Managing Price Risk in the Pakistan Wheat Market

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Rashid Faruqee
Jonathan R. Coleman

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Contents

Foreword ...................................................................................................................... v
Abstract ....................................................................................................................... vi
Acknowledgments ....................................................................................................... vii
Executive Summary ...................................................................................................... ix

1. Background .............................................................................................................. 1
   Objectives of the Study ......................................................................................... 2
   Overview of the Wheat Marketing and Pricing System ........................................... 3
   Who Bears the Price Risk? .................................................................................... 12

2. Price Stabilization and Risk Management: Some Basic Considerations .............. 15
   Future Role of Government Intervention ............................................................... 15
   Lessons for Pakistan ............................................................................................ 17

3. Managing Wheat Price Risk By Hedging ............................................................... 20
   Alternative Hedging Instruments Available .......................................................... 20
   Potential Obstacles to Using Hedging Instruments .................................................. 21
   Effectiveness of Hedging Pakistan Wheat Price Risk ........................................... 25
   How Much of the Wheat Position Should Be Hedged? ........................................... 27
   Internal Procedures and Requirements for Hedging .............................................. 29
   Practical Aspects of Implementing a Price Risk Management Program .................. 30

   Assumed Wheat Policy Environment ...................................................................... 32
   Strategy I: Hedging with Futures Contracts ........................................................... 33
   Strategy II: Hedging with Options Contracts .......................................................... 39
   Strategy III: Hedging with Swaps .......................................................................... 42

5. Conclusion ................................................................................................................ 47
   Key Findings and Policy Implications .................................................................... 47
   Future Considerations ........................................................................................... 48

Annex 1. Previous Studies ........................................................................................... 51
Annex 2. Types of Price Stabilization Methods ............................................................ 53
Annex 4. Derivation of the Optimal Hedge Ratio ......................................................... 60

References ................................................................................................................... 62
Foreword

Like many other developing countries, Pakistan is liberalizing its agricultural markets to boost growth, improve rural incomes, and reduce poverty. In Pakistan the government is beginning to pull out of agricultural markets (dropping price controls and subsidies) and reforming trade policies (replacing the distortionary system of high customs duties and nontariff barriers with a uniform tariff). The reforms include a redirection of public spending, especially in agricultural research and extension, and an emphasis on policies to encourage more efficient and sustainable use of the country's natural resource base. The aim is to induce the private sector to take over in areas where government intervention has been inefficient and has stifled growth.

These are ambitious goals, and experience in Pakistan and round the world shows how difficult implementing such reforms can be. As governments have pulled out of price protection programs for farmers, market liberalization has provided opportunities for the private sector to develop new price risk management instruments. But the willingness of the private sector to take on the risk and uncertainty associated with reduced government intervention depends in large measure on having transparent policies, strong supporting institutions, and adequate marketing infrastructure and facilities.

In countries where these preconditions are in place, one way private agents have responded has been through commodity hedging to reduce risk. This study explores the potential for widespread use of commodity price hedging in Pakistan. The study is part of a continuing effort by the South Asia Country Department I to support the Government of Pakistan in implementing market reforms in the agricultural sector. It contributes to a growing body of literature demonstrating that financial instruments such as futures, options, and swaps can be effective in managing the impact of commodity price volatility as long the mechanisms are clearly understood and regulatory, legal, and institutional barriers are kept to a minimum. The report explores commodity hedging from many perspectives, explaining the instruments available, potential obstacles, and practical considerations for their use. It is intended to ease the acceptance and use of such instruments and thereby to help farmers and traders moderate the effects of swings in commodity prices.

Ridwan Ali
Acting Director
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Abstract

The purpose of government intervention in the wheat market in Pakistan is to ensure food security of consumers and to provide adequate and stable incomes for producers. The cost of this intervention is high and its impact on the performance of agriculture has been significantly negative. The World Bank is urging policy changes such as removing agricultural trade restrictions, price supports and subsidies. However, such reform are often resisted by policy-makers because of a fear that the domestic market will be exposed to fluctuating international commodity prices.

Recently, interest in financial risk management instruments by developing countries has grown significantly—instruments that can be highly suitable for Pakistan to reduce the impact of international price volatility on the domestic market. To date very little research has been done on hedging price risks of Asian grain importing countries such as Pakistan. This study aims at filling this gap and deals with the wheat sector in Pakistan. The objectives are to assess the risk management needs of the sector, and to evaluate whether using financial instruments would provide improved risk management than its current methods of stabilization through direct market intervention.

The results of the study show that price risk is now borne principally by the government in the form of unstable import subsidy payments. Simulations based on monthly data for 1994 show that futures hedging by the government could fix the international price it pays for wheat for the entire season. An alternative strategy using options would limit subsidies when international prices rise, but allow the government to benefit from favorable price movements. These findings show that market-based methods of risk management could reduce the impact of international price volatility on domestic market without distorting price signals or causing a fiscal burden to the government.
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Executive Summary

Because of the importance of wheat as Pakistan's leading agricultural commodity, the government has long intervened in the sector. Justification for this intervention has been based on the need to ensure the food security for the nation's 120 million people and to guarantee adequate and stable incomes to its farmers. But the cost of distortionary price policies has been high and their impacts on agricultural growth significantly negative.

The government's wheat policy has two primary goals: lowering the average level of prices for consumers and reducing the volatility of prices for producers. The first objective is achieved through a system of subsidized imports that keeps domestic prices below international parity levels. The second objective is achieved through a complex system of government procurement that prevents prices from falling below an administratively set minimum level during periods of plentiful supplies. Clearly policies that lower average price levels create disincentives for producers and should be discontinued immediately. The government has justified keeping the price of wheat below import parity on the grounds that it raises the real incomes of the urban poor. The government needs to recognize that there are more efficient methods which are far less distortionary, such as targeted food subsidies.

Although the government has succeeded in stabilizing wheat prices, the cost of its policies has been high. A report recently prepared by the World Bank in close collaboration with the government of Pakistan and local experts noted that agricultural policies have tended to distort price signals in both output and input markets, and that such distortions represent a significant constraint on the prospects for future growth. That report called for liberalization of the wheat sector, an end to subsidies on imports, and a phasing out of the system of government pricing and procurement. But the economic and political consequences of sharply fluctuating commodity prices are of genuine concern to the government, and it is hesitant to fully implement market liberalization policies unless some alternative price stabilization mechanisms are in place.

This study analyzes the risk management needs of the wheat sector in Pakistan and evaluates the use of market-based financial instruments (futures contracts, options, and swaps) to manage price risk. The study concludes that nondistortionary, market-friendly approaches to price stabilization and risk management could be beneficial in Pakistan, but that major policy changes are required to create an environment in which the private sector could effectively use financial risk management instruments.

Because of the large number of relatively small wheat farmers and traders who cannot engage in price risk management on their own, the current structure of risk distribution, whereby the government pools the risk of small producers and traders, may be appropriate in Pakistan. Having assumed the risk, however, government needs to employ mechanisms with which to pass on or
transfer the risk to entities willing and able to take it on.

One way of transferring this risk would be to hedge the price of wheat with futures markets. Hedging is a method of managing price risks involving the buying and selling of financial assets whose values are linked to the underlying commodity markets. Four major types of hedging instruments can be used: forward contracts, futures contracts, options, and swaps. Hedging facilitates better financial management and planning, and allows buyers and sellers of commodities to protect themselves against the potentially catastrophic consequences of sudden and unforeseen changes in market conditions. For hedging to take place, however, the instruments must be available and their use must be fully understood. Moreover, economic policies or institutional barriers (such as legal constraints and distortionary agricultural price and input policies) that are not consistent with hedging activities may need to be eliminated.

In theory, managing commodity price risks with the use of hedging instruments could be highly beneficial to Pakistan. In practice, however, certain key preconditions must be met for hedging to be effective, such as the absence of informational, institutional, and legal barriers. Hedging effectiveness depends also on several additional factors, including the nature of the commodity traded, the timing of purchases, transportation costs, and policy variables. All of these factors create differences between the prices quoted on the commodity exchanges and the prices actually paid by Pakistani wheat importers (this price difference is known as the basis). If the basis is large then risk management by hedging will not be effective.

To quantify the potential effectiveness of hedging Pakistan wheat on U.S. futures exchanges, regression analysis of the relationship between the actual price of imported wheat and each of three futures contract prices (No. 1 soft white wheat traded on the Minneapolis Grain Exchange, No. 2 hard red winter wheat traded on the Kansas City Board of Trade, and No. 2 soft red winter wheat traded on the Chicago Board of Trade) was performed. These contracts were chosen because they cover wheat of the quality and characteristics most representative of wheat commonly imported by Pakistan.

A high degree of correlation was found between the wheat futures contract price on the Minneapolis Grain Exchange and the U.S. dollar FOB price of Western white wheat quoted at Pacific Northwest ports. The results showed that 89 percent of the variation in the cash prices can be explained by variations in the futures prices, with a basis risk of only 11 percent (most likely reflecting variability in transportation costs). The soft white wheat contract that has been traded on the Minneapolis Grain Exchange since 1991 specifies wheat with quality characteristics similar to the grades most frequently imported by Pakistan; perhaps for this reason Pakistan’s FOB price was found to be highly correlated with the price of this contract. The high correlation between the two prices indicates that at least the U.S. dollar FOB Pacific Northwest price faced by Pakistan could be fairly well hedged by trading wheat futures contracts on the Minneapolis Grain Exchange, provided that all institutional and financial constraints are removed.
Three specific hedging strategies using futures, options, and swaps were analyzed using actual data from 1994. The results indicated that hedging would have been highly effective at reducing market uncertainty: By hedging the government could have avoided the financial burden of the sudden and unexpected increase in imported wheat prices that occurred between August and October of that year, when prices rose roughly 20 percent.

Based on the analysis of hedging instruments and specific hedging strategies, key findings of the study include the following:

- **Commodity hedging could be a useful method of managing commodity price risks as long as the mechanisms are understood and that regulatory, legal, and institutional barriers are kept to a minimum.** The nature of hedging, the various instruments available, potential obstacles, and practical considerations must be well understood by the government and potential market participants.

- **Commodity hedging using futures, options, and swaps could significantly reduce the variability of the cost of imports.** The simulations of actual hedging strategies indicated that hedging would reduce the variability of import costs, thereby facilitating the management of public expenditures and planning.

- **Other mechanisms for price stabilization are generally may be costlier than hedging.** If the government needs to borrow to finance additional subsidies resulting from unforeseen increases in international wheat prices, the cost of borrowing represents the cost of not hedging. While hedging involves risks and costs, not hedging may be riskier and costlier.

- **Commodity hedging operations involve simultaneous transactions in cash and futures markets and can be complex.**

- **Attempts to establish an Agricultural Stabilization Fund should be avoided.** Although the proposal to establish a price stabilization fund has some merit, implementation of such a fund for wheat might be very difficult. Experiences of other countries shows that stabilization funds often run into financial difficulties due to prolonged low commodity prices and mismanagement.

Of special significance to wheat import practices in Pakistan will be the nature of the global wheat market. Some analysts suggest that the global wheat market has been undergoing its greatest transformation in at least twenty years, and that this transformation is likely to continue and will have implications for Pakistan. Key points include the following:

- **Government subsidies from exporting countries for export commodities will almost certainly decline during the latter half of the 1990s.** Indeed, the World Trade Organization (WTO)
mandates that both the volume and value of subsidized exports be decreased. It is possible that subsidies will decline further than WTO mandates because of high market prices and budgetary pressures to cut farm assistance.

- **The volatility of prices and the absolute price level of wheat are likely to increase relative to their 1980s levels.** Combined with the anticipated decline in subsidies, the cost of imported wheat will likely be higher for Pakistan than it has been in ten years.

- **Higher world wheat prices in themselves could lead to lower exports subsidies by major wheat exporting countries in that governments will need to provide less in the way of subsidies to make their own wheat competitive in world markets.**

To conclude, these market changes are likely to result in an environment that is more amenable for hedging world physical cash wheat prices on U.S. based futures exchanges. With U.S. prices less isolated from global factors (in part because of lower subsidies), U.S. wheat futures prices should be more highly correlated to world wheat prices than has been the case in the past. This could mean that countries such as Pakistan should find hedging price risk on U.S. exchanges a more viable option.
1. Background

Wheat is Pakistan's most important agricultural commodity. It is grown by more than four million farmers (80 percent of the total number) on close to 40 percent of the cropped area, and contributes roughly one-quarter of total crop sector value added. Wheat is also the major staple food, especially for low income consumers, accounting for about 50 percent of per capita daily intake of calories and 85 percent of protein. Because of the importance of wheat, the government of Pakistan has intervened in the sector. Justification for intervention in the wheat sector has been based on the need to ensure food security for the nation's 120 million people and to guarantee adequate and stable incomes to farmers.

The government has intervened in practically every aspect of the domestic marketing system. The government interventions seems to have two objectives—to protect the interests of consumers by keeping the domestic price below the import parity price, and to protect the interests of producers by reducing price fluctuations and guaranteeing a support price. Foremost among the mechanisms used to meet the first objective is an import subsidy that keeps domestic prices below import parity levels and a ban on private sector trading on international markets. To support both objectives, the government also operates a procurement mechanism through the Pakistan Agricultural Storage and Service Corporation (PASSCO), a government parastatal engaged in all aspects of product procurement, preservation, storage, and distribution. By law, PASSCO is required to purchase all quantities offered to it by farmers when market prices fall below a government-determined support price. This policy is designed to arrest a decline in wheat prices below a certain level and thus protects farmers with limited storage capacity, who otherwise would be forced to sell at seasonally depressed prices immediately following harvest time.

The policy of artificially depressing prices is costly to the economy and government. Such a price policy has a significant economic cost in that it distorts market signals faced by farmers and private traders throughout the sector. Subsidy payments to wheat farmers are both large and highly unstable because of their direct link with the volatile international price of wheat. In addition, the system of government procurement has run into difficulties in recent years. PASSCO has failed to operate efficiently, reporting a loss of approximately 89 million rupees in 1993 (about 3 percent of net sales revenue) without including subsidies (explicit and implicit) from the government. PASSCO has also been criticized for disproportionately benefiting its own officials and large farmers.

A comprehensive assessment of the major policy issues facing Pakistan's agriculture and strategy for the future was recently prepared by the World Bank (World Bank 1994b), in close collaboration with the government and local experts. An overriding theme of that report was that agricultural policies have tended to distort price signals in both output and input markets, and that such distortions represent a significant constraint on the prospects for future growth. The report outlines a strategy to alter price signals and incentive structures by removing the wide array of trade restrictions, price supports, and subsidies, thereby encouraging production by sectors in
which the country has a comparative advantage. For wheat, the strategy calls for liberalization of the sector, including an end to subsidization of imports and phase out of the system of pricing and procurement. As Pakistan’s commodity prices become increasingly market determined, production incentives for crops in which it has a comparative advantage (such as wheat) will improve.

Keeping domestic wheat prices artificially low is highly distortionary and the need to end the policy is generally recognized by policymakers. However, the idea of phasing out public sector direct intervention in wheat marketing would face opposition by policymakers fearing possible short-run repercussions of agricultural price instability. The economic and political consequences of sharply fluctuating commodity prices are of genuine concern to the government, and it is hesitant to fully implement market liberalization policies recommended by the World Bank sector report unless some alternative price stabilization mechanisms are put in place. Acknowledging this possibility, the Bank sector report also recommended that a thorough study of alternative means of reducing agricultural price volatility be undertaken. In particular, the Bank report called for a detailed analysis of nondistortionary, market-friendly approaches to price stabilization and risk management that could be used in Pakistan.

Interest in market-based risk management techniques, including the use of commodity futures, options and swaps, by developing countries has grown significantly in recent years. The use of such financial instruments could provide Pakistan with an attractive method of managing its price risk, as long as the mechanisms are understood well and used appropriately. Because they require less government intervention and are more cost effective than alternative approaches, the use of financial risk management instruments may be preferable to more interventionist stabilization methods in Pakistan.

Objectives of the Study

This study deals with price risk of the wheat crop in Pakistan. It has two major objectives. First, it seeks to assess the risk management needs, if any, of the wheat sector, by identifying the market participants and institutions exposed to risk and measuring the levels of those risks. To meet this objective the study (a) analyzes the production and marketing chain for wheat (including production, merchandising, storage, transportation, end-use processing and manufacturing, warehouse distribution, and consumption); (b) identifies the sources of price risk at each stage of the chain and quantifies of those risks; and (c) analyzes the current mechanisms used to deal with price risk in the sector.

Second, the study seeks to evaluate whether market-based financial instruments would provide an improved method of managing wheat sector price risks relative to the stabilization methods

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1 Although studies document that some international commodity prices are unstable and result in disruption of domestic agricultural markets, these problems are often exaggerated (Claessens and Duncan 1993; Gilbert 1993). After all, prices and their variation are market signals to which agricultural production needs to respond.
currently used. To meet this objective the study (a) examines the major commodity risk management instruments that could be used; (b) reviews the experiences of similarly placed countries in hedging to determine what lessons can be learned, if any; (c) identifies the potential obstacles (both internal and external) to hedging with commodity risk management instruments; (d) evaluates the extent to which hedging would be effective in risk management; (e) demonstrates the potential ways in which these instruments could be used and evaluates specific risk management strategies; and (f) simulates how risk management strategies affect domestic price variability and quantifies their overall costs and benefits to producers, consumers, and the government.

Overview of the Wheat Marketing and Pricing System

This section identifies the major stages in the wheat marketing chain and analyzes the nature of price incentives faced by different market participants. In doing so, it reveals the level of risk exposure at the various stages to which alternative risk management mechanisms can be targeted appropriately.

The Marketing System

The marketing system for wheat includes production, procurement and distribution, storage, international trade, processing, retailing, and final consumption (figure 1.1). It involves a large number of market participants and transactions. Although many production and marketing activities are now performed by the private sector, the government continues to intervene throughout most of the system in an effort to provide market stability to producers, traders, and consumers. A system of government procurement and pricing establishes a floor when market prices are low, especially after harvest. Government controls also constrain private sector activity in storage, interregional trade, and importing.

Production

Over the last quarter of a century the combination of rapid productivity growth and area expansion led to significant increases in wheat production, with output more than doubling from 6.5 million tons in 1970-71 to 16 million tons in 1993-94 (table 1.1). Because the potential to expand wheat production through increased area is now limited, future growth will have to come from gains in productivity. Growth in yields has slowed significantly since the 1970s, and the average of about 2 tons per hectare remains well below potential (as evidenced by both much higher yields in neighboring Indian Punjab and yield gaps, that is, the difference between best and average wheat growers). Frequently cited problems are the inappropriate policies of the government in agriculture, which has led to inefficient systems of input distribution, a crisis in irrigation, and an unproductive research and extension system. Inadequate price incentives have tended to prevent the private sector from overcoming these problems, many of which were identified in the Bank's agricultural strategy report. Efforts to eliminate these problems through policy and institutional reforms remain top priorities for the Bank in Pakistan.
Figure 1.1 Wheat Marketing System

Table 1.1 Recent Trends Wheat Supply/Demand Balance

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<th></th>
<th></th>
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<tr>
<td>Production a/</td>
<td>14,316</td>
<td>14,565</td>
<td>15,684</td>
<td>16,157</td>
<td>15,213</td>
</tr>
<tr>
<td>Seed, feed, waste</td>
<td>1,432</td>
<td>1,457</td>
<td>1,568</td>
<td>1,616</td>
<td>1,521</td>
</tr>
<tr>
<td>Imports</td>
<td>972</td>
<td>2,018</td>
<td>2,868</td>
<td>1,902</td>
<td>2,500</td>
</tr>
<tr>
<td>Government procurement</td>
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<td>3,159</td>
<td>3,249</td>
<td>4,120</td>
<td>4,640</td>
</tr>
<tr>
<td>Government release</td>
<td>5,608</td>
<td>5,400</td>
<td>4,595</td>
<td>5,488</td>
<td>5,475</td>
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<tr>
<td>Availability</td>
<td>14,080</td>
<td>15,350</td>
<td>15,462</td>
<td>15,909</td>
<td>14,527</td>
</tr>
<tr>
<td>Per capita availability</td>
<td>123.8</td>
<td>130.9</td>
<td>128.0</td>
<td>127.8</td>
<td>113.5</td>
</tr>
</tbody>
</table>

\(a/\) One year lag between production and consumption.


Public Sector Procurement and Distribution

As noted, the public sector is a key player in wheat marketing in Pakistan. One-third of all wheat grown is procured by the government in price support operations. Most government procurement is done through private traders, although some farmers circumvent the traders and sell directly to the government. An even smaller share is sold by farmers directly to flour mills. From the mills, flour is sold to private retailers, commercial bakeries and the armed forces for final consumption.
Both provincial and federal governments have procurement institutions. Approximately 450 provincial procurement centers, or buying stations, are operated by the Provincial Food Departments (PFDs). As an alternative, traders may sell directly to the federal government via the Pakistan Agricultural Storage and Service Corporation (PASSCO), which has approximately 250 procurement centers, mostly in the Punjab. Wheat procured by PASSCO is generally resold to the PFDs in wheat deficit areas (mainly Northwest Frontier Province and Balochistan), although some product goes to the armed forces, international agencies, and the World Food Program. Over the past ten years, government wheat procurement averaged just over one-quarter of total production.

An important feature of the procurement system is that although the food handling agencies are obligated to accept delivery of all wheat offered, farmers are not mandated to sell to the government and can choose between the government and private traders. This choice is made largely on the basis of profitability, so that farmers tend to sell directly to the millers when the market price exceeds the government-determined procurement price, and to deliver to the procurement centers when the market price is below the procurement price. Farmers delivering directly to the PFDs also receive gunny bags in which to collect their wheat and payment for transportation.

Wheat is sold by the PFDs to private mills at an officially determined release, or issue, price. Such sales are generally unrestricted, although the drawdown of government stocks is controlled at some period during the year (such as during harvest when supplies are plentiful) to prevent declines in market prices. Typically the government continues to control the amount it sells until about October, allowing mills to purchase only as much wheat as they can use in a certain number of hours a day. Monthly releases increase during the local marketing year and annual quantities sold increase when the domestic crop is poor. This stock management policy serves to stabilize domestic prices both within and between years.

Storage

The federal and provincial governments are the major holders of effective operational and buffer stocks. Over the past five years these have remained in the 4—5 million ton range, of which roughly 85 percent is held by provincial governments and 15 percent is held by the federal government, primarily by PASSCO. The government also has a policy of maintaining a strategic reserve of 1 million tons to provide food in times of shortage or national or local emergency. Most wheat is procured and released within each crop year and only about 1 million tons in any one year is held over to the next. Government stocks have ranged between 0.6 and 1.45 million tons in recent years.

Private storage is severely limited, both by law and by the system of pan-seasonal pricing, which weakens economic incentives to store. Access to credit for construction of storage facilities is also limited. In spite of these impediments, however, private stocks are generally larger than government stocks, although private stockholding is quite fragmented. There are few good quality, privately owned storage facilities and most private stocks are held on the farm.
International Trade

Purchases of wheat on the international market have filled the gap between local production and consumption that has emerged as a result of the government setting prices below domestic market clearing levels. Since the mid-1980s imports have increased, reflecting the decline in the rate of productivity growth and the acceleration in consumption associated with the elimination of the domestic wheat rationing system in 1987 (table 1.1). In recent years imports have been close to 2 million tons, representing roughly 15 percent of total consumption. In the future, consumption is expected to increase at a rate of about 4.5 percent annually, widening the gap between demand and domestic supplies.

A consequence of imports making up the difference between domestic supplies and consumption is that import volumes have been highly variable from year to year. Coupled with the instability of international prices, this has meant that the import bill has been highly volatile, especially during the past few years (figure 1.2). For example, expenditures increased from about 3 billion rupees in 1990-91 to almost 8 billion rupees in 1991-92, then rose again in 1992-93 to just over 10 billion rupees. This was followed by a drop of almost 50 percent in 1993-94 to a little over 5 billion rupees. Since the mid-1980s, the major suppliers to Pakistan have been the United States (70 percent of shipments) and Australia (16 percent). Argentina, Canada, and the European Union have not traditionally been major suppliers.

Figure 1.2 Instability of Wheat Import Costs

![Graph showing the instability of wheat import costs from 1970-71 to 1993-94.](https://example.com/graph.jpg)

Two major factors contributed to the strong performance of U.S. wheat in the Pakistani market. First, until very recently the government’s standard contracts have specified soft white wheat, of which the United States is the largest supplier. Although Australia also exports white wheat, supplies are limited and its harder varieties generally sell at a premium relative to U.S. soft varieties. The second factor behind U.S. dominance is that during the Soviet occupation of Afghanistan (1980-1990) the bilateral trade relationship between the United States and Pakistan was cemented by large flows of U.S. military, development, and commodity assistance. U.S. commodity assistance included provisions for commodity grants and credits for wheat and other commodities that were not matched by competing wheat exporters.

Processing

In contrast to the wheat market, the flour market has witnessed relatively little direct government intervention since its privatization in the 1970s. Prices and profit margins are now determined entirely by market conditions, although the government has retained the legal authority to control them. With wheat costs representing 80-90 percent of millers’ total costs, however, wheat pricing policies have indirectly affected the flour milling sector. In particular, mills benefit substantially from the government sales of wheat at a release price that is set below market prices.

Retailing

Historically, subsidized flour was provided to consumers through a system of ration shops—a system that was once the cornerstone of policy in Pakistan. In the early 1980s almost three-quarters of the urban population obtained flour from ration shops. To offset a large portion of milling and marketing costs associated with flour sold cheaply through the shops, millers could purchase wheat with a government subsidy. Because of increased competitiveness in the private sector, the gap between the free market price of flour and the prices at ration shops narrowed and by the mid-1980s less than one-quarter of flour purchases were made from the ration shops. In addition, substantial amounts of subsidized wheat found their way into private sector flour sales, which weakened the credibility of the system. In April 1987, the rationing system was finally abandoned, as the number of urban residents who bought flour from the ration shops diminished. Today, flour retailing is almost exclusively a private sector activity, with most retailing done on a consignment basis from the mills. In contrast to wheat, the government does not control the amount of flour that is stored but some restrictions on finance for wheat storage facilities also apply to flour.

Consumption

Although total wheat consumption increased almost 4 percent annually during the 1980s, rapid population growth led to modest per capita consumption growth of less than 1 percent per year. Currently, annual per capita wheat use is a little over 150 kilograms, compared with 130 kilograms in 1980 and 119 kilograms in 1970. Estimating actual net human consumption is made difficult by the lack of reliable data on feed and seed use, waste, and illegal exports. The growth
in wheat disappearance stems from its role as the major food staple in a country in which incomes are low and real per capita incomes are expanding at about 3 percent annually. There has also been little substitution for wheat for other cereals, such as rice, as incomes have risen. In addition, government policies have ensured stable and declining real prices over time, also spurring consumption.

Over the last few decades, the rapid growth of the livestock industry (particularly agro-industrial production of poultry) has led to some rise in the demand for wheat for feed, which currently represents about 2 percent of total demand. About 6 percent of wheat output is estimated to be commercially produced for seed by large farmers under contract to public sector provincial seed corporations. Although exporting wheat out of the country (and out of the province, in the case of the Punjab) by the private sector is illegal, a substantial quantity of wheat (perhaps as much as 25,000-50,000 tons) likely is smuggled out of Pakistan each year (Enders, Wasay, and Mahmood 1992). The remaining wheat is used for human consumption.

The Pricing System

In an effort to manage wheat prices the government intervenes heavily in the market, through both procurement and trade controls. To determine the risk management needs of the wheat sector it is necessary to analyze the various prices faced by different market participants. Clearly market participants whose prices are fixed by the government have no price risk, whereas those facing highly unstable prices will likely be the ones most interested in risk management.

Pricing Policies for Domestically Produced Wheat

The provincial food departments (PFDs) are the chief institutions through which the government’s support price policy is implemented. By law the PFDs are required to purchase any volume of wheat delivered to them as long as the wheat meets certain quality standards. The price paid to farmers and private traders includes a payment for the wheat (known as the *procurement price*) plus a small amount to cover the costs of transportation from the farm to the centers. The procurement price for the crop to be harvested the following April-June is announced before sowing begins in November. Since the PFDs must accept all deliveries, the procurement price becomes a floor below which the free market price cannot fall. This price is fixed throughout the year and is constant across all centers nationwide.

\[\text{Typically farmers sell to procurement centers during and immediately after harvest (May-June) when the free-market wholesale price is at its lowest point. During the remainder of the season, market prices are generally higher than the procurement prices so farmers sell directly to private traders rather than to the government. Thus, the government is the buyer of last resort within the marketing system. This policy was developed because small producers, who dominate farm production, have neither adequate storage nor sufficient staying power to hold on to their marketable surplus in the hope of getting better prices later. In the absence of such a policy, farmers would be forced to part with their produce soon after harvest, when profitability is at its lowest level.}\]

\[\text{The current pricing system was developed in the early 1980s with the establishment of the Agricultural Prices Commission (APCom) to provide systematic input into commodity price policy decision of the Ministry of Food, Agriculture, and Cooperatives (MINFAC). Many factors are considered in setting the level of procurement prices each year. The task is}\]
The provincial food departments sell the majority of the public sector wheat stocks to private flour mills at the official release, or issue, price. Like the procurement price, the release price is set at the same level in all areas of the country. Taken into consideration in setting the price are the procurement price, the buying power of consumers, the cost to the government, and the impact on incentives for private storage and trading. The release price enables the government to control the price of wheat at the wholesale level. If the wholesale price is significantly higher than the release price (as is generally the case), private millers purchase their wheat from the government. Because wheat represents a large share of the total cost of producing flour, the release price is used as an instrument to control the price of flour to consumers.

Trends in procurement, release, and wholesale prices are given in current rupee terms in figure 1.3, which shows that the release price was sometimes below the procurement price and never higher than the 400—600 rupee price necessary to fully cover marketing costs. The private sector has thus not had an incentive to store wheat for most of the marketing year, since it could not earn a sufficient return on its investment in storage facilities. Rather, millers have come to depend on the government to supply a substantial part of their requirements of wheat, especially during the nonharvest period.

The revenue received by the PFDs from sales of wheat (at the release price) is generally less than the cost of procuring wheat (the procurement price plus transport, handling, and storage charges). As a result, subsidies are incurred, paid mainly by the provincial governments. The potential burden to the government of this subsidy on domestic wheat has been reduced, however, by the depressed producer price. That is, if the government had to procure domestic wheat at a price comparable to world wheat prices, the subsidy (the difference between the procurement and release prices) would have been greater. A breakdown of the provincial subsidy payments on wheat production is given in table 1.2. On average, between 1984-85 and 1993-94, the subsidy amounted to 340 rupees per ton, approximately 18 percent of the procurement price. Multiplying the per unit subsidy by the total quantity procured yields a rough estimate of the total subsidy payments made. Total subsidies ranged from 533 million rupees in 1984-85 to 3.3 billion rupees in 1986-87, and averaged 1.3 billion rupees over the 1984-93 period.

Pricing Policies for Imported Wheat

Decisions affecting wheat imports and import procedures are made at the highest level of government through the Economic Coordination Committee (ECC), which meets each June to set import quantities, determine the timing of purchases, and establish priorities for utilization of credits and grants offered by suppliers for the coming year. The level of wheat imports depends on several factors, including the level of public sector stocks, the expected procurement of domestic output, port handling capacity, the levels of reserve stocks, international wheat market
Figure 1.3  Trends in Nominal Wheat Prices, 1980—1992

Price (rupees per ton)


Table 1.2  Components of Provincial Subsidy on Domestically Produced Wheat, 1984-85—1993-94

<table>
<thead>
<tr>
<th>Year</th>
<th>CIF price (rupees per ton)</th>
<th>Total cost (rupees per ton)</th>
<th>Release price (rupees per ton)</th>
<th>Unit subsidy (rupees per ton)</th>
<th>Quantity procured ('000 tons)</th>
<th>Total subsidy (millions of rupees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984-85</td>
<td>2,489</td>
<td>1,937</td>
<td>1,703</td>
<td>234</td>
<td>2,275</td>
<td>533</td>
</tr>
<tr>
<td>1985-86</td>
<td>2,538</td>
<td>2,101</td>
<td>1,703</td>
<td>399</td>
<td>2,533</td>
<td>1,010</td>
</tr>
<tr>
<td>1986-87</td>
<td>2,120</td>
<td>2,367</td>
<td>1,703</td>
<td>664</td>
<td>5,035</td>
<td>3,346</td>
</tr>
<tr>
<td>1987-88</td>
<td>2,341</td>
<td>2,403</td>
<td>2,000</td>
<td>403</td>
<td>3,975</td>
<td>1,603</td>
</tr>
<tr>
<td>1988-89</td>
<td>3,440</td>
<td>2,504</td>
<td>2,100</td>
<td>404</td>
<td>3,494</td>
<td>1,411</td>
</tr>
<tr>
<td>1989-90</td>
<td>3,960</td>
<td>2,601</td>
<td>2,300</td>
<td>301</td>
<td>4,135</td>
<td>1,244</td>
</tr>
<tr>
<td>1990-91</td>
<td>3,068</td>
<td>2,926</td>
<td>2,600</td>
<td>326</td>
<td>4,412</td>
<td>1,440</td>
</tr>
<tr>
<td>1991-92</td>
<td>4,170</td>
<td>3,406</td>
<td>3,100</td>
<td>306</td>
<td>3,159</td>
<td>967</td>
</tr>
<tr>
<td>1992-93</td>
<td>4,301</td>
<td>3,697</td>
<td>3,400</td>
<td>297</td>
<td>3,249</td>
<td>965</td>
</tr>
<tr>
<td>1993-94</td>
<td>4,140</td>
<td>3,950</td>
<td>3,550</td>
<td>400</td>
<td>4,210</td>
<td>1,684</td>
</tr>
</tbody>
</table>


conditions, and foreign exchange reserves. The decisions of the ECC are implemented by Ministry of Food, Agriculture, and Cooperatives (MINFAC), which also handles the financing of imports, including foreign aid and ocean shipping. All imported wheat arrives at Karachi, where it
is inspected, unloaded, and stored before being turned over to the PFDs for distribution. Because most wheat arrives in bulk it must be bagged before leaving the port. The PFDs then transport the bagged wheat to storage and distribution facilities throughout the country. Most of the imported wheat is sent to the largest deficit province of Sindh, which includes the metropolitan areas of Karachi and Hyderabad.

The PFDs buy imported wheat from the federal government at the same release price at which they sell domestically produced wheat to private millers. In addition, the PFDs are required to pay the in-country transportation costs. In general, the government pays more for wheat than it receives from selling to the PDFs at the release price. This margin between the CIF import price and the release price is financed by a specific federal budget allocation for imported wheat subsidies (table 1.3). Once received at the regional distribution centers, imported wheat is treated as if it were produced domestically and sold to flour millers at the same subsidized administered release price.

Table 1.3 Components of Federal Subsidy on Imported Wheat, 1984-85—1993-94

<table>
<thead>
<tr>
<th>Year</th>
<th>Imports ('000 tons)</th>
<th>CIF price (rupees per ton)</th>
<th>Release price (rupees per ton)</th>
<th>Subsidy (rupees per ton)</th>
<th>Total subsidy (million rupees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984-85</td>
<td>980</td>
<td>2,489</td>
<td>1,703</td>
<td>786</td>
<td>771</td>
</tr>
<tr>
<td>1985-86</td>
<td>1,909</td>
<td>2,538</td>
<td>1,703</td>
<td>835</td>
<td>1,594</td>
</tr>
<tr>
<td>1986-87</td>
<td>378</td>
<td>2,120</td>
<td>1,703</td>
<td>417</td>
<td>157</td>
</tr>
<tr>
<td>1987-88</td>
<td>601</td>
<td>2,341</td>
<td>2,000</td>
<td>341</td>
<td>205</td>
</tr>
<tr>
<td>1988-89</td>
<td>2,171</td>
<td>3,440</td>
<td>2,100</td>
<td>1,340</td>
<td>2,910</td>
</tr>
<tr>
<td>1989-90</td>
<td>2,047</td>
<td>3,960</td>
<td>2,300</td>
<td>1,660</td>
<td>3,399</td>
</tr>
<tr>
<td>1990-91</td>
<td>972</td>
<td>3,068</td>
<td>2,600</td>
<td>468</td>
<td>454</td>
</tr>
<tr>
<td>1991-92</td>
<td>2,018</td>
<td>4,170</td>
<td>3,100</td>
<td>1,070</td>
<td>2,159</td>
</tr>
<tr>
<td>1992-93</td>
<td>2,868</td>
<td>4,301</td>
<td>3,400</td>
<td>901</td>
<td>2,583</td>
</tr>
<tr>
<td>1993-94</td>
<td>1,902</td>
<td>4,140</td>
<td>3,550</td>
<td>590</td>
<td>1,121</td>
</tr>
</tbody>
</table>


In 1993-94, this subsidy amounted to 590 rupees per ton. Given total imports for 1993-94 of approximately 1.9 million tons, the total subsidy payment incurred by the government was about 1.1 billion rupees. This subsidy payment per ton has been quite variable over time, ranging between 341 rupees per ton in 1987-88 and to 1,660 rupees per ton in 1989-90. Total subsidy payments have also fluctuated dramatically, as a result of both variations in the per ton subsidy

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4 The majority of wheat imports enter the country under some form of concessional arrangements with the suppliers. For example, since the mid-1980s, roughly 90 percent of all U.S. wheat sales have been made under U.S. export programs, including grants through P.L. 480; Title II; commodity grants from the Agency for International Development; Section 416 donations; and commercial sales through GSM-102 credits. U.S. GSM-102 credits and AID grants became particularly important in the late 1980s, as wheat import demand increased. In September 1992, Pakistan became eligible for concessionally priced purchases of U.S. wheat under the Export Enhancement Program (EEP).
and the level of imports. For example, the total subsidy payment was only 205 million rupees in 1987-88 (when only 601,000 tons were imported), compared to 2.9 billion rupees the next year (when imports exceeded 2 million tons).

As shown in more detail in chapter 2, through its system of procurement and subsidization, the government is addressing two separate policy goals—reducing average prices for consumers and stabilizing prices for producers. Use of these policy instruments to address these goals is very costly, in terms of both financial cost and efficiency losses. It should also be noted that the subsidy on domestically produced wheat would be significantly larger if prices were not kept artificially low by restrictive trade policies, as indicated by the difference between the CIF price and the total cost to the government.

Who Bears the Price Risk?

To gauge the level of price risk exposure in the marketing system an analysis of prices paid and received by different market participants was undertaken. The level of price risk was assumed to be determined by the instability of prices over time, as measured by the standard deviation and coefficient of variation (the ratio of the standard deviation to the mean). These instability measures were calculated using a series covering the sixteen-year period between May 1980 and April 1995, with prices converted into real terms using the producer price index as deflator. The domestic prices analyzed were the government-determined procurement and release price, and the wholesale prices recorded at two major markets in the Punjab, Lahore and Multan. International prices included were the FOB price of U.S. white wheat at Pacific Northwest ports, freight charges to Karachi; the U.S. dollar/Pakistan rupee exchange rate; and wheat subsidies under the Export Enhancement Program (EEP). Finally, the instability of subsidy payments per ton imported was included to indicate the price risk exposure of the government. The results are reported in table 1.4.

In terms of price exposure the results show that domestic farmers and private traders face relatively little price risk. The government-determined prices have coefficients of variation of 6.4 and 5.8 for the procurement price and release price, respectively. This means that in any season, prices on average will be about 6 percent higher or lower than the long-run average price. Wholesale wheat prices at Lahore and Multan have also varied very little since the early 1980s, with coefficients of variation of about 8 percent.

By contrast, international prices have been substantially more volatile than domestic prices. The U.S. dollar price of wheat at Pacific Northwest ports has a coefficient of variation of about 17 percent; when freight charges are included the figure rises to more than 20 percent. Interestingly, when the Karachi U.S. dollar price is converted into rupees the instability of the price series declines considerably with a coefficient of variation of only 14 percent. One explanation for this change is that although wheat prices and freight costs have declined in real terms over time, the value of the rupee in terms of the U.S. dollar has fallen. As a result, the decline in the commodity
price has been offset by the change in the exchange rate, with the net effect that the international price in rupees has remained relatively stable.

<table>
<thead>
<tr>
<th><strong>Table 1.4 Measures of Price Variability, May 1980—April 1995</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price per ton a/</strong></td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Procurement price (rupees)</td>
</tr>
<tr>
<td>Release price (rupees)</td>
</tr>
<tr>
<td>Wholesale price (rupees)</td>
</tr>
<tr>
<td>Lahore</td>
</tr>
<tr>
<td>Multan</td>
</tr>
<tr>
<td>FOB Pacific Northwest (U.S. dollars)</td>
</tr>
<tr>
<td>CIF Karachi (U.S. dollars)</td>
</tr>
<tr>
<td>CIF Karachi (rupees)</td>
</tr>
<tr>
<td>FOB Pacific Northwest with EEP (U.S. dollars)</td>
</tr>
<tr>
<td>CIF Karachi with EEP (U.S. dollars)</td>
</tr>
<tr>
<td>CIF Karachi with EEP (rupees)</td>
</tr>
<tr>
<td>Government import subsidy (rupees)</td>
</tr>
</tbody>
</table>

*a/ Prices deflated by producer price index.


The effect of the EEP subsidies is to increase the instability of wheat prices considerably, with the U.S. dollar prices at Pacific Northwest ports and at Karachi having coefficients of variation in excess of 20 percent. It is important to note that comparing the coefficients of variation of prices with and without EEP overestimates the impact of these export subsidies on variability, because the EEP subsidies lower the average price (the denominator in the coefficient of variation calculation), thereby giving rise to an increase in the coefficient of variation for a fixed standard deviation. Finally, the government’s price risk exposure is measured by the variability of subsidy payments per ton (simplified as the CIF price measured in rupees less the release price). The coefficient of variation of this subsidy series is almost 60 percent, indicating that in a typical year subsidy payments will be 60 percent above or below the average payment. This indicates the high degree of instability and risk that the government faces each year.

These findings have several important implications for risk management. They indicate that the government has been successful in stabilizing prices through its procurement and policy of fixed producer and miller prices. Because of its distortionary impact on economic incentives and because there may be more effective and less costly methods of price stabilization, the policy may nevertheless be inadvisable. Another important implication for risk management is that given the current policy regime, farmers and millers have little incentive to undertake risk management on their own behalf. In effect, private sector risk management has been crowded out by the
government and farmers and millers have little need to worry about fluctuating prices when making production and investment decisions.

Price stabilization policies involving government procurement and pricing do not remove price risk from the economy as whole but merely transfer the risk within the economy. The risk is transferred from wheat market participants in the form of unstable prices to the government (and ultimately taxpayers throughout the economy) in the form of unstable subsidy payments.

Given the large number of relatively small wheat farmers and traders in Pakistan, it is infeasible for wheat market participants to pursue risk management strategies on their own. The current structure of risk distribution, whereby the government pools the risk of small producers and traders, may therefore be appropriate. The problem for the government is that it does not have mechanisms, such as futures markets, to externalize the price risk or transfer it to another entity.
2. Price Stabilization and Risk Management: Some Basic Considerations

As noted in chapter 1, the government’s wheat policy has two primary goals: lowering the average level of prices for consumers and reducing the volatility of prices for producers. The first objective is achieved through a system of subsidized imports that keeps domestic prices below international parity levels. The second objective is achieved through a complex system of government procurement that prevents prices from falling below an administratively set minimum level during periods of plentiful supplies. This chapter examines the appropriateness of these goals and suggests a minimalist role for the government in wheat price stabilization.

It is important to keep in mind that issues of risk management are only concerned with reducing price variability, and not with the allocative and distributive issues associated with government artificially influencing price levels. The policy instruments used to control the mean level and variability of prices are closely intertwined, however, and it is difficult separate them. Because imports are sold at a fixed price, the subsidization of imports, for example, not only reduces average domestic prices but also stabilizes them. Government procurement, which has the explicit purpose of stabilizing prices, also changes the average price level, and in doing so transfers income among market participants. Providing a guaranteed minimum price but no ceiling redistributes income on average from the government to sellers of wheat.

Future Role of Government Intervention

Many countries, developing and industrialized, have policies aimed at providing stability to their agricultural markets. As the government of Pakistan rethinks its agricultural price risk management policies, it should reassess whether both of its wheat policy goals are legitimate, or whether it is time to revise government objectives in the light of changing economic and agricultural conditions.

Should Government Hold Down Average Price Levels?

The government of Pakistan has kept the price of wheat below import parity in order to raise the real incomes of the urban poor; concerns about distribution of food rather than market failure are the primary motive for the government setting domestic prices below international levels. Is the policy achieving its goal? Ryan and Khan (1992) argued that artificially lowering wheat prices at the wholesale level simply improves the profits of flour millers rather than benefiting consumers through lower flour prices. Even if consumers benefit from the subsidy, the distributional arguments for government intervention are weaker than they once were, as the portion of the population in poverty has fallen and pressure on the government to reduce subsidy expenditures has increased. If these trends continue, the issue of whether a targeted subsidy as an alternative to
the current system should be considered. It may make sense to replace food security programs with social security programs. The policy question for Pakistan then would be to determine whether the social objectives are best achieved through price-based schemes or through targeted provision of money or food.

Although lowering of wheat prices might be justified in some instances on distributional grounds, the policy is unequivocally bad from the standpoint of economic efficiency. Lower consumer prices create disincentives to produce, which lead to lower wheat production and lower returns to growers. Although the government attempts to offset lower prices with subsidized inputs, such as fertilizer and water, price distortions in both product and factor markets lead to poor allocative efficiency. For these reasons, a recent Bank report (World Bank 1994b) recommended that all price interventions for both agricultural products and inputs be phased out.

**Should Government Reduce Price Variability?**

More pertinent to a study on risk management is whether the government has a legitimate role in stabilizing wheat prices. To the extent that stable prices increase certainty of Pakistan's wheat growers about the price they will receive at harvest time, stabilization allows them to make more rational and efficient planting decisions regarding how much wheat to plant and how intensively to cultivate. Furthermore, the reduction in uncertainty could lead to increased investment in wheat production and marketing technology, and hence raise the level of output. Whether this leads to gains in producer welfare depends on several factors, including the volatility of price fluctuations, producers' attitudes toward risk, and the opportunities for diversification into other sources of income (Knudsen and Nash 1990). Stabilizing the price of wheat might also encourage specialization in production of the commodity, in which Pakistan has a comparative advantage (Longmire and Debord 1993; World Bank 1994b).

A number of arguments have been advanced suggesting that governments should not try to stabilize agricultural prices. In a policy environment with little or no government intervention, domestic wheat prices in Pakistan would be determined by domestic demand and supply but would fall within a ranged determined by FOB and CIF price of internationally traded wheat (Byerlee and Morris 1993). Free trade and market price determination would result in a price band for domestic prices, with the import parity price establishing the lower band and the export parity price establishing the upper band. However, although the limits of price movements are set through interaction with world markets, the band may be very wide, especially when, as in the case of Pakistan, transportation costs to terminal markets are high. As a result, domestic prices may still be able to vary considerably.

A second argument against price stabilization is that price may not be as good an indicator of risk or uncertainty as income and profitability. Stabilizing prices does not stabilize income or profit, and in fact stabilizing prices with year to year fluctuations on production would result in greater
income instability than if prices were allowed to adjust to the level of supplies\(^5\). Price stabilization also leads to welfare losses associated with producers and consumers failing to react to market signals. According to economic theory, wheat should be produced at the level at which prices are equal to the marginal cost of production. But if producers are insulated from the market through a government stabilization scheme they will tend to overproduce in periods of lower international prices, when domestic prices are artificially raised, and underproduce in periods of high international prices, when domestic prices are artificially lowered. Stabilized domestic prices also lead to different consumption patterns than would prevail in a free-market environment. Depending on the level of stabilization and elasticities of demand and supply, the economic losses associated with suboptimal production and consumption can be considerable (Massell 1969)\(^6\).

Other arguments against stabilization concern difficulties in implementing schemes effectively and inexpensively. Depending on the scheme, stabilization can be so expensive to operate that the costs of operating the program outweigh any benefits that might accrue to producers and consumers. Implementation of the policy often requires a huge bureaucracy. Furthermore, stabilization schemes with direct government influence in the market are highly prone to political manipulation as experience from many countries has shown. Government stabilization in a commodity market (such as wheat) also constrains the active participation of the private sector, particularly in storage, transportation, and general trading activities. This is of great relevance to Pakistan, where a system of pan-seasonal and pan-territorial pricing is in operation. This has seriously weakened the economic incentives for private sector involvement in the storage and transportation.

Despite the failure of economic arguments to support intervention to stabilize prices, considerable pressure will likely remain for the government to provide such assistance. After all, almost all countries provide some form of price support or stabilization, motivated largely by social and political factors—factors that remain very strong in Pakistan. Because of the shortcomings of the current system, however, alternative methods of stabilization that are consistent with the market liberalization and reforms that are taking place in Pakistan today should be examined.

**Lessons for Pakistan**

Based on experience in the use of domestic price stabilization schemes (see annex II for description of the major types of stabilization methods), it is possible to identify several lessons

\(^5\) An example is a product with random production and a demand elasticity of unity. In such an instance, although production fluctuates from year to year, low production is offset by higher prices and vice versa, so that income is stable in the market without any intervention. If prices in this instance are stabilized, the income of producers fluctuates with production and price stabilization destabilizes income (Thomas 1985).

\(^6\) One practical problem associated with price stabilization involves determining the level at which prices should be stabilized. One option would be to stabilize prices at a long-run “trend” price. Determination of the long-run price is difficult, however, and requires government officials to make judgments about whether observed world price movements are transitory or part of a long-run trend. If movements are actually part of a trend but are thought to be transitory, the price will be adjusted in the expectation that they will be readjusted when the price returns to its previous level. Since the price will never return to this level, the adjustment becomes a permanent change in protection of the good (Thomas 1985).
that should be noted as Pakistan reforms its agricultural policies\textsuperscript{7}. In terms of both the direct fiscal cost and the distortion of economic incentives it causes, the stabilization of seasonal price variations using government procurement and storage is extremely costly. Procurement and storage also involve huge bureaucracies. The government of Pakistan must realize that it is impossible to stabilize wheat prices completely and that the more the price is stabilized the more costly it becomes (because greater stability requires greater storage capacity, which is expensive to construct and maintain). Since production is subject to wide interseasonal swings, there will be a time when many consecutive years of excess production will defeat efforts to control price through storage schemes. It is generally better to use a buffer scheme, which stabilizes prices imperfectly, but to allow them to deviate from their long-run trend with little or no intervention. The government should adopt policies that do not require the government to handle the commodity directly.

The government must ensure that any stabilization scheme it operates allows the domestic price to approximate the long-run average market-determined price. In the case of a buffer fund (see box 2.1), if the government sets a price that is too high it will continually accumulate reserves. Alternatively, if the stabilized price is set too low, the reserve will frequently run out of funds. Setting a price different from the long-run world price is costly to the economy, because it will cause too many or too few resources to be devoted to production. Establishing too low a price may also adversely affect the government’s budget, from which large quantities of imports are subsidized. Analytically it is very difficult to determine the long-run average price, because it requires distinguishing between price changes due to transient factors from permanent changes in market fundamentals.

As mentioned, another shortcoming of the current system is that the price stabilization schemes crowd out private sector processors, storers, and marketers, something that should be avoided in the future. Pricing policies must recognize that prices between harvests must rise to cover private sector storage costs, that producer prices in outlying areas must be lower than those in areas close to consumption centers by a margin large enough to cover transportation costs, and that prices of processed food must exceed producer prices by a margin large enough to cover processing costs.

Methods based on market forces are generally most effective for stabilizing prices. Experience from around the world shows that stabilization schemes are often costly and may not be effective in stabilizing domestic prices relative to international prices. Market-based stabilization methods should therefore be relied upon to the maximum extent possible. Such mechanisms include allowing the real exchange rate to adjust and facilitating private sector storage and distribution\textsuperscript{8}.

\textsuperscript{7} This section draws heavily on Knudsen and Nash (1990).

\textsuperscript{8} One way of stabilizing prices is simply through changes in the real exchange rate. When the international price of a country’s imports increases, pressure is put on the exchange rate to appreciate, tending to partially offset the increase in world prices. Thus the price paid by importers rises less than the world price. Such an appreciation would make exports more expensive in overseas markets, thereby reducing the incomes of exporters. Exchange rate movement does not insulate the economy from changes in the commodity prices, but it does enable the risk to be shared within the economy as a whole rather than by a single sector.
Hedging using futures markets is another market-orientated method (increasingly being used by developing countries) that can reduce short-term price risk instability.

**Box 2.1 Should There be an Agricultural Buffer Fund for Pakistan?**

Alternatives to the current system have been proposed by the Agricultural Pricing Commission (APC), which has argued the case for an agricultural buffer fund (Afzal and others 1993). They identify several problems with the current system. In particular, stabilization agencies (PASSCO in the case of wheat) must borrow funds from the government to purchase commodities on a cash-credit basis, and such funds can be obtained only up to a certain level. If funds are required over and above the cash-credit limit, they must be obtained at a higher rate from commercial banks. Under the current system, stabilizing agencies have to depend on financial assistance from the government for all other activities, such as transportation and storage. Annual profits earned by these agencies are credited to their revenues; any annual losses are not made up by the government promptly.

The APC has proposed the establishment of an agricultural buffer fund. The fund would receive the profits that would be earned when the FOB costs are below the international prices. But when losses occur because the domestic price (FOB cost) is higher than international prices, the losses would be met from the fund. Under the proposal, when the aggregate profits in the fund remain above the specified level for a period of, say, three years, one-third of the surplus could be allocated for promoting the production of these crops, and one-third allocated for promoting agricultural research, with the remaining one-third used for the conservation of resources.

Although the proposal has some merit, implementation of such a fund for wheat will be difficult given the time series properties of commodity prices. Commodity prices tend to have persistent and large swings and a significant element of uncertainty (Deaton 1992). Their revision to some kind of mean takes place very slowly, and it is difficult to distinguish between temporary and permanent commodity price shocks. Moreover, the creation of a fund is not costless. If the government ties up resources by creating a fund it will insure itself against adverse price outcomes. However, the cost of such self-insurance is the opportunity cost associated with investing these funds in productive activities that yield higher returns. Furthermore, in the case of wheat it is unclear how such a fund would operate given that the commodity is imported and that domestic prices are artificially held below international price levels.

Overall, the evidence points to a minimalist approach to wheat price stabilization in Pakistan. Where possible, efforts to stabilize wheat prices should rely on market mechanisms, avoid schemes that require physical handling of the commodity, stabilize prices only partially, and try to mimic prices that would be established in a freely operating market.
3. Managing Wheat Price Risk By Hedging

Under the current system, stabilization of wheat prices by the government involves significant intervention in the market. This chapter examines the use of commodity hedging as a market friendly and nondistortionary alternative that would be significantly less costly in terms of government outlays.

Hedging is a method of managing price risks that involves the buying and selling of financial assets whose values are linked to the underlying commodity markets. Hedging can be used by any market participants who intend to buy or sell a commodity some time in the future, and who wish to know with greater certainty what price they will pay or receive. Hedging enables better financial management and planning, and allows buyers and sellers of commodities to protect themselves against the potentially catastrophic consequences of sudden and unforeseen changes in market conditions.

For hedging to take place effectively the appropriate instruments must be available, their use must be fully understood, and economic policies or institutional barriers (such as legal constraints and distortionary agricultural price and input policies) that are not consistent with their use must be eliminated.

Alternative Hedging Instruments Available

Four major types of hedging instruments are available for managing commodity price risk: forward contracts, futures contracts, options, and swaps (see annex III for more detail on these instruments). A forward contract requires its buyer to purchase a given asset on a specified day at a specified price. At maturity, if the actual price is higher than the contracted price, the buyer makes a profit, if the price is lower, the buyer suffers a loss.

Hedging with futures contracts involves the buying and selling of futures contracts in such a way that movements in the value of the contracts offset the movement in the price of the commodity that the hedger will buy or sell in the future. Futures differ from forward contracts in that they are standardized, take place on organized exchanges, and are insured against default risk (World Bank 1994a).

Options give the purchaser the right to sell a certain asset at a preset price on or before a specified date. A buyer of the option owns the right to buy or sell; a seller of the option gives the right to sell or buy to a buyer. Options are written on futures contracts for commodities and financial instruments. They differ from forward contracts and futures contracts in two respects. First, they provide the opportunity to take advantage of favorable price movements. The cost for this opportunity usually is the premium, which is paid up front. Second, although the seller of the option is required to be creditworthy, the buyer is not, and it is the seller who is liable to deliver on the option if required, not the buyer.
Swap contracts obligate two parties to exchange, or swap, specified cash flows at specified intervals. A swap contract can thus be viewed as a series of forward contracts according to specified schedules. Commodity swap contracts have the same characteristics as forward contracts—no cash flows are involved at the beginning and there is substantial credit risk. However, commodity swaps are purely financial exchanges and do not involve delivery of physical commodities.

Potential Obstacles to Using Hedging Instruments

In theory, managing commodity price risks with the use of hedging instruments could be highly beneficial to Pakistan. In practice, however, the feasibility of using hedging instruments to stabilize wheat prices depends critically on various economic and institutional conditions. In many developing countries barriers that make hedging impractical or even illegal exist. Varangis (1994) identified a number of such obstacles, including legal and regulatory barriers, government intervention, lack of familiarity with hedging instruments, financial constraints, and basis risk. The relevance of each of these potential obstacles in Pakistan is examined briefly below.

Legal and Regulatory Barriers

In many developing countries, market-based hedging is prevented because of legal and regulatory barriers. Foreign exchange controls, for example, which are common in developing countries, often make hedging impossible. In some countries, such as Indonesia, laws explicitly prohibit commodity brokerage activities. In terms of regulatory barriers, since the structural adjustment program in Pakistan was introduced, financial markets have become increasingly liberalized and most foreign exchange controls have now been lifted. In particular, there are no controls on transactions on the current account, including goods, services, and transfers. There are restrictions on the capital account, however (box 3.1). No current laws or statutes that would automatically prohibit hedging in commodities futures markets by Pakistani residents.

Government Intervention

The current system of fixing procurement and release prices for the whole season and announcing the prices well before planting means that private farmers and traders do not need to carry out risk management activities of their own. In this sense, the government has crowded out private sector risk management activities as it has private sector storage and transportation.

Lack of Familiarity with Hedging Instruments

The lack familiarity with futures markets and expertise in how to use them is a major obstacle to hedging in many countries. Another problem concerns misconceptions that hedging is a form of speculation. There is also some misunderstanding about the tradeoffs between risks and returns that can lead to the perception that hedging strategies that result in higher total import bills are counterproductive. In response to this lack of understanding of hedging, the World Bank has
been providing technical assistance in the use of financial instruments to manage commodity price risk to some governments in developing countries. As familiarity and experience with such instruments increase and as the liquidity, breadth, and depth of futures exchanges around the world grow, developing countries can be expected to play an increasingly important role in these markets.

Box 3.1 Current Foreign Exchange Arrangements

A managed flexible exchange rate system is in operation in Pakistan in which the central bank sets the official exchange rate at which it will buy and sell U.S. dollars in transactions with authorized dealers and money lenders. There is also a free market for foreign currency entered into by banks and money dealers and where a free market exchange rate is set in Karachi.

Since July 1995, the rupee has been fully convertible on current account basis (satisfying IMF article VIII that requires the removal of all restrictions on foreign exchange movements related to current account transactions). Certain items may not be imported or exported and trade with some countries is prohibited but these restrictions are permitted under GATT rules. Restrictions do apply to transactions on the capital account, however, into which category fall financial outflows involved in hedging, such as options contract premia, margins on futures contracts, and settlement price differentials in forward commodity and exchange rate contracts (net settlement on forward interest rate is treated on the current account). However, these capital account restrictions are moderate, as evidenced by the relatively small premium of the market exchange rate over the official exchange rate.

Pakistani residents may use foreign exchange to buy foreign currency paper, of which there are three major types. Foreign currency bearer certificates (FCBCs) have maturities up to five years and are denominated in major currencies (including U.S. dollars). They may be brought into and taken out of the country, and may be cashed at any time for rupees or for foreign exchange at the prevailing exchange rate. They may be used by residents in any current or international capital transaction. Dollar bearer certificates (DBC)s generally have a maturity of one year, are denominated in U.S dollars, and yield roughly 0.25 percent above LIBOR. Foreign exchange bearer certificates (FEBCs) are denominated in both rupees and in foreign currencies. At maturity, the holder can use the foreign exchange to make foreign transactions, including the purchase of imports or securities, although these must be reported to the central bank. Transfers of capital abroad by a resident national are, in general, not permitted.

FEBCs could be used to finance the foreign exchange outflows associated with hedging, although this method is somewhat inflexible, especially for maintaining margin accounts that have to be settled on a daily basis. Foreign exchange inflows resulting from hedging would not be subject to any controls, however.

Although international financial markets, including those for risk management, are well understood by many in the private sector, such understanding may be lacking in Pakistan’s public
sector. Because hedging has never been used in Pakistan, public officials are not likely to understand how such financial instruments are used for risk management. It is hoped that this study will go some way in improving knowledge and awareness among public officials and policymakers.

**Financial Constraints**

Some hedging instruments require upfront costs, which can represent obstacles for some potential market participants. Option contracts, for example, require a premium, futures contracts require a margin, and some forms of financial collateral may be required for swaps and over-the-counter arrangements. Several potential participants in developing countries (both governments and private traders) have found their country's credit standing has prevented commercial banks and commodity brokers from dealing with them. Creditworthiness is less of an issue for short-dated instruments (such as futures) because default risk is handled through formal mechanisms at the exchanges. Options that are purchased also do not involve significant credit risk on the side of the developing country. However, options that are sold and forward swaps do involve credit risk; the longer the contract, the greater the volatility of the underlying prices, and therefore the greater the credit risk. Because many developing countries lack sufficient credit standing their access to some risk management instruments is limited. Market participants may be unwilling to offer even the more creditworthy developing countries swap contracts extending beyond one year.

Pakistan is not a severely indebted country and has remained prompt in servicing its debt to official creditors. It has an especially good record with respect to the World Bank Group. Nevertheless, a financial intermediary offering an over-the-counter instrument to Pakistan may have some reservations because of perceptions that over the medium-term the balance of payments position may deteriorate as a result of an external shock or macroeconomic policy slippage. In early 1996, for example, Pakistan's official reserves of $1.5 billion, though well above pre-1994 levels, were sufficient to cover only about 7—8 weeks of imports. In addition, net short-term foreign currency liabilities (foreign currency deposits) were roughly $7 billion. Furthermore, the external debt to GDP ratio is high at around 40 percent (the ratio falls to about 15 percent when concessional debt is taken out), and close to one-quarter of the total external debt is at variable interest rates, making the debt servicing requirements vulnerable to adverse interest rate swings. Finally, political and social unrest within Pakistan, particularly Karachi, adversely affects the perception of the country's creditworthiness.

**Basis Risk**

Even if all legal and institutional barriers were removed and no informational or awareness constraints existed, hedging might still not provide Pakistan with an effective means of managing its commodity price risk. The effectiveness of hedging depends on a number of factors, including the nature of the commodity traded, the timing of purchases, transportation costs, and policy variables—factors that disassociate prices quoted on the commodity exchanges with those
actually paid by importers in Pakistan. If the disassociation becomes too great, risk management with futures will not be effective.

A commodity futures contract sets forth a series of specifications that the commodity must meet if it is to be honored by making or taking delivery of the physical product. The futures price applies only to commodities meeting these characteristics. Most hedgers do not trade commodities whose characteristics are identical to those specified in the futures contract. Wheat growers in southern Illinois might deliver their output to millers in the local market in Springfield, for example, while wheat futures contracts traded on the Chicago Board of Trade are deliverable at warehouses in Chicago, Toledo, and St. Louis. In this case, the difference in the cash price received and the futures price would reflect (among other factors) the freight differential between Springfield and Chicago. Different quality characteristics also affect the cash price received. A farmer who hedges a contract on the Minneapolis Grain Exchange for delivery of soft white wheat No.1 could expect a lower cash price than that indicated in the futures contract if he delivers soft white wheat No. 2. This difference is called the basis\(^9\). Many developing countries do not participate in hedging activities because of large variations in the basis (composed of factors such as ocean freight, currency rates and export subsidies).

By observing the basis overtime, experienced hedgers are able to predict the basis with good degree of accuracy. Unforeseen differences between the futures contracts and cash prices result in an unpredicted basis. This risk is known as basis risk, which cannot be managed by hedging. Because hedging does not eliminate all uncertainty, it can be viewed as merely substituting basis risk for price risk. Overall risk is nevertheless reduced because basis risk is considerably less than price risk (since cash and futures prices tend to be closely correlated).

Another way of viewing the risk of hedging is to break the price risk for a hedger into two components—the price risk inherent in the futures prices and the balance of price risk inherent in the basis. This can be represented by the formula cash price = futures price + basis. By hedging in futures markets, the hedger is able to eliminate the components of price risk represented by the futures price. What is left is a residual price risk, or a basis price risk.

Overseas hedgers face additional sources of basis risk. Importers generally pay the freight charges (CIF price), which can be highly volatile, especially during periods of unstable energy prices. Subsidies (or bonuses, as they are sometimes called) paid to developing country importers by major wheat exporters (particularly the United States and European Union) are policy driven and can vary substantially from one period to the next. Finally, a high degree of volatility in the exchange rate can limit the effectiveness of hedging for offshore traders. Because the basis for overseas traders includes additional factors, the basis risk is higher.

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\(^9\) Other possible sources of basis risk involve the size of the contract and the maturity. The mismatch may be with respect to maturity given that the market for futures and options usually is limited to a maximum two-year horizon. Markets for longer-maturity risk-hedging financial instruments have not developed enough to be used widely in developing countries. Over-the-counter arrangements often provide the best solution to overcome basis risk problems because such arrangements can be customized in order to reflect the specific quality, maturity, and location of interest to the hedger.
Effectiveness of Hedging Pakistan Wheat Price Risk

If hedging is to be effective in Pakistan, it must be demonstrated that the basis can be measured with a fair degree of accuracy and that the basis risk is not excessive. The effectiveness of hedging in Pakistan depends on the extent to which the cash prices of government wheat purchases on the international market are correlated with wheat futures prices. A commonly used test for this correlation is to regress a time series of nearby futures contract prices on the corresponding cash price series. The higher the correlation, as measured by the $R^2$ statistic, the greater the extent to which movements in cash prices can be explained by movements in futures prices, and therefore the more effective the hedging operations will be. The basis risk can be measured by the variability in cash prices not explained by futures price movements, or simply by $(1 - R^2)$. The rule of thumb of experienced hedgers suggests that a measure of more than 15—20 percent represents a high level of risk.

To quantify the potential effectiveness of hedging Pakistan wheat on U.S. futures exchanges, tests were made for three futures contracts—No. 1 soft white wheat traded on the Minneapolis Grain Exchange, No. 2 hard red winter wheat traded on the Kansas City Board of Trade, and No. 2 soft red winter wheat traded on the Chicago Board of Trade. These contracts were chosen because they cover wheat whose characteristics are closest to those of wheat commonly imported by Pakistan. Monthly data for the three contracts were collected from February 1991 (when the Minneapolis contract started trading) to April 1995 providing a total of 51 observations.

Correlations were tested against four different import (cash) prices—the U.S. dollar FOB price of western white wheat at Pacific Northwest ports, the price of wheat delivered at Karachi, the Karachi price adjusted for EEP, and the Karachi price in Pakistani rupees. Because all price series were found to be nonstationary based on the Durbin-Watson test, they were transformed by taking first differences. Subsequent tests of the transformed series showed them to be stationary in all cases.

A high degree of correlation was found between the wheat futures contract price on the Minneapolis Grain Exchange and the U.S. dollar FOB price of western white wheat quoted at Pacific Northwest ports. The results showed that 89 percent of the variation in the cash prices can be explained by variations in the futures prices, with a basis risk of only 11 percent (most likely reflecting variability in transportation costs). This indicates that at least the U.S. dollar

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10 Measuring the basis risk in this manner is sometimes complicated by the statistical properties of time series data. In particular, the validity of testing the correlation between cash and futures prices using regression requires that each price series be stationary. A stationary series is one in which the underlying stochastic process generating the series is invariant with respect to time (that is, the stochastic process is in equilibrium over time about a constant mean level and the probability of any given fluctuation around that mean level is the same at any point in time). Typically, time series price data are nonstationary because they are influenced by seasonal factors. Fortunately, several straightforward tests for stationarity such as the Durbin-Watson test of Sargan and Bhargava and the Dickey-Fuller test can be performed (Palaskas and Varangis 1991). In most cases, cash and futures price series that are found to be nonstationary can be transformed into stationary series simply by taking first differences (that is, the price in period $T$ minus the price in period $T-1$). The differenced series can then be regressed against one another, with the $R^2$-squared coefficient from the regression providing a valid measure of hedging effectiveness and basis risk.
FOB price at Pacific Northwest ports faced by Pakistan could be fairly well hedged by trading wheat futures contracts on the Minneapolis Grain Exchange.

<table>
<thead>
<tr>
<th>Measure of Hedging Effectiveness and Basis Risk, February 1991—April 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td><strong>Minneapolis Soft White #1</strong></td>
</tr>
<tr>
<td>FOB dollar price at Pacific Northwest ports</td>
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<tr>
<td>CIF dollar price at Karachi</td>
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<tr>
<td>CIF dollar price at Karachi adjusted for EEP subsidies a/</td>
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<tr>
<td>CIF rupee price at Karachi adjusted for EEP subsidies a/</td>
</tr>
<tr>
<td><strong>Kansas City Hard Red Winter #2</strong></td>
</tr>
<tr>
<td>FOB dollar price at Pacific Northwest ports</td>
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<tr>
<td>CIF dollar price at Karachi</td>
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<tr>
<td>CIF dollar price at Karachi adjusted for EEP subsidies a/</td>
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<tr>
<td>CIF rupee price at Karachi adjusted for EEP subsidies a/</td>
</tr>
<tr>
<td><strong>Chicago Soft Red Winter #2</strong></td>
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<tr>
<td>FOB dollar price at Pacific Northwest ports</td>
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<tr>
<td>CIF dollar price at Karachi</td>
</tr>
<tr>
<td>CIF dollar price at Karachi adjusted for EEP subsidies a/</td>
</tr>
<tr>
<td>CIF rupee price at Karachi adjusted for EEP subsidies a/</td>
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</tbody>
</table>

a/ From Ordinary Least Squares regression; cash price = a + b * nearby futures price. All price series were transformed into first differences. Regressions were run from September 1992, the first time Pakistan qualified for EEP subsidies.

Source: Authors’ Estimates.

Correlations between the western white wheat price adjusted for freight charges and the Minneapolis wheat futures contract were then tested. Because the variation in freight rates between Pacific Northwest ports and Karachi has been low since early 1991, the correlation was the same (R-squared of 89 percent), with a corresponding basis risk of only 11 percent. This indicates that hedgers in Pakistan could manage the risk of fluctuating U.S. dollar CIF prices, assuming there were no export subsidies.

The picture changed dramatically when correlations between Minneapolis futures prices and U.S. dollar Karachi price of western white wheat adjusted for EEP subsidies were tested. The R-squared from the regression was only 0.59, implying a basis risk of 41 percent, considerably above the 15—20 percent considered acceptable. This decline in correlation reflects not only the instability of EEP payments but also the fact that they represent a large percent of the overall purchase price. The finding also suggests that continuation of subsidies would significantly limit the effectiveness of hedging as a risk management mechanism. Converting the CIF Karachi price into rupees yielded a slightly lower correlation with the Minneapolis futures prices (R-squared of 0.55), a level also well below that needed to make hedging effective.

26
The same set of correlations was tested using the prices of the No. 2 hard red winter wheat futures contract traded on the Kansas City Board of Trade and the No. 2 soft red winter wheat futures contract traded on the Chicago Board of Trade. Overall, changes in the price of these futures contract were less correlated with changes in the relevant wheat prices for Pakistan. Even before adjusting for transport costs, EEP subsidies, and exchange rates, only half the changes in the U.S. dollar western white wheat price at Pacific Northwest ports could be explained by the changes in the futures price on the Chicago Board of Trade. This finding indicates that the Chicago wheat futures contract would not be an effective hedging instrument for Pakistani importers.

How Much of the Wheat Position Should be Hedged?

If there is no basis risk and all changes in cash prices are explained by changes in futures prices, hedgers should cover all cash transactions with futures contracts. When there is basis risk, however, hedgers should generally cover only a portion of their cash position. The portion of the cash position covered by futures contracts is called the hedge ratio. The hedge ratio is an important policy variable that can be determined by statistical analysis of cash and futures prices, as described below.

In Pakistan, the instability of wheat import costs depends on the variability of both the volume of imports and import prices. However, since the import volume is controlled by the government, fluctuating prices are the main source of risk exposure and controlling price fluctuations is the main objective of risk management strategies. One way to view the hedging decision is as a portfolio selection problem in which the hedger selects the optimal proportions of wheat imports that are unhedged (cash) and hedged (futures). In this case, the goal is to minimize the variance of the value of the portfolio of hedged and unhedged imports. Based on portfolio selection theory, it can be demonstrated that the optimal hedge ratio is equivalent to the slope coefficient in the ordinary least squares regression between changes in the cash and futures prices (see annex IV for mathematical derivations).

Calculating the optimal hedge ratio in this manner assumes that the hedger seeks to minimize risk. Selecting the portfolio of hedged and unhedged imports that minimizes risk may result in a higher import bill that could otherwise be obtained. Whether the importers consider the higher import bill acceptable depends upon how risk averse they are. If the importers are infinitely risk averse, minimizing risk is appropriate. If the importers are less risk averse, they would be willing to bear some risk, in order to reduce the cost of imports. Given its concern over commodity price risks, it seems reasonable to assume that the government is infinitely risk averse and to select hedge ratios accordingly (table 3.2).

Assuming risk minimization, hedging the U.S. dollar FOB wheat prices at Pacific Northwest ports using the Minneapolis Grain Exchange yields a hedge ratio of 0.92. This means that if the government wished to purchase, say, 2 million tons of wheat, it would need to cover 1.84 million metric tons with futures contracts, or roughly 13,522 contracts (assuming about 136 tons per
Hedge ratios range from 0.91 for the U.S. dollar CIF price adjusted for EEP subsidies to 0.94 for the U.S. dollar CIF price without the subsidy. Hedge ratios decline using the Chicago wheat contract, ranging between 0.64 and 0.66. In general, the hedge ratios decline as the level of basis risk increases. This is because $R^2$ is a measure of the hedging effectiveness, and $1 - R^2$ is the basis risk. Thus the greater (lesser) the hedging effectiveness, the lesser (greater) the basis risk.

Table 3.2 Risk Minimizing Hedge Ratio, February 1991—April 1995

<table>
<thead>
<tr>
<th>Price</th>
<th>Hedge ratio a/</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minneapolis Soft White #1</strong></td>
<td></td>
</tr>
<tr>
<td>FOB dollar price at Pacific Northwest ports</td>
<td>0.92</td>
</tr>
<tr>
<td>CIF dollar price at Karachi</td>
<td>0.94</td>
</tr>
<tr>
<td>CIF dollar price at Karachi adjusted for EEP subsidies</td>
<td>0.91</td>
</tr>
<tr>
<td>CIF rupee price at Karachi adjusted for EEP subsidies</td>
<td>0.84</td>
</tr>
<tr>
<td><strong>Kansas City Hard Red Winter #2</strong></td>
<td></td>
</tr>
<tr>
<td>FOB dollar price at Pacific Northwest ports</td>
<td>0.75</td>
</tr>
<tr>
<td>CIF dollar price at Karachi</td>
<td>0.76</td>
</tr>
<tr>
<td>CIF dollar price at Karachi adjusted for EEP subsidies</td>
<td>0.76</td>
</tr>
<tr>
<td>CIF rupee price at Karachi adjusted for EEP subsidies</td>
<td>0.74</td>
</tr>
<tr>
<td><strong>Chicago Soft Red Winter #2</strong></td>
<td></td>
</tr>
<tr>
<td>FOB dollar price at Pacific Northwest ports</td>
<td>0.66</td>
</tr>
<tr>
<td>CIF dollar price at Karachi</td>
<td>0.66</td>
</tr>
<tr>
<td>CIF dollar price at Karachi adjusted for EEP subsidies</td>
<td>0.64</td>
</tr>
<tr>
<td>CIF rupee price at Karachi adjusted for EEP subsidies</td>
<td>0.65</td>
</tr>
</tbody>
</table>

a/ Slope coefficient regression between first differences of cash and nearby futures prices.

Source: Authors' Estimates.

The analysis indicates that, absent export subsidies, hedging Pakistani wheat purchases using the soft white wheat contract that is traded on the Minneapolis Grain Exchange could be effective. The existence of export subsidies severely limits the effectiveness of hedging, however. If the level of export subsidies were to decline over time, the effectiveness of hedging would increase. Two developments suggest that export subsidies may be reduced in the future. One of the key provisions of the Uruguay Round of the General Agreement of Tariffs and Trade (GATT), which was signed in late 1993 was to reduce the overall level of export subsidies (a provision most affecting the United States and the European Union). The agreement called for a 21 percent decline in the volume of export subsidies and a 36 percent drop in their value from a 1986–90 base period. In the United States, proposals for new farm legislation call for a restructuring of agricultural programs. Budgetary pressures are expected to limit agricultural spending, with the EEP a target for major cuts. Although elimination of the EEP is unlikely, a large reduction in funding is expected that could result in a reduction of subsidies below the levels required under the GATT.
Internal Procedures and Requirements for Hedging

How involved should the government be in hedging activities? What should the organizational structure of the government's risk management activities be? At one end of the spectrum is complete government control of the risk management process; at the other extreme is the government facilitating private sector utilization of derivative instruments, such as futures and options. Which strategy is best for the government? The government's current role in the wheat market suggests that at least in the initial stages it is likely to continue to play a dominant role. A unit could be established that would work in conjunction with other agencies involved in wheat importation. In thinking about the organizational structure of such a unit, it is helpful to identify the primary sources of price risk inherent in the wheat importation process. At least four components contribute to price risk: the FOB price of wheat from the exporting country; ocean freight; the currency rate; and, in the case of wheat imported from the United States, the value of the export subsidies or bonuses received. A price risk management program would focus on the FOB price component, with other specialized departments conducting price risk management activities in the other areas.

A possible design structure is shown in figure 3.1. The coordinating group would oversee the risk management activities of all of the areas below it. In addition, it would manage the actual purchase and distribution of the wheat imports. The purpose here is to show how risk management functions should be incorporated into the overall organizational structure.

Figure 3.1 Organizational Structure for Risk Management

Derivative instruments used in price risk activities are sophisticated instruments that require specialized training and experience. Moreover, adequate controls and oversight must be exercised in order to ensure proper implementation. Within the context of a centrally controlled government organization, training and oversight are so concentrated that the development of a viable risk management program can be implemented in a relatively short time. If the eventual goal, however, is a broader application of these concepts within the commercial and producer sector, a much more extensive program of education and training must be developed, with ample time given for the broadest possible exposure (assuming that government policies that crowd out private risk management activities are removed). A good starting point for such a program is the incorporation of risk management into academic teaching and research. In this way a cadre of young professionals familiar with these concepts can be trained and ready for eventual participation. Broad training for professionals in the form of a series of one to two week seminars
has also proven effective in other economies (such as Central Europe) for building skills and awareness within the general business community.

**Practical Aspects of Implementing a Price Risk Management Program**

To implement a price risk management strategy, the entity established by the government to execute the program will have to deal with a variety of external institutions and issues, which are summarized below.

*Trade Execution*

In a conventional price risk management program hedging transactions would take place through a licensed broker who is a member of the relevant commodity exchange or exchanges. Given the expected size of the government's hedging program, it would likely use the services of several brokers in order to conceal activity in the market. Brokers also act as sources of information and market intelligence. Using several brokers thus helps expand the information network for the brokerage customer.

*Broker Registration and Compliance*

Registering with a broker is a relatively straightforward and simple process. An entity affiliated with the government would register as a hedger rather than as a speculator. All entities that register to trade commodities in the United States are restricted in the number of futures contracts that can be held at any given time. These limits are higher for hedgers than they are for speculators. In the case of wheat, hedgers in the United States are allowed to control 16 million bushels (436,000 metric tons) and up to 3 million bushels (82,000 metric tons) in the spot month. These parameters are probably below what the government would need to institute a hedging program, given annual wheat imports of 2 million metric tons or more. In this case, the government could apply to the Commodity Futures Trading Commission for a waiver of the position limits. Such waivers are not generally difficult to obtain.

*Broker Margins and Brokerage Commissions*

To ensure performance against contracts, brokers typically require customers to post margin money against active positions. These margins vary somewhat depending on the absolute price level of the commodity and the underlying volatility. In the case of wheat, margins could be expected to be about $500 per contract, or about $3.70 per metric ton. At the close of trading each day, the margin account is debited or credited depending on the direction of prices.

The broker is paid a commission for this service and is ultimately responsible for the integrity of the client's contracts. Brokerage fees in the United States are negotiable and for grains range from about $12 to $60 per contract (or $0.09 to $0.44 per tons). Given the size of a Pakistani hedging program it is likely that the lowest commission could be negotiated. Assuming an import
program of 2 million metric tons, the lowest commission level would imply a yearly commission cost of roughly $180,000.

Account Monitoring

As noted in the strategic discussion, internal oversight of market activities of a price risk management unit within the government is extremely important. From a risk management standpoint, the futures position must always be compared to and reconciled with the physical cash position in order to obtain an accurate picture of the overall price risk position of the organization. In a more general sense, adequate reports must be developed so that there are never any surprises or unforeseen problems with regard to the futures hedging activities.

In chapter 3 hedging was shown to provide an alternative to price stabilization schemes currently employed by the government. Provided that all institutional and financial constraints are removed, hedging could protect the government against sharp increases in world wheat price (as experienced over the past year), the benefits of which could be distributed among market participants. This chapter analyzes specific hedging strategies using actual data for 1994.

Assumed Wheat Policy Environment

The government has intervened in the wheat market in Pakistan both to stabilize prices and to lower their average level. As noted earlier, the policy of maintaining wheat prices below an equilibrium (import parity price) is not tenable and should be discontinued. The policy and institutional environment in which hedging is, therefore, assumed to take place is outlined below:\textsuperscript{11}

- The wheat import subsidy is eliminated and the government sets a price (the release price) at which it sells imported wheat to mills equal to the expected average import parity price for the coming year. To provide the market with stability, the release price is announced at the beginning of the year and remains fixed throughout.

- By buying at a variable international price and selling at a fixed domestic price, the government effectively pools the risk of individual market participants and assumes the risk for itself. In particular, the government is exposed to the risk of international prices rising by more than expected, thereby requiring a subsidy to maintain the fixed price (figure 4.1). Of course, if the international price falls below the fixed domestic price, the government would impose a tax on wheat imports, bringing the import price up to the domestic price level\textsuperscript{12}.

- As mentioned in chapter 3, the international wheat price cannot be predicted accurately so that the subsidies required when the international price rises higher than the fixed domestic price cannot be expected to be offset by the revenues received when the international price falls below the fixed domestic price. To manage this risk, the government can hedge using

\textsuperscript{11} Other strategies could be developed. One alternative would be for the government to abstain from importing when the parity price is below the fixed price, in order to let the private sector import at the import parity price. This would reduce the cost of flour and would also benefit consumers. This policy would work as a call option from the government to wheat millers: the government subsidizes imports as long as the local price is lower than the import parity price but when the parity price falls below the fixed price, the government allows millers to benefit from lower world prices. The government could use hedging to manage its exposure to higher international prices.

\textsuperscript{12} Such a variable levy scheme may be illegal under the Uruguay Round agreement, although this remains a fuzzy area. Variable levies that determine the tariff rate based on the price of each individual shipment are illegal. But if the tariff rate is based on some international comparator so that all shipments on the same day face the same tariff rate, the mechanism is legal, although even this seems to be in doubt.
financial instruments. Three hedging strategies using futures, options, and swaps are outlined below, and their effectiveness is evaluated.

Figure 4.1 Prices, Subsidies and Taxes Under Assumed Wheat Policy

Strategy I: Hedging with Futures Contracts

One possible hedging strategy using futures contracts would enable the government to lock in an international price for its wheat purchases at the beginning of the year. This price would be equal to the weighted sum of wheat futures prices maturing at various month throughout the coming year, with weights determined by the quantities of wheat imported in the months between each contract expiration\textsuperscript{13}. Say, for example, that in December 1993 the government wished to fix the release price for the 1994 crop. Wheat futures contracts can expire in five different months (March, May, July, September, and December); in December 1993 prices for delivery in each of these months in 1994 were established in the market. On the basis of historical import trends, the government could predict fairly well the proportions of the total import requirements before each of the delivery months (for example, January, February, March, 10 percent; April and May, 20 percent; June and July, 30 percent; August and September, 25 percent; and October, November, and December, 15 percent). These proportions could then be used to obtain a weighted import price for the coming year. This price would be guaranteed and could be used to set the fixed release price assuming expected freight costs, export subsidies, and exchange rates\textsuperscript{14}. This strategy can be represented as follows:

\textsuperscript{13} Multiple variations of this strategy exist whereby hedging is concentrated or dispersed among various contract months. Which month to hedge in involves judgment and expertise. For the purpose of these examples the conventional hedge approach was used, matching calendar months with the corresponding futures contract months.

\textsuperscript{14} In practice establishing an import parity price at one point during the marketing year is difficult, for two important reasons. First, it is not always possible to obtain quotes for export wheat twelve months ahead; typically such quotes are made only five
\[ IP = \sum_{i=1}^{t} w_i FP_i \]  
\[ w_i = \frac{I_i}{TI} \]  
\[ RP = (IP + FC + ES) \cdot ER \]

where: \( IP = \) fixed international price, \( FP_i = \) futures price for contract \( i \) at beginning of year, \( w_i = \) percentage of imports required in months between expiration of contract \( i \) and expiration of previous contract, \( I_i = \) imports required in months between expiration of contract \( i \) and expiration of previous contract, \( TI = \) total annual imports, \( RP = \) release price, \( FC = \) expected freight costs, \( ES = \) expected export subsidies, and \( ER = \) expected exchange rate.

This strategy is evaluated using actual cash and futures prices for 1993 and 1994, with futures prices quoted for the white wheat futures contract traded on the Minneapolis Grain Exchange\(^5\). In mid-December 1993 the government decides that its import needs for calendar year 1994 are about 1.2 million tons of white wheat (roughly the average annual import volume over the past ten years), and wishes to purchase of 100,000 tons in each month during the year. The government also wishes to lock in the prevailing mid-December price of $133 per ton for the entire purchase, on the basis of which the fixed release price is announced (assuming expected freight costs, export subsidies from suppliers and exchange rates). In executing the strategy, the

to six months into the future. An actual example from December 16, 1993, is typical. On that day, quotes for white wheat FOB Portland (measured in U.S. dollars per metric tons) were as follows: December 1993, $133.20; January 1994, $133.38; February 1994, $134.50; March 1994, $134.70; April 1994, $135.00, and May 1994, $135.20. Price quotes beyond May of 1995 were not available. If the government wanted to establish prices thereafter it would have had to do so by special negotiation and would likely have to pay a heavy premium for doing so. A second practical problem in establishing prices for an entire year is that the magnitude of MINFAC purchases would make it difficult to operate in the physical cash markets without causing strong increases in prices as a result of market reaction to the higher expected demand. An advantage of futures markets is the degree of anonymity that executing orders through a broker allows.

\( ^5 \) It should be noted that at the time of this example it is unlikely that the large volume could have been effectively hedged on the Minneapolis Grain Exchange. Contracts from other exchanges (the Chicago Board of Trade and Kansas City Board of Trade) could also have been used, as the Minneapolis Grain Exchange white wheat contract did not have a great deal of liquidity in 1993 and 1994. For simplicity, however, the futures operations aspect of this example is confined to Minneapolis Grain Exchange contracts. This raises two practical issues that need to be addressed with regard to hedging white wheat. First, as already noted, liquidity on the white wheat contract is low and therefore represents a problem for hedging large quantities. However, the basis volatility between the FOB white wheat to the Chicago Board of Trade and Kansas City Board of Trade wheat contracts was found to be substantially higher than for white wheat futures contracts on the Minneapolis Grain Exchange. It should be noted however, that contract volume on the Minneapolis Grain Exchange Minneapolis Grain Exchange white wheat contract is growing and the prospects of this market providing an adequate hedge in the future are improving. More importantly, as the role of governments in the export wheat trade declines, the wheat contracts on the Chicago Board of Trade and Kansas City Board of Trade should more closely reflect global export wheat prices. Under these conditions, these futures contracts will provide a better hedging mechanism than has been the case in the past. The critical point is that the recent and significant structural changes in the wheat market mean that past cash and futures price relationships may not hold in the future, and it is possible that in the new trade environment prices on the Chicago Board of Trade and the Kansas City Board of Trade may better reflect global supply and demand conditions. This being the case, the type of techniques described here will be even more effective as price risk management tools than is currently possible.
government buys 100,000 tons of wheat on the first trading day of each month, and buys and sells futures contracts with expiration dates coinciding with future purchases (see table 4.1).

To illustrate how the hedging operates, take the two months January and December. On January 3, 1994, the government purchases 100,000 tons of wheat on the international market and at a price of $133.4 per ton. On the same day, it sells 676 of the March futures contracts at a price of $136.5 per ton. Buying the March futures at $136.7 per ton and selling them at $136.5 yields a loss of $0.18 per ton, or $0.17 per ton with the 0.92 hedge ratio. Including a brokerage fee of $0.15 per ton, the effective price paid was $133.7 per ton ($133.4 per ton cash price plus $0.17 per ton loss from the futures transaction plus the $0.15 per ton brokerage fee). By comparison on December 1, 1994, the government purchases 100,000 tons of wheat on the international market at a price of $164.2 per ton. On the same day, it sells 676 of the December futures contracts at a price of $166.4 per ton. Buying the December futures back in March at $130.4 per ton and selling them at $166.4 per ton in December yields a profit of $36.01 per ton, or $33.13 per ton with the 0.92 hedge ratio. Including a brokerage fee of $0.15 per ton, the effective price paid was $131.3 per ton ($164.2 per ton cash price less $33.1 per ton gain from the futures transaction plus the $0.15 per ton brokerage fee).

The pattern of cash wheat prices showed a decline into April of 1994 followed by strong price increases in the succeeding months. This is not an unusual market pattern and, in fact, is the type of price activity expected in the international wheat market. However, it is important to remember that the original objective of the hedging strategy was to establish an import price at or near the desired level of $133 per ton. Losing sight of this will lead to the erroneous conclusion that it would have been better not to hedge purchases up to April 1994, a period of declining market prices.

A comparison of the gross FOB import price (what the government would have paid if it had not hedged) and the net FOB import price (the price that would have been paid for white wheat FOB Portland net of brokerage charges and including the gain or loss from futures transactions) are shown in the first two columns of table 4.2 and in figure 4.2. As shown, the government would have paid a lower price in eight of the twelve months; in two of the remaining four months the higher net import price was less than $1 per metric ton.

It is also informative to look at the total import cost for wheat under each scenario. Under the nonhedged scenario (gross FOB import price) total expenditure is 6.1 billion rupees (average monthly price times import volume of 1.2 million tons). Under the hedged scenario (net FOB import price) total expenditure is 5.7 billion rupees. Clearly the government was better off having hedged. The results also clearly show the effectiveness of hedging in terms of reducing the variability of import costs. If the government had not hedged the monthly import bill would have ranged from 457 million rupees in April to 595 rupees in October, with the biggest month to month change between September and October, when the cost would have increased by 67
Table 4.1 Analysis of Cash and Futures Transactions

<table>
<thead>
<tr>
<th>Month</th>
<th>Date bought</th>
<th>Cash price paid ($)</th>
<th>Contract expiration date</th>
<th>Cash Date</th>
<th>Future Date</th>
<th>Future purchase price ($)</th>
<th>Gain/loss with hedge ratio c/ ($)</th>
<th>Brokerage fee ($)</th>
<th>Effective price paid e/ ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>01/03/94</td>
<td>133.4</td>
<td>Mar 94</td>
<td>12/16/93</td>
<td>01/03/94</td>
<td>136.5</td>
<td>-0.18</td>
<td>-0.17</td>
<td>0.15</td>
</tr>
<tr>
<td>February</td>
<td>02/01/94</td>
<td>130.4</td>
<td>Mar 94</td>
<td>12/16/93</td>
<td>02/01/94</td>
<td>132.3</td>
<td>-4.40</td>
<td>-4.05</td>
<td>0.15</td>
</tr>
<tr>
<td>March</td>
<td>03/01/94</td>
<td>127.5</td>
<td>Mar 94</td>
<td>03/01/94</td>
<td>129.0</td>
<td>-7.71</td>
<td>-7.09</td>
<td>0.15</td>
<td>134.7</td>
</tr>
<tr>
<td>April</td>
<td>04/04/94</td>
<td>126.8</td>
<td>May 94</td>
<td>04/04/94</td>
<td>130.1</td>
<td>-6.25</td>
<td>-5.75</td>
<td>0.15</td>
<td>132.7</td>
</tr>
<tr>
<td>May</td>
<td>05/02/94</td>
<td>137.8</td>
<td>May 94</td>
<td>05/02/94</td>
<td>139.4</td>
<td>3.12</td>
<td>2.87</td>
<td>0.15</td>
<td>135.1</td>
</tr>
<tr>
<td>June</td>
<td>06/01/94</td>
<td>134.1</td>
<td>July 94</td>
<td>01/01/94</td>
<td>134.1</td>
<td>-0.73</td>
<td>0.67</td>
<td>0.15</td>
<td>133.6</td>
</tr>
<tr>
<td>July</td>
<td>07/01/94</td>
<td>132.3</td>
<td>July 94</td>
<td>01/01/94</td>
<td>134.1</td>
<td>0.00</td>
<td>0.00</td>
<td>0.15</td>
<td>132.4</td>
</tr>
<tr>
<td>August</td>
<td>08/01/94</td>
<td>127.9</td>
<td>Sept 94</td>
<td>02/16/94</td>
<td>131.5</td>
<td>1.84</td>
<td>1.69</td>
<td>0.15</td>
<td>126.3</td>
</tr>
<tr>
<td>September</td>
<td>09/01/94</td>
<td>147.0</td>
<td>Sept 94</td>
<td>02/16/94</td>
<td>131.5</td>
<td>19.10</td>
<td>17.57</td>
<td>0.15</td>
<td>129.6</td>
</tr>
<tr>
<td>October</td>
<td>10/03/94</td>
<td>169.0</td>
<td>Dec 94</td>
<td>03/01/94</td>
<td>130.4</td>
<td>44.09</td>
<td>40.56</td>
<td>0.15</td>
<td>128.6</td>
</tr>
<tr>
<td>November</td>
<td>11/01/94</td>
<td>166.4</td>
<td>Dec 94</td>
<td>03/01/94</td>
<td>130.4</td>
<td>38.95</td>
<td>35.83</td>
<td>0.15</td>
<td>130.7</td>
</tr>
<tr>
<td>December</td>
<td>12/01/94</td>
<td>164.2</td>
<td>Dec 94</td>
<td>03/01/94</td>
<td>130.4</td>
<td>36.01</td>
<td>33.13</td>
<td>0.15</td>
<td>131.3</td>
</tr>
</tbody>
</table>

a/ Quantity purchased = 100,000 tons; b/ Quantity purchased = 92,000 tons equivalent to 676 futures contracts; c/ Price received minus price paid; d/ Gain/loss with hedge ratio is gain/loss * hedge ratio of 0.92; and e/ Net price = cash price - gain/loss with hedge ratio + brokerage fee.

Steps: (1) On December 16, 1993, the government purchases 2,028 white wheat futures contracts expiring in March 1994 and 1,352 contracts expiring in May 1994. The number of March contracts purchased (2,028) is based on purchases of 100,000 tons of wheat in January, in February, and in March, and a hedge ratio of 0.92. The number of May contracts purchased (1,352) is based on purchases of 100,000 tons of wheat in April and in May. At the time the hedging program was initiated, not all of the necessary contracts were being traded. For example, as of December 16, 1993 the December 1994 and July 1994 contracts were not yet active. The example assumes that the government was able to initiate hedging on those contracts as soon as they became available on January 1 and March 1, 1994. (2) On January 3, 1994, the government purchases 100,000 tons of wheat on the international market at the current cash market price. On the same day, it sells 676 of the March futures contracts at the prevailing futures price. (3) At the beginning of February the government buys 100,000 tons of wheat on the international market and sells 676 March futures contracts on the same day the purchases are made. The effective price is again the cash price paid plus the net profit or loss from the futures transaction plus the brokerage fee. In mid-February, the government buys 1,352 contracts expiring in September 1994, to cover wheat purchases in August and September. (4) At the beginning of March the government buys 100,000 tons of wheat on the international market and sells 676 March futures contracts on the same day the purchases are made. Also at the beginning of March, the government buys 2,028 contracts expiring in December 1994, to cover wheat purchases in October, November, and December. (5) At the beginning of April and May the government buys 100,000 tons of wheat on the international market, and sells 676 May futures contracts on the same day the purchases are made. (6) At the beginning of June and July, the government buys 100,000 tons of wheat on the international market, and sells 676 July futures contracts on the same day the purchases are made. (7) At the beginning of August and September, the government buys 100,000 tons on the international market, and sells 676 September futures contracts on the same day the purchases are made. (8) At the beginning of October, November, and December the government buys 100,000 tons of wheat from the international market, and sells 676 December futures contracts on the same day the purchases are made.

Source: Authors' Estimates.
Table 4.2 Impact of Futures Hedging Program on Wheat Import Payments

<table>
<thead>
<tr>
<th>Month</th>
<th>FOB price</th>
<th>CIF price a/</th>
<th>Import cost</th>
<th>Release price</th>
<th>Government subsidy/tax</th>
<th>Government subsidy/tax</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without hedging</td>
<td>With hedging</td>
<td>Without hedging</td>
<td>With hedging</td>
<td>Without hedging</td>
<td>With hedging</td>
</tr>
<tr>
<td></td>
<td>dollars per ton</td>
<td>(rupees per ton)</td>
<td>millions of rupees</td>
<td>per ton</td>
<td>millions of rupees</td>
<td>per ton</td>
</tr>
<tr>
<td>January</td>
<td>133.4</td>
<td>133.7</td>
<td>4,800</td>
<td>4,810</td>
<td>480.5</td>
<td>481.0</td>
</tr>
<tr>
<td>February</td>
<td>130.4</td>
<td>134.6</td>
<td>4,710</td>
<td>4,839</td>
<td>471.0</td>
<td>483.9</td>
</tr>
<tr>
<td>March</td>
<td>127.5</td>
<td>134.7</td>
<td>4,621</td>
<td>4,842</td>
<td>462.1</td>
<td>484.2</td>
</tr>
<tr>
<td>April</td>
<td>126.8</td>
<td>132.7</td>
<td>4,598</td>
<td>4,778</td>
<td>459.8</td>
<td>477.8</td>
</tr>
<tr>
<td>May</td>
<td>137.8</td>
<td>135.1</td>
<td>4,935</td>
<td>4,852</td>
<td>493.5</td>
<td>485.2</td>
</tr>
<tr>
<td>June</td>
<td>134.1</td>
<td>133.6</td>
<td>4,822</td>
<td>4,806</td>
<td>482.2</td>
<td>480.6</td>
</tr>
<tr>
<td>July</td>
<td>132.3</td>
<td>132.4</td>
<td>4,767</td>
<td>4,771</td>
<td>476.7</td>
<td>477.1</td>
</tr>
<tr>
<td>August</td>
<td>127.9</td>
<td>126.3</td>
<td>4,632</td>
<td>4,585</td>
<td>463.2</td>
<td>458.5</td>
</tr>
<tr>
<td>September</td>
<td>147.0</td>
<td>129.6</td>
<td>5,215</td>
<td>4,683</td>
<td>521.5</td>
<td>468.3</td>
</tr>
<tr>
<td>October</td>
<td>169.0</td>
<td>128.6</td>
<td>5,887</td>
<td>4,655</td>
<td>588.7</td>
<td>465.5</td>
</tr>
<tr>
<td>November</td>
<td>166.4</td>
<td>130.7</td>
<td>5,806</td>
<td>4,718</td>
<td>580.6</td>
<td>471.8</td>
</tr>
<tr>
<td>December</td>
<td>164.2</td>
<td>131.3</td>
<td>5,741</td>
<td>4,735</td>
<td>574.1</td>
<td>473.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>6,053.4</td>
<td>5,707.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>141.4</td>
<td>131.9</td>
<td>5,044</td>
<td>4,756</td>
<td>504.5</td>
<td>475.6</td>
</tr>
</tbody>
</table>

Note: a/ FOB price is converted into a CIF price by adding a freight cost of $24 per ton, assuming no export subsidies, and using an exchange rate of 30.5 rupees per dollar.

Source: Authors' Estimates.
 million rupees (from 468 million rupees to 595 million rupees). If the government had hedged the import cost would have varied only slightly, with a difference between the highest and lowest months' payments of less than 20 million rupees.

Assume also that the government set a release price for the year of 4,800 rupees (equivalent to an FOB price of $133 per ton). If the government did not hedge, the unexpected rise in prices toward the end of the year would have resulted in huge subsidy payments of 320 million rupees for the entire year. These payments would be required because of the increase in international prices of more than $40 per ton between August and October. However, having hedged and locked in a price, the government subsidy payments would not have been incurred.

This hedging program resulted in a lower total import cost because market prices increased in the later half of the year. It is important to note, however, lowering the import bill was not the goal of the hedging program and the program should not be considered successful because it was profitable. If international prices had fallen, the government would have ended up paying more in subsidies than if it had not hedged. Payment of additional subsidies would not have indicated the failure of the strategy, however. The hedging strategy was a success because it reduced the volatility of international prices and the cost of imports, enabling the government to better manage its finances, not because in the example shown it also reduced overall cost of imports and thereby saved the government money. In the long-run the government could expect neither to gain nor to lose money through hedging, and the cost of using hedging instruments would be equal to the brokers' fees on the contracts.
Strategy II: Hedging with Options Contracts

A second strategy involves the purchase of call options. Call options give the holder the right to buy a specific commodity at a specified strike price. In a sense, call options provide insurance against prices rising at a later date. Use of call options is appropriate for the government of Pakistan in managing future wheat imports. A call option differs from a futures contracts strategy in that a futures contract locks in the import price. For the government one downside of the futures hedging strategy is that if prices were to decline, it would not be able to take advantage of lower prices and would incur higher subsidy payments than if it had not hedged. Purchasing a call option enables the buyer to establish a maximum price for a commodity by providing protection from upward price movements while at the same time allowing the buyer to participate in the benefits of downward price movements of the underlying commodity. The premium paid for the option is the cost of receiving the upward price protection, and can be viewed as the "insurance policy" premium.

A specific hedging strategy using options contracts would work as follows. In January 1994 the government decides to import 1.2 million tons of wheat during the calendar year. It also decides to make half the purchases during the second quarter and half during the fourth quarter (with purchases of 600,000 tons in each case). In early January, a price of $135 per ton is offered by U.S. exporters. If the government believes that prices could move lower during the year, it would prefer to delay its purchase of the wheat until the time of actual delivery. By waiting, however, the government risks the possibility that prices will rise, increasing the cost of imports. In effect, the government would like to participate in any downward move in prices while at the same time protecting itself against upward price changes. In early February 1994 the government decides it will import the first 600,000 tons of wheat during the month of April. It would like to lock in the $135 per ton price being offered for April delivery but be able to benefit if wheat prices fall. To accomplish this objective, on February 7, 1994, the government purchases 4,410 May white wheat call options (equivalent to 600,000 tons) with a strike price of $132.28 per ton. The cost of these options is $3.86 per ton. As noted above, physical cash white wheat FOB Portland for April at this time was trading at $135 per ton, and the May futures contract was trading for $133.19 per ton. In purchasing these call options, the government buys the right (or option) to purchase white wheat futures at $132.28 per ton.

By April, May futures are trading at $130.07 per ton, cash white wheat FOB Portland is trading at $126.77 per ton, and May white wheat options with a $132.28 per ton strike price are worth $0.37 per ton. Given that the May futures price ($130.07 per ton) is below the $132.28 per ton strike price, the options held by the government have little value and will likely expire worthless. Physical cash prices, however, have followed the general price decline and the government can

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16 Data used in the options examples are from the Minneapolis Grain Exchange, the United States Department of Agriculture, and trade sources.
17 In 1994 there was limited liquidity on the Minneapolis Grain Exchange for both futures and options in white wheat. As previously noted, although the volume of these contracts is growing large volumes of wheat orders would likely have to be processed at other exchanges, such as the Chicago Board of Trade and Kansas City Board of Trade.
purchase its wheat at prices that are substantially lower than those that prevailed in January. Although in this case the price protection was not exercised, the government was given the flexibility to wait for lower prices, as its upside risk was covered by the options.

The government paid the cash price of $126.77 per ton, plus the net cost of options of $3.49 per ton ($3.86 purchase price less $0.37 sale price), less a $0.10 per ton brokerage fee, yielding a net of $130.36 per ton—$3.59 per ton more than if it had not hedged (table 4.3). Although hedging resulted in a higher price paid, the strategy was nevertheless an appropriate one because it protected the government against an increase in prices. The difference between the $130.36 per ton paid and the cash price of $126.77 per ton ($3.59 per ton) represents the insurance premium for guaranteeing a price of no more than $132.28 per ton. Relative to the February forward price of $135 per ton, the effective price of $130.36 per ton represents a saving of $4.64 per ton, a reduction of $2.8 million in import costs.

The time frame is now April 1994 and the government now wishes to purchase the remaining 600,000 tons of white wheat for delivery in November of 1994. The situation is such that no FOB offers for white wheat in Portland are currently available for November or December delivery. However, it is known that December white wheat futures on the Minneapolis Grain Exchange are trading at $129.97 per ton. In addition, December white wheat call options with a $128.60 per ton strike price are trading at $4.78 per ton. As in the first example, the government decides to purchase 4,410 December call options with the $128.60 strike price as protection against a price increase. As in the April hedge, the government has protected itself from upside price risk but is still able to reap the benefit of price declines in the physical cash market.

When November 1994 arrives, December futures are trading at $169.39 per ton, cash white wheat FOB Portland is worth $166.36 per ton, and December white wheat options with a $128.60 strike price are worth $40.79 per ton. Obviously there has been a very substantial increase in white wheat prices that is reflected in the futures price, the options price and the physical cost of FOB white wheat. Because the futures price is well above the strike price, the government will exercise its right to purchase futures at $128.60 per ton, as these contracts are now worth $169.39 per ton.

To evaluate the actual cost of the wheat purchase taking the options hedging operation into consideration, the price of the option ($40.79 per ton) is subtracted from the wheat purchase price ($166.36 per ton) and the original cost of the option ($4.78) and brokerage ($0.10) are added.

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18 In practice, the options would likely simply be sold on the exchange and the difference or profit applied to the hedging transaction. Key practical problem associated with price stabilization involves determining the level at which prices should be stabilized.
Table 4.3 Impact of Options Hedging Program on Wheat Import Payments

<table>
<thead>
<tr>
<th>Month</th>
<th>FOB price Without hedging (dollars per ton)</th>
<th>FOB price With hedging (dollars per ton)</th>
<th>CIF price a/ Without hedging (rupees per ton)</th>
<th>CIF price a/ With hedging (rupees per ton)</th>
<th>Import cost Without hedging (millions of rupees)</th>
<th>Import cost With hedging (millions of rupees)</th>
<th>Release price Without hedging (rupees per ton)</th>
<th>Release price With hedging (rupees per ton)</th>
<th>Government subsidy/tax Without hedging (rupees per ton)</th>
<th>Government subsidy/tax With hedging (rupees per ton)</th>
<th>Government subsidy/tax Without hedging (millions of rupees)</th>
<th>Government subsidy/tax With hedging (millions of rupees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>126.8</td>
<td>130.4</td>
<td>4,598</td>
<td>4,682</td>
<td>2,759</td>
<td>2,826</td>
<td>4,800</td>
<td>202</td>
<td>91</td>
<td>120.9</td>
<td>54.5</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>166.4</td>
<td>130.5</td>
<td>5,806</td>
<td>4,768</td>
<td>3,484</td>
<td>2,827</td>
<td>4,800</td>
<td>-1,006</td>
<td>88</td>
<td>-100.6</td>
<td>852.7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>146.6</td>
<td>130.5</td>
<td>5,202</td>
<td>4,711</td>
<td>3,121</td>
<td>2,826</td>
<td>4,800</td>
<td>-402.2</td>
<td>89.3</td>
<td>-241.3</td>
<td>53.6</td>
<td></td>
</tr>
</tbody>
</table>

a/ FOB price is converted into a CIF price by adding a freight cost of $24 per ton, assuming no export subsidies, and using an exchange rate of 30.5 rupees per dollar.

*Source: Authors' Estimates.*
back, yielding a net purchase price of $130.45 per ton. The use of options contracts enabled the purchaser to protect itself against upside price risk. What must not be overlooked is that had prices fallen, the buyer of the option would also have benefited. In this case, the government reduced its import bill by $21.5 million by hedging.

The impact of the options hedging program on government subsidy payments is shown in table 4.3. Over the year, the average FOB price with hedging is $130.4 per ton compared to $146.6 per ton without hedging, resulting in 590 million rupee savings on imports. If a 4,800 rupee per ton release price were established, the policy would have cost the government 483 million rupees without the options hedging, compared to 56 million rupees in revenues with hedging.

**Strategy III: Hedging with Swaps**

A third hedging alternative is to use a commodity swap. Swaps were developed to meet relatively long-term risk management needs and are generally available on over-the-counter market (that is, they are negotiated between parties rather than traded on an exchange). Swaps are purely financial instruments in that no exchange of physical goods takes place. This feature distinguishes swaps from futures and options contracts, where making or taking delivery of the physical commodity is always an option for agricultural commodities. (In practice, of course, only the net amounts change hands).

For the hedger the basic objective of utilizing swaps is to shift price risk to the investment community and manage the price risk of the commodity portfolio of the business. In a swap transaction this is accomplished by establishing three variables: the amount or volume of the swap, a fixed price level, and a variable price level. Fluctuations of the variable price around the fixed price are used to establish a stream of payments to each party to the swap. In a swap with two parties there will typically be a consumer of the commodity and a producer, and a bank or other type of financial institution will act as intermediary. The consumer will pay the fixed price amount and be paid the variable price amount. The producer will be paid the fixed price amount and will pay the variable price amount.

The great advantage of swaps is that they afford great flexibility by decoupling the hedging activity from the physical trading activities of an organization. Swaps also enable an organization to manage price risk for relatively long periods of time. A major drawback of swaps is that they require cash flow and are very credit intensive. Because there is a high counterparty risk in swap transactions, banks may require upfront cash collateral (in an escrow offshore account that could earn interest) to cover a predetermined level of risk exposure. Another drawback is that the market for swaps in the agricultural area is not yet fully developed; to date most swaps of physical commodities have been in metals and petroleum.

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19 Some contracts for agricultural commodities have been developed that allow for delivery of cash rather than the physical good. In the case of wheat futures, all contracts in the United States require delivery of the physical commodity.

20 The great advantage of swaps is that they afford great flexibility by decoupling the hedging activity from the physical trading activities of an organization. Swaps also enable an organization to manage price risk for relatively long periods of time. A major drawback of swaps is that they require cash flow and are very credit intensive. Because there is a high counterparty risk in swap transactions, banks may require upfront cash collateral (in an escrow offshore account that could be earning interest) to cover a predetermined level of risk exposure. Another drawback is that the market for swaps in the agricultural area is not yet fully developed; to date most swaps of physical commodities have been in metals and petroleum.
be earning interest) to cover a predetermined level of risk exposure. Another drawback is that the market for swaps in the agricultural area is not yet fully developed; to date most swaps of physical commodities have been in metals and petroleum.

To see how a swap would work, assume that the government is interested in securing a long-term price of wheat equal to $135 per ton. It enters into a swap agreement with a bank whereby it is agreed that the fixed price of the swap will be $135 per ton and the variable price used will be the monthly average price of the nearby white wheat futures contract traded on the Minneapolis Grain Exchange. The amount will be 100,000 tons per month. At the end of each month the price of white wheat on the exchange will be averaged and the fixed price of the swap ($135 per ton) will be subtracted from the variable price to determine the payment to be made to or received from the government. Assume that prices averaged $127 per ton in the first month and $145 per ton in the second month. The government would pay the bank $8 per ton, or $800,000, the first month and would receive $10 per ton, or $1,000,000, the second month. The cash flows from the swap transaction are applied against the actual physical market transactions the government is undertaking in the white wheat market. Presumably in the first month the government was able to buy 100,000 tons of white wheat at $8 per ton less than the prevailing price; the next month the price in the physical market was $10 per ton higher.

Applying the swap concept to wheat purchases during 1994 would yield the results shown in tables 4.4 and 4.5, and figure 4.3. The example uses spot cash white wheat values from 1994 and assumes a desired import price of $135 per ton (this price will constitute the fixed price level).

<table>
<thead>
<tr>
<th>Month</th>
<th>Average futures Price</th>
<th>Fixed target price</th>
<th>Net payment a/</th>
<th>Cash price b/</th>
<th>Net price c/</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>136.4</td>
<td>135.0</td>
<td>1.4</td>
<td>133.4</td>
<td>133.3</td>
</tr>
<tr>
<td>February</td>
<td>132.8</td>
<td>135.0</td>
<td>-2.2</td>
<td>130.4</td>
<td>134.0</td>
</tr>
<tr>
<td>March</td>
<td>128.6</td>
<td>135.0</td>
<td>-6.4</td>
<td>127.5</td>
<td>135.2</td>
</tr>
<tr>
<td>April</td>
<td>134.3</td>
<td>135.0</td>
<td>-0.7</td>
<td>126.8</td>
<td>128.8</td>
</tr>
<tr>
<td>May</td>
<td>137.4</td>
<td>135.0</td>
<td>2.4</td>
<td>137.8</td>
<td>136.7</td>
</tr>
<tr>
<td>June</td>
<td>133.6</td>
<td>135.0</td>
<td>-1.7</td>
<td>134.1</td>
<td>136.9</td>
</tr>
<tr>
<td>July</td>
<td>133.0</td>
<td>135.0</td>
<td>-2.0</td>
<td>132.3</td>
<td>135.6</td>
</tr>
<tr>
<td>August</td>
<td>142.4</td>
<td>135.0</td>
<td>7.4</td>
<td>127.9</td>
<td>121.8</td>
</tr>
<tr>
<td>September</td>
<td>161.7</td>
<td>135.0</td>
<td>26.7</td>
<td>147.0</td>
<td>121.6</td>
</tr>
<tr>
<td>October</td>
<td>173.9</td>
<td>135.0</td>
<td>38.9</td>
<td>169.0</td>
<td>131.5</td>
</tr>
<tr>
<td>November</td>
<td>168.3</td>
<td>135.0</td>
<td>33.3</td>
<td>166.4</td>
<td>134.4</td>
</tr>
<tr>
<td>December</td>
<td>167.3</td>
<td>135.0</td>
<td>32.3</td>
<td>164.2</td>
<td>133.3</td>
</tr>
</tbody>
</table>

a/ Average Minneapolis futures price minus fixed price of $135 per ton.
b/ Price actually paid in the market. c/ Price actually paid in the market minus net payment plus 1% brokerage ($1.35 per ton).

Source: Authors' Estimates.
### Table 4.5 Impact of Swaps Futures Hedging Program on Wheat Import Payments

<table>
<thead>
<tr>
<th>Month</th>
<th><strong>FOB price</strong></th>
<th><strong>CIF price a/</strong></th>
<th><strong>Import cost</strong></th>
<th><strong>Release price</strong></th>
<th><strong>Government subsidy/tax</strong></th>
<th><strong>Government subsidy/tax</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without hedging (dollars per ton)</td>
<td>With hedging (dollars per ton)</td>
<td>Without hedging (rupees per ton)</td>
<td>With hedging (rupees per ton)</td>
<td>Without hedging (rupees per ton)</td>
<td>With hedging (rupees per ton)</td>
</tr>
<tr>
<td>January</td>
<td>133.4</td>
<td>133.3</td>
<td>4,800</td>
<td>4,798</td>
<td>480.5</td>
<td>479.8</td>
</tr>
<tr>
<td>February</td>
<td>130.4</td>
<td>134.0</td>
<td>4,710</td>
<td>4,820</td>
<td>471.0</td>
<td>482.0</td>
</tr>
<tr>
<td>March</td>
<td>127.5</td>
<td>135.2</td>
<td>4,621</td>
<td>4,856</td>
<td>462.1</td>
<td>485.6</td>
</tr>
<tr>
<td>April</td>
<td>126.8</td>
<td>128.8</td>
<td>4,598</td>
<td>4,660</td>
<td>459.8</td>
<td>466.0</td>
</tr>
<tr>
<td>May</td>
<td>137.8</td>
<td>136.7</td>
<td>4,935</td>
<td>4,902</td>
<td>493.5</td>
<td>490.2</td>
</tr>
<tr>
<td>June</td>
<td>134.1</td>
<td>136.9</td>
<td>4,822</td>
<td>4,908</td>
<td>482.2</td>
<td>490.8</td>
</tr>
<tr>
<td>July</td>
<td>132.3</td>
<td>135.6</td>
<td>4,767</td>
<td>4,868</td>
<td>476.7</td>
<td>486.8</td>
</tr>
<tr>
<td>August</td>
<td>127.9</td>
<td>121.8</td>
<td>4,632</td>
<td>4,446</td>
<td>463.2</td>
<td>444.6</td>
</tr>
<tr>
<td>September</td>
<td>147.0</td>
<td>121.6</td>
<td>5,215</td>
<td>4,442</td>
<td>521.5</td>
<td>444.2</td>
</tr>
<tr>
<td>October</td>
<td>169.0</td>
<td>131.5</td>
<td>5,887</td>
<td>4,743</td>
<td>588.7</td>
<td>474.3</td>
</tr>
<tr>
<td>November</td>
<td>166.4</td>
<td>134.4</td>
<td>5,806</td>
<td>4,831</td>
<td>580.6</td>
<td>483.1</td>
</tr>
<tr>
<td>December</td>
<td>164.2</td>
<td>133.3</td>
<td>5,741</td>
<td>4,797</td>
<td>574.1</td>
<td>479.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>141.4</td>
<td>131.9</td>
<td>5,044</td>
<td>4,755.9</td>
<td>504.5</td>
<td>475.6</td>
</tr>
</tbody>
</table>

* a/ FOB price is converted into a CIF price by adding a freight cost of $24 per ton, assuming no export subsidies, and using an exchange rate of 30.5 rupees per dollar.

*Source: Authors' Estimates.*
The financial intermediary charges a 1 percent commission for the service of arranging the swap. The variable price used as a reference is the average Minneapolis nearby futures prices (column one in table 4.4). As in previous examples, the wheat import program is for 100,000 tons per month, or 1.2 million tons for the entire 1994 year. As the last two columns in the table 4.4 demonstrate, the price paid in the actual physical market (second column from the right) is adjusted by the net payments to achieve a net (or effective) price close to the target price of $135 per ton. In fact, the average price paid for all of 1994 in the actual physical market is $141 per ton.

Figure 4.3 Hedging Effectiveness Using Swaps

![Graph showing hedging effectiveness using swaps](image)

Source: Table 4.5.

The impact of using the swap agreement on import costs is shown in table 4.5. Without the swap mechanism the government would have paid a total of 6.05 billion rupees for wheat purchases in 1994; utilizing a swap mechanism the payment would have been only 5.71 billion rupees. Assuming a release price of 4,800 rupees per ton as in the previous two examples, the wheat swap significantly reduced the variability of subsidy payments and tax revenues. With the swap the monthly payments and revenues ranged from 108 million rupees in subsidies to 358 million rupees in taxes; without the swap payments and revenues ranged from 1.09 billion rupees in subsidies to Rs 202 million rupees in taxes. More important, the swap arrangement allowed the government to avoid the net cost of 293 million rupees in subsidy payments that would have resulted if the government had not hedged.
In this example, one advantage of utilizing a swap rather than futures and options is that the consuming entity (in this case the government) does not have to worry about liquidity problems on the exchange or the mechanics and strategy of executing futures and options contracts. Care must be taken, however, to ensure that the variable price used has a strong relationship to the actual physical cash market and cannot be manipulated.
5. Conclusion

This chapter summarizes the key findings and policy implications of this study and examines likely changes in the external environment that might affect Pakistan's wheat policies.

Key Findings and Policy Implications

The analysis of the mechanisms currently used to deal with price risk in Pakistan give several findings:

- **Domestic wheat prices have been relatively stable over time:** The government has been successful in stabilizing prices. The policy is nevertheless undesirable because of its distortionary impact on economic incentives and because there may be more effective and less costly methods of stabilizing prices.

- **Domestic prices have been largely isolated from world markets by government intervention.** Government procurement and intervention in international trade has succeeded in reducing price fluctuations within the wheat market. Current policies have not removed risk from the economy as whole, however, but merely transferred the risk from wheat market participants in the form of unstable prices to the government (and ultimately taxpayers throughout the economy) in the form of unstable subsidy payments.

- **The current system provides farmers and millers with very little incentive to undertake risk management on their own behalf.** The private sector has little need to worry about fluctuating prices when making production and investment decisions. In effect, private sector risk management activities have been crowded out by the government.

Overall, the risk management needs assessment found that the government is the entity most exposed to price variability. Given the large number of relatively small wheat farmers and traders, it is infeasible for market participants to pursue risk management strategies on their own. The current structure of risk distribution, whereby the government pools the risk of small producers and traders, may therefore be appropriate. However, having assumed the price risk, the government needs to manage it by taking advantage of mechanisms to externalize the price risk or transfer it to other entities.

Both internal and external obstacles to hedging with commodity risk management instruments were identified and the extent to which hedging will be effective in risk management was evaluated. Finally, the potential ways in which these instruments can be used and evaluations of specific risk management strategies were demonstrated. This analysis was based on simulations of how risk management strategies affect on domestic price variability and government import costs. The key findings included the following:
**The current system appears to violate many of the best practices identified for price stabilization schemes.** Too much emphasis is placed on market intervention through pricing, procurement, area and production targets, storage, and transportation; no emphasis is placed on using market-orientated approaches. The private sector must be more involved in the marketing system. Concrete recommendations for achieving private sector involvement are contained in a Bank report outlining a strategy for future agricultural growth (World Bank 1994b).

**Attempts to establish an Agricultural Stabilization Fund should be avoided.** Although the proposal (as outlined in box 2.1) to establish a price stabilization fund has some merit, implementation of such a fund for wheat might be very difficult. Experiences of other countries shows that stabilization funds often run into financial difficulties due to prolonged low commodity prices and mismanagement.

**Commodity hedging could be a useful method of managing commodity price risks as long as the mechanisms are understood and that regulatory, legal, and institutional barriers are kept to a minimum.** The nature of hedging, the various instruments available, potential obstacles, and practical considerations must be well understood by the government and potential market participants.

**Commodity hedging using futures, options, and swaps could significantly reduce the variability of the cost of imports.** The simulations of actual hedging strategies indicate that hedging would reduce the variability of import costs, thereby facilitating the management of public expenditures and planning.

**Other mechanisms for price stabilization are generally costlier than hedging.** If the government needs to borrow to finance additional subsidies resulting from unforeseen increases in international wheat prices, the cost of borrowing represents the cost of not hedging. While hedging involves risks and costs, not hedging may be riskier and costlier.

**Commodity hedging operations, which involve simultaneous transactions in cash and futures markets, can complex and hence require specialized expertise.** Of the instruments evaluated, swaps could be more attractive than futures and options because they are easier to implement and financial intermediaries are available to facilitate the transactions.

**Future Considerations**

Of special significance to wheat import practices in Pakistan will be the future configuration of the global wheat environment. Changes in this environment could affect how Pakistan imports wheat, from whom it imports, and at what price it imports. Some analysts suggest that the global wheat market is undergoing its greatest transformation in at least twenty years. This transformation can
be attributed to changes in both the policy environment and the fundamental supply-demand situation.

From a policy standpoint, the general trend in global economies is to reduce government spending and adopt more market-oriented policies. The context for these changes was the GATT negotiations that led to the formation of the World Trade Organization and a phased reduction of agricultural subsidies. This has already led to reforms in the Common Agriculture Policy of the European Union, which were first instituted in 1992 and will continue to be implemented through at least 1996. These reforms have lowered guaranteed wheat prices and have led to lower planted acreage, lower production, and lower intervention stocks of wheat\textsuperscript{21}.

In the United States, debate is currently underway with regard to developing a new five year farm bill that will define agricultural policies to the year 2000. It is clear that the bill will include some changes to the EEP and that these changes will likely reduce the importance of this program in the import programs of recipient countries, including Pakistan. In Canada, the government has decided to abolish transportation subsidies that have historically supported wheat movements to the Canadian West Coast ports and favored wheat production at the expense of feedgrain and oilseed crops. The removal of these subsidies will likely mean some crop shifts in the Western Provinces away from wheat.

In terms of changes in the world wheat market itself, the supply-demand situation is dramatically different from the situation that existed in the 1980 and early 1990s. World stocks of wheat are lower than they have been since the late 1970s. More important, stocks as a percentage of usage are lower than they have been in at least 35 years, having fallen to about 20 percent of usage in the most recent marketing year. An analysis of price movements over the past 30 years suggests that given the current stocks-to-use ratio world wheat prices are very susceptible to increases. Indeed, during 1995 white wheat prices from the Pacific ports of the United States have increased from $150 per ton in April to $202 per ton in December. Although much of this price increase was driven by concerns over supply, underlying demand provided the impetus to push prices higher and still further increases are expected in 1996.

These changes in the environment could have several implications for Pakistan.

- \textit{Government subsidies from exporting countries for export commodities will almost certainly decline during the latter half of the 1990s.} Indeed, the WTO mandates that both the volume and value of subsidized exports be decreased. Subsidies may decline by even more than the WTO-mandates levels because of high market prices and budgetary pressures to cut farm assistance.

\footnote{For example, from 1988 to 1992 total wheat acreage in the European Union averaged 17.4 million hectares (U.S. Department of Agriculture 1995). In 1993 and 1994 wheat acreage had fallen to roughly 15.7 million hectares. During this same period net exports (exports minus imports) fell from roughly 20 million tons per year to about 17 million tons. It is likely that European Union wheat exports will be reduced to the 13 million ton level by the end of the decade.}
• The volatility of prices and the absolute price level of wheat is likely to increase relative to the level of the 1980s. As a result, the cost of imported wheat will likely be higher for Pakistan than it has been in ten years.

• Higher world wheat prices in themselves could lead to lower subsidies for export wheat in that as prices rise governments need to provide less in subsidies to make their own wheat competitive in world markets\textsuperscript{22}.

The market changes described here will likely result in an environment that is more amenable for hedging world physical cash wheat prices on U.S. based futures exchanges. With U.S. prices less isolated from global factors, U.S. wheat futures prices should be more highly correlated to world wheat prices than has been the case in the past. This could mean that countries such as Pakistan should find hedging price risk on U.S. exchanges a more viable option.

To conclude, these market changes are likely to result in an environment that is more amenable for hedging world physical cash wheat prices on U.S. based futures exchanges. With U.S. prices less isolated from global factors (in part because of lower subsidies), U.S. wheat futures prices should be more highly correlated to world wheat prices than has been the case in the past. This could mean that countries such as Pakistan should find hedging price risk on U.S. exchanges a more viable option.

\textsuperscript{22} An example of this could be seen in 1995, when the price of edible oils increased dramatically in response to tight supplies and increased demand from China. In this instance the U.S. Department of Agriculture chose to discontinue EEP vegetable oil subsidies, viewing them as unnecessary given the environment.
Annex I. Previous Studies

This study adds to the growing body of research on how developing countries can hedge the risk associated with fluctuating agricultural commodity prices. The recent World Bank book, *Managing Commodity Price Risk in Developing Countries*, contains close to a dozen case studies. These case studies and others in the academic literature are fairly limited in their scope and coverage, however, and focus largely on exporting countries in Latin America and Africa. Previous studies have also looked at a somewhat limited group of agricultural commodities, concentrating mainly on cocoa, coffee, and cotton. To date, very little work has been done from the perspective of a developing country importer wishing to hedge price risk in the world grain markets, and very few studies have looked at the prospects for commodity hedging by countries in Asia.

Several studies have focused on the commodity risks of exporters of coffee and cotton. Myers (1993) and Claessens and Varangis (1993), for example, looked at a number of hedging strategies for the coffee sector in Costa Rica. They showed that the risks of coffee price fluctuations can be managed effectively using futures and options instruments. The authors warned that these strategies would require major institutional changes to the marketing system, however, as well as establishment of mechanisms to control exchange rate risk. In another study, Claessens and Coleman (1993) examined the case of Papua New Guinea, which faces substantial exposure to price fluctuations for its major primary commodity exports; gold, copper, coffee, cocoa, logs, and palm oil. They argue that existing commodity risk management schemes (mineral and agricultural stabilization funds) are costly and provide only limited short-term protection against the impact of fluctuating prices, and that hedging instruments are better suited to manage external risks in world commodity markets.

A series of articles investigated the viability of hedging cotton price risks by cotton exporting developing countries using New York cotton futures and options contracts. Satyanarayan, Thigpen, and Varangis (1993) looked at hedging cotton price risk in francophone Africa, where cotton exports provide a large share of total commodity exports and price volatility is substantial. The authors showed that hedging with New York cotton futures and options contracts could reduce price volatility by as much as 30—60 percent. In a related article, Varangis, Thigpen, and Satyanarayan (1994) investigated the effectiveness of using cotton futures contracts as hedging mechanisms in developing countries. They found that hedging reduced cotton price volatility by 30—70 percent. Hedging was also found to reduce expected returns, however; attitudes toward risk determine how much lower a return is acceptable.

Varangis, Thigpen, and Akiyama (1993) evaluated the risk management prospects for the cotton sector in Egypt and found that the New York futures market does not provide an appropriate mechanism for hedging the price risks of Egyptian cotton. The authors speculated that liberalizing the marketing and pricing system in Egypt would cause domestic cotton prices to better reflect international market conditions, thereby making hedging more effective.
Few studies have looked at hedging grain price fluctuations in developing countries. Herrmann (1993) evaluated the effectiveness of hedging rice price risks using U.S. futures markets. In general, she found little correlation between futures prices in Arkansas (as traded on the Chicago Board of Trade) and cash prices, both in the United States and overseas. The results indicate limited effectiveness of rice futures markets to manage risk by developing countries.

In another study, Larson (1993) examined managing price risks for maize imports by Mexico. Much of this paper concerns domestic price stabilization using variable border tariffs and subsidies to keep domestic prices within a price band. The study also includes a discussion of how the government could use options to manage the risk of international prices movements that would require subsidy payments to keep domestic prices within the price band (for exports, export subsidies if international prices fell below the lower band; for imports, import subsidies if the international price rose above the upper band).

Finally, Sheales and Tomek (1987) examined the effectiveness of hedging wheat prices in Australia using U.S. futures markets. They conclude that when the variation in export revenues depends heavily on the variation of quantity and the variation in quantity has little effect on price, the scope for reducing the variability of returns through hedging is limited. Another issue raised is that optimal hedging could result in the Australian Wheat Board holding about 30 percent of the open interest in the Chicago wheat market. This would have a large impact on prices in this market and make actual implementation of such a hedging strategy very difficult.
Annex 2. Types of Price Stabilization Methods

This annex provides a brief overview of some of the methods used by both industrialized and developing countries to stabilize their domestic commodity prices. The sequence in which the various schemes are presented is from the more interventionist approaches to the more market-orientated approaches.

Direct Government Intervention

The most market distorting method of stabilizing prices is through direct government intervention, most commonly achieved through administered prices or production quotas. Typically, administered prices are used to stabilize prices in countries in which decisions are made centrally. When rigidly enforced, the policy of fixing prices can be successful in stabilizing prices and can have the distributional effects desired by policymakers. The administration generally involves large losses in economic efficiency, however, particularly when market forces are not considered.

Instead of controlling prices, the government can control production through quotas. Restricting the quantity produced causes prices to rise, thereby generating a transfer from producers to consumers. Such a policy involves no budget outlays from the government and can achieve the distributional goals required. By allocating production to established producers with high production costs, however, production quotas prevent entry or expansion of low cost producers.

Variable Levies and Subsidies

Domestic prices can be controlled by imposing variable levies or providing subsidies to control fluctuations of import and export prices. The levy or subsidy varies depending on the world price of the commodity. When the domestic price is set below the international price (as in the case of wheat and cotton in Pakistan, for example), an increase in the world price requires an increase in the tariff on exports and an increase in the subsidy on imports to prevent domestic prices from rising. When the world price falls, taxes and subsidies must be lowered so that domestic prices do not fall proportionately with the world price. When the domestic price is set above the international price (as in the European Union), an increase in the world price leads to a decline in the tax rate on imports and the subsidy rate on exports (and vice versa for a drop in the world price). The variable levy is a flexible policy tool in that all international price movements can be reflected in changes in the levy, allowing domestic prices to remain stable.

Alternatively, levies or subsidies can be imposed only when the international price falls outside a certain range or price band. This forces domestic producers to respond to some international price fluctuations while insulating them from extreme changes in prices. Variable levies and subsidies work when there is an effective means of collecting the taxes and paying the subsidies.

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23 This section draws heavily on Gilbert (1993).
something that is often not the case in many developing countries. Furthermore, when domestic producer prices are determined by variable levies and subsidies, producers face additional uncertainty unless the government is consistent in applying the policy.

**Buffer Stock Stabilization**

A government agency can stabilize prices by buying stocks of a commodity in times of surplus and releasing them in times of shortage. Such a scheme can be profitable if purchases are made when prices are low (such as after harvest) and sold when prices are high. This form of intervention is appropriate if the country is large in relation to the world market for the commodity or its imports and exports of the commodity are insignificant or controlled. Such schemes are operated when private sector storage is inadequate, when food security is an important policy objective, and when the government wishes to control commodity distribution.

One drawback to using an official buffer stock agency is that the agency is likely to carry part of the stocks that would have been carried by the private sector, in addition to the incremental stocks needed to reduce price swings. Given that the private sector holds stocks in anticipation of capital gains, public sector storage will tend to reduce this anticipated gain, especially when the producer price is fixed and does not allow intraseasonal variation. This discouragement of private sector stockholding is likely to lead to inefficiency. There is also the fear that political pressures will force the government to stabilize prices at too high or too low a level, resulting in economic inefficiency in the long-run.

**Buffer Fund**

Under a buffer fund scheme, producers receive less than the world price for the commodity when the world price is high and more than the world price for the commodity when the world price is low. When the world price is high, the difference between it and the producer price is added to a buffer fund, which is drawn upon to finance subsidies in periods of low world prices. Operation of a buffer fund scheme requires an effective mechanism for collecting taxes and paying subsidies, mechanisms that do not exist in many developing countries. For a buffer fund scheme to operate, the government must be able to prevent smuggling out when the commodity is taxed and smuggling in when it is subsidized, and the producer price must be set appropriately in order to minimize efficiency losses. This can be done by setting the domestic price as close as possible to the long-run trend price of world prices, thereby minimizing the financial losses to the buffer fund. Because the producer price is set in relation to a world price, a buffer fund is usually set up for an internationally traded commodity.

**Hedging**

In recent years, several developing countries have turned to market-based financial instruments (forward contracts, futures contracts, option contracts, and swaps) to manage their commodity price risks. These instruments have been available for more than a century, but until recently were
used almost exclusively by industrialized countries. The availability of futures and options contracts for agricultural and mineral commodities has increased dramatically, with markets increasing in terms of both liquidity and trading volume. Today futures exchanges operate in Europe, Japan, and the United States, as well as in developing countries, including Argentina, Brazil, Malaysia, and Singapore. Commodity hedging involves buying and selling financial assets (futures, options, and swaps) whose payoffs are linked to the prices of commodities that will be bought or sold in the future. Hedging positions are taken so that changes in the value of the physical commodity resulting from changes in its international price are offset by opposite changes in the value of the financial assets. Consequently, the net financial position (the value of the commodity and the financial asset) remains stable following changes in the price of the commodity price. Hedging allows the price rises associated with the purchase or sale of commodities to be passed on to other agents (often speculators) willing to take on such risks.

Hedging provides several advantages over other methods of domestic price stabilization. It is the most cost effective way of dealing with commodity price risks, particularly short-term (less than one year) risk, and it increases the likelihood that planned income and costs will be realized. Hedging is a highly transparent method of price stabilization and uses market fundamentals. Perhaps most important it enables the risks to be externalized, that is, passed on to markets that want to assume and can better deal with them, rather than merely transferring the risk from producers to consumers (through production quotas) or, as is more often the case, to the government (through variable levies and subsidies and buffer funds).

Forward Contracts

A forward contract is an agreement between two parties to purchase or sell a specific commodity at a specific time in the future at an agreed upon price (known as the exercise price). Forward contracts involve negotiations covering all aspects of the transaction, including the method of delivery, quality, quantity, payment terms, and predetermined dispute resolution procedures. In practice, many standard contracts are formulated by trade associations that facilitate this type of trade. The seller of the contract agrees to deliver a given quantity of a commodity to a buyer at a preset price. Physical delivery of the commodity is expected and no payment is made at origination or during the term of the contract.

Although forward contracts allow producers and consumers to lock in perceived favorable prices for a future date, they do not eliminate risk in that prices can move in the opposite direction of the forward contract price. Thus the key problem with forward contracts is the risk of default by one party. For example, an importer of wheat buys a forward contract for a specific quantity of wheat. If the price of wheat falls, the importer will incur an opportunity loss. In this situation, the importer may be tempted to default on the contract, either by not recognizing the contract or by demanding product of higher quality than specified in the contract. Alternatively, if the price of the commodity increases, the seller of the forward contract may be tempted to abrogate the contract and sell at the higher price. Because of these problems, forward contracts are not used extensively to manage agricultural commodity price risks or are used so in conjunction with other risk management instruments, such as futures contracts.

Futures Contracts

A futures contract is a legally binding commitment between a buyer and a seller to make or take delivery of a specific quantity and quality of a commodity at a specific time in the future. Futures contracts are similar to forward contracts, with some important differences. Forward cash contract trading often takes place over the phone or informal markets; futures contracts are traded on organized exchanges, such as the Chicago Board of Trade. Futures contracts also specify all conditions of the transaction except the price in advance, whereas forward contracts leave all aspects of the contract open to negotiation. Very few futures contracts are ever fulfilled through delivery of the physical commodity, since most positions are closed out with equal but offsetting futures transactions. By contrast, a cash forward contract typically involves actual physical delivery of the commodity.

Futures contracts can be used to manage the risks of fluctuating commodity prices using hedging. There are two types of hedges, the selling (or short) hedge and the buying (or long) hedge. The
serving hedge is used to protect a later selling price for a commodity. It might, for example, be used by a farmer whose crops are still in the ground or by an exporter who has purchased grain that has not yet been sold. The buying hedge is used to lock in the price of a commodity to be bought at a future date. A wheat importer who plans to buy wheat at a later date might buy futures contracts now to protect against a possible rise in prices. Because cash and futures prices tend to move together, the wheat importer can protect against rising prices by purchasing wheat futures contracts.

**Options on Futures Contracts**

An option is the right to purchase or sell a certain asset at a preset price on (or before) a specified date. A buyer of an option owns the right to buy or sell; a seller (or “writer”) of an option gives the right to a buyer. A number of technical terms are involved in options transactions. An option that gives the right to buy is known as a *call* option; an option that gives the right to sell is known as a *put* option. The asset on which the option is written is known as the *underlying* asset. For agricultural options, the underlying assets are commodity futures contracts. The price at which the buyer of the option can buy or sell the underlying asset is called the *strike*, or *exercise*, price. The date on (or before) which the buyer can buy or sell the underlying asset is called the *maturity*, or *expiration*. An option that can be exercised only on the expiration date is called a *European* option; one that can be exercised either on or before the expiration date is called an *American* option. The price of the option is called the *premium*. The buyer pays the premium to the seller at the time of contracting.

Options contracts are bought and sold under the same strict regulations as futures contracts. Options differ from forward and futures contracts in two respects. First, in contrast to forward and futures contracts, they provide an opportunity to take advantage of favorable price movements. The cost for this opportunity is the premium that is paid up front. Second, only the seller, not the buyer, of the option is required to be creditworthy and to maintain a margin account. Options can be combined in various ways to achieve a specific hedging strategy. For example, call and put options can be combined to create “collars”, such that prices can be guaranteed within a specified upper and lower level.

**Swaps**

A swap contract obligates two parties to exchange, or swap, specified cash flows at specified fixed intervals, and can be viewed as a series of forward contracts. Commodity swap contracts have the same characteristics as forward contracts in that no cash flows are exchanged at the beginning of the contract and there is substantial credit risk. Swaps involve credit risk on the part of both parties to the contract, because depending on whether the prevailing market price is above or below the predetermined price, one party owes, or is due, the net amount. However, a swap contract allows market participants to engage in a contract that improves cash flow predictability beyond one to two years because futures contracts for agricultural commodities are traded only
twelve to eighteen months into the future. At this time, most global swap activity is in metals and petroleum, with agricultural goods accounting for a small portion of total swap activity.

**Over-the-Counter Market**

In recent years, many financial intermediaries have made commodity risk management instruments available that are tailor-made to a particular client’s needs. The increased involvement of financial intermediaries has been accompanied by significant product innovation, especially in the area of long-term instruments with maturities of one to fifteen years. One of these innovations is the commodity swap, described above. In the absence of matching counterswap (an exporter wishing to enter a swap with an importer, for example), financial intermediaries offering long-term commodity risk management instruments will typically manage the price risk on the swap themselves by using the short-dated futures and options markets. By dynamic hedging through the use of short-dated instruments, the intermediary can duplicate a long-dated hedge. The simplest form of dynamic hedge is a rollover in which short-dated hedge instruments are renewed at maturity. Although the use of over-the-counter hedging instruments is less common for agricultural commodities than for minerals, energy, and financial assets, some transactions have taken place in developing countries. Development of longer-term over-the-counter instruments for agricultural commodities in developing countries may be impeded by existence of counterparty risk (sovereignty risk, in many cases) and the risk of abrupt changes in agricultural prices due to supply shocks.

**Simple Hedging Examples**

**Futures**

Assume that the market price of wheat is $130 per ton in May and the government wishes to lock in this price for purchases of wheat that are not expected to take place until the following August. To protect itself against the risk that the price will be higher than $130 per ton in August, buys August futures contracts for, say, $140 per ton. Suppose that in August the price rises to $145 per ton, involving a $15 per ton loss ($130 per ton less $145 per ton). The government sells the August contract, thus closing out the futures account. But since futures and cash prices move together the value of the contract will also have risen, perhaps to $155 per ton, thus giving the government a $15 per ton profit. The cash purchase price of $145 per ton less the $15 per ton futures gain results in a net purchase price of $130 per ton, the price desired back in May.

**Options**

Suppose the government wishes to import 500,000 tons of wheat in six months time and wants to pay no more than $130 per ton (implying a total import bill of $65 million). In this situation, the government buys call options giving it the right to buy wheat futures contracts at a price of $130 per ton. Say the premium quoted is $8 per ton, so that $4 million is paid to cover the entire 500,000 tons. If after six months the price is less than $130 per ton—say, $110 per ton—the government would not exercise its options and would pay $55 million in wheat costs (plus the $4 million premium). However, if the price increased to $150 per ton, the government would exercise its option, enabling it to buy futures contracts at $130 per ton. The futures contracts
could then be sold at $150 per ton (because spot and futures prices are always equal at expiration of the contract), resulting in a profit of $20 per tons. The government could then buy the wheat at the spot price of $150 per ton. The gain of $20 per ton on the futures contracts combined with the $150 per ton paid on the physical commodity would yield an overall price of $130 per ton and total costs of $65 million (plus the cost of the premium). In effect, the wheat options provide price insurance to the GOP, guaranteeing it a cost of no more than $65 million in exchange for a premium of $8 million.

Swaps
Say the government wished to lock in the price of its wheat imports using a swap contract instead of options. The government and a seller overseas (exporter) enter into a long-term contract in which the exporter agrees to sell 250,000 tons of wheat every six months over the ensuing five years, receiving the wheat price prevailing at each six-month interval. Assume the importing agency wishes to lock in the dollar costs at the time the contract was signed. The importer could enter into a commodity swap contract with a bank. Assume that the term for the swap is $130 per ton. The importer would agree to pay the bank $32.5 million (250,000 tons at $130 per ton) every six months for the ensuing five years. The bank would then agree to pay the exporter the value of 250,000 tons of wheat using the spot price on the same dates the bank received its payments from the importer. A “difference” check would settle the transaction every 6 months. In this way the commodity swap contract is equivalent to a series of ten forward contracts lined up over five years, locking in a price of $130 per ton.
Annex 4. Derivation of the Optimal Hedge Ratio

The hedging decision can be reviewed as a portfolio selection problem in which the hedger selects the optimal proportions of wheat imports that are unhedged (cash) and hedged (futures). The import portfolio can be represented as

\[ E(\Delta IC) = I_u E(C_t - C_{t+1}) + I_h E(F_t - F_{t+1}) \quad (1) \]

where \( E(\Delta IC) \) = expected change in the cost of wheat imports, \( I_u = \) unhedged imports, \( E(C_t - C_{t+1}) \) = expected change in the cash price from \( t \) to \( t+1 \), \( I_h = \) hedged imports, and \( E(F_t - F_{t+1}) \) = expected change in the futures price from \( t \) to \( t+1 \). Note that \( C_{t+1} \) and \( F_{t+1} \) are unknown at time \( t \) and are random variables.

To hedge against price increases on wheat purchases to be made at a later date—say, at time \( t+1 \)—the importer buys wheat futures contracts in time \( t \). In hedging jargon, the importer has a short position in the cash market, \( I_u < 0 \), and a long position in the futures market, \( I_h > 0 \). When time \( t+1 \) is reached, wheat is purchased on the international market at the current cash price, \( C_{t+1} \), and futures contracts are sold at the current futures price, \( F_{t+1} \) (closing the existing long position in the futures). If the price increased between time \( t \) and \( t+1 \), the first term in equation (1), \( I_u E(C_t - C_{t+1}) \) would be positive, because \( I_u < 0 \) and \( E(C_t - C_{t+1}) < 0 \), resulting in an increase in the cost of imports. However, this increased cost would be offset by the second component of equation (1), \( I_h E(F_t - F_{t+1}) \), which would be negative, because \( I_h > 0 \) and \( E(F_t - F_{t+1}) < 0 \). Equation (1) can be rearranged as

\[ E(\Delta IC) = I_u \left[ E(C_t - C_{t+1}) + \left( \frac{I_h}{I_u} \right) E(F_t - F_{t+1}) \right] \quad (2) \]

Setting \( I_u \) equal to -1, equation (2) becomes,

\[ E(\Delta IP) = -1 \left[ E(C_t - C_{t+1}) + h E(F_t - F_{t+1}) \right] \quad (3) \]

where: \( E(\Delta IP) \) is the change in import cost per unit of unhedged imports and \( h = \left( \frac{I_h}{I_u} \right) \) represents the portion of the cash position that is hedged in the futures market (the hedge ratio). Setting \( I_u \) equal to -1 is equivalent to dividing both sides of equation (2) by \( I_u \), and represents the portfolio in terms of import price changes instead of total import cost changes.

Simplifying equation (3) gives

\[ E(\Delta IP) = \left[ E(C_{t+1} - C_t) + h E(F_t - F_{t+1}) \right] \quad (4) \]

The imports are completely hedged if \( h \) is set equal to 1 so that each unit in the cash market is hedged with a unit of futures (sometimes referred to as a naive hedge). At the other extreme, \( h = \)
0 indicates that there is no hedging and changes in import prices are totally determined by changes in cash market prices.

The variance of the per unit import cost portfolio is a measure of its riskiness. The variance of $\Delta IP$ with $I_u = -1$, is given by

$$\text{Var}(\Delta IP) = \text{Var}(C_{t+1} - C_t) + h^2 \text{Var}(F_t - F_{t+1}) + h \text{Cov}((C_{t+1} - C_t),(F_t - F_{t+1}))$$

or

$$\text{Var}(\Delta IP) = \text{Var}(C_{t+1} - C_t) + h^2 \text{Var}(F_t - F_{t+1}) - 2h \text{Cov}((C_{t+1} - C_t),(F_{t+1} - F_t))$$

If the objective is to minimize the risk, the optimal hedge ratio ($h^*$) is the value of $h$ which minimizes $\text{Var}(\Delta IP)$. This can be found by differentiating equation (6), setting the derivative equal to zero and solving for $h$, as follows:

$$\frac{\delta \text{Var}(\Delta IP)}{\delta h} = 2h \text{Var}(F_t - F_{t+1}) - 2 \text{Cov}((C_{t+1} - C_t),(F_{t+1} - F_t)) = 0$$

Solving equation (7) for $h^*$ gives

$$h^* = \frac{\text{Cov}((C_{t+1} - C_t),(F_{t+1} - F_t))}{\text{Var}(F_t - F_{t+1})}$$

Since $\text{Var}(F_t - F_{t+1})$ is the same as $\text{Var}(F_{t+1} - F_t)$, equation (8) can be expressed as

$$h^* = \frac{\text{Cov}((C_{t+1} - C_t),(F_{t+1} - F_t))}{\text{Var}(F_{t+1} - F_t)}$$

Therefore, under these assumptions the optimal hedge ratio is equivalent to the slope coefficient in the regression of changes in cash prices on changes in futures prices. These are reported for Pakistan wheat prices in table 3.2.
References


62


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