne only by rice sold domestically \( Q_d = Q - Q_e \). Using constant elasticity supply and demand curves as before, after some manipulations we obtain the following expression for government costs as a fraction of farm harvest value under self-sufficiency:

\[
C/V^{50} = \left[ \frac{P}{P^{50}} \right] \left\{ (1.10 \frac{P}{P^{50}}) - (P_u/P^{50}) \right\} - \left[ \frac{P}{1.28 P^{50}} \right] \left\{ (P_u/P^{50}) - (0.18k P/P^{50}) - P_e/P^{50} \right\}.
\]

To predict government costs, one must have some idea of the relevant export price for Korea \( P_e \), for 1979-80. Table 2-8 is helpful in this regard. The f.o.b. export price of Thai rice 5 percent broken, shown in column (2), is often used as an indicator of world price. This has been converted into won per 80 kilograms in column (3), which may then be compared with the Korean wholesale price in column (6) of table 2-3. It is seen that the domestic price of Korea is consistently much higher than the Thai export price in all years. Thus the price Korea would face in the world market is likely to be lower than its domestic price. At an export price
of $300 per metric ton (or about W11,600 per 80 kilograms) for 1979–80, with adjustment for loading and other costs, and in view of the price premium for Thai rice in the world market because of high quality, it may be assumed that Korea cannot receive more than, say, W9,500 per 80 kilograms. This gives $P_i/P_i^0 = 9,500/28,500 = 1/3$, and this ratio would be lower if part of the export were concessional. Since $P_i/P_i^0 = 36,480/28,500 = 1.28$ and $P_i/P_i^0 = 1.228$, and if $\beta = 1$, $\gamma = 0.3$, and $V_0 = W1,075$ billion are substituted into (9.5), government program costs are found to be W384 billion for $k = 1$ and W265 billion if $k = 1/2$, compared with W422 billion and W295 billion respectively in the case of sales only in the domestic market. While there is a reduction in program costs, it is rather small. This is because, first, the costs of seasonal stabilization remain substantial, and second, unless there are unexpected changes in the international rice market, the price received by Korean exporters is likely to be lower than the domestic self-sufficiency price. A conceptually cheaper policy would be for Korea to export goods for which costs of production are at or below world prices. There may also be practical impediments to the export of extra rice when Korean consumers are paying a price much higher than the world price.

Partial Seasonal Price Stabilization

Figure 9-3 shows that in the absence of any stabilization the wholesale price rises continuously from harvesttime to the end of the season. With complete seasonal price stabilization, the wholesale price becomes totally flat throughout the year. The government has to be prepared to purchase the entire amount of urban consumption. From the end of the harvest season (time 0), prices begin rising at a rate determined by the cost of storage until time $t^*$ when government releases begin, after which the constant release price $P_r$ is maintained till the end of the crop year (time 1). This results in the kinked seasonal price pattern shown in figure 9-3. The quantity of stocks $Q'$ accumulated by the government (and released from $t^*$ to time 1) determines the degree of seasonal stabilization achievable. Before $t^*$ the price increase tends to reflect storage costs as stocks held by private storers, $Q''$, are being released. The level of the price pattern is such that the total consumption for the year adds up to the total amount of rice marketed. If prices at harvesttime are too low, for example, private storers will run out of stocks before government releases begin, and the price will jump. Private storers could make money by holding additional stocks and selling after the price jump. Their attempts to hold
more stocks, however, would bid up prices at harvesttime until the prospect of a price jump is eliminated.

To analyze these interdependencies, we begin by using the same demand function \( Q = aP_w^\beta \). Rice consumption during the period covered by government releases is

\[
Q' = \int_0^{t^*} aP_w^{-\lambda} dt = (1 - t^*)aP_w^{-\beta}
\]

where \( P_w^* \) is the flat release price. The remainder of the rice, \( Q'' \), is marketed out of private storage. When adjusted for transport and processing, the wholesale price begins rising from a point about 10 percent above farm harvest price at a rate equal to the cost of private storage \( c \). Consumption from time 0 to \( t^* \) is given by

\[
\int_0^{t^*} aP_w^{-\lambda} dt.
\]
Substituting $P_\omega$ and integrating, we get

$$Q^\prime = \frac{aP_f}{c} \left[ \frac{1}{1 - \beta} \right] (1.10)^{1-\beta} \left[ (1 + ct^*/1.10)^{1-\beta} - 1 \right] \quad \text{if } \beta \neq 1$$

and

$$Q'' = \frac{aP_f}{c} \ln (1 + ct^*/1.10) \quad \text{if } \beta = 1.$$

Note that both $Q'$ and $Q''$ depend on prices and, in particular, prices have to be such that $Q = Q' + Q''$. Prices would just rise to the level of the government release price at time $t^*$, or $P^*_f = 1.10 P_f + cP_f t^*$. Using these two conditions, we obtain, after some rearranging,

(9.6) \[ P_f = (aQ)^{1/\beta} K^{1/\beta} \cdot \frac{1}{1.10} \]

with

$$K_0 = (1 - t^*) (1 + ct^*/1.10)^{-\beta} + 1.10 [(1 + ct^*/1.10)^{1-\beta} - 1]/\alpha (1 - \beta) \quad \text{if } \beta \neq 1$$

and

$$K_1 = (1 - t^*) (1 + ct^*/1.10)^{-\beta} + 1.10 \ln [(1 + ct^*/1.10)]/c \quad \text{if } \beta = 1.$$

Substituting into the formula for $P^*_f$ and then into $Q'$ gives

$$P^*_f = (1 + ct^*/1.10) (aQ)^{1/\beta} K^{1/\beta}$$

and

$$Q' = (1 - t^*) (1 + ct^*/1.10)^{-\beta} (Q/K).$$

Since the price rise is proportional up to $t^*$, the time for government release, the seasonal stabilization objective may be expressed in terms of $t^*$. For instance, if the objective is to eliminate two-thirds of the seasonal price rise, the government must be in a position to make releases during the last two-thirds of the season, in which case $t^* = 1/3$. A measure of seasonal stabilization is provided by $(1 - t^*)$, since it is the fraction of seasonal price rise which is eliminated.

We now develop the expression for government cost $C$. The average length of time government rice is held in storage is $(t^* + 1)/2$, since the first stocks to be released are held for a length of time $t^*$, while the stocks released last are held for one complete time period. If $c$ is the private cost of holding stocks for one year as a fraction of the acquisition price, the cost of storage per bag for the government is, on average, $kP_f c(t^* + 1)/2$.

Adding 10 percent for transport and processing, subtracting the release
price $P^*_e$, and multiplying by the quantity stored by the government $Q'$ gives the net cost to the government as

$$C = \left\{ \left[ 1.10 + \frac{kc(t^*+1)}{2} \right] P_f - P^*_e \right\} Q',$$

which can then be expressed in terms of $t^*$, using the solution for $P_f$, $P^*_e$, and $Q'$ derived above. Expressed as a fraction of the value of marketings,

$$\frac{C}{P_f Q} = \left\{ \frac{kc}{2} \left( t^* + 1 - \frac{2t^*}{k} \right) \right\} \cdot \left\{ (1 - t^*) \left( 1 + \frac{ct^*}{1.10} \right)^{-\beta} / K \right\},$$

which replicates the results obtained earlier for complete stabilization in the special case where $t^* = 0$. The first bracketed expression represents net cost per bag as a fraction of farm harvest price. As $t^*$ is reduced, and thereby the degree of stabilization is increased, the average length of time of storage decreases (since government stocks are released earlier) and thus the $kc(t^*+1)/2$ component of costs tends to decrease. The seasonal rise in the wholesale price (given by $ct^*$) is reduced, however, which decreases the release price $P^*_e$ and increases net costs. This result more than offsets the first effect so that the first bracketed expression increases as $t^*$ is reduced. If $k = 1$, or government and private storage costs are the same, the first bracketed expression becomes $(c/2) (1 - t^*)$, and net costs per bag are proportional to the degree of seasonal stabilization.

The second bracketed expression is for $Q'/Q$, or government storage as a fraction of rice marketed. If the rate of consumption were unchanged throughout the season with no response to price, the amount of government storage needed for seasonal stabilization would be proportional to the period of government releases $1 - t^*$, which is in the first set of parentheses in the second pair of brackets. Then if $k = 1$, $\frac{C}{P_f Q} = (c/2) (1 - t^*),^4$ indicating costs increase with the square of the degree of stabilization. The second brackets also contain $(1 + ct^*/1.10)^{-\beta} / K$, which gives the additional storage needed because of price effects on consumption. As the degree of seasonal stabilization is increased, prices during the later part of the year are lowered in relation to those earlier in the year.

3. When $t^* = 0$, $K_o = K_i = 1$ and equation (9.8) reduces to $kc/2$. In the earlier analysis $c = 0.36$ for the case of complete stabilization, and the two alternative values $k = 1$ and $k = 1/2$ give 0.18 and 0.09 respectively as the ratio of government cost to the value of marketings. With $t^* = 1$, $\frac{C}{P_f Q} = 0$ since there is no stabilization and therefore no cost.

4. The range of the average length of storage $(t^* + 1)/2$ is from $1/2$ (when $t^* = 0$) to 1 (when $t^* = 1$). When $t^* = 0$, there is complete stabilization and stocks are held on the average for half a season. If $t^* = 1$, stocks held are not released during the season.
Figure 9-4.  Government Cost of Partial Seasonal Stabilization

This encourages consumption later in the year, thereby requiring more government storage.

In figure 9-4 the dotted straight line is a benchmark of proportionality. The dotted curve is \((c/2)(1-t^s)^2\) which shows how program costs as a fraction of the value of marketings would vary with the degree of stabilization, if there were no price effects. The solid curve takes into account these price effects and is drawn for the case \(k = 1, \beta = 1\). The shape of the curve suggests significant cost savings if partial rather than total stabilization is attempted. Since

\[
\frac{C}{P_j Q^*} = \left( \frac{C}{P_j Q} \right) \left( \frac{P_j Q}{P_j^0 Q^0} \right),
\]

we can rewrite equation (9.8) so that government cost is expressed as a fraction of \(V^0\), the crop value under self-sufficiency. Substituting \(Q = \)
bPf into the expression for Pf under partial stabilization and multiplying by Q, we get

$$Pf = b \left[ \left( \frac{aK}{b} \right)^{1/\gamma} \right]^{1+\gamma}.$$  

The value of rice marketed if there is no program $PfQ_{0}$ is simply $PfQ$ when $t^* = 1$. Then we finally have

$$\frac{PfQ}{PfQ_{0}} = \left[ \frac{K}{K_{0}} \right]^{1+\gamma \over \beta+\gamma},$$

where $K_{0}$ is the value of K when $t^* = 1$. Multiplying equation (9.8) by the above expression then gives

(9.9)  
$$\frac{C}{PfQ_{0}} = \left( \frac{k}{2} \right) \left( t^* + 1 - \frac{2t^*}{k} \right) \left( 1 - t^* \right) \times \left( 1 + \frac{ct^*}{1.10} \right)^{1-\beta \over \beta+\gamma} [K_{0}]^{1+\gamma \over \beta+\gamma},$$

which is the partial seasonal stabilization cost as a fraction of self-sufficiency value and may be compared with equation (9.2).

If a seasonal stabilization program is undertaken to eliminate half the seasonal price rise, then $t^* = 1/2$. Under the assumptions $\beta = 1$, $\gamma = 0.3$, $c = 0.36$, and $PfQ_{0} = W1,075$ billion, an application of equation (9.9) gives a program cost of W48 billion if $k = 1$ and -W24 billion if $k = 1/2$. The negative cost in the second case is because capital gains on the rice owing to seasonal price rise (which reflects private storage costs) exceed government storage costs, which by definition are lower. From (9.9) it can be seen that for $k = 1/2$, $(t^* + 1 - 2t^*/k)$ will be negative for $t^* > 1/3$. Thus the government will make a profit when a seasonal price rise of one third or more is allowed.\(^5\) Such profits, however, can be obtained only by a large amount of temporary government borrowing to finance the seasonal stocks. With $t^* = 1/2$, $PfP_{0} = [K/K_{0}]^{0.75}$, or eliminating half the seasonal price rise will raise the farm harvest price by 2.6 percent (from W28,500 to W29,240). This is consistent with the earlier conclusion that program costs rise much more than in proportion to the degree of seasonal stabilization.

In the previous example it was shown that there is a required purchase price for each degree of seasonal stabilization given by $t^*$. Alternatively, one might also want to look at the effect of alternative purchase prices on

\(^5\) With $k = 1$, seasonal stabilization in any degree must have positive net costs. The lower the value of $k$, the higher the degree of seasonal stabilization (lower $t^*$) which can be achieved without positive net costs.
costs when stabilization is less than complete. The general approach is as follows. For a certain purchase price first check whether equation (9.3) holds. If it does, then the purchase price is high enough for complete seasonal stabilization and equation (9.2) may be applied; if it does not, stabilization is incomplete and the following procedure may be adopted. Demand at the point of self-sufficiency is given by \( Q(s) = a(P(s) - P_f)^{-\beta} \) where \( P_f = 1.28P^{o}\). Solving for \( a \) gives \( a = Q(s) [1.28 P_f^{-\beta}] \). Since under partial seasonal stabilization \( P_f = a(Q)^{(10K^{(9\gamma)})}/10 \), substituting \( a \) into the expression for \( P_f \) and solving for \( K \) gives \( K = (10/1.28P_f)^{(10K^{(9\gamma)})} \). Thus for any \( P_f \) we can calculate the value of \( K \). Then, depending on the value of \( \beta \), the solutions of \( K_0 \) or \( K_1 \) may be used to find \( t^* \) iteratively by inserting alternative values of \( t^* \) into these solutions until the required value of \( K_0 \) or \( K_1 \) is obtained. Equation (9.9) may then be applied using this value of \( t^* \).

As an illustration, consider the purchase price of W29,780 per bag. The value of \( P_f / P^{o} = 1.045 \), which under the assumptions \( \beta = 1, \gamma = 0.3 \) gives \( K \) a value of 0.91. Using the solution of \( K_0 \) (since \( \beta = 1 \)) and iterating indicates the value of \( t^* \) is about 0.33. This is precisely the purchase price that gives zero net program cost if \( k = \frac{1}{2} \). If \( k = 1 \), net program costs are W91 billion.

Other purchase prices can be considered, and alternative supply and demand elasticity assumptions can be made. In general, program costs are higher if the elasticity of supply is higher, since supply response results in a greater quantity on which a loss has to be borne by the government. But program costs are higher if the elasticity of demand is lower, since the wholesale price at which rice can be sold is reduced more. Table 9-1 shows government program costs for purchase prices of W29,500, W32,450, and W35,000 with different assumptions about elasticities. The longer a price is maintained the higher these elasticities are likely to be. The self-sufficiency price \( P^{o} \) itself would increase or decrease over time, depending on whether demand or supply grows faster.

Effects of Changes in Seasonal Price Pattern on Consumer and Producer Welfare

For analyzing welfare, the benchmark is the situation without government seasonal stabilization, in which case the wholesale price \( P_w \) rises at harvesttime from a level 10 percent above the farm harvest price (to allow for transport and processing) at a rate determined by private costs of storage. This condition may be written in continuous compounding form as \( P_w = 1.10 P_f e^{\gamma} \), which replaces the earlier representation of this condition that expressed price as a linear function of time. As will be seen later this new form leads to easier evaluation of integrals.
Table 9-1. Korea: Government Program Costs under Alternative Rice Purchase Prices
(billion won)

<table>
<thead>
<tr>
<th>Farm harvest purchase price</th>
<th>Elasticity of demand (β)</th>
<th>0.5</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>(won per 80 kilograms)</td>
<td>0.1</td>
<td>0.3</td>
<td>1</td>
</tr>
<tr>
<td>Government and private storage costs are equal (k=1)</td>
<td>29,500</td>
<td>55</td>
<td>74</td>
</tr>
<tr>
<td>32,450</td>
<td>230</td>
<td>306</td>
<td>577</td>
</tr>
<tr>
<td>35,000</td>
<td>377</td>
<td>503</td>
<td>954</td>
</tr>
<tr>
<td>Government storage costs are half of private costs (k=1/2)</td>
<td>29,500</td>
<td>-21</td>
<td>-10</td>
</tr>
<tr>
<td>32,450</td>
<td>118</td>
<td>192</td>
<td>452</td>
</tr>
<tr>
<td>35,000</td>
<td>255</td>
<td>377</td>
<td>809</td>
</tr>
</tbody>
</table>

The rate of seasonal price increase \( r \) depends on storage costs. \( P_{w0} \), the wholesale price at the beginning of the season, is 1.10 \( P_f \). Without government seasonal stabilization, \( P_{w1} \), the wholesale price at the end of the season, will be higher than \( P_{w0} \) by 36 percent because of storage costs, or \( P_{w1} = P_{w0} + 0.36 P_f = 1.46 P_f \). This implies that the ratio of the ending to beginning price is

\[
P_{w1}/P_{w0} = e^r = 1.46/1.10 = 1.33.
\]

Taking natural logarithms on both sides gives \( r = \ln (1.33) = 0.285 \), which is the continuous compounding rate of price increase giving the same yearly price rise as the earlier cost of storage analysis.

Recall that the level of rice prices must be such that the entire amount of marketing is demanded, or

\[
Q = \int_0^T q \, dt
\]

where \( Q \) is the amount of marketings for the year and \( q \) is the rate of consumption at time \( t \) during the year. Substituting into the integral the demand relation \( q = cP_{w}^{-b} \) and the price rise condition \( P_{w} = 1.10 P_f e^r \), integrating and solving for \( P_f \) gives

\[
(9.10) \quad P_f = \frac{cP Q}{1.10} \left[ \frac{(1 - e^{-b})}{b^r} \right]^{\frac{1}{b}}.
\]
which is the farm harvest price expected in the absence of government seasonal price stabilization efforts. The wholesale price in this case is

\[ P_w = 1.10 P e^{rt} = e^{\theta Q - \frac{1}{\beta r} \left( \frac{1 - e^{-\beta r}}{\beta r} \right)^{1/\beta}}. \]

and substituting into \( q_t \) gives the rate of consumption during the year as

\[ q_t = Q \left( \frac{1 - e^{-\beta r}}{\beta r} \right)^{1/\beta}. \]

**Urban Consumer Well-Being**

In considering the effect of seasonal stabilization on the well-being of urban consumers, two measures may be used: changes in their expenditure on rice and changes in consumer surplus.

**CHANGE IN EXPENDITURE BY CONSUMERS.** While expenditure is not a fully adequate measure of welfare, it provides a starting point for the discussion. Total expenditures by consumers during the year are

\[ \int_0^1 P_w q_t dt. \]

Substituting the demand equation \( q_t = c P_w^{-\beta} \), the price rise condition \( P_w = 1.10 P e^{rt} \), and then the expression for \( P \) in equation (9.10) into the above expression gives, on integration, the value of consumer expenditure without seasonal stabilization as

\[ E = c d^B \left( \frac{e^{1 - \beta r} - 1}{(1 - \beta)r} \right) \left( \frac{\beta r}{1 - e^{-\beta r}} \right)^{1 - 1/\beta} \quad \text{if } \beta \neq 1 \]

\[ = c d \quad \text{if } \beta = 1. \]

Under complete seasonal stabilization, neither the rate of consumption nor the wholesale price varies throughout the year. Thus \( q_t \) is a constant and \( P_w = 1.10 P \) for all \( t \). Solving the demand equation \( Q = c P e^{rt} \) for \( P_w \) and multiplying by \( Q \) gives total expenditure with complete stabilization as

\[ E' = c d^B Q^{1 - 1/\beta}. \]

The ratio of consumer expenditure under complete seasonal stabilization to expenditure with no stabilization is
(9.13) \[ E'/E = \begin{cases} \frac{(1 - \beta)\rho}{e^{(1-\beta)\rho} - 1} \left[ \frac{1 - e^{-\rho}}{\beta r} \right]^{1-1/\beta} & \text{if } \beta \neq 1 \\ 1 & \text{if } \beta = 1. \end{cases} \]

(A prime is used in this section to denote values under seasonal stabilization.) As an illustration, if \( \beta = 0.5 \), substituting \( \rho = 0.285 \) into the above expression gives \( E'/E = 1.003 \).

In the above discussion, discounting is ignored. Because of high interest rates in Korea, the value of expenditure depends heavily on when it is made. The discounted value of expenditure by consumers during the crop year is

\[ \int_0^1 P \cdot q \cdot e^{-it} dt \]

where \( i \) is the compound interest rate. To find the discounted value of consumer expenditure in the absence of seasonal stabilization, we may substitute into the above integral the demand function, the price rise relation, and equation (9.12). The discounted value of consumer expenditure in the absence of stabilization \( E_d \) is found to be

(9.14) \[ E_d = c_i^\beta Q^{1-1/\beta} \left[ \frac{e^{(1-\beta)\rho - i} - 1}{(1 - \beta)\rho - i} \right] \left( \frac{\beta r}{1 - e^{-\rho}} \right)^{1-1/\beta}. \]

Under complete seasonal stabilization, neither \( P_w \) nor \( q_t \) varies during the year. Thus

\[ \int_0^1 P \cdot q \cdot e^{-it} dt = P \cdot q \int_0^1 e^{-it} dt. \]

Since under complete stabilization \( q_t = Q \) and \( P_w = (c_i/Q)^{1/\beta} \), on integration, discounted consumer expenditure under complete seasonal stabilization is found to be

(9.15) \[ E_s' = c_i^\beta Q^{1-1/\beta} \left( \frac{1 - e^{-i}}{i} \right). \]

The ratio of discounted consumer expenditure under complete seasonal stabilization to that in the absence of stabilization is

(9.16) \[ \frac{E_d}{E_s'} = \left[ \frac{1 - \rho}{\rho i} \right] \left( \frac{1 - \beta)\rho - i}{e^{(1-\beta)\rho - i} - 1} \right) \left[ \frac{1 - e^{-\rho}}{\beta r} \right]^{1-1/\beta}. \]

The value of \( \rho \) consistent with storage costs was found to be 0.285, while three-fourths of private storage costs are interest charges. The continuous compound interest rate which maintains this relation is \( i = 0.223 \).
If $\beta = 0.5$, applying equation (9.16) gives a ratio of 0.993. Note that the ratio $E'/E$ falls below one when discounting is introduced. If $\beta = 1$, then $E'/E = 1$, and discounted expenditure would not be affected by seasonal stabilization.

CHANGE IN CONSUMER SURPLUS. This section considers the effect of seasonal stabilization on consumer surplus, defined as what consumers would be willing to pay over what they actually pay.6

The wholesale price will rise seasonally in the absence of any stabilization program. The limits of price variation are $P_{w}^{0}$ and $P_{w}^{1}$ in figure 9-5. The stabilized price $P_{w}'$ is between $P_{w}^{0}$ and $P_{w}^{1}$ in the figure because with seasonal stabilization the price is higher (than without stabilization) early in the year owing to government purchases and lower later in the

6. Throughout this section, $p$ represents values along a curve, while $P$ denotes a particular value, with primes denoting values under seasonal stabilization. Thus, for example, $P_{w}'$ denotes the wholesale price in the absence of seasonal stabilization, while $P_{w}$ denotes the wholesale price under seasonal stabilization.
year owing to government releases. The implication is that stabilization results in a loss in consumer surplus early in the year and a gain in consumer surplus later in the year. Thus at time 1, the gain in consumer surplus is $MFGN$ since the wholesale price in the absence of stabilization would have been $P^{(0)}$. Whether there is a net gain or loss to consumers from seasonal stabilization depends on whether the integral of the discounted changes in consumer surplus over the year is positive or negative.

From figure 9-5 it can be seen that the change in consumer surplus as a result of the government program can be broken into two components. The first component (area $MFHN$), equal to $(P_w - P') q$, is the addition to or subtraction from consumer expenditure necessary to buy the original quantity for consumption owing to the change in price. The second component (area $FGH$) is the difference between what consumers would be willing to pay and what they actually pay for the change in consumption induced by the program. The change in consumer expenditure measured earlier may also be divided into two components. The fall in consumer expenditure when the wholesale price is lowered from $P^{(0)}$ to $P'$ is area $MFHN$ minus area $HGUW$. The first component is the same as the first component of the change in consumer surplus. The second component is the stabilized price $P'$ times the change in consumption induced by the program $q' - q$, and is therefore the change in consumer expenditure owing to a change in consumption. When the price is lowered from $P^{(0)}$ to $P'$, consumers pay less on the original quantity, but since they purchase more of the good, their expenditure on the good may increase or decrease depending on whether the elasticity of demand is greater or less than unity. The implication of a change in expenditure on consumer well-being is therefore ambiguous. Consumer surplus has the desirable feature that it will be increased if price is lowered by a government program and decreased if price is raised.

In the absence of seasonal price stabilization, consumer surplus is

$$CS = \int_0^{t'} (p_w - P_w) \, dq.$$  

With seasonal stabilization, consumer surplus is

$$CS' = \int_0^{t'} (p_w - P'_w) \, dq.$$  

The change in consumer surplus as a result of seasonal stabilization is

$$\Delta CS = CS' - CS = \int_0^{t'} p_w dq - (P'_w q' - P_w q).$$
where the term inside parentheses is simply the change in consumer expenditure, and the first term is the value placed by consumers on the induced change in consumption. The solution for \( p_\omega \) in the demand relation \( q = c_\omega p_\omega^{-\beta} \) and formulas for \( P'_\omega, q'_\omega, P'_w, \) and \( q'_w, \) may be inserted into the expression for \( CS' - CS. \) In the absence of stabilization, prices and consumption are given by (9.11) and (9.12). With complete seasonal stabilization, \( q'_\omega = c_\omega P'_\omega^{-\beta}, \) giving \( P'_\omega = (c_\omega q'_\omega)^{1/\beta} \) where \( P'_\omega \) and \( q'_\omega = Q \) are constants. Using these values in the expression for \( \Delta CS \) gives

\[
\Delta CS = CS' - CS = \frac{c_\omega^\beta Q'^{1-1/\beta}}{\beta - 1} \left\{ 1 - \frac{(1 - e^{-\beta \rho})}{\beta r} \right\}^{1-1/\beta} e^{(1-\beta \rho) r}, \quad \beta \neq 1
\]

and

\[
= c_\omega \left\{ \ln \left( \frac{1 - e^{-\beta \rho}}{\beta r} \right) + \beta \rho t \right\}, \quad \beta = 1.
\]

The change in discounted consumer surplus for the year is

\[
\int_0^1 \Delta CSe^{-\rho t} dt.
\]

On evaluation, it is found that for \( \beta \neq 1, \)

\[
(9.17) \quad \Delta CS_{\delta} = CS'_\delta - CS_{\delta} = \frac{c_\omega^\beta Q'^{1-1/\beta}}{\beta - 1} \left\{ 1 - \frac{e^{-\beta \rho}}{i} - \frac{(1 - e^{-\beta \rho})}{\beta r} \right\}^{1-1/\beta} e^{(1-\beta \rho) r - i} - \frac{1}{i}.
\]

where \( CS'_\delta \) denotes discounted consumer surplus. Dividing by \( E_{\delta}, \) the discounted consumer expenditure in the absence of seasonal stabilization as given by (9.14), the result for \( \beta \neq 1 \) is:

\[
(9.18) \quad \frac{\Delta CS_{\delta}}{E_{\delta}} = \frac{c_\omega^\beta Q'^{1-1/\beta}}{\beta - 1} \left\{ \frac{1 - e^{-\beta \rho}}{\beta r} \right\}^{1-1/\beta} \left\{ \frac{1 - e^{-\beta \rho}}{\beta r} - 1 \right\}.
\]

For \( \beta = 1, \) the change in discounted consumer surplus is

\[
(9.19) \quad \Delta CS_{\delta} = CS'_\delta - CS_{\delta} = \frac{c_\omega}{i} \left\{ \ln \left( \frac{1 - e^{-r}}{r} \right) [1 - e^{-i}] + \frac{rc_{\delta}}{i} \right\} \left[ 1 - e^{-i(1+i)} \right].
\]
The above expression is then divided by discounted expenditure in the absence of stabilization shown in equation (9.14); since with β = 1, \( E_d = e_d [(1 - e^{-\gamma t})] \), on division

\[
\frac{\Delta CS_d}{E_d} = \frac{r}{i} \left[ \frac{1 - (1 + i)e^{-r}}{1 - e^{-r}} \right] + \ln \left[ \frac{1 - e^{-r}}{r} \right] \quad \text{for } \beta = 1,
\]

which shows the ratio of the change in discounted consumer surplus resulting from seasonal stabilization to discounted consumer expenditure in the absence of stabilization when \( \beta = 1 \). With \( r = 0.285 \) and \( i = 0.223 \), the above formula gives \( \Delta CS_d/E_d = -0.010 \).

To make (9.20) comparable with earlier formulas, the change in discounted surplus \( \Delta CS_p \) should be expressed as a fraction of farm harvest value under self-sufficiency and no government intervention \( V^0 = P_0^0 Q^0 \). Multiplying (9.10) by \( Q \) and setting \( \beta = 1 \) gives farm harvest value in the absence of seasonal stabilization effort as

\[
P_0^0 Q = \frac{e_d}{1.10} \left( \frac{1 - e^{-r}}{r} \right) \quad \text{for } \beta = 1.
\]

The ratio of discounted expenditure in the absence of stabilization to farm harvest value in the absence of government program is

\[
E_d/P_0 Q = 1.10 [(1 - e^{-r}/i)/(1 - e^{-\gamma r})] \quad \text{for } \beta = 1.
\]

For \( r = 0.285 \) and \( i = 0.222 \), the ratio is 1.13. Using the earlier estimate of the farm harvest value in the absence of seasonal stabilization \( (P_0 Q) \) of W1,075 billion, the discounted change in consumer surplus as a result of seasonal price stabilization (with elasticity of demand equal to unity) is \((-0.010 \times 1.13 \times 1,075) = -W12.15 \) billion.

**Farm Income and Government Cost**

The effects of seasonal stabilization on income redistribution and resource allocation are now considered more fully, bringing together estimates of effects on producer and consumer welfare and government cost.

**PRODUCER SURPLUS.** Since the effects of seasonal stabilization on yearly marketings have already been considered under the discussion on changes in average prices, in considering the change in producer surplus resulting from changes in the seasonal price pattern, we need examine only the change in the farm harvest value for a given quantity of marketing. Discounting is not necessary in this case since income of farmers as rice marketers is received at time 0 (harvesttime). If farmers market their crop later, they are in effect acting as storers, and income received from this source is of no concern here.
With complete seasonal stabilization, \( P' = 1.10 P' \), or the farm harvest price is 1/1.10 times the stable wholesale price \( P' \) for the year. Thus, farm income (valued at the farm level) \( F' \) is 1/1.10 times the value of consumer wholesale expenditure \( E' \), or

\[
F' = P' Q \frac{1}{1.10} = \frac{1}{1.10} \left( e^{\beta Q} - 1 \right)^{1/b}.
\]

Farm harvest value without seasonal stabilization \( F \) is obtained by multiplying \( P_f \) as given by (9.10) by \( Q \), giving

\[
F = P_f Q = e^{\beta Q} \left( \frac{1 - e^{-br}}{br} \right)^{1/b}.
\]

Change in producer surplus owing to complete seasonal stabilization as a fraction of farm harvest value without stabilization is

\[
\frac{F' - F}{F} = \left( \frac{1 - e^{-br}}{br} \right)^{1/b} - 1.
\]

For \( \beta = 1 \) and \( r = 0.285 \), the value of this expression is 0.14. The money estimate of the change in producer surplus owing to complete stabilization is 0.14 \( \times \) 1,075 = \( \text{W}150.5 \) billion.

GOVERNMENT COST. The present value of government costs can now be estimated, on the assumption of continuous compounding. With complete seasonal stabilization, government outlay at harvesttime is equal to the entire value of rice to be marketed plus 10 percent for transport and processing, or

\[
1.10 F'' = e^{\beta Q} Q^{1 - 1/b}.
\]

To obtain net program costs, discounted value of storage costs must be added and discounted revenue from sales subtracted from the above expression. In this section, all outlays and revenues are discounted to the same point in time, namely harvesttime 0. As a result, interest is not charged as part of storage costs.\(^7\) The noninterest component of storage costs (which includes payment for warehouse space and losses during storage) as a fraction of the value of rice in storage is \( r - i \), where \( r \) is the storage cost (including interest) and \( i \) is the interest rate component. Under seasonal stabilization, the rate of consumption throughout the year is constant, and thus the amount remaining in storage at any point in time \( t \) is \( Q(1 - i) \). The present value of storage cost for the year is therefore

\[7\] The procedure of not charging interest might be thought to yield lower estimated costs, but it does not because the revenue from the sale of stocks has to be discounted back to harvesttime.
where, \( P_i Q = F' \) is the farm harvest value with complete seasonal stabilization and equal to
\[
\frac{1}{1.10} c^{1/\beta} Q^{1-1/\beta}.
\]
Evaluating the above integral gives discounted storage costs as
\[
(9.24) \quad c^{1/\beta} Q^{1-1/\beta} \left( \frac{r}{i} - 1 \right) \cdot \left\{ \frac{1}{i} \left[ 1 - \left(\frac{1}{i} e^{-i t}\right) \right] \right\}.
\]
The discounted revenue from sales is
\[
\int_0^1 P_w Q e^{-i t} dt
\]
where \( P_w \) is the wholesale price with seasonal stabilization and equal to \( c^{1/\beta} Q^{1-1/\beta} \). On evaluation the integral is found to be
\[
(9.25) \quad c^{1/\beta} Q^{1-1/\beta} \left[ \frac{1 - e^{-i t}}{i} \right].
\]
The net cost to the government is government outlay in (9.23) plus discounted storage costs in (9.24) minus discounted sales revenue in (9.25). This may be expressed as a ratio of farm harvest value in the absence of seasonal stabilization
\[
P_f Q = \frac{c^{1/\beta} Q^{1-1/\beta}}{1.10} \left[ \frac{(1 - e^{-\beta r})}{\beta r} \right]^{1/\beta}
\]
where \( P_f \) is from (9.10). The resulting expression (for \( \beta = 1 \)) is
\[
(9.26) \quad \frac{r}{i} \left[ 1 - \left(\frac{1}{i} e^{-i t}\right) \right] \left( \frac{0.10 i + r}{1 - e^{-i t}} \right) \quad \text{for} \quad \beta = 1.
\]
Substituting \( r = 0.285 \) and \( i = 0.222 \) gives a value of 0.154. For the farm harvest value in the absence of stabilization of W1.075 billion, the money cost estimate is W165.55 billion.

Summary and Conclusions

This chapter developed a seasonal price stabilization model for rice in Korea and examined how government cost is affected by varying degrees of stabilization. The self-sufficiency price of rice for Korea, defined as the
price which would prevail in a normal year in the absence of trade and government program, was taken to be W28,500 per bag in 1979-80. Given elasticities of demand and marketed supply, it was estimated that a government purchase price of W32,450 per bag would just be sufficient for complete stabilization, in which case government program costs would be about W255 billion. With a purchase price of W35,000 per bag, which is about 8 percent higher than that required for complete stabilization, government program costs would be W422 billion. This chapter also examined cases in which extra supplies can be sold in the international market after complete seasonal stabilization has been achieved. With the same purchase price of W35,000, government program costs would be W384 billion, or about 10 percent lower. The reduction in program cost from exporting extra rice is fairly small, partly because the world price of rice is below that in Korea. The above estimates of government costs assume that government and private costs of storage are equal.

Cases in which some seasonal rise in price is allowed were then considered. An important result was that program costs rise much more than in proportion to the degree of seasonal stabilization. There could thus be substantial savings in program costs if partial, rather than complete, seasonal stabilization were attempted. If government and private costs of storage are equal, any degree of seasonal price stabilization involves net costs. But if the government cost of storage is lower than the private, cost is reduced, and profits can even be generated under partial seasonal stabilization. As an illustration, if the government cost of storage is half that of private, net program costs are zero if the government removes two-thirds of the seasonal price rise. This requires a government purchase price of W29,780 per bag. A profit can be obtained if a seasonal price rise of more than two-thirds is allowed. Other examples can be found in table 9-1.

We have also examined the effects of changes in the seasonal price pattern on producer and consumer welfare and government cost. Estimates of these effects have been discounted back to harvesttime for comparison. Under the elasticity assumptions, complete seasonal stabilization, through affecting the seasonal price pattern, reduces discounted consumer surplus by W12.15 billion and increases discounted producer surplus by W150.5 billion. Discounted government net costs, defined as initial government outlay plus discounted storage cost less discounted sales revenue, increase by W165.5 billion.

8. \( \beta = 1, \gamma = 0.3 \).
Analyzing Programs with Interrelated Commodities

This chapter illustrates how government program costs in various agricultural subsectors are affected by a change in policy in one of them. Market dependence among commodities in production and consumption is taken into account, as well as input-output relations. The aim is to identify the main sources of government intervention and then to quantify both the direct effect and the most important induced effects. As mentioned in chapter 5, in quantifying the direct effect it is assumed that the quantities handled by the government are unaffected by price policy changes. Thus any proposed change in price or subsidy may be multiplied by the existing quantity to predict the change in government costs. Such a simple method of prediction will be in error, however, because the indirect or induced effects of government policy are not taken into account. First, the quantities supplied and demanded of the commodity will almost certainly change when its price is affected by government policy, and the result will be further changes in government costs. Second, the prices and quantities supplied and demanded of other commodities can be affected either through market dependence or input-output relations, and government program costs in these commodities will be affected if they are originally taxed or subsidized. If they are not, changes in prices in these markets might still rebound on the original sector and induce further changes in government costs.

It was also argued in chapter 5 that it may not be practical to use large-scale econometric models to take account of all these induced effects because such models require estimates of literally hundreds of coefficients, and they are based on often unreliable and scanty data in developing countries. Moreover, if a very complicated solution is required and the mechanism implied by the model is imperfectly understood, it would be
difficult to explain why certain results are obtained. The predictions of such models regarding the effects of policy changes would be reliable only if their underlying assumptions are valid or if their fundamental relations are correctly specified.

The present approach attempts to avoid these extremes. It tries to isolate and quantify major direct and induced effects of government programs without becoming hopelessly lost in details. First, to keep the analysis simple, inputs and outputs which are essentially similar are aggregated. Second, attention is narrowed to those commodities in which government interventions are significant. The expressions for government costs for these commodities are then written down, and the effects on program costs of government changes in prices or subsidies are examined. In each case the change in cost is divided into the direct effect and various indirect and induced effects.

The grain and livestock sector of Venezuela is used to illustrate the approach. Attention is focused on government costs; the effects of programs on producer and consumer surpluses are ignored. The concept of cost of government program is more readily understood and of particular concern to decisionmakers because it indicates how costly it is to pursue a certain policy.

In chapter 5 milk subsidies and the feed program were identified as the chief forms of government intervention in Venezuelan agriculture. The effects of various policy changes on government costs are examined here by means of simple mathematical models, and the importance of interdependencies among commodities in affecting program outcomes is indicated. (See chapter 5 for a nontechnical description of the changes in program costs predicted by the mathematical models and for a detailed description of government policies in the grain and livestock sector.)

A Milk Model

Milk subsidies represent the single largest component of government program costs in Venezuela. The price of powdered milk is held down for consumers and supported for domestic producers, the difference being the domestic subsidy. There is also an import subsidy on powdered milk. The world price of powdered milk is assumed to be given. With perfect substitutability in consumption, the prices to consumers of both imported and domestically produced powdered milk would both be equal to the world price minus the import subsidy. Thus a domestic subsidy on powdered milk greater than the import subsidy implies that the producer price is supported above the world price. Fluid milk is not imported, and its
domestic price is not controlled. Since a subsidy on fluid milk is now under debate, it is included in the model for analytical purposes. Fluid milk and powdered milk are of course close substitutes in both production and consumption.

The model consists of four equations. The supply of powdered milk is

\[ Q_p = C_p \left[ (P_w - S_p) + (P_F + S_F) \right] \]

where \( Q_p \) is the domestic production of powdered milk, \( P_w \) is the world price of powdered milk including cost of bringing it to the retail outlet, \( P_F \) is the retail price of fluid milk, \( S_p \) is the import subsidy on powdered milk, \( S_F \) is the domestic subsidy on powdered milk, and \( S_F \) is the domestic subsidy on fluid milk. Under our assumptions \((P_w - S_p + S_F)\) and \((P_F + S_F)\) are respectively prices received by the producer for powdered milk and for fluid milk. The demand for powdered milk \( B_p \) is met by domestic production \( Q_p \) and import \( I_p \), or

\[ Q_p + I_p = B_p \left[ (P_w - S_p), P_F \right] \]

and \( B_p \) depends on the prices of powdered milk and fluid milk facing the consumer, \((P_w - S_p)\) and \( P_F \).

Similarly, the quantity supplied of fluid milk \( Q_F \) is

\[ Q_F = C_F \left[ (P_w - S_p) + (P_F + S_F) \right] \]

and the quantity of fluid milk demanded, met entirely from domestic production, is

\[ Q_F = B_F \left[ (P_w - S_p), P_F \right] \]

the exogenous or policy variables are \( P_w, S_p, S_F \), and \( S_F \), and the endogenous variables are \( Q_p, I_p, Q_F, \) and \( P_F \).

The cost of milk program \( C \) is the sum of domestic subsidy payments on fluid milk and powdered milk and import subsidy payments on powdered milk, or

\[ C = Q_p S_F + Q_F S_F + I_p S_F \]

To examine the effects of changing various subsidies on government program costs, we take the total differential of equations (10.1) to (10.4):
where \( C_y \) and \( B_y \) are respectively partial derivatives of the quantity supplied and demanded of commodity \( i \) with respect to the price of \( j \) (with \( i, j = F, P \) where \( F \) is fluid milk and \( P \) is powdered milk). The basic determinant of the system is \( C_{FF} - B_{FF} \).

**Change in Subsidy on Fluid Milk (\( S_F \))**

For a change in \( S_F \) with \( S_P \) and \( S_I \) constant, the change in program cost is

\[
\frac{dC}{dS_F} = S_F \frac{dQ_F}{dS_F} + S_I \frac{dI_F}{dS_F} + S_P \frac{dQ_P}{dS_F} + Q_F.
\]

Setting \( dP_F = dS_I = dS_P = 0 \) in (10.6) and taking total derivatives with respect to \( S_F \) give

\[
\begin{align*}
\frac{dQ_P}{dS_F} &= C_{PF} \frac{dP_F}{dS_F} + C_{PF} - \frac{C_{PF}C_{FF}}{C_{FF} - B_{FF}} \\
\frac{dI_F}{dS_F} &= 0 - \left( C_{PF} + C_{PF} \frac{dP_F}{dS_F} \right) \\
&+ B_{PF} \frac{dP_F}{dS_F} = 0 - \left( C_{PF} - \frac{C_{PF}C_{FF}}{C_{FF} - B_{FF}} \right) - \frac{B_{PF}C_{FF}}{C_{FF} - B_{FF}}
\end{align*}
\]

1. In this chapter \( C_i \) represents the supply function of commodity \( i \), and \( B_i \) represents the total demand (including imports) for commodity \( i \). \( C_i \) is the partial derivative of the supply of commodity \( i \) with respect to the price of commodity \( j \), and similarly \( B_i \) is the partial derivative of the total demand for \( i \) with respect to the price of \( j \). The corresponding supply and demand elasticities are

\[
\gamma_i = C_i \frac{P_i}{Q_i} \quad \text{and} \quad \beta_i = B_i \frac{P_i}{Q_i} = B_j \frac{P_j}{Q_j} + I_i
\]

For convenience, supply and demand elasticities are defined with respect to the same prices.
ANALYSIS OF POLICY OPTIONS

\[ \frac{dQ_p}{dS_p} = C_{pp} \frac{dP_p}{dS_p} + C_{pf} = C_{ff} - \frac{C_{pp}C_{fp}}{C_{ff} - B_{ff}}, \]

since \[ \frac{dP_p}{dS_p} = \frac{-C_{pp}}{C_{ff} - B_{ff}} \]

Substituting (10.8) into (10.7) and converting into elasticities\(^2\) give, after some manipulation,

\[ \frac{dC}{dS_F} = \frac{S_F S_Q}{P_F C} \left( \gamma_{FP} - \frac{\gamma_{FP} \beta_{FP}}{\gamma_{FF} - \beta_{FF}} \right) + 0 \]

\[ - \frac{S_F S_Q}{P_F C} \left( \gamma_{FP} - \frac{\gamma_{FP} \beta_{FP}}{\gamma_{FF} - \beta_{FF}} \right) \]

\[ - \frac{S_F S_Q (Q_F + I_F)}{P_F C} \frac{\beta_{FP} \gamma_{FP}}{\gamma_{FF} - \beta_{FF}} \]

\[ + \frac{S_F S_Q}{P_F C} \left( \gamma_{FP} - \frac{\gamma_{FP} \beta_{FP}}{\gamma_{FF} - \beta_{FF}} \right) + \frac{S_Q Q_F}{C} , \]

which may be broken down into the direct effect and various indirect effects, as shown in column (1) of table 10-1.

Change in Domestic Subsidy on Powdered Milk (\(S_p\))

For a change in \(S_p\) with \(S_F\) and \(S_I\) constant, the change in program cost is

\[ \frac{dC}{dS_F} = S_p \frac{dQ_F}{dS_p} + S_f \frac{dI_F}{dS_p} + S_F \frac{dQ_F}{dS_p} + Q_p. \]

Setting \(dP_W = dS_I = dS_F = 0\) in (10.6) and taking total derivatives with respect to \(S_p\) noting \(dP_p/dS_p = -C_{fp}/(C_{ff} - B_{ff})\) give

\[ \frac{dQ_F}{dS_p} = C_{fp} - \frac{C_{pp} C_{fp}}{C_{ff} - B_{ff}} \]

\[ \frac{dI_F}{dS_p} = 0 - \left( C_{fp} - \frac{C_{pp} C_{fp}}{C_{ff} - B_{ff}} \right) - \frac{B_{pp} C_{fp}}{C_{ff} - B_{ff}} \]

\[ \frac{dQ_F}{dS_p} = C_{fp} - \frac{C_{pp} C_{fp}}{C_{ff} - B_{ff}}. \]

Substituting (10.11) into (10.10) and converting to elasticities give

2. See the note to table 10-1 for full definitions of elasticities; see also note 1 above.
\[ \frac{dC}{dS_p} = \frac{S_p S_t Q_{pF}}{P_p C} \gamma_{pp} - \frac{S_p S_t Q_{pF}}{P_p C} \gamma_{FF} \beta - \frac{S_p S_t Q_{pF}}{P_p C} \beta_{FF}^p + 0 \]

\[ = \frac{S_p S_t Q_{pF}}{P_p C} \left( \gamma_{pp} - \frac{\gamma_{FF} \beta_{FF}}{\gamma_{FF} - \beta_{FF}} \right) \]

\[ - \frac{S_p S_t Q_{pF}}{P_p C} \beta_{FF}^p \]

\[ + \frac{S_p S_t Q_{pF}}{P_p C} \left( \gamma_{FF} - \beta_{FF} \right) \]

\[ + \frac{S_p S_t Q_{pF}}{P_p C} \left( \gamma_{FF} - \beta_{FF} \right) \]

which has been broken down into component effects in column (2) of table 10-1.

**Change in Import Subsidy on Powdered Milk (S)**

For a change in \( S_t \) with \( S_p \) and \( S_p \) constant, the change in program cost is

\[ \frac{dC}{dS_t} = \frac{S_p dQ_{pF}}{dS_t} \gamma_{pp} + \frac{S_t dQ_{pF}}{dS_t} \gamma_{FF} \beta_{FF} + \frac{dI_p}{dS_t} \]

Setting \( dP_w = dS_p = dS_t = 0 \) in (10.6) and taking total derivatives with respect to \( S_t \) (with \( dP_w/dS_t = [C_{FF} - B_{FF}] \) give

\[ \frac{dP_w}{dS_t} = -C_{pp} \left( C_{FF} - B_{FF} \right) \]

\[ \frac{dI_p}{dS_t} = -B_{pp} \left( C_{pp} - C_{FF} - B_{FF} \right) \]

\[ \frac{dQ_{pF}}{dS_t} = -C_{pp} \left( C_{FF} - B_{FF} \right) \]

Substituting into (10.13) and converting to elasticities give

\[ \frac{dC}{dS_t} = \frac{S_p S_t Q_{pF}}{P_p C} \left( \gamma_{pp} - \frac{\gamma_{FF} \beta_{FF}}{\gamma_{FF} - \beta_{FF}} \right) \]

\[ - \frac{S_p S_t Q_{pF}}{P_p C} \beta_{FF}^p \]

\[ + \frac{S_p S_t Q_{pF}}{P_p C} \left( \gamma_{FF} - \beta_{FF} \right) \]

\[ + \frac{S_p S_t Q_{pF}}{P_p C} \left( \gamma_{FF} - \beta_{FF} \right) \]
Table 10-1. Venezuela: Percentage Change in Cost of Milk Program from 1 Percent Change in Milk Subsidy

<table>
<thead>
<tr>
<th>Effect</th>
<th>Subsidy on fluid milk ($S_F$)</th>
<th>Subsidy on domestic powdered milk ($S_P$)</th>
<th>Import subsidy on powdered milk ($S_I$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Change in powdered milk subsidy costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct effect (increase in cost on existing level of powdered milk production)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-S_F Q_F$</td>
<td>$S_F Q_F$</td>
<td>$-S_I Q_I$</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Changes in payments owing to change in powdered milk production induced by</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in producer price of powdered milk</td>
<td>$S_F \frac{S_F Q_F}{P_F}$</td>
<td>$-S_F \frac{S_F Q_F}{P_F}$</td>
<td>$S_I \frac{S_I Q_I}{P_I}$</td>
</tr>
<tr>
<td>Change in producer price of fluid milk</td>
<td>$\gamma_F \left( \frac{\gamma_F}{\gamma_P} - \beta_F \right)$</td>
<td>$-\gamma_F \left( \frac{\gamma_F}{\gamma_P} - \beta_F \right)$</td>
<td>$S_I \frac{S_I Q_I}{P_I}$</td>
</tr>
<tr>
<td>Change in import subsidy costs</td>
<td>$S_F S_F Q_F \left( \gamma_F \frac{\gamma_F}{\gamma_P} - \beta_F \right)$</td>
<td>$-S_F S_F Q_F \left( \gamma_F \frac{\gamma_F}{\gamma_P} - \beta_F \right)$</td>
<td>$S_I \frac{S_I Q_I}{P_I} \gamma_F (\gamma_F - \beta_F)$</td>
</tr>
<tr>
<td>Change in payments owing to change in consumption of powdered milk induced by</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in consumer price of powdered milk</td>
<td>$S_F S_F Q_F + L_I$</td>
<td>$-S_F S_F Q_F + L_I$</td>
<td>$S_I S_I Q_I + L_I$</td>
</tr>
<tr>
<td></td>
<td>$\frac{P_F}{C}$</td>
<td>$\frac{P_F}{C}$</td>
<td>$\frac{P_I}{C}$</td>
</tr>
<tr>
<td></td>
<td>$0$</td>
<td>$0$</td>
<td>$0$</td>
</tr>
</tbody>
</table>

Percentage change in cost of milk program from 1 percent change to subsidy.
| Change in consumer price of fluid milk | - \frac{\partial}{\partial P_F} \left( P_F C \right) \frac{\partial}{\partial P_F} | -0.0002307 | \frac{\partial}{\partial P_F} \left( P_F C \right) \frac{\partial}{\partial P_F} | 0.003496 | \frac{\partial}{\partial P_F} \left( P_F C \right) \frac{\partial}{\partial P_F} | -0.006118 |
| Change in payments owing to changes in powdered milk production induced by | | | | | | |
| Change in producer price of powdered milk | | | | | | |
| Change in producer price of fluid milk | | | | | | |
| Change in fluid milk subsidy costs | | | | | | |
| Direct effect (increase in cost on existing level of fluid milk production) | \frac{S_F Q_F}{C} | 0.06 | - | - | - | - |
| Change in payments owing to change in fluid milk production induced by | | | | | | |
| Change in producer price of powdered milk | | | | | | |
| Change in producer price of fluid milk | | | | | | |

**Note:** The following supply and demand elasticities are assumed: \( \gamma_{PF} \) (elasticity of supply of powdered milk) = 2; \( \gamma_{FP} \) (cross-elasticity of supply of powdered milk with respect to the price of fluid milk) = -0.1; \( \gamma_{PP} \) (elasticity of supply of fluid milk) = 0.1; \( \gamma_{FP} \) (elasticity of demand for powdered milk) = -0.5; \( \beta_{PF} \) (cross-elasticity of demand for fluid milk with respect to the price of powdered milk) = 0.25; and \( \beta_{PP} \) (elasticity of demand for fluid milk) = -1. The following subsidy-price ratios are used: \( S_F/P_F = 0.5 \) and \( S_F/P_F = 0.25 \) for powdered milk, and \( S_F/P_F = 0.033 \) for fluid milk. The ratios of milk subsidy payments to milk program costs are: \( S_F Q_F/C = 0.78 \), \( S_F Q_F/C = 0.16 \), and \( S_F Q_F/C = 0.06 \). The ratio of powdered milk import to total consumption, \( I_P/(P_F + Q_P) \), is taken to be 0.52.
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\[- \frac{S_f}{P_f} \frac{Q_F}{C} \gamma_{FF} + \frac{S_f}{P_f} \frac{Q_F}{C} (\gamma_{FF} - \beta_{FF}) + \frac{S_f}{C},\]

which has been broken down into component effects in column (3) of table 10-1.

Direct and Indirect Effects of Milk Subsidy Changes

In table 10-1 a numerical example has been given along with the algebraic expressions, based on assumptions listed in the note to the table. The various elasticities are based on previous professional studies or judgment of experts, while the other magnitudes are chosen to approximate the actual situation in Venezuela.3

The features of the milk program in Venezuela are illustrated in figure 10-1. The market for powdered milk is shown in the upper diagram. \(S_p\) is the domestic supply curve of powdered milk and \(D_p\) is the demand curve for powdered milk. The world price of powdered milk \(P_w\) is assumed to be given. With import subsidy \(S_f\), the price facing Venezuelan consumers is \(P_w - S_f\). At this price, consumption will be \(Q_{B1}\), and in the absence of any production subsidy, only \(Q_{F1}\) would be produced and therefore \(B_{P1} - Q_{F1}\) would have to be imported. There is, however, also a production subsidy \(S_p\), and the price received by domestic producers of powdered milk is \((P_w - S_f + S_p)\), which would be higher than the world price \(P_w\) if \(S_p > S_f\). With the production subsidy, \(Q_{P1}\) will be produced and imports will be \(I_{P1} = B_{P1} - Q_{P1}\). The program cost on powdered milk is given by area \(\text{Ifgm}\) plus area \(\text{ibcg}\), the former being the domestic subsidy cost and the latter being the import subsidy cost.

The market for fluid milk is shown in the lower diagram. In the absence of any government intervention, the market price is given by the intersection between the supply curve of fluid milk \(S_F\) and the demand curve for fluid milk \(D_F\). The domestic subsidy \(S_F\) lowers the consumer price to \(P_{F1}\) and raises the producer price to \(P_{F1} + S_F\). As there is no import of fluid milk, the market clears internally, and both domestic production and domestic consumption are \(Q_{F1}\). The domestic subsidy cost on fluid milk is area \(\text{ABCD}\).

Change in Subsidy on Fluid Milk (\(S_F\))

Suppose the subsidy on fluid milk is raised from \(S_F\) to \(S'_F\) in the lower diagram of figure 10-1. To be specific, suppose the subsidy on fluid milk

3. For illustration, a subsidy on fluid milk of 3.3 percent has been assumed, though there is no subsidy on fluid milk at present.
Figure 10-1. Effect of a Change in Subsidy on Fluid Milk ($S_f$) on Milk Program Cost

is doubled so that $S'_f = 2S_f$ (not drawn to scale). The price of fluid milk to consumers is lowered further to $P_{F2}$ while the price received by producers is raised further to $P_{F2} + S'_f$. Fluid milk program costs are now area $EGHJ$. The direct effect on program cost, which assumes that the quantity of fluid milk handled by the government does not change, is given by area $EFBA + DCIJ$. Because of the increase in price to fluid milk producers, however, the quantity of fluid milk supplied increases from $Q_{F1}$ to $Q_{F2}$, with an additional cost of area $FGHI$. As shown in column (1) of table 10-1, a doubling of the subsidy on fluid milk has a direct effect
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on program cost of 6 percent, while supply response by fluid milk producers adds a further 0.018 percent. There are also cross-elasticity effects. A lower price of fluid milk to consumers leads to a fall in demand for powdered milk and shifts $D_p$ to $D'$. The reduction in total consumption of powdered milk from $B_p$ to $B'_{p2}$ leads to a saving in import subsidy costs by area $abcd$ (or 0.02307 percent of program costs in the numerical example). A higher price of fluid milk to producers shifts the supply of powdered milk to the left to $S'_{p}$, Domestic production of fluid milk declines from $QP_1$ to $QP_2$, with a saving of domestic subsidy cost by area $efgh$, partially offset by import subsidy payments of $jgb$ on the quantity $QP_1 - QP_2$, which must now be imported, so that the net effect is $efj$. The expression is:

$$- \frac{S_f (S_f - S_p)Q_P}{P_f} \left[ \frac{\gamma_{PP} - \gamma_{PP} \gamma_{PP}}{\gamma_{PP} - B_{PP}} \right] 100\%$$

$$= (0.0443 - 0.234)\% - 0.1897\%.$$

The former algebraic expression is negative if $S_f < S_p$ or when the domestic subsidy is higher than the import subsidy. The net decline in subsidy payment on powdered milk is given by $abcd + efj$, or $0.1897 + 0.02307 = 0.21277$ percent of total program costs. Overall a doubling of $S_f$ has a direct effect of increasing program costs by 6 percent, and all indirect effects together result in an offsetting decline of about 0.2 percent. The net percentage increase in program cost is about 5.8 percent.

To give some idea about the order of magnitude, in a year when milk program costs are Bs500 million, doubling the subsidy on fluid milk from its original 3.3 percent of the industry’s price would increase program costs by Bs30 million, while the overall effect would be an increase of Bs29 million.

**Change in Domestic Subsidy on Powdered Milk ($S_p$)**

In the previous example, an increase in the subsidy on fluid milk shifts the supply curve and demand curve for powdered milk. This, however, affects only domestic production and the import of powdered milk. Both the producer price and the consumer price of powdered milk remain unchanged, and there are no further induced cross-elasticity effects with the fluid milk sector. This is because of the assumption that the world

4. Powdered milk imports may increase or decrease, depending on assumptions about supply and demand elasticities in the fluid milk market and cross-supply and -demand elasticities. Under our assumptions, $jgb > abcd$, and import subsidy payments increase by $0.0443 - 0.02307 = 0.02123$ percent of total program costs.
Figure 10-2. Effect of a Change in Domestic Subsidy on Powdered Milk (Sp) on Milk Program Cost

price of powdered milk is given. Thus after adjusting for various subsidies, it determines the producer and consumer prices of powdered milk in Venezuela.

An increase in the domestic subsidy on powdered milk would not affect the price of powdered milk to consumers but would raise the price received by producers. The various effects on program costs are illustrated in figure 10-2. As in figure 10-1, before any policy change, the total milk program cost is fluid milk subsidy payments of ABCD plus domestic subsidy payments on powdered milk of lfgm plus import subsidy payments on powdered milk of ibcg. If the domestic subsidy on powdered milk is doubled so that $Sp = 2 S_p$, the price of powdered milk to consumers remains
unchanged at \( P_w - S_p \), but the price of producers is increased. According to column (2) of table 10-1, a doubling of \( S_p \) has the direct effect of increasing program costs by 78 percent. The direct effect on program cost is given by area \( stfl \) in the upper diagram of figure 10-2. The increase in the price of powdered milk shifts the supply curve of fluid milk to the left, from \( S_F \) to \( S_p \). Had the price received by producers of fluid milk remained constant, \( Q_F \) would be produced so that fluid milk subsidy payments would fall by area \( EBCK \), or 0.3 percent of program cost according to table 10-1. With \( S_F \) constant and an upward shift of the supply curve, however, the producer price has risen to point \( H \) so that \( HL = BC = S_F \), and production is \( Q_F2 \) rather than \( Q_F3 \). Thus the reduction in fluid milk subsidy payment is only \( EBCK - THLM = EBCK - EFJK = FBCJ \), or \( 0.3 - 0.0272 = 0.2728 \) percent of program costs.

The prices to both producers and consumers of fluid milk have risen and caused further reactions on the powdered milk market. The demand curve for powdered milk shifts up from \( D_P \) to \( D'_P \), and the increase in consumption (to \( B_1 \)) results in an increase in import subsidy payments by area \( bqyc \), or 0.3496 percent of total program cost. The supply curve of powdered milk shifts up from \( S_p \) to \( S'_p \). In the absence of this shift, the higher producer price because of the increase in domestic subsidy would have led to an increase in production to \( Q_{p3} \), with a resulting increase in domestic subsidy payments of \( tbrg \) partially offset by a reduction in import subsidy payment of \( ivrg \). The net change is area \( tbrg \), or \( 7.8 - 1.4768 = 6.3232 \) percent of total program cost. When the cross-elasticity supply effect is taken into account, only \( Q_{p3} \) is produced, and the net increase in payment is area \( tjwi \), or \( 6.3232 - (0.3545 - 0.0671) = 6.0358 \) percent of program cost. Thus all indirect effects together increase program cost by \( 6.0358 + 0.3496 - 0.2728 \) percent, or a little over 6 percent.

From the upper diagram of figure 10-2 it can be seen that while domestic subsidy payments on powdered milk have increased, powdered milk imports and import subsidy payments on powdered milk may either increase or decrease. In this example there is a net decline in import subsidy payments by \( 1.4768 - 0.0671 - 0.3496 = 1.0601 \) percent of program cost. It is conceivable that if cross-demand effects with the fluid milk industry are sufficiently strong, area \( bqyc \) in figure 10-2 can be greater than \( iwkg \), and both domestic and import subsidy payments may increase when \( S_p \) is raised.

**Change in Import Subsidy on Powdered Milk (\( S_p \))**

An increase in the import subsidy on powdered milk lowers the prices to both producers and consumers of powdered milk; the result is a shift
in the supply and demand for fluid milk, which generates further interaction effects. Those who have followed the discussion on the previous two cases should have no difficulty constructing a diagram and interpreting the various effects in column (3) of table 10-1. Simply stated, in terms of figure 10-1 or 10-2 an increase in the import subsidy will shift down the $P_w - S_f$ line and lower the consumer price of powdered milk. With the domestic subsidy on powdered milk constant, the implication is that the producer price of powdered milk $(P_w - S_f + S_p)$ has also fallen. The fall in the producer price of powdered milk shifts the supply curve of fluid milk to the right, while the fall in the consumer price of powdered milk shifts the demand curve for fluid milk to the left. The quantity of fluid milk consumed (and therefore fluid milk subsidy payments) may either increase or decrease although an increase is indicated under the elasticity assumptions. In either case both the producer price and consumer price of fluid milk would fall and shift the supply curve of powdered milk to the right and the demand curve for powdered milk to the left. The rightward shift of the supply curve of powdered milk offsets somewhat the original reduction in domestic subsidy payments resulting from a decline in production in response to the lower producer price; the leftward shift of the demand curve offsets in part the original increase in import subsidy payments owing to an increase in consumption resulting from a lower consumer price.

Table 10-1, column (3), indicates that the total (direct plus indirect) effect is an increase in program cost of about 16.7 percent: increased import subsidy payments add 19.9 percent to program cost, increased fluid milk subsidy payments add a further 0.1 percent, while decreased domestic subsidy payments on powdered milk cause a decline of 3.3 percent.

A Government Feed Program

As noted in chapter 5, government operations on beef and pork and poultry are rather small. Thus although prices in these commodities are controlled, they very likely approximate market clearing levels. Pork and poultry prices are influenced mainly by the government subsidies on inputs such as grain used to produce feed, which lower the costs of production and in turn benefit consumers through lower product prices. Beef is a close substitute for pork and poultry in consumption. Since cattle are fed with grass, however, beef and pork and poultry are not close substitutes in production.
In the model for the pork and poultry, beef, and feed sectors,\textsuperscript{5} the demand for pork and poultry is

\begin{equation}
Q_A = B_A(P_A, P_B)
\end{equation}

where $P_A$ is the price of pork and poultry and $P_B$ is the price of beef. Similarly the quantity supplied of pork and poultry is

\begin{equation}
Q_A = C_A(P_A, \overline{P}_{EP})
\end{equation}

where $\overline{P}_{EP}$ is the price paid for feed by pork and poultry producers and is set by the government. Domestic feed production $Q_E$ is a function of the price received for feed by farmers, $\overline{P}_{ER}$, which is also set by the government, or

\begin{equation}
Q_E = C_E(\overline{P}_{ER}).
\end{equation}

Feed used in pork and poultry production $E$ comes from either domestic production $Q_E$ or import $I_E$. A higher price of pork and poultry encourages more use of feed to increase production, while a higher price paid for feed lowers its use. Thus

\begin{equation}
E = B_E(P_A, \overline{P}_{EP}) = Q_E + I_E.
\end{equation}

The demand for beef is

\begin{equation}
Q_B = B_B(P_A, P_B),
\end{equation}

and the total supply of beef (which includes unofficial imports from Colombia) is

\begin{equation}
Q_B = C_B(P_B).
\end{equation}

There are two components of cost in the government feed program. First, the price paid for feed by livestock producers ($\overline{P}_{EP}$) is below the price received by feed producers ($\overline{P}_{ER}$), and the government has to pay the difference for each ton of feed produced domestically. Second, in the case of imported feed the world price ($P_{EW}$) is above the price paid by livestock producers, and the government has to pay the difference for each ton imported. Thus

\begin{equation}
C = Q_E (\overline{P}_{ER} - \overline{P}_{EP}) + I_E (P_{EW} - \overline{P}_{EP}).
\end{equation}

\textsuperscript{5} The notation is the same as in the previous section (see note 1). Subscripts $A$, $B$, and $E$ stand for pork and poultry, beef, and feed. Full definitions of elasticities are given in the notes to tables 10-2 and 10-3.
The situation is illustrated in figure 10-3. $S_E$ is the domestic supply curve of feed and $D_E$ is the demand curve. The world price of feed $P_{EW}$ is assumed to be given. The price of feed received by domestic producers is fixed above the world price at $P_{ER}$, and as a result $Q_E$ is produced. The price of feed paid by livestock producers is fixed below the world price at $P_{EP}$, and $B_E$ of feed is used in livestock production. Area $abcd$ represents the government loss on feed produced domestically, while area $efge$ represents the government loss on feed imports.

**Program Cost of Changes in Policies**

To examine the effects of changes in the policy variables $P_{ER}$ and $P_{EP}$ on program cost $C$, interactions with the beef sector are taken into account. First (10.20) and (10.21) are totally differentiated and solved for $dP_B$, to give

$$dP_B = \frac{B_{BE}}{C_{BB} - B_{BB}} \ dP_A.$$

Then (10.16) to (10.19) are totally differentiated and the above formula for $dP_B$ is substituted into the expressions to give:
\[ (10.23) \begin{bmatrix} -1 & B'_{A}\lambda & 0 & 0 \\ 1 & -C_{AA} & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & -B_{EE} & 1 & 1 \end{bmatrix} \begin{bmatrix} \frac{dQ_A}{dP_A} \\ \frac{dP_A}{dP_{ER}} \\ \frac{dI}{dI_{ER}} \\ \frac{dQ_E}{dQ_{ER}} \end{bmatrix} = \begin{bmatrix} \frac{0}{C_{AE}} \\ \frac{0}{C_{EE}} \end{bmatrix} \frac{dP_{ER}}{dP_{ER}}. \]

with \( \text{det.} = B'_{AA} - C_{AA} \), where \( B'_{AA} = \frac{dQ_A}{dP_A} = B_{AA} + (B_{AB}B_{BA})(C_{BB} - B_{BB}) \) measures the responsiveness of demand for pork and poultry to price, taking into account interactions with the beef sector.\(^6\)

**Price of Feed Received by Farmers** \((\bar{P}_{ER})\). Totally differentiating (10.22) with respect to \( P_{ER} \) gives

\[ (10.24) \frac{dC}{dP_{ER}} = Q_L + (P_{ER} - \bar{P}_{EP}) \frac{dQ_E}{dP_{ER}} + (P_{EW} - \bar{P}_{EP}) \frac{dI}{dP_{ER}}. \]

Setting \( dP_{ER} = 0 \) in (10.23) and solving give \( \frac{dQ_E}{dP_{ER}} = C_{EE} \) and \( \frac{dI}{dP_{ER}} = -C_{EE} \). Substituting in (10.24) and converting into elasticities give

\[ (10.25) \frac{dC}{dP_{ER}} \frac{P_{ER}}{C} = \frac{P_{ER}Q_E}{C} + \gamma_{EE} \frac{(P_{ER} - \bar{P}_{EP})Q_E}{C} - \gamma_{EE} (P_{EW} - \bar{P}_{EP})Q_E. \]

The effects are broken down into components in table 10-2, and a numerical example is also given. If the original value of feed production is Bs400 million, a 1 percent increase in the price received by feed producers would raise program costs by Bs4 million. The supply response of feed producers to the higher price results in a further increase of Bs0.42 million in costs. Imports are displaced by the same amount as the increase in production, with a subsequent reduction in losses on imports of Bs0.12 million. In figure 10-3 the direct effect on government cost of raising \( P_{ER} \) by 1 percent to \( \bar{P}_{ER} \) is given by area \( \text{ibba.} \) Feed use is unchanged at \( B_E \) since \( \bar{P}_{EP} \) is fixed independently by the government, but domestic feed production increases to \( Q_E^* \) because of supply response of domestic feed producers, and imports fall by \( Q_E^* - Q_E \). Thus losses on domestic production increase by area \( \text{ibmc.} \) partially offset by a reduction of losses on imports of \( \text{elm} \). Thus the net loss on the additional production \( Q_E^* - \)

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\(^6\) A reduction in the price of pork and poultry shifts demand away from beef; this shift in the demand curve lowers the price of beef, and the demand for pork and poultry is thereby reduced. The curve from which the slope \( B'_{AA} \) is obtained is the locus of equilibrium prices and quantities in the pork and poultry sector when these interactions are taken into account.
Table 10-2. Venezuela: Effect of 1 Percent Increase in Price Received by Feed Producers ($\bar{P}_{EP}$) on Government Cost

<table>
<thead>
<tr>
<th>Effect</th>
<th>Formula</th>
<th>Numerical value (million bolivares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct effect; no supply response of feed producers assumed</td>
<td>$\bar{P}_{EO}Q_E \times 1/100$</td>
<td>4.0</td>
</tr>
<tr>
<td>Increase in cost to government because of supply response of feed</td>
<td>$\gamma_{EO}(\bar{P}<em>{EO} - \bar{P}</em>{EP}) \times 1/100$</td>
<td>0.4208</td>
</tr>
<tr>
<td>producers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction in losses on imports because of supply response</td>
<td>$-\gamma_{EO}(P_{EW} - \bar{P}_{EP}) \times 1/100$</td>
<td>-0.1169</td>
</tr>
</tbody>
</table>

Note: $\gamma_{EO}$ (the elasticity of supply of feed with respect to $\bar{P}_{EO}$) is assumed to be 0.3. The ratio of the price of feed received by feed producers to the price paid by livestock producers ($\bar{P}_{EO}/\bar{P}_{EP}$) is 1.54. The ratio of the world price of feed to the price paid by livestock producers ($P_{EW}/\bar{P}_{EP}$) is 1.15.

$Q_E$ is area elk$b$, which is given by the last two terms of (10.25) and is equal to $0.42 - 0.12 = \text{Bs0.3 million}$.7

FEED PRICE PAID BY PORK AND POULTRY PRODUCERS ($\bar{P}_{EP}$). Totally differentiating (10.22) with respect to $\bar{P}_{EP}$ gives

(10.26) $\frac{dC}{d\bar{P}_{EP}} = -(Q_E + I_E) + (\bar{P}_{EO} - \bar{P}_{EP}) \frac{dQ_E}{d\bar{P}_{EP}} + (P_{EW} - \bar{P}_{EP}) \frac{dI_E}{d\bar{P}_{EP}}$.

Setting $d\bar{P}_{EO} = 0$ in (10.23) and solving give

$$\frac{dQ_E}{d\bar{P}_{EP}} = 0 \text{ and } \frac{dI_E}{d\bar{P}_{EP}} = \frac{dE}{d\bar{P}_{EP}} = \frac{E}{C_{AA} - B_{AA}}.$$

Substituting into (10.26) and converting to elasticities give, after some manipulation,

7. The last two terms of (10.25) may be written as

$$\gamma_{EO} = \frac{(\bar{P}_{EO} - P_{EW}) \times Q_E}{C}.$$

Since $\gamma_{EO}$ is positive, the offsetting reduction of losses on imports would be only partial as long as the price received by domestic feed producers is above the world price, or $\bar{P}_{EO} - P_{EW} > 0$. 


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The first term represents the direct effect: a reduction of $P_{EP}$ will lead to a loss in revenue to the government. The second and third terms represent the indirect effects. A reduction in $P_{EP}$ leads to more feed use; as a result, imports increase and there are more losses for the government since feed users pay a price below the world price. This loss is partially offset since a reduction in $P_{EP}$ reduces the price of pork and poultry, thereby reducing the demand for beef, which is a close substitute in consumption. The resulting fall in the price of beef reduces the demand for pork and poultry, lowers pork and poultry prices, and causes an offsetting decline in feed use. The second term represents losses on imports if no interaction between the beef and pork and poultry sectors is assumed. The third term is the adjustment factor for these interaction effects.

Table 10-3 shows the breakdown of effects and an example with assumed values of $\beta_{AA}$, $f_{EE}$, $f_{BB}$, and $\gamma_{EE}$. To obtain the elasticity of supply of pork and poultry and derived demand elasticities for feed, we make use of a production function for pork and poultry

$$Q_A = f(E, \cdot).$$

The marginal productivity condition for profit maximization is

$$\bar{P}_{EP} = f_s P_A$$

where $f_s$ is the marginal product of feed. Differentiating (10.28) and (10.29) totally (all factors other than feed are assumed fixed in the short run) and rearranging give

$$\begin{bmatrix} 1 & -f_s \\ 0 & P_{A_{FE}} \end{bmatrix} \begin{bmatrix} dQ_A \\ dE \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \begin{bmatrix} d\bar{P}_{EP} \\ -f_s \end{bmatrix}$$

with det. = $P_{A_{FE}}$. Solving the above equation gives

$$\frac{dQ_A}{dP_{EP}} = \frac{f_s}{P_{A_{FE}}}$$

$$\frac{dE}{dP_{EP}} = \frac{1}{P_{A_{FE}}} \frac{dQ_A}{dP_A}$$

$$\frac{dE}{dP_{EP}} = \frac{-f_s^2}{P_{A_{FE}}}$$

and

$$\frac{dE}{dP_A} = \frac{-f_s}{P_{A_{FE}}}.$$
### Table 10-3. Venezuela: Effect of 1 Percent Decrease in Price Paid for Feed by Pork and Poultry Producers (\(P_{EP}\)) on Government Cost

<table>
<thead>
<tr>
<th>Effect</th>
<th>Formula</th>
<th>Numerical value (million bolivares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct effect (decrease in revenue from sales of existing quantity of feed)</td>
<td>(\bar{P}_{FE}E \cdot \frac{1}{100})</td>
<td>7.50</td>
</tr>
<tr>
<td>Increase in loss on feed imports owing to higher demand by pork and poultry producers, with assumption of zero cross-price elasticity of demand with beef</td>
<td>((- (P_{EW} - \bar{P}<em>{EP})E \frac{\beta</em>{EA} \gamma_{AE}}{\gamma_{AA} - \beta_{AA}}) \cdot \frac{1}{100})</td>
<td>0.625</td>
</tr>
<tr>
<td>Partial offset to loss on feed imports owing to cross-demand elasticity effects with the beef sector</td>
<td>(- (P_{EW} - \bar{P}<em>{EP})E \left{ \frac{\beta</em>{EA} \gamma_{AE}}{\gamma_{AA} - \beta_{AA}} \right} \cdot \frac{1}{100})</td>
<td>-0.025</td>
</tr>
</tbody>
</table>

Note: The following elasticities are assumed: \(\beta_{EA}\) (elasticity of demand for pork and poultry) = -0.5; \(\beta_{AA}\) (cross-elasticity of demand for pork and poultry with respect to the price of beef) = 0.15; \(\gamma_{AA}\) (elasticity of supply of beef) = 0.5; and \(\gamma_{BE}\) (elasticity of demand for feed) = 0.5.

A production function for pork and poultry \(Q_A = \alpha E^\theta\) is assumed, in which case conditions of profit maximization imply the following elasticities: \(\gamma_{AA}\) (elasticity of supply of pork and poultry) = 5; \(\gamma_{AE}\) (elasticity of supply of pork and poultry with respect to \(P_{EP}\)) = -1; and \(\gamma_{BE}\) (elasticity of demand for feed used in pork and poultry production with respect to \(P_{EP}\)) = -5.

The ratio of the world price of feed to the price paid by livestock producers, \(P_{EW}/P_{EP}\), is 1.15.

With a Cobb-Douglas production function

\[Q_A = \alpha E^\theta, \text{ then } f_E = \eta Q_A/E \text{ and } f_{EE} = \eta(\eta - 1)Q_A/E^2.\]

Since \(\eta = f_E/Q_A = (\bar{P}_{EP})E/(P_{EP}Q_A)\), we get

\[\gamma_{AA} = \frac{dQ_A}{dP_A} \frac{P_A}{Q_A} = -\frac{\eta}{1 - \eta}, \quad \beta_{EA} = \frac{dE}{dP_A} \frac{P_A}{E}, \]

\[= \frac{1}{1 - \eta}, \quad \gamma_{AE} = \frac{dQ_A}{d\bar{P}_{EP}} \frac{\bar{P}_{EP}}{Q_A} = -\frac{\eta}{1 - \eta}.\]
and \[ \beta_{EP} = \frac{dE}{dP EP} \overline{P}_{EP} = \frac{-1}{1 - \eta}. \]

The value of \( \eta \) is assumed to be 0.8.

Under our assumptions, in a year when the value of feed used by pork and poultry producers is Bs750 million, the direct effect of a 1 percent reduction of \( P_{EP} \) will be Bs7.5 million. Because of increased feed consumption, government losses on imports will increase by Bs0.625 million if there are no cross-elasticity effects with the beef sector. Because of the interaction effects described earlier, however, losses on imports will be cut by about Bs0.025 million.

**Effect of Government Feed Program on the Beef Sector**

Changes in the price of feed received by feed producers (\( \overline{P}_{EP} \)) would not affect the cost of pork and poultry production since the price of feed paid by livestock producers (\( P_{EP} \)) is independently fixed by the government. Thus the beef sector will be similarly unaffected. A change in \( P_{EP} \) will affect poultry and pork prices, however, and through demand substitution also beef prices and beef supply.

Totally differentiating (10.20) and (10.21) with respect to \( P \), and equating give

\[ \frac{dP_B}{dP_{EP}} = \frac{B_{BA}}{C_{BB} - R_{BB}} \frac{dP_A}{dP_{EP}}. \]

Solving for \( dP_A/dP_{EP} \) in (10.23), substituting into the above expression, and converting to elasticities give

\[ (10.30) \quad \frac{dP_B}{dP_{EP}} \overline{P}_{EP} = \frac{-\beta_{BA}\gamma_{AE}}{\gamma_{AA} - \beta_{AA}(\gamma_{BB} - \beta_{BB}) - \beta_{AB}\beta_{BA}}, \]

and

\[ \frac{dQ_B}{dP_{EP}} \overline{P}_{EP} = \gamma_{BB} \left( \frac{dP_B}{dP_{EP}} \overline{P}_{EP} \right) \]

\[ = \frac{-\gamma_{BB}B_{BA}\gamma_{AE}}{\gamma_{AA} - \beta_{AA}(\gamma_{BB} - \beta_{BB}) - \beta_{AB}\beta_{BA}}. \]

Under our assumptions about elasticities,

\[ \frac{dP_B}{dP_{EP}} \overline{P}_{EP} = 0.1340 \quad \text{and} \quad \frac{dQ_B}{dP_{EP}} \overline{P}_{EP} = 0.0670. \]

Thus reducing the price of feed paid by 1 percent does have a considerable effect on the beef sector, lowering beef prices by 0.13 percent and beef supply by 0.07 percent.
Summary and Conclusions

Analyzing the effects of government price policy on agriculture is not an easy task because of the large number of subsectors and input-output relations that have to be considered. This chapter attempted to identify the major sources of government intervention and quantify the direct and major induced effects in the case of the grain and livestock sector of Venezuela. Since each of the component effects of government policy can be estimated and interpreted, studies of the type just presented could be a valuable basis for a nontechnical report for the decisionmaker.

The case of the milk subsidy was presented to illustrate the type of induced and indirect effects which should be considered when a product with close substitutes is subsidized, while in the feed program case input price is the key policy variable. Finally, the effect of the feed program on the beef sector demonstrated how government policy in one sector can have a sizable and sometimes unintended effect on another industry.

The indirect effects of government policy in reality may or may not be small. In the study on Venezuela, elasticities were chosen conservatively so as not to overstate the indirect effects. In using this approach it is suggested that sensitivity tests be carried out in which elasticities and various response coefficients are varied systematically over plausible ranges. Crucial elasticities and input-output coefficients should be subject to intensive econometric and field experiment studies. As more reliable estimates of these magnitudes become available, the quality of the investigation will also improve.
Conclusion

We have examined agricultural price interventions in four developing countries—Korea, Bangladesh, Thailand, and Venezuela—using basic economic tools. The primary purpose has been not to recommend price policies, but rather to set out their objectives and their major effects. Time after time, price programs have gone awry not necessarily from lack of good objectives, but more because their effects have been inadequately understood. Usually policies have a variety of consequences, unforeseen by policymakers, owing to the responses of producers and consumers to price changes. A tendency to minimize the expected response to price in the behavior of consumers and producers often leads to difficulties in operating programs. In this book, we have tried to demonstrate relatively simple methods of analyzing and measuring the major effects of price policies.

Although a unified method of analysis has been used, one result has been to bring to light the difficulties in advancing general policy conclusions across countries. The relevance of policy recommendations varies according to the individual circumstances of a country and its stage of development. The comparison between Bangladesh and Korea is particularly revealing. Bangladesh has experienced much less economic growth than Korea and faces severe socioeconomic problems: rapid population growth, little possibility of expanding cultivation on new land, and limited nonagricultural employment possibilities. To overcome demographic, institutional, and administrative bottlenecks and to develop organizational capabilities Bangladesh requires correspondingly greater efforts than Korea.

At the same time, in Bangladesh—as in some other developing nations—the government has been trying to reverse past price disincentives to raising agricultural productivity. The achievement of self-sufficiency as quickly as possible is a principal developmental goal. Regardless of the
merits of this objective, policymakers need to find the most cost-efficient ways of meeting it. In contrast, Korea has for a decade pursued a high farm-price policy and in some recent years has achieved essential food self-sufficiency. Now the country needs to phase out some of its high-cost price programs and thus free resources for other development goals.

Country situations demonstrate both the potential strengths and the shortcomings of price policies. Various authors consider adequate price incentives—and rational pricing policies in general—important for the success of agricultural strategies, a view supported here. Although limited to four countries, this study covers a broad spectrum of development situations in which the response of farm productivity to price incentives appears general. On the one hand, Korea's success in rapidly augmenting its rice production is due, at least in part, to price incentives. On the other hand, Thailand's tax on rice exports seems to have held back paddy yields. Nonprice factors such as lack of water control and expansion into areas ill-suited for rice, however, have also contributed to the low yields.

In considering the potential contribution of adequate price incentives to raising agricultural productivity, longer term effects also need to be accounted for. The dynamic response of farm investment to favorable prices of output and inputs has been noted in this study. If the dynamic effects are important, the implied longer term benefits would constitute the main contribution of price incentives. In the case of Bangladesh, minimum harvest prices, by mitigating wide price fluctuations, could lower the perceived risks to farm investment and encourage the adoption of new technology. In the case of Thailand, the possibility that the rice tax would inhibit the adoption of new technology detracted from the merits of the tax.

The potential benefits—mainly higher agricultural productivity—accruing from price policies have been noted, and emphasis has been given to striking a balance in the use of such policies. Consideration of their major effects should guide policymakers in reaching such a balance. The consequences for government cost and revenue, farm income, and producer and consumer welfare have been analyzed, as well as the effects on agricultural diversification, inflation, economic growth, and balance of payments. The analysis has broad implications for the desirability and timing of different types of price intervention and reveals the need for complementary or alternative programs in the agricultural sector.

A common experience has been that price interventions tend to outlast their useful life. While price incentives over a limited period can speed the adoption of new inputs, for instance, their use indefinitely can be costly. An input subsidy may be initiated, justifiably, to stimulate the adoption of a new input such as fertilizer, but often it is continued even
when the input price is no longer the constraint to adoption. As long as adequate farm prices prevail and farmers know the advantages of using the modern input, gains from continued subsidization became questionable. Phasing out the subsidy could release scarce resources for other development purposes, and efforts could be usefully devoted to ensuring the adequate and timely supply of the new inputs. The need for continued efforts to ensure more and timely water supply for farmers has been emphasized in the Bangladesh case. Similarly, it is beneficial to reverse historically low farm-price policies and restore incentive prices effectively at the farm level. But the continued raising of output prices beyond the need for minimum incentives through government price support will have a high opportunity cost. This point has been illustrated in the study of Korea.

As in the cases of input subsidies and price supports, the timing and extent of use are important in determining the value of taxing the export of an agricultural commodity. The optimal export tax argument could justify the rice export tax of Thailand for a certain period, although its detrimental effects on HYV adoption and income distribution should also be considered. In any event, whether it is wise to continue the tax depends crucially on the future characteristics of the international rice market. If world trade in rice were liberalized, Thailand might do best to phase out restrictions and export at world prices.

If price interventions are too extensive for too long, there will be both a social cost from a misallocation of resources and a government (financial) cost. While society bears the resource cost, the government cost is often an immediate overriding consideration. Therefore, in evaluating the effects of price policies, a full and accurate measurement and projection of the implications for the government cost are necessary. Indirect and induced effects arise from supply and demand responses and from input-output relations, as illustrated in the grain and livestock subsector in Venezuela. In the case of the milk subsidy a variety of effects must be considered when a product with close substitutes is subsidized, while input price is a key policy variable in the feed program. The response of the beef sector to this program is an example of how government policy in one sector can have a sizable and sometimes unintended effect on another industry.

To recapitulate the examples from the Venezuela study, with either an increase in the price paid to domestic feed producers or a decrease in the price paid for feed by pork and poultry producers, there will be a large direct increase in government cost. But an additional 8 percent increase in indirect cost can result in each case under reasonable assumptions. A higher feed price to producers raises the direct government cost by inducing a larger feed supply. A lower feed price to consumers raises the
direct cost by increasing imports and subsidy losses on them. Similarly, when the domestic subsidy on powdered milk is doubled, an estimated increase in program cost of 7.8 percent occurs because of an induced supply response of powdered milk. At the same time, the increase in domestic production displaces powdered milk and indirectly reduces import subsidy payments by 1.5 percent. A doubling of import subsidy on powdered milk induces lower domestic production and indirectly reduces the subsidy on it by about 4 percent; at the same time, the higher induced consumption indirectly raises import subsidy further by about 4 percent. A doubling of fluid milk subsidy, however, lowers consumption and thus indirectly reduces domestic subsidy payments by 0.2 percent. All these indirect and induced effects are stronger when supply and demand elasticities and the input-output coefficients are larger.

In the studies of Korea and Bangladesh, the rising government cost of price policies has been quantified with examples of seasonal stabilization and input and output subsidies. As discussed in the Korea study, one way to contain program cost is through partial rather than complete seasonal stabilization. In the case of Bangladesh, a price support scheme, with seasonal market grain sales rather than year-round ration distribution in urban areas, lowers government cost.

While rising government cost limits price policies, selective interventions can be made more effective by emphasizing complementary or alternative policies. Discussions of such nonprice policies have been beyond the scope of this book, but their importance has been pointed out. The contribution of direct government investment in irrigation and water control has been substantial across countries. Similarly, agricultural research has been of fundamental importance. The Bangladesh research has had some early impact on the rather small acreage planted to irrigated crops. A challenge only beginning to be realized is the yield potential of rice grown under conditions of deep flooding during the most important growing season of aman. Even in the case of Bangladesh's irrigated crops, results have been disappointing, partly because of problems with managing and maintaining the pumps required for the cultivation of a dry season crop. The development of organizational capabilities for activities such as the management of irrigation systems can be very rewarding.

In any agricultural strategy that adopts price or nonprice policy instruments, or both, there is a need to evaluate continuously the role of agriculture in development. Many poor countries, faced with the need to feed growing populations while seeking to phase out their dependence on commercial and aid imports of food in international markets, have attached considerable importance to increasing domestic production. In recent years this necessity has guided the pricing of products. On the question
of how to price a commodity properly, the world price provides a useful guide. Using world prices as a benchmark has two advantages. First it permits a country to avail itself of the gains from trade. Second, it provides a relatively objective measure of the value of the commodity, possibly separating the pricing issue from political considerations. In the case of a commodity such as rice, however, the world price has fluctuated considerably from year to year. To follow the world price each year could lead to domestic instability. A procedure in this case could be to follow a five-year moving average of the world prices.

Another issue is how the additional output of food will be distributed among people. Higher food production can make some contribution toward raising rural incomes. But overall, to provide adequate incomes for the poor so that they can buy greater quantities of food, ways to increase productive employment and incomes outside agriculture are urgently needed.
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