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Wheat Policy Reform in Egypt

Adjustment of Local Markets and Options for Future Reforms

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Foreword

As governments around the world have undertaken reforms to reduce the role of the state in their economies in the past decade or so, they have confronted the issue of precisely where to draw the line between public sector and private sector activities. Egypt faces this question in regard to its wheat sector.

In 1987 Egypt partially liberalized wheat production and marketing, reducing taxes on wheat production and allowing more private traders to participate in domestic wheat markets. These steps have led to greater wheat and flour production. Still, the government remains involved in wheat trading and processing, a situation that creates a number of inefficiencies. Private sector traders have been limited to small-scale activity. And although a universal consumer subsidy on certain flour and bread serves the poor (and everyone else), it is costly for the government.

This research report quantifies the effects of the 1987 reforms and presents policy alternatives that can help Egypt achieve its goals of protecting the poor and maintaining stable wheat prices in ways that are more efficient and less costly. The government's goal of wheat self-sufficiency is needlessly expensive, the authors argue. Targeting subsidies to the poorest people instead of making them available to all would free government funds and make markets more efficient. Flexible import tariffs can help maintain stable wheat prices. Instead of participating in processing and marketing wheat, this report shows, the Egyptian government would do better to focus on creating an environment in which private markets can thrive, and on investing in agricultural research and extension.

The findings of this report are generally applicable to many developing countries that are concerned that market liberalization will hurt the poor by leading to higher and less stable prices and should be of great interest to researchers and policymakers in such countries.

Per Pinstrup-Andersen
Director General

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Summary

Since 1987, as part of a general shift toward a more market-oriented economy, Egypt's wheat sector has been partially liberalized, primarily in production and trade. The main objectives of this study are twofold: to analyze the structure and performance of the Egyptian wheat sector following the agricultural market reforms initiated in 1987, and to present the economywide impacts of alternative policy options that may be considered for future reforms in the Egyptian wheat sector. The study uses various types of analysis, including a descriptive and econometric analysis of cross-section data from market surveys, a time-series investigation of price behavior, and a computable general equilibrium model of Egypt's wheat economy. The study findings can be summarized as follows:

- In the period before reforms, wheat producer prices were heavily taxed, whereas the prices received by Egyptian farmers after reforms are approximately at international levels. The introduction of higher-yielding wheat varieties and the resulting improved profitability of wheat relative to competing crops raised local wheat production significantly. The self-sufficiency rate increased from 21 percent in 1986 to 47 percent in 1996. Furthermore, the quantity of domestic wheat procured by the government for its subsidy program for *baladi* flour (a coarse flour made by extracting 82 percent of wheat grain) and bread has increased from less than 0.1 million metric tons in 1986 to 1.8 million metric tons in 1998.
- The reforms in the wheat sector have promoted the participation of private traders in the domestic wheat marketing system, resulting in a more open and competitive trading environment. This has contributed to stabilizing wheat market prices and improving market integration.
- The liberalization of the more-refined *fino* flour (made by extracting 72 percent of wheat grain) market has induced new private investments in wheat milling, greater domestic production of flour, and a noticeable reduction in *fino* flour prices, to the benefit of consumers.

Despite these changes, the performance of the wheat marketing sector in Egypt is limited by the current design of the universal consumer subsidy on *baladi* flour and bread and by the continued involvement of the public sector in wheat trading and

processing. More specifically, although many new private traders have entered the wheat sector, expansion of private sector activities beyond small-scale trading has been more limited. Despite the absence of severe infrastructural deficiencies—such as access to transport, storage, or information—market integration in Egypt is still low compared with other developing economies. The milling sector suffers from unequal competition between the public and private sectors, resulting in overcapacity buildup, the cost of which is being borne by the private sector. Continued state involvement in wheat milling is also delaying the transformation of many old and small mills into processing facilities that are more efficient and cost-effective and that can benefit from economies of scale.

The general equilibrium analysis of this study evaluates the economywide impacts of several policy options that the government may wish to implement in the wheat sector. The results are as follows:

- Wheat self-sufficiency is often cited as a goal of Egyptian wheat policy. Achieving this goal through price policy would be costly and would distort the efficient allocation of resources.
- If the government wishes to reduce the costs of the consumer subsidy on *baladi* flour and bread, while protecting the poor, two alternative options can be considered. One is to target the subsidy to the poorest groups. The other is to eliminate the subsidy and compensate the poor through cash or alternative safety nets. Both measures would lead to substantial cost savings, although the administrative costs and feasibility of the options would have to be considered. The main advantage of these two options is that they would allow full liberalization of the wheat marketing sector, which would raise economic efficiency.
- The government may be interested in reducing the impact of international price instability on domestic wheat prices, especially once the consumer subsidy on wheat flour and bread is eliminated. A feasible and market-friendly option is to use a flexible import tariff that keeps the border price at a target level.

Four main policy implications can be derived for Egypt on the basis of the above findings:

- The goal of increasing wheat self-sufficiency and delivery of domestic wheat to the government using price policy would be expensive and ill-advised. Egypt's wheat production would benefit more from public investment in agricultural research, extension, and market information—all of which could boost yields and productivity.
- Targeting the consumer subsidy for *baladi* bread and flour to the poorest households would not only reduce subsidy costs and free government resources for more productive uses, it would also liberalize the wheat marketing sector with high potential for efficiency gains.
- Domestic price stability in the face of international fluctuations in wheat prices can be achieved with less distortionary measures than fixed consumer or producer prices by using a flexible import tariff regime.

- The public sector should shift its resources from wheat marketing and processing activities (which can be more effectively conducted by the private sector) toward more supportive activities, such as providing rules and regulations regarding market conduct, a system of commodity grading and standards, and policies to foster the development of rural credit organizations for small farmers and traders.

The findings and policy implications of this study can be used to draw lessons for other developing countries undergoing similar types of reforms. In particular, this study has shown that concern that market liberalization may lead to domestic price instability and higher consumer prices is not warranted. Egypt's experience indicates that participation of the private sector in marketing activities leads to more stable and integrated markets and lower retail prices for wheat. Partial liberalization, in contrast, dampens the potential investment response of the private sector and leads to leakage of the controlled commodity into the free market. Furthermore, when the objective of a commodity policy is to protect consumers, targeting the subsidy directly to the beneficiaries is more efficient than controlling the entire marketing channel. Finally, the goal of attaining self-sufficiency is expensive and unnecessary, given the increasing world trend toward globalization and reliance on international markets. Governments are advised to shift their resources from production and marketing activities that can be conducted more efficiently by the private sector toward more public-good activities, such as conducting research; offering extension services; providing public market information; investing in roads and communication infrastructure; implementing regulations regarding market conduct; and developing safety nets for the poor.

CHAPTER 1

Introduction

In response to a stagnating agricultural sector and unsustainable levels of food imports projected for the future, the government of Egypt embarked on a series of agricultural reforms in 1987. The main objective of the reforms was to convert Egypt's agriculture from a state-dominated into a more market-oriented sector. The government began the program by liberalizing prices, removing production controls, and introducing market forces into the provision of agricultural goods and services. In the wheat subsector, the reforms helped to boost domestic wheat production and wheat marketing by the private sector. The transition toward a fully liberalized system of wheat marketing is not complete and will require further changes in government policies.

Because of its importance in the Egyptian diet, wheat is considered a strategic commodity in the country. It provides more than one-third of the daily caloric intake of Egyptian consumers and 45 percent of their total daily protein consumption (Rowntree 1993; Rosen 1993; Abdel Ghaffar 1994). Wheat is mainly consumed in the form of bread. It is also the major staple crop produced in Egypt, occupying about 32.6 percent of the total winter crop area. One dilemma that the government faces is how to move to a private wheat marketing system without jeopardizing food security for low-income groups.

This study has two main objectives: to analyze the structure and performance of the wheat sector following the market liberalization programs initiated in 1987, and to explore the economywide effects of changes in three areas that are critical to wheat policy—consumer subsidies on bread and flour, producer subsidies aimed at raising self-sufficiency, and responses of the domestic economy to changes in international wheat prices.

The contributions of this report to the existing literature are manifold. While the International Food Policy Research Institute (IFPRI) has devoted many years to analyzing the food subsidy system in Egypt,[1] none of the previous studies take an in-

[1] See Farrar (2000) for a review of this research as well as reports and papers by Alderman, von Braun, and Sakr (1982); Scobie (1981); von Braun and de Haen (1983); Alderman and von Braun (1984, 1986); and Ahmed et al. (1999a).

depth look at its agricultural marketing system. This report complements current research at IFPRI on the subsidy program for wheat flour and bread in Egypt by presenting a comprehensive analysis of the systems for producing and marketing wheat. It builds on previous papers by El Aamir and Siam (1996), Harrison (1996), and Khedr, Erich, and Fletcher (1996). These authors qualitatively investigate the response of the wheat sector to the reforms in Egypt. Using primary survey data collected from 1996 to 1998, this report provides information on the impact of the most recent changes in wheat policy on production, processing, trading, and price behavior. It also gives new results from an economywide model designed to simulate alternative wheat policy scenarios that have not been investigated in the past. The findings of this research could be useful to both Egyptian policymakers and development researchers by offering additional knowledge that could be used to design future policy changes in Egypt.

The study's research activities are divided into several tasks that are organized by chapter. The following chapter reviews the wheat policy environment in Egypt. Chapters 3 and 4, respectively, evaluate the response of wheat farmers and traders to the reforms in Egypt's economy. In Chapter 5, the behavior and adjustment of local wheat prices are examined. Chapter 6 analyzes the structure and performance of the wheat milling sector. In Chapter 7, a computable general equilibrium (CGE) model is used to simulate the economywide effects of alternative wheat policy scenarios. The last chapter concludes the study and summarizes its main policy implications.

CHAPTER 2

Evolution of Wheat Policy in Egypt

The contemporary involvement of the government in the wheat sector started as early as the 1940s.[2] Before World War II, farmers were free to produce and sell their crops to private retail traders or wholesalers. Wholesalers in turn sold wheat grain to private mills. From the mills, wheat flour was sold to bakeries or consumers at market prices. In 1940, a large decline in wheat prices caused by an excess supply of wheat discouraged farmers from planting wheat. Poor harvests, high wheat prices, and subsequent protest strikes in 1941 induced the government to impose retail-price controls on wheat flour and bread, and to pass a decree mandating that wheat be planted on 50 percent of agricultural land holdings (Scobie 1981). Table 1 summarizes the evolution of the wheat policies implemented by the Egyptian government from 1941 to the present.

In the period from 1945 to 1955, the government slowly began to tighten its control over the production and trading of wheat. The government's stated goal was to promote the equitable distribution of food and income in Egypt. However, it is also likely that the government's underlying objective was to finance industrial growth through the provision of inexpensive food to urban consumers (Farrar 2000). Reversals in policy were common during the period. For example, by 1955 the government had reduced the area allocation requirement for wheat production to 33 percent of farmland. At the same time, the government imposed a compulsory delivery policy, whereby each farmer had to sell a specific quota of wheat (between 1 and 3 *ardeb* per *feddan*[3]) at a fixed price that was lower than international prices (Scobie 1981). Any surplus exceeding the quota was available for the farmer to use in home consumption or for local retail sale at market prices.

In the early 1960s, agricultural cooperatives were created in each village to control production and marketing of major crops, including wheat. Cooperatives provided agricultural inputs to farmers, imposed crop rotation schedules and crop area

[2] For a detailed history of wheat policy in Egypt, see Scobie (1981).

[3] An *ardeb* of wheat is equivalent to 150 kilograms, and 1 *feddan* is equivalent to 0.42 hectares.

Table 1—Evolution of government intervention in the wheat sector, various years, 1941–96

Approximate year	Main government policy changes in the wheat sector
1941	Fifty percent of all agricultural land holdings are allocated to wheat production.
	Consumer prices of all types of bread and flour are subsidized.
1955	Allocation of wheat area is reduced to 33 percent of all agricultural land holdings.
	Delivery of wheat quota is made compulsory at fixed prices.
1970	Allocation of wheat area is reduced to 27.5 percent of all agricultural land holdings.
	Government begins controlling marketing, distribution, and imports.
1976	Compulsory delivery is replaced with an optional delivery program.
1985	Compulsory delivery is reinstated.
1987	Mandatory area allocations and delivery quotas are abolished.
	Optional delivery at guaranteed floor prices is introduced.
1992	The private sector is allowed to import, produce, and trade *fino* flour.
	The subsidy on *fino* flour and bread is eliminated.
1993	All restrictions on marketing *fino* flour are eliminated.
	Mills are not allowed to produce more than one type of flour.
1996	Private and public millers that produce *fino* flour are required to use imported wheat.
	Production of *shami* flour and bread is stopped.

Source: Compiled by the authors.

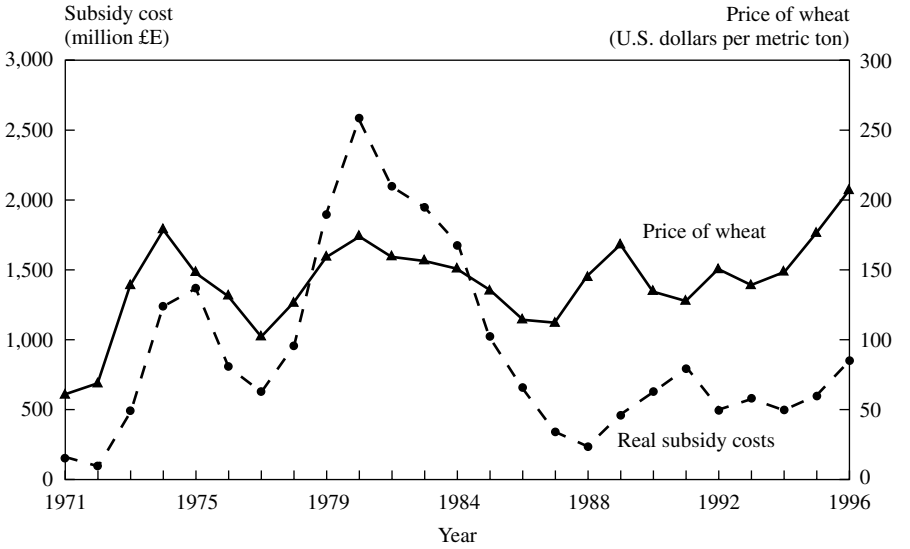
Note: Egypt has three main categories of bread: *baladi,* a coarse bread made from *baladi* flour, which is produced by extracting 82 percent of wheat grain; *shami,* made of *shami* flour, which is produced by extracting 76 percent of wheat grain; and *fino,* a fine bread made from *fino* flour, produced by extracting 72 percent of wheat grain.

allocations, bought the delivery quota of crops under the compulsory system at fixed prices, and marketed the crops (Hansen and Nashashibi 1975; Rowntree 1993; Moursi 1993). Transport of wheat between governorates was prohibited without permission from the Ministry of Supply.

In the early 1970s, the percentage of land allocated to wheat was further reduced to 27.5 percent, but the delivery procurement system persisted. In 1976, the Principal Bank for Development and Agricultural Credit (PBDAC) was created and worked along with the cooperatives in providing credit to farmers and receiving their output quota. From 1976 to 1984, compulsory delivery was replaced by an optional delivery program, whereby farmers could voluntarily sell their wheat to the government at a fixed procurement price. In 1985, however, compulsory delivery was reinstated and maintained until the implementation of the Agricultural Reform Program in 1987.

With the food subsidy system in place and heavy control over wheat production and marketing, the government became the major marketing channel for wheat grain, flour, and bread. The extent of government involvement reached its peak in fiscal year 1980/81, when the real cost (in 1987 constant prices) of the subsidy of wheat

Figure 1—Real subsidy costs for wheat bread and flour, and the current international wheat price, 1971–96



Sources: The source for subsidy costs for 1971–74 is Alderman, von Braun, and Sakr 1982; for 1975–93, FAO 1995; and for 1996, MOTS 1997. Real subsidy costs are calculated by deflating subsidy costs in current prices by the 1987 consumer price index. The price of wheat is the U.S. export price for wheat (U.S. hard red wheat no. 1, FOB gulf port), from IMF 1996.

grain and flour increased to 2.58 billion Egyptian pounds (£E),[4] absorbing around 11.6 percent of government expenditure (Figure 1).[5] Real subsidy costs declined during the mid- to late 1980s and reached their lowest levels (£E236 million) in 1987/88. In the 1990s, real subsidy costs increased slightly compared with 1987/88 but remained much lower than their levels in the mid-1970s or early 1980s.The subsidy costs for wheat flour and bread rose to £E862 million in real terms (£E2.5 billion in current prices) mainly because of the rise in international wheat prices to more than US$200 per metric ton in 1996.[6] This corresponded to approximately 68 percent of the total food subsidy cost and 7.56 percent of total government expenditure.

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[4] The annual official exchange rate for the Egyptian pound is shown in Table 68, Appendix 1. The official exchange rate was £E2.03 for each U.S. dollar in 1987, and £E3.39 for each U.S. dollar in 1997.

[5] According to Abdel Rahman (1997), food subsidy costs are usually calculated by subtracting the total value of the sale of the commodity from the total costs of supplying the commodity (including administrative costs).

[6] Other sources, such as Ali et al. (1997), report a wheat- and bread-subsidy cost of £E1.9 billion for fiscal year 1995/96. For many variables, especially those related to prices and values, figures from the statistical offices of various Egyptian ministries such as the Ministry of Trade and Supply, the Ministry of Agriculture and Land Reclamation, and the Central Agency for Public Mobilization and Statistics are not always consistent. In these cases the numbers reported are checked against nongovernmental sources or other published papers.

The subsidy system and government intervention in production and marketing created many inefficiencies and imposed a heavy burden on the budget and foreign exchange reserves. The inefficiencies included delivery quotas and area allocation requirements that distorted choices among competing crops, an overvalued exchange rate and artificially low wheat producer prices that suppressed wheat production, and a complicated and costly collection and distribution system for both wheat grain and wheat flour. In the mid-1980s, the widening food gap, stagnation of the agricultural sector, and the rising costs of the food subsidy system encouraged the Egyptian government to reform the wheat sector. Therefore, supported by the U.S. government and multilateral donor organizations, the government of Egypt in 1987 embarked on a series of agricultural market reforms that included the liberalization of many production and marketing controls.

The Agricultural Reform Program initiated in 1987 was designed to help the government realize its main policy objectives in the agricultural sector, namely (1) to provide an adequate supply of food to all income groups, (2) to promote greater self-sufficiency in crop production, (3) to increase farm income, (4) to conserve foreign exchange, and (5) to bring the budget deficit under control (Rosen 1993). The program consisted of two phases. In the first phase, prices, quotas, and marketing controls were partially liberalized for 10 crops. Import subsidies were also reduced, and markets were opened to private investment.

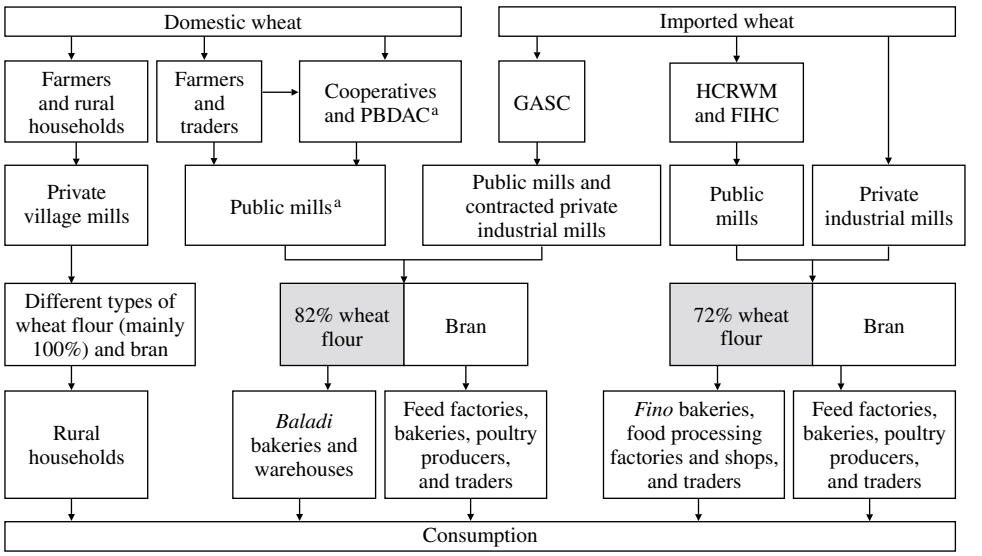
With respect to wheat, area restrictions and quota deliveries were eliminated in 1987. The government replaced the compulsory delivery program (reinstated in 1985) with an optional program. Moreover, rather than determining the procurement price at the harvest period, the procurement price was replaced by a floor price that was announced before the planting season to encourage farmers to plant wheat. Finally, the Ministry of Supply established a more liberal framework for the trading of wheat grain and wheat flour.

The second phase of the reform coincided with the launching of the Economic Reform and Structural Adjustment Program in 1991. With the assistance of the International Monetary Fund, the World Bank, and international lenders, this program sought to shift Egypt from a state-controlled economy into a more-efficient, market-oriented economy where the private sector could play a major role. Building on the earlier program, phase II of the Agricultural Reform Program liberalized the production and marketing of all remaining crops, principally rice and cotton. It also eliminated all remaining input subsidies and encouraged the private sector to play a greater role in agricultural trading.

General Structure of the Wheat Industry

Understanding the current structure of the wheat industry in Egypt is helpful in understanding the changes that occurred in the wheat sector following the reforms. Figure 2 outlines the structure and marketing channels of the wheat sector. As shown in this flowchart, there are two main sources of wheat in Egypt: domestic production and imports. In 1996, the country's wheat supply stood at about 12 million metric

Figure 2—Structure of the wheat industry in Egypt



Notes: PBDAC = Principal Bank for Development and Agricultural Credit; GASC = General Authority for Supply Commodities; HCRWM = Holding Company for Rice and Wheat Mills; and FIHC = Food Industries Holding Company.

[a] PBDAC and the public mills collect the wheat from farmers and traders on behalf of GASC, which allocates fund to each of these institutions to pay the procurement price to farmers and traders.

tons, about half of which was imported. Domestic wheat is mainly consumed in rural areas. Rural households process the wheat into different types of flour in local village mills and use the flour to bake their own bread. About 1 to 2 million metric tons of domestic wheat is also sold annually by farmers or traders to the government. The government collects the wheat through cooperatives, local branches of PBDAC, and public mills. This wheat is transformed by the public mills or contracted private mills into *baladi* (82 percent) flour. *Baladi* flour is either sold directly to consumers or is processed to make *baladi* bread, a coarse and dark-grained type of pita bread. *Baladi* flour and bread are sold at subsidized prices to consumers in government-licensed warehouses and bakeries. The warehouses and the bakeries purchase the flour from the government at discounted fixed prices and are expected in turn to sell the flour or bread at subsidized prices set by the government.

Given the insufficient levels of domestic wheat procured, the government mainly relies on imported wheat to supply its *baladi* flour and bread subsidy program. The General Authority for Supply Commodities (GASC) is the public organization responsible for importing and procuring domestic wheat for the government. In 1996, about 4.6 million metric tons of imported wheat were purchased by the GASC for the production of *baladi* flour and bread.

Another important segment of the wheat industry in Egypt is the *fino* flour market. This flour is of higher quality than *baladi* flour and is sold at free market prices.

It is used to make French breads, higher-quality pita bread, and pastries. The *fino* flour market was liberalized in 1992. This involved allowing the private sector to purchase wheat and process it into *fino* flour, as well as selling the flour at free-market prices. However, shortly after liberalization, the government issued a decree allowing only imported wheat to be used for the processing of *fino* flour. The private sector is still not permitted to import wheat and sell it as grain. (Policy changes in the *fino* flour market are discussed in more detail later in this report.) Until 1996, 76 percent wheat (*shami*) flour was also produced and sold at subsidized prices by the government. However, its production was banned in 1996 because of its easy sifting into the free-marketed *fino* flour that was sold at higher prices.

Although the government controls the *baladi* flour subsector, it also contracts with the private sector to help in its processing and distribution. In contrast, both the private and the public sectors compete in the processing and marketing of *fino* flour. Since the liberalization of the *fino* flour market, the private sector has built several large industrial mills to process and market this type of flour. As will be discussed further in Chapter 6, the public mills were reorganized in 1996 into two public holding companies: the Holding Company for Rice and Wheat Mills (HCRWM) and the Food Industries Holding Company (FIHC). Although both of these companies have sold parts of their subcompanies' shares to the private sector, they are still managed by the government as public organizations.

Agricultural Market Reforms and Changes in Wheat Prices and Consumption

As indicated in Table 2, the reforms initiated in 1987 led to an increase in the net nominal protection coefficient[7] from an average of 0.68 in the prereform period (1971–87) to an average of 1.05 after reform (1988–95). This indicates that, while in the past farmers incurred a 32 percent tax on their output prices, they now received market prices that were almost equivalent to world prices. Similarly, the difference between market and procurement prices declined significantly in the postreform period. Table 2 shows that, in 1995, market prices were only 6 percent higher than procurement prices, compared with 37 percent just before the reform period. Procurement prices for wheat increased from £E167 per metric ton in 1987 to £E600 per metric ton in 1995, while market prices increased from £E229 per metric ton to £E636 per metric ton, respectively.

Starting in 1996, however, domestic wheat prices have diverged from trends in world wheat prices. The domestic procurement price remained at £E633 per metric ton in 1997—the same price support level set in 1996, despite the substantial drop

[7] The net nominal protection coefficient (NPC) is a measure of price taxation (or subsidization) of prices. It is defined as the domestic price divided by the border price of wheat. An NPC of greater than one indicates that producers are receiving higher prices than they would otherwise, while an NPC smaller than one indicates that producers are being discriminated against (Tsakok 1990).

Table 2—Procurement, market, farmgate, and border wheat prices by fiscal year, 1970–95

Year	Procurement price	Market price	Farmgate price	Border price	Procurement price over average wheat export price	Net nominal protection coefficient
			(Egyptian pounds per ton)			
1970	34	39	38	28	n.a.	n.a.
1971	33	35	35	35	0.63	0.95
1972	33	35	35	35	0.49	0.95
1973	34	38	37	42	0.37	0.86
1974	43	47	46	109	0.43	0.41
1975	49	51	51	85	0.45	0.57
1976	48	47	47	72	0.60	0.62
1977	50	54	54	60	0.64	0.86
1978	52	61	61	65	0.62	0.89
1979	65	64	64	144	0.60	0.42
1980	78	88	87	163	0.58	0.51
1981	80	92	91	185	0.47	0.47
1982	80	82	82	189	0.54	0.41
1983	93	110	109	198	0.67	0.53
1984	120	124	127	216	0.61	0.55
1985	120	172	168	236	0.54	0.69
1986	120	231	225	244	0.76	0.90
1987	167	229	223	233	0.90	0.94
1988	233	459	467	331	0.98	1.32
1989	400	528	533	445	1.18	1.13
1990	467	531	540	402	1.27	1.26
1991	467	568	550	547	0.93	0.99
1992	500	569	527	558	1.05	0.97
1993	500	570	556	572	1.15	0.95
1994	567	574	533	581	1.13	0.94
1995	600	636	565	704	n.a.	0.86

Sources: *Procurement price* is defined as the fixed price at which the Government of Egypt would purchase the wheat (quota) from the farmer. The source for 1970–85 is Dethier (1989); for 1986–95, MOTS (1997). *Market price* is defined as the average annual free market price for an indicative market. The source for 1970–85 is Dethier (1989); for 1986–95, USDA, *Attache Report: Grain and Feed Annual,* various years. The *farmgate price* is defined as the average wheat price received by the farmer at the farm gate. The source for 1970–85 is Dethier (1989); for 1986–95, *USDA Agricultural Situation Annual,* various issues. The source for the *border price* for 1970–78 is Dethier (1989); for 1979–95, the price is computed as the sum of average wheat export price and freight rate (IGC, various issues) multiplied by the black market exchange rate (International Currency Analysis, Inc., *World Currency Yearbook,* various issues). The net nominal protection coefficient is computed as the ratio of the market price over the sum of the border price and a 5 percent marketing margin.

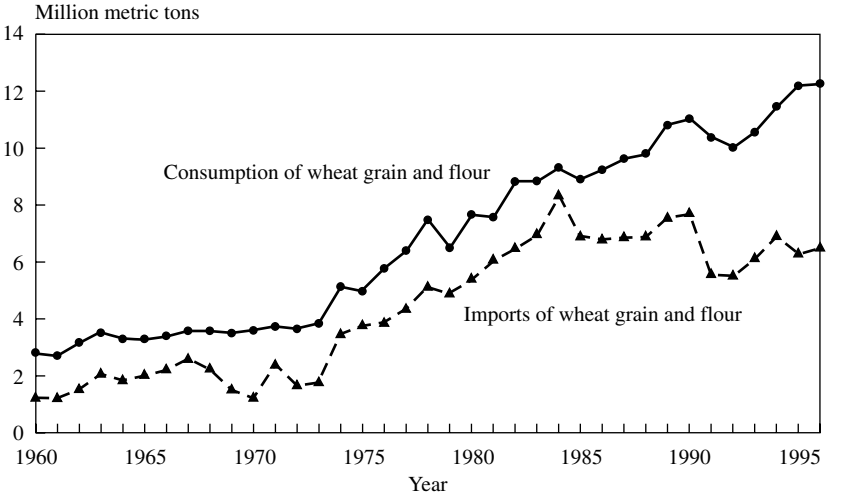
Note: n.a. indicates not available.

in the international price of wheat from a high of US$262 per metric ton in May 1996 (equivalent to £E888 per metric ton) to US$126 per metric ton (£E427 per metric ton) by the end of May 1998 (IGC, various issues). This may be part of the government's continued effort to stimulate the production of domestic wheat, but it may also be caused by the political difficulty in reducing the support price to levels lower than in the preceding years.

In the postreform period, the prices of *baladi* flour and bread set by the government were also gradually increased. *Baladi* flour prices are usually set at a lower rate for bakeries than for warehouses. By 1996, the price of *baladi* flour had reached £E290 per metric ton to bakeries and £E500 per metric ton to warehouses. On the retail side, the government increased the price of *baladi* bread from £E0.02 per loaf in 1988 to £E0.05 per loaf in 1989, where it has remained until the year 2000, despite significant increases in overall prices.

Bread prices rose in 1988, and *fino* prices were liberalized in 1992. However, consumption of wheat grain and flour continued to grow throughout the 1990s, except for 1991 and 1992, which were characterized by a general economic slump in the country (Figure 3). In 1996, average per capita consumption of wheat grain and flour was around 200 kilograms per year, constituting one of the highest levels of per capita wheat consumption in the world.

Figure 3—Consumption and imports of wheat grain and flour (in wheat equivalents), 1960–96



Sources: For the data on domestic wheat production, FAO (1997); for the data on wheat grain and flour imports, 1960–80, FAO (1997); for 1981–84, MOTS (1996b); for 1985–95, CAPMAS (1996a); and for 1996, USDA (1997). For the data on net change in wheat stocks, 1960–75, FAO (1981), for 1976–84, FAO (1995); for 1985–95, CAPMAS (1996a); and for 1996, USDA (1997).
Note: Total consumption is computed on the basis of domestic wheat grain production, wheat grain and flour imports, and net change in stocks.

The positive consumption trend of wheat flour and bread (especially the consumption of the heavily subsidized *baladi* bread) is due to several factors. First is the continued high population growth rate of more than 2 percent per year. Second, the *baladi* bread retail price is subsidized to the extent that it covers only one-third of its average unit cost of production, making it the cheapest source of calories compared with other food items (Ali and Adams 1996). Third, in the past few years, a general decline in purchasing power has occurred that has induced a substitution to subsidized bread from other more expensive food items (USDA 1995). Finally, low bread prices relative to animal feed prices have encouraged farmers to use bread as feed for livestock and poultry. In 1995, the wheat grain equivalent of subsidized *baladi* bread was about £E418 per metric ton. The farmgate price of maize, the most commonly used feed grain, was about £E512 per metric ton. Alderman and von Braun (1984) estimated that in 1981/82, about 4 to 7 percent of *baladi* bread purchases were fed to animals. More recent estimates by Kherallah, Minot, and Gruhn (1999b) suggest that in 1998 about 7 to 8 percent of the *baladi* bread purchased by Egyptian wheat farmers was used as animal feed.

Agricultural Market Reforms and Changes in Wheat Area, Production, and Yields

In general, the agricultural reforms initiated in 1987 had a positive impact on wheat production. From 1986 to 1996, the wheat area planted doubled, yields increased by 48 percent, and wheat production almost tripled. These results are attributed to several factors, including

- higher relative wheat prices
- the increased profitability of wheat-based rotation
- the adoption of higher-yielding seed varieties that are also more resistant to heat, drought, and salinity
- the implementation of more productive cultural practices
- a more liberal policy environment, which allowed farmers to base their crop planting decisions on market forces and provided them with an incentive to adopt modern technology

All these factors reinforced each other in making investment in wheat production a more attractive and lucrative enterprise.

The resulting rise in wheat production also led to a significant improvement in the wheat self-sufficiency ratio[8] from 21 percent in 1986 to 47 percent in 1996. Owing to a continued increase in demand, however, higher production has only kept pace with the growth in consumption, requiring the import of 6 to 7 million metric tons of wheat per year. Although the government revises its wheat self-sufficiency target yearly, its goal is to maximize the share of domestic production in total wheat

[8] The self-sufficiency ratio is defined as the percentage ratio of domestic production over both domestic and imported wheat supply.

consumption. This goal is fueled by concerns over requirements for balance of payment and foreign exchange and by political and strategic considerations given the importance of wheat in Egypt's food security.

Agricultural Market Reforms and Changes in Wheat Marketing and Milling

The partial liberalization of the wheat trading sector started in 1992 in the *fino* flour market. Until then, the government had maintained a monopoly over the importation of all types of wheat grain and flour. In 1992, the government freed the prices of *fino* flour and *fino* bread and allowed the private sector to import wheat for the production of *fino* flour. Resale of wheat in excess of the milling needs for *fino* flour was not permitted. The government also allowed private traders to import *fino* flour directly. In 1993, all the remaining restrictions on *fino* flour production and trading were removed, allowing both the public and private sectors to freely import, produce, distribute, and sell *fino* flour at free market prices. The quotas of government-milled *fino* flour going to food processing factories, shops, and bakeries were also eliminated, thus allowing these outlets to purchase their *fino* flour freely in the market.

All restrictions on the exchange, sale, and transport of wheat bran and germ were canceled in 1992 as well. However, the government retained control over bran prices. The large difference between private and public prices for bran created a strong incentive for illegal arbitrage. In 1994, the government reinstated control over bran resulting from *baladi* flour production, allowing only its sale to feed factories and to livestock and poultry producers for animal feed. In 1997/98, as a result of the increasing supply of *fino* flour, market bran prices declined to the government-specified price of £E400 per metric ton. This has diminished the incentive for illegal trading.

In 1992, the government also began to liberalize the wheat milling sector. At that time, around 80 percent of all industrial wheat mills in the country belonged to the public sector; the rest were privately owned but were licensed to mill for the government under specific arrangements. Furthermore, during this period only the public sector was equipped with mills capable of generating *fino* flour; the private sector was forced to contract with these mills to process its flour. Owing to the high fees that the public milling companies were charging and the relative profitability of milling wheat, the private sector started to build its own storage and milling facilities in 1996.

By the end of 1997, nine new private mills had started producing *fino* flour. Coupled with the flour produced by the public sector, this created an excess supply in the market and reduced flour imports to less than 100,000 metric tons in 1997. (See Chapter 6 for further discussion on excess capacity in the milling sector and the contribution of the private and public sectors to *fino* flour production.) The new challenge facing the milling industry is how to tackle the buildup of overcapacity, which is pushing *fino* flour prices down and forcing some of the new mills to operate at 50 percent capacity (USDA 1997, 1998).

More Recent Policy Changes

Because of the high price differential between the two types of flour, there is an incentive to divert subsidized *baladi* flour for the production of the free-marketed *fino* flour. Therefore, to reduce leakage, a decree was introduced in 1993 forbidding *fino* flour mills from producing any other type of flour. According to Ahmed et al. (1999a), in 1997, estimated national average leakage of *baladi* flour was still at about 28 percent of total supply.

Given its desire to minimize wheat import costs and because of low levels of domestically procured wheat for *baladi* flour production, the government announced in 1996 that *fino* flour could be produced only from imported wheat. Police enforcement was stepped up to detect any attempts to use domestic wheat for the production of *fino* flour, and the production of subsidized *shami* flour was canceled because of its easy and profitable transformation into *fino* flour. In response to these new restrictions and pressures to deliver an expected quota of wheat to the government, some local officials have illegally imposed restrictions on the transportation of wheat outside of their governorates to try to force increased delivery of domestic wheat after the harvest season.

In another attempt to decrease Egypt's dependence on imported wheat, to capitalize on the domestic production of white maize (about 5.5 million metric tons per year), and to reduce the costs of the subsidy for *baladi* bread and flour (since white maize tends to be cheaper than wheat), the Ministry of Trade and Supply (MOTS) introduced an initiative to mix 80 percent *baladi* flour with 20 percent white-maize flour to make subsidized *baladi* bread and flour. This new bread is sold at the same subsidized price of £E0.05 per loaf and has almost the same taste as the regular *baladi* bread. The initiative was implemented in 1996 on a pilot basis in a few bakeries in Cairo, and MOTS is planning to extend the program on a larger scale. The main constraint to this extension is the low level of domestic procurement of white maize; most domestic maize is used by rural households for home consumption as animal feed. In 1997, the government was able to procure only about 140,000 metric tons of white maize for the new mix. Consequently, the government is counting on increasing maize yields, which are currently below potential and appear more promising than increasing wheat yields. The government is also promoting the delivery of farmers' marketable surplus of white maize.[9] Procurement experience with wheat indicates, however, that the government is unlikely to be able to obtain enough domestic white maize to extend this initiative nationwide.

Conclusion

The Egyptian reforms to local wheat production and the *fino* flour market have resulted in significant changes in the wheat sector. Farmers are receiving higher rela-

[9] According to Al Akhbar (1998), the Minister of Agriculture and Land Reclamation announced that the government was expecting to obtain 1 million metric tons of white maize from local farmers in 1998.

tive prices for wheat, have more outlets to sell their products, and have more of an incentive to invest in yield-increasing modern varieties and other agricultural technologies. The reforms have also encouraged private sector participation in the production and marketing of wheat flour. Despite these changes, the government is still heavily involved in the wheat sector and several restrictions are still in place. The next four chapters investigate the impact of the reforms on wheat production, marketing, price behavior, and processing

CHAPTER 3

Adjustment of Wheat Production to Market Reform in Egypt

This chapter analyzes the results of a survey of 800 wheat farmers to answer three questions.[10] First, what are the patterns in wheat production and marketing that have emerged following the economic reforms? National statistics document the growth in area and yield, but this study provides a more detailed picture of the characteristics of wheat farmers, the role of wheat in farmer rotations, patterns in input use, costs of production, and food consumption patterns. Second, why is the government unable to purchase more than a small portion of national wheat production? The government is particularly interested in understanding wheat usage and marketing patterns to determine why it has been unable to increase procurement of domestic wheat for the production of *baladi* flour and bread. Third, how does wheat supply and input demand respond to wheat and input prices? These parameters are necessary ingredients for informed analysis of wheat policy in Egypt.

Survey Design

The Egypt Wheat Producers Survey (EWPS) was carried out in 1998 in 20 out of the 26 governorates in the country.[11] The sample was designed to be representative of farm households growing wheat in the 1997/98 season. It uses a four-stage stratified random sample that relies, in part, on lists of wheat farming households prepared by the Ministry of Agriculture and Land Reclamation (MALR).[12]

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[10] Significant parts of this chapter were published in Kherallah, Minot, and Gruhn (1999a).

[11] The governorates included in the EWPS survey were Alexandria, Qalubia, Kafr El-Sheikh, Gharbia, Menufia and Beheira in the Western Delta; Damietta, Dakahlia, Sharkia, and Ismailia in the Eastern Delta; Giza, Fayum, Beni Suef, and Minia in Middle Egypt; Assiut, Sohag, Qena, and Aswan in Upper Egypt; Matruh and New Valley in the Frontier region; and the Nubaria region, which is not a governorate, but a new agricultural land region that crosses several governorates.

[12] Appendix 2 describes in more detail the four-stage, stratified, random-sampling method used.

Because each wheat farmer in Egypt did not have an equal probability of being selected for the sample, weights were applied during data analysis. The weights (also called expansion factors) are the inverse of the probability of selection. Thus, if wheat farmers in a region were underrepresented in the sample, the weights compensate for this by giving greater weight to these farms in the calculation of national averages and percentages.

The survey used a 23-page, precoded questionnaire. The questionnaire is composed of 16 sections: household member characteristics, household characteristics, land-use and cropping patterns, crop production and sales, wheat usage, wheat by-product use, wheat storage, wheat and bread consumption, labor use, inputs, ownership of farm assets, credit, ownership of consumer durables, sources of income, sources of information, and farmer perceptions.

Basic Characteristics of Wheat Production

Characteristics and Income Sources of Wheat Farming Households

Analysis of the EWPS suggests that around 54 percent[13] of household heads are literate, even though only 47 percent received any formal education. About 64 percent of wheat farmers consider farming as their main activity; other primary activities include employment in the public and service sectors.

The value of consumer durables was used as a measure of wealth and thus a proxy for the standard of living of the households. Average wealth and farm size were disaggregated by wealth quintiles.[14] Average wealth ranges from £E173 for the poorest households to £E18,226 for the wealthiest ones. This indicates a highly concentrated distribution of wealth, where 81 percent of all consumer durables are owned by 20 percent of the wheat farm population. Farm size is also positively associated with household wealth. Figure 4 indicates that wealth distribution differs by geographical region (see the definition of geographic regions and a map of Egypt in Appendix 3). Average household wealth is significantly higher in the Nubaria and Frontier regions than in other regions.[15] In the Nile Valley regions, average wealth is higher in the Delta regions than in Middle and Upper Egypt.

The major sources of income for wheat farmers are crop sales and consumption of home-produced crops. As Table 3 indicates, 97 percent of wheat farm households

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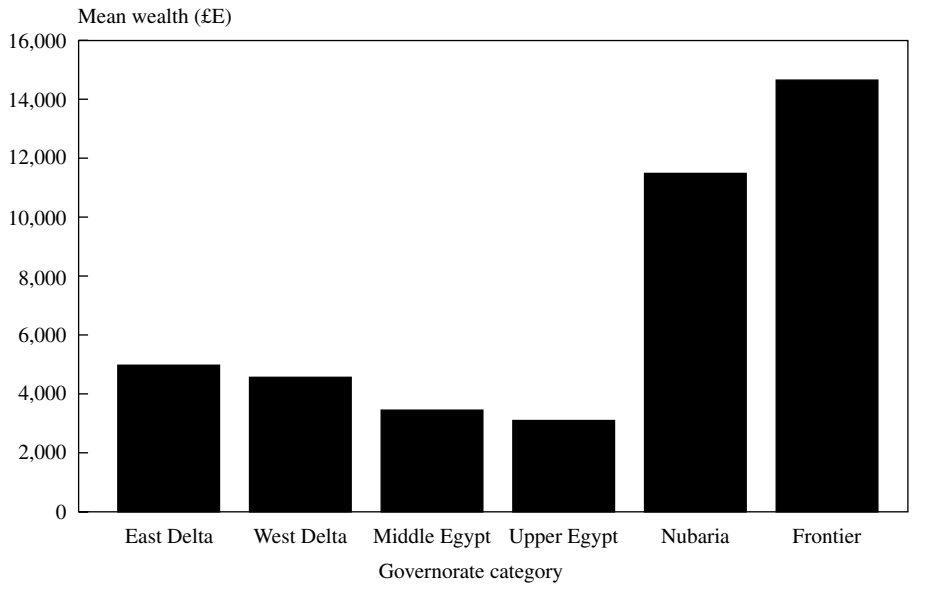
[13] All the statistics reported in this chapter are weighted averages or percentages.

[14] Each quintile groups 20 percent of the households, ranked by the value of their consumer durables. For example, the first quintile represents the 20 percent of households with the smallest value of consumer durables, while the fifth quintile is made up of the wealthiest 20 percent of the households.

[15] Results from Nubaria and the Frontier should be interpreted with caution because of the small sample size: 30 households in Nubaria and 20 in the Frontier. The Nubaria and Frontier regions are characterized by large firms, mostly on reclaimed land. A government program has reserved reclaimed land in Nubaria for university graduates that participate in farm training classes. The graduates receive technical and financial help from the government to manage the farms.

Figure 4—Geographical distribution of wealth in Egypt



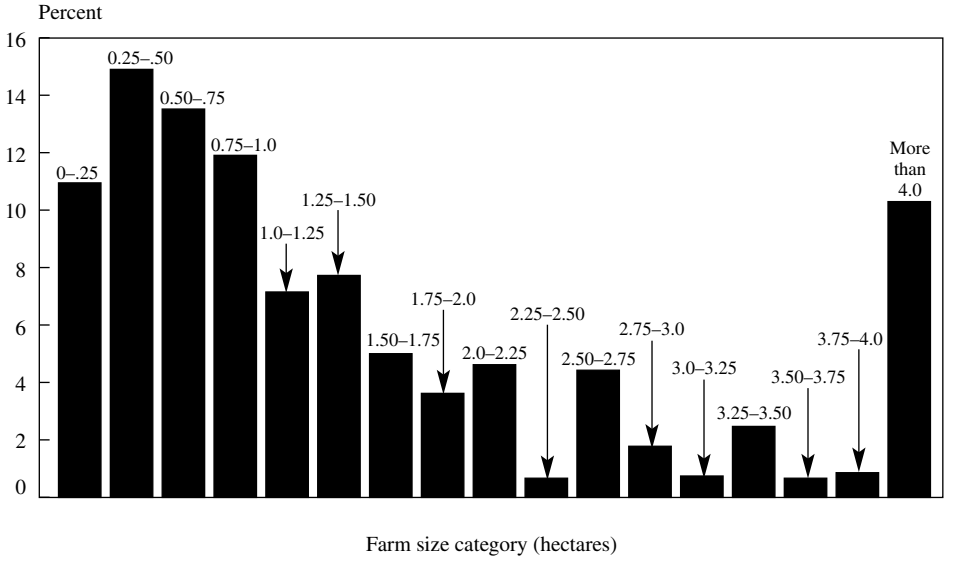
derive in-kind income from consumption of their own crops, while 89 percent of the households receive income from crop sales. Income shares from crop sales and crop home consumption are 30 and 25 percent, respectively. More than three-quarters of the wheat farmers have income from livestock activities, but these activities account for just 20 percent of income. Wages from nonagricultural activities provide 12 percent of total income.

Table 3—Sources of income and income shares for wheat farmers

Income source	Share of households that receive this type of income	Average income share
	(percent)	(percent of total income)
Agricultural wage income	17	4
Other wage income	45	12
Nonfarm self-employment	15	4
Crop sales	89	30
Home consumption of crops	97	25
Animal product sales	75	11
Animal product home consumption	83	9
Remittances	7	2
Transfers	18	2
Other	4	1
Total		100

Source: IFPRI/MALR-EWPS (1999).

Figure 5—Distribution of wheat farms by farm size



Land Use and Crop Production

The vast majority of Egyptian wheat farms are small, irrigated, and owner-operated. The average farm size is 1.7 hectares, but 50 percent cultivate less than 1.0 hectare (Figure 5). About 10 percent of the households have more than 4 hectares. The largest farms are found in Nubaria and the Frontier. If Nubaria and the Frontier governorates are excluded, only 2.5 percent of the households would own more than 4 hectares, which is consistent with MALR estimates (MALR 1998).

Irrigation is almost universal in Egyptian agriculture, allowing the cultivation of summer and winter crops and a cropping intensity ratio of 1.9.[16] More than three-quarters of the land of wheat farmers is irrigated by pump from a canal. One exception to this pattern is that, in the Frontier, irrigation water comes from wells, both private and public.

The survey also confirms that wheat plays an important role in farmers' crop rotations. The most common winter–summer rotations are wheat–rice (20 percent of the cultivated area), berseem (clover)–cotton (12 percent), wheat–maize (10 percent), and berseem–maize (8 percent). Four-fifths of the wheat farmers in Egypt grow wheat every year. This implies that, although 1.67 million households (or 60 percent

[16] The cropping intensity ratio is calculated as the sum of sown area across seasons divided by the annual cultivated area.

Table 4—Measures of the importance of each crop to wheat farmers

Crop	Percent of households growing	Percent of sown area	Percent of value of crop production
Rice	40.3	12.3	15.3
Wheat	100.0	23.6	18.7
Maize	60.1	11.9	7.8
Sorghum	17.6	4.7	2.8
Fava beans	15.2	3.7	2.5
Other legumes	5.8	1.6	1.4
Tomatoes	3.9	1.8	3.0
Other vegetables	10.6	2.9	4.3
Fruit	5.9	2.0	3.4
Cotton	46.0	13.0	23.5
Berseem	76.5	16.8	11.6
Feed maize	10.7	1.5	0.6
Other crops	14.1	4.2	5.1
Total		100.0	100.0

Source: IFPRI/MALR-EWPS (1999).

of all farming households) grow wheat in a given year, approximately 2 million households grow wheat overall.[17] Interestingly, only 58 percent of the smallest wheat farmers grow wheat every year, compared with 92 percent in the category of the largest wheat farmers. The explanation appears to be that small farms have fewer plots (just two on average), so it is more difficult to grow wheat every year and rotate winter crops.

Wheat farmers devote one-half of their winter cropland (or slightly less than one-quarter of their total sown area) to wheat (see Table 4). In terms of the value of production, the most important crops grown by wheat farmers are cotton (24 percent of the total), wheat (19 percent), and rice (15 percent). Cotton, fruits, and vegetables account for a larger share of the value of production than of area because value per hectare is higher than for staple foods.

The survey results also highlight the intensity of wheat production in Egypt. The average wheat farmer harvests crops worth close to £E12,000, although this amount varies considerably. About 23 percent produce less than £E3,000, while 9 percent of them produce more than £E30,000 worth of crops. The average wheat farmer harvests 3.2 metric tons of wheat from 0.76 hectares of planted wheat, implying an average yield of 4.3 metric tons per hectare. Similarly, the average yields among wheat farmers are 7 metric tons per hectare for rice, and 4.8 metric tons per hectare for maize.

[17] This figure is estimated by adding the total number of farmers who grow wheat every year to twice the number of those who grow wheat every two years, three times the number of farmers who grow wheat every three years, and so on. This calculation adjusts for the undercounting of occasional wheat farmers in the sample.

The estimated wheat yield of 4.3 metric tons per hectare would imply national wheat production of 5.4 million metric tons, which is lower than the official figure of 6.1 million metric tons in 1998. The reason for this discrepancy appears to be that the official yield estimate (5.7 tons per hectare) is higher than the average estimated from the EWPS data. Farmer recall (used in the EWPS) is not necessarily more accurate than crop-cutting samples (used by the MALR), but the discrepancy is worth further investigation. It may be that official numbers overestimate yields and domestic production in Egypt. (See Abdel-Latif [1999] for a discussion of these issues.)

Finally, the survey indicates that Egyptian wheat farmers are highly commercialized. The market surplus ratio[18] is between 50 and 70 percent for the main food grains: rice, wheat, maize, and sorghum. For legumes, fruits, and vegetables, 85–98 percent of the harvest is sold. Virtually all cotton (99 percent) is sold. This pattern is not the result of just a few large producers, as shown by the high proportion of producers that sell some of their output. Even for the basic grains (wheat, maize, and sorghum), the proportion of growers that sell part of their crop is more than half. The least-commercialized crops are berseem and feed maize, grown mainly for on-farm use as animal feed.

The average value of crop sales is £E8,311 per wheat farm, although more than half of wheat farmers sell less than £E4,000 worth of crops. At the other extreme, roughly 5 percent of wheat farmers have annual crop sales of more than £E30,000. Through comparison of the average value of sales to the average value of production, 70 percent of the crop production of Egyptian wheat farmers was estimated to be sold. Again, most households sell a smaller percentage of their harvest, but the patterns of large farms tend to dominate the average. The market-surplus ratios are highest in Nubaria and the Frontier, and are higher (on average) among large and wealthy farmers.

Input Use

Seeds. Before the agricultural reforms of 1987, about 61 percent of the total cultivated wheat area in Egypt was sown with low-yielding, long-stalked wheat varieties (Sallam et al. 1989). Because the market price of wheat stalk (£E160 per metric ton) was higher than the fixed price of wheat grain (£E120 per metric ton), farmers preferred to sow traditional seed varieties that produced long stalks and large straw (Harik 1996). With the liberalization of the wheat market and the introduction of improved modern seed varieties, farmers started to adopt semidwarf varieties that were both higher yielding and more resistant to heat and pests. By 1998, only 3 percent of wheat farmers used traditional seed varieties.

On average, farmers apply about 162 kilograms of seed per hectare of land and obtain 4.3 metric tons of wheat per hectare. As expected, traditional varieties are less

[18] The market surplus ratios are calculated as the total volume of sales as a percentage of the total volume of production. As a result, it is more influenced by the patterns of large producers than by those of small producers.

expensive, have lower yields, and are typically sown by poorer farmers. Yields of modern wheat varieties are about 15 percent higher. Although they are not major wheat producing areas, yields in the Frontier and Nubaria are about 16 and 7 percent higher than the national average, respectively. The ratio of wheat output to seed input[19] suggests that wheat output from traditional varieties and older modern varieties are generally lower than for the most modern varieties. The output–input ratio is substantially higher for the most modern varieties.

Nearly 55 percent of the farmers obtain their wheat seeds from cooperatives, and about 14 percent purchase them from traders. A further 27 percent obtain their seeds from either other farmers or from the previous years' harvest. Cooperatives and traders provide mainly modern varieties, while other farmers provide more than 85 percent of the traditional varieties purchased by farmers. Cash is the primary means of payment; only 4 percent of farmers received seed on credit from their suppliers. Farmers typically travel about 0.5 kilometers to purchase seeds, with cooperatives usually being closer than traders and village banks. Seeds retail for about £E1.47 per kilogram on average.

Fertilizers. Before 1987, the government controlled the distribution, marketing, and pricing of fertilizers through PBDAC. The general subsidy on the distribution of fertilizers was gradually reduced starting in 1988 and was completely phased out in 1992. In 1991, the government began to break up PBDAC's monopoly on the distribution of fertilizer by allowing the private sector to import and purchase domestically produced fertilizer. By 1992, the fertilizer market's share of private sector traders was more than 75 percent.

Wheat farmers rely principally on inorganic fertilizers and crop rotation to maintain the fertility of their wheat fields; use of manure is limited. According to the EWPS, the three most widely used fertilizers by Egyptian wheat farmers are ammonium nitrate, urea, and single super-phosphate. In the 1997/98 agricultural year, nearly 100 percent of wheat farmers used some form of nitrogenous fertilizer, usually urea or ammonium nitrate, while 44 percent used single super-phosphate on their wheat fields. Egypt has one of the highest application rates for nitrogenous fertilizer in the world (390–450 kilograms per hectare).

About 45 percent of wheat farmers purchase their fertilizer from cooperatives, and 41 percent from agricultural traders. Fertilizer prices vary between £E320 to £E970 per metric ton, depending on the type of fertilizer. On average, farmers travel about 0.5 kilometers to purchase fertilizers from a cooperative, and about 1 kilometer to make their purchases from an agricultural trader. As is the case for seeds, cash is the primary means of payment for purchases of inorganic fertilizers. About 92 percent of farmers purchased fertilizer in cash, 7 percent purchased it on credit from suppliers, and only 1 percent obtained it through loans from a financial institution.

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[19] The ratio of output to input is computed by dividing the approximate wheat yield (kilograms per hectare) by the average seed-application rate (kilograms per hectare).

Labor

Unlike many other countries in the world, Egypt produces wheat labor-intensively. On average, farmers use 79 person-days of labor on each hectare of wheat during the growing season. Farm work is about evenly split between family labor (51 percent) and hired labor (49 percent). The single most labor intensive activity is harvesting: more than 23 person-days of labor are devoted to harvesting 1 hectare of wheat and 16 person-days to threshing.

Labor use varies with farm size. As shown in Table 5, households with small farms use more labor per hectare, most of which is family labor. Large farms, by contrast, use less labor per hectare, most of which is hired. They also hire more machinery. Wage rates in wheat production are about £E8 to £E15 per day, depending on the activity and the period of the year. Almost all farmers pay their hired labor in cash.

Agricultural Machinery

Shortages of family labor and high wage rates for hired labor during peak periods have been an impetus for the mechanization of Egyptian agriculture (Khan 1993). Virtually all wheat farmers (99 percent) use tractors, albeit for an average of just three-quarters of a day over the wheat season. Despite high usage in wheat farming, tractors are owned by only 14 percent of wheat farmers; the remainder rent. Wealthier and larger farmers are more likely to own a tractor than poorer households. On average, the daily rental rate for a tractor is £E116. Although 93 percent of wheat farmers use pumps to irrigate their wheat fields, only 58 percent own a water pump. The remainder rent pumps primarily from friends and neighbors.

Credit

According to the EWPS, few wheat farmers are able to purchase inputs on credit. Cash transactions account for 92 percent of fertilizer purchases, 95 percent of seed purchases, and 98 percent of the purchases of agricultural chemicals. On the other

Table 5—Labor usage in wheat production by labor type and total area category

	Farm size quintile					
Type of labor	**Smallest**	**2**	**3**	**4**	**Largest**	**Overall**
	(person-days per hectare)					
Family	65.6	48.1	35.4	26.5	14.4	40.6
Hired	36.3	33.9	36.1	32.2	43.3	36.2
Exchange	2.3	3.5	1.3	1.9	.2	1.9
Total	104.2	85.5	72.8	60.6	57.8	78.7

Source: IFPRI/MALR-EWPS (1999).

hand, 24 percent of the wheat farmers were able to obtain a loan for the 1997/98 season, and 30 percent had received a loan within the past five years. Virtually all the loans (96 percent) came from PBDAC, which offers loans at below-market interest rates (11–13 percent per year). The average loan is for £E3,454, with a repayment period of 302 days.

Access to credit varies according to household wealth, in part because PBDAC uses the amount of land under cultivation as an important criterion in the allocation of credit. Just 12 percent of the poorest wheat farmers had obtained a loan, compared with 24 percent on average among all wheat farmers. Furthermore, poorer farmers received smaller loans, the average amount being one-third less than the overall average. Poorer households were also more likely to use the loans for nonbusiness purposes. Of the poorest loan recipients, 24 percent used the loan for consumption or home improvement, compared with just 6 percent of the richest loan recipients.

Land

As part of the economic reforms, land rental prices were liberalized in 1992. Wheat farmers in the EWPS report that land rents have increased by about 76 percent since the agricultural year 1992/93, equivalent to a 17 percent increase in real terms. Increases have been particularly large in the governorates of Giza, Qalubia, and Beheira, which are close to Cairo and where agricultural land is relatively scarce. About 62 percent of the wheat farmers in Egypt report that the removal of the land-rent ceiling has had little effect on their households. Furthermore, relatively few of the poorest households (30 percent) indicated that the new land law had made them worse off.

These results can be better understood in light of land ownership patterns. According to the EWPS, the overwhelming majority (90 percent) of the land cultivated by wheat farmers is owned by the farm household. Just 8 percent is rented, and the remainder is sharecropped. The proportion of rented area is much higher (about 24 percent of total land area) for the poorer than for the wealthier households (about 4 percent). This implies that about three-quarters of the poorest wheat farmers are not directly affected by the liberalization of land rents. The survey also reveals that a significant portion of the rented land is rented by relatively large and wealthy farmers. For example, almost 45 percent of the land rented by Egyptian wheat farmers is rented by those in the top two quintiles. This suggests that the benefits of land-rent controls were not necessarily well targeted to the poor.

Costs and Returns of Wheat Production

The gross value of wheat production is calculated as the sum of the value of wheat sales, the value of wheat retained for home consumption, and the value of wheat stalks produced. The returns to family labor and family-owned assets are calculated as the gross value of wheat production minus the cost of hired labor, seed (including retained seed), fertilizer, other inputs, land rental, equipment rental, and animal rental for wheat production. An estimate of the overall cost of production is not attempted,

Table 6—Revenue and costs of wheat production

Revenue or cost category	Cost per farm	Cost per hectare of wheat	Cost per kilogram of wheat	Cost per person-day family labor	Percent of revenue	Percent of costs
			(Egyptian pounds)			
Revenue	2,642	3,798	.81	178	100.0	—
Wheat sales	1,132	1,627	.35	76	42.8	—
Retained wheat grain	1,077	1,548	.33	73	40.7	—
Wheat stalks	433	623	.13	29	16.4	—
Variable costs	937	1,347	.29	63	35.5	100.0
Hired labor	251	360	.08	17	9.5	26.8
Seeds	129	185	.04	9	4.9	13.8
Fertilizer	212	305	.07	14	8.0	22.6
Ag chemicals	54	78	.02	4	2.0	5.8
Equipment rental	190	273	.06	13	7.2	20.2
Land rental	68	98	.02	5	2.6	7.3
Other inputs	33	48	.01	2	1.3	3.5
Net revenue	1,705	2,452	.53	115	64.5	—

Source: IFPRI/MALR-EWPS (1999).
Note: — indicates not applicable.

because of the conceptual and practical difficulties of imputing a value for family labor and family-owned land.

The gross revenue from wheat production, defined as the value of wheat grain and stalk production, is £E2,642 per farm or £E0.81 per kilogram of wheat produced (see Table 6). The value of wheat grain is £E0.68 per kilogram, but stalks add another 19 percent to the value of the grain. Variable costs of production are 36 percent of revenue. The largest cost categories are hired labor (27 percent of costs), fertilizer (23 percent), and equipment rental (20 percent). Nitrogen fertilizers, such as urea and ammonium nitrate, are the largest items in fertilizer costs, while threshing and tractor services are the most important types of equipment rental. Net revenue (gross revenue minus variable costs) averages 64 percent of revenue. This represents the implicit "wages" of family labor, the implicit "rent" on family-owned land, and the return on family-owned equipment and animals used in wheat production.

Looking at crop budgets across farm-size categories, gross revenue per metric ton is essentially constant, being determined by market prices, but variable costs decline with farm size. This is largely because larger farms rent a smaller share of the cultivated land. Thus, returns to family labor and family-owned assets rise from £E473 per metric ton for the smallest farm-size category to £E551 per metric ton in the largest (Table 7). Gross revenue per hectare is somewhat higher among smaller farms because of more intensive cultivation and higher yields. However, per-hectare costs are also higher among small farms, largely because of the cost of renting land. The combined effect is that the net revenue is somewhat (13 percent) higher for the largest

Table 7—Revenue and costs of wheat production per unit of input by farm-size category

Revenue or cost category	Farm-size category				
	Smallest	2	3	4	Largest
	(Egyptian pounds)				
Revenue per metric ton	807	806	817	795	824
Cost per metric ton	334	338	321	274	272
Returns per metric ton	473	468	496	522	551
Revenue per hectare	3,878	4,445	4,037	3,967	3,593
Cost per hectare	1,606	1,866	1,586	1,366	1,187
Returns per hectare	2,272	2,578	2,451	2,601	2,405
Revenue per person-day	65	93	115	170	379
Cost per person-day	27	39	45	58	125
Returns per person-day	38	54	70	111	253

Source: IFPRI/MALR-EWPS 1999.

farm-size category than it is for the smallest. The returns per person-day also rise sharply as farm size increases. This is not surprising, since labor productivity is strongly influenced by the amount of other factors of production per worker, and by definition large farms offer more land per family member.

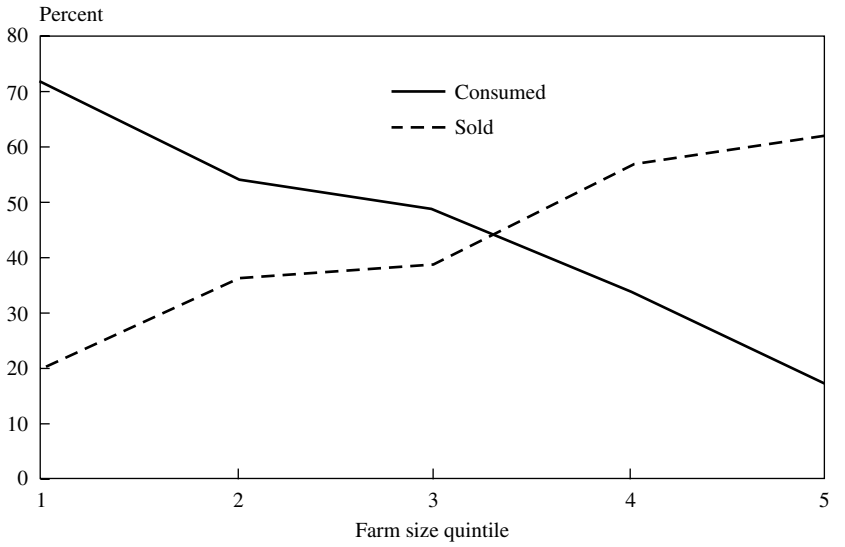
Wheat Usage and Marketing

In 1998, the average quantity of wheat harvested per wheat farm household was 3.25 tons. Of the total quantity harvested, about 52 percent was sold, 31 percent was used for household consumption, 6 percent was stored for other uses, and 6 percent was given out as a gift or for other reasons. The remaining 5 percent was used to pay farm workers or landlords, stored for seed, and used as animal feed.

The share of wheat used for household consumption is highest for small farmers and tends to decrease with farm size (see Figure 6). Conversely, the share of wheat sold increases with farm size. In small farms, most wheat is used for subsistence and, therefore, only a small amount of wheat harvested is left to be sold. As farm size increases, however, once wheat used for household subsistence has been allocated, the rest of the wheat is sold. Therefore, wheat sales tend to increase more than proportionately with farm size.

As expected, the frequency and volume of wheat sales was found to be correlated with farm size. Whereas 63 percent of households in the smallest farm-size quintile never sell wheat, about 67 percent of the largest farm-size quintile always sell wheat. On average, a little less than one-third of the farmers never sell wheat, and a little more than one-third always sell wheat. On a volume basis, a little more than one-third of all farmers sell more than 50 percent of their wheat; another one-quarter of farmers sell less than 50 percent; and less than 10 percent of all farmers

Figure 6—Percentage of wheat consumption and sales over total harvest by farm size



sell all their wheat. However, even if most farmers sell less than 50 percent of their wheat, those that sell more wheat own larger farms, so that overall more than 50 percent of all wheat production is sold.

Table 8 shows the characteristics of the wheat sale transactions by the type of buyer. The types of wheat buyers include private traders, neighbors, public mills, cooperatives, the village banks, MALR, and others. As noted earlier, GASC uses the public mills, the cooperatives, and village branches of PBDAC to buy the wheat from the farmers on its behalf. This government-procured wheat is then channeled to the public mills to make the subsidized 82 percent wheat flour for the *baladi* bread and flour subsidy program. MALR, on the other hand, contracts with large-scale farms to multiply wheat seeds.

The numbers in Table 8 indicate that about 39 percent of the wheat farm households sell to traders, while only 6 percent sell to their neighbors, and less than 5 percent sell to the mills, the cooperatives, or the village banks. In terms of volume, private traders receive two-thirds of all the wheat sold by farmers, or the equivalent of 1.88 million metric tons of wheat on a nationwide basis. The next-largest marketing outlets for farmers are the mills and the village banks, each buying about 9 percent of the marketed wheat. The cooperatives bought just 5 percent of the wheat sold.

Results from the wheat traders survey presented in the following chapter indicate that about 61 percent of the wheat bought by traders is in turn sold to the government through the mills or PBDAC. This implies that about 1.15 million metric tons of the wheat bought by traders in 1988 was potentially sold to MOTS. These estimates in-

Table 8—Characteristics of wheat sale transactions by type of buyer

Type of buyer	Percent of households selling	Average volume sold per household	National sales	Percent allocation among buyers
		(kilograms)	(million metric tons)	
Private trader	39.1	1,127	1.88	66.3
Neighbor	6.0	41	0.07	2.4
Mill	3.9	156	0.26	9.2
Cooperative	4.2	85	0.14	5.0
Village bank	4.8	156	0.26	9.2
MALR	0.5	98	0.16	5.8
Other	0.6	37	0.06	2.2
Total	58.9	1,700	2.83	100.0

Source: IFPRI/MALR-EWPS (1999).

dicate that the total quantity of wheat sold to the government (directly or indirectly) would be about 1.8 million metric tons. Given the variance of the four-stage random sample used for the EWPS, this estimate is consistent with the official figure of 1.75 million metric tons of domestic wheat sold to the government in 1998.

One question of interest to the government is why farmers sell primarily to traders rather than to the cooperatives, mills, or village banks that facilitate direct government procurement. The EWPS asked farmers why they chose to sell to one buyer rather than another. The main reason was good prices (60 percent), followed by close location (23 percent). Regarding price, the average price paid to farmers by traders (£E0.67 per kilogram) was at least as high as the price paid by regular government outlets, such as the mills, village banks, and cooperatives (£E0.64 to 0.66 per kilogram). It is also toward the top of the range of government procurement prices, which range from £E0.63 to £E0.67 per kilogram depending on quality.

Regarding the location of sale, traders usually purchase wheat on the farm (64 percent) or at a market (25 percent). In contrast, to sell to a mill, a cooperative, or village bank, the farmer must transport the harvest to these sites. These findings confirm results from the traders' survey (presented in the next chapter), which suggest that farmers prefer to deal with traders because traders offer better prices, buy smaller quantities, and pick up the wheat from the farmers' dwelling, which saves transport costs. In some cases, traders also give an advance to the farmer.

On-farm wheat storage is quite common. Almost all wheat farmers use their own houses to store their wheat (the exception is the Frontier, where most farmers do not have wheat storage capacity). Farmers rarely rent storage space. The average quantity of wheat in storage is seasonal. The quantity of wheat stored reaches a peak after harvest in April or May, at about 1.1 to 1.4 metric tons, and gradually declines to 150 kilograms just before the next harvest season the following year. Most of the wheat (86 percent) is stored for consumption throughout the year rather than for sale.

Wheat Consumption Patterns

To shed more light on wheat marketing decisions, this section describes the consumption patterns of staple grains (wheat, rice, and maize) among wheat farmers. The most widely consumed grain product in the sample was home-baked bread from wheat produced on the farm, as reported by 91 percent of the households. Most households also make other wheat products from their own harvest (65 percent), bake bread from purchased flour (70 percent), buy rice (62 percent), and buy *baladi* bread (59 percent). A minority of wheat farmers consumed rice that they produced, purchased *fino* bread, or consumed bread made from purchased wheat.

Baladi bread is purchased by more than half of the wheat farmers, regardless of wealth (Table 9). In contrast, the proportion of households buying *fino* bread rises from just 7 percent in the poorest category to 55 percent in the richest. This reflects the higher cost of *fino* bread, which makes it a "luxury" good among grain products. The percentage of wheat farm households consuming home-made bread from purchased flour and purchased wheat tends to decline in the high-wealth categories, reflecting the higher opportunity cost of time of these households.

When asked why they would not sell their wheat and buy bread, the majority of farmers (56 percent) noted that they preferred the taste of home-baked bread. The rest of the farmers responded either that the bakery might not have bread (17 percent), that the bakery was too far (14 percent), or that it was more economical to bake bread at home (10 percent). The distance to *baladi* bread bakeries and limited availability of the bread in rural areas reflect the urban bias of the government in *baladi* bread distribution. Although 57 percent of the population of Egypt lives in rural areas, less than one-third of the *baladi* bread subsidy goes to rural consumers (Ahmed et al. 1999a).

The EWPS highlights the high level of wheat consumption in rural Egypt. Egyptian wheat farmers purchase 242 loaves of *baladi* bread per person per year or 31.5 kilogram per person per year. Among those who buy it, the average is 410 loaves per

Table 9—Percentage of households that consume different grain products, by wealth category

	Wealth category				
Grain product	**Poorest**	**2**	**3**	**4**	**Richest**
Purchased *baladi* bread	56.0	66.3	50.8	57.7	64.8
Purchased *fino* bread	6.8	33.8	21.7	31.1	55.0
Bread from purchased flour	81.8	75.5	62.0	67.1	64.5
Bread from purchased wheat	22.4	26.7	14.1	9.6	6.3
Purchased rice	70.4	63.3	55.2	65.8	58.8
Bread from own wheat	93.6	97.5	81.0	93.8	88.5
Other from own wheat	56.2	61.3	63.3	68.6	73.3
Rice from own harvest	37.0	47.0	39.1	35.9	52.0

Source: IFPRI/MALR/MOTS (1999).

person per year, or 53 kilograms per person per year. The average consumption of *fino* bread is about one-half that of *baladi* bread (84 loaves per person per year, or 15 kilograms per person per year).

Overall consumption of wheat products is 214 kilograms per capita. This figure corresponds closely to estimates for rural consumption in the Egypt Integrated Household Survey (Bouis, Ahmed, and Hamza 1999), confirming Egypt's position as having one of the highest levels of per capita wheat consumption in the world. Most of the wheat consumption among wheat farmers (61 percent) is in the form of wheat retained from the household's own production. Purchased flour and purchased *baladi* bread are the second and third most important wheat products, representing 17 and 12 percent of the total grain equivalent, respectively.

The survey also asked wheat farming households about the use of *baladi* bread as animal feed. Almost 20 percent of the households surveyed reported feeding *baladi* bread to their animals. The proportion does not vary much with wealth category or farm size. On average, households feed 12 loaves of *baladi* bread per week (or 82 kilograms per year) to their animals. This implies that 7–8 percent of the *baladi* bread purchased by Egyptian wheat farmers is used for animal feed. It is true that much of the bread fed to animals may be stale. (According to the Egyptian Integrated Household Survey, about half of the households feeding *baladi* bread to animals gave this as the reason.) Nonetheless, the consistent excess purchases by these households is a reflection of the subsidized price.

The *net* sales of wheat by farmers was calculated through combining information on the purchase of wheat products (in wheat equivalent) with information on wheat sales. The net position of households is important because it determines whether they would lose or gain from increased wheat prices in the absence of subsidies. Although two-thirds of Egyptian wheat farmers sell wheat, less than half (46 percent) are *net sellers,* whose wheat sales exceed the grain equivalent of their purchases of bread and other wheat products. Just 4 percent are self-sufficient, without purchases or sales of wheat or wheat products. One-half of the Egyptian wheat farmers are *net buyers,* whose wheat purchases (expressed in grain equivalent) exceed their sales. Most of these households are wheat farmers that do not sell wheat at all and supplement their wheat production with purchases of bread and other wheat products.

Profitability Perceptions, Information Sources, and Extension Services

Next, wheat farmers were asked about their perceptions regarding changes in crop profitability since 1995. Although perceptions about profits are subjective and do not adequately measure changes in profit levels, they give an indication of how farmers feel about the environment in which they operate. As shown in Table 10, 58 percent of farmers indicated that the profitability of Egypt's main crops increased since 1995. The increased profitability of wheat was noted by a higher percentage of farmers than for most other crops (64 percent versus less than 60 percent). The lowest-ranked crop was maize. Farm size does not seem to influence perceptions regarding the change in profit levels of the five main commodities.

Table 10—Perceived changes in profitability by main crop type

Crop type	Change in profit level since 1995			
	Higher	Same	Lower	Total
		(percent)		
Wheat	63.9	8.6	27.5	100
Berseem	58.7	33.3	8.0	100
Cotton	55.7	13.2	31.0	100
Maize	43.3	35.6	21.1	100
Rice	56.6	9.4	34.1	100
Overall	57.7	21.4	22.9	100

Source: IFPRI/MALR/MOTS (1999).

Across all regions, farmers indicated that their increased profit levels in wheat production were a result of higher yields and wheat prices. In addition, in Nubaria, improved wheat profitability was also a function of low, fixed fertilizer and other input prices. Of the farmers who indicated that wheat profitability had declined over the past three years, higher labor costs, lower wheat yields, and lower by-product prices were cited most frequently. The effect of lower wheat yields was most strongly felt in the more difficult agroclimatic regions of the Frontier and Nubaria, followed by Middle and Upper Egypt. Lower wheat by-product prices were a particularly large factor in Middle Egypt and the West Delta.

Wheat producers rely on a number of sources to obtain information to produce and market wheat. As shown in Table 11, extension agents play an important role in

Table 11—Main information sources for wheat producers

Information about	Main information source	Percent of farmers
Seed varieties	Extension agent	62
	Cooperatives	24
Fertilizer prices	Cooperatives	44
	PBDAC	14
Fertilizer use	Extension agent	54
	Cooperatives	21
Pest and weed control	Extension agent	65
	Cooperatives	20
Soil management	Cooperatives	35
	Extension agent	33
Irrigation methods	Extension agent	30
	Neighbor	22
Wheat prices	Wheat traders	59
	PBDAC	12
Wheat marketing opportunities	Wheat traders	37
	Cooperatives	17

Source: IFPRI/MALR-EWPS (1999).

disseminating information on seed varieties, fertilizer use, and control of pests and weeds. Wheat producers report being visited by an extension agent five times during the wheat season, on average. Traders are the primary source of information on output markets and wheat prices, while cooperatives are the main source of information on fertilizer prices and soil management.

Wheat Supply Response and Input Demand Analysis

This section uses the EWPS to examine the factors that influence wheat supply and input demand. In particular, three questions are addressed:

- How responsive are Egyptian wheat farmers to changes in wheat prices?
- What are the most important nonprice factors affecting wheat supply?
- How do prices and nonprice factors influence the demand for labor and fertilizer on Egyptian wheat farms?

Survey Methods

In the short run, farmers' decisions are based in part on the relative prices of inputs and outputs and on the fixed factors of production available to the farm household, including family labor, family-owned land, and family-owned agricultural assets. Because prices vary from one region to another and fixed factors vary from one household to another, multiple-regression analysis can be used to study the differences in household-level input use and output supply as a function of differences in input prices, output prices, and fixed factors available to the household.

A profit function approach is used in which output supply and input demand are estimated jointly and cross-equation restrictions are imposed on the parameters. These restrictions ensure that the results are consistent with economic theory and in doing so, they improve the efficiency of the estimation by using more information. This approach was pioneered by Yotopoulos and Lau (1979) and has been widely used since. Several profit function studies have been conducted that use data on Egyptian agriculture. Antle and Aitah (1983) use the profit function with farm-level data to study rice supply and input demand in the East Delta of Egypt. Antle and Aitah (1987) broadened the analysis to consider three summer crops (maize, rice, and cotton) as well as several inputs. Esfahani (1987) applied the profit function approach to study supply response in the Nile Delta.

The wheat supply and input demand model is specified as follows. Under certain conditions, the behavior of a rational profit-maximizing producer can be described by a restricted profit function in the form

$$\pi = f(p, z),$$

where π is the return on fixed factors of production, p is a vector of the prices of outputs and variable inputs, and z is a vector of fixed factors of production.

This is a *restricted* profit function in that it is assumed that the producer can decide on the levels of variable inputs but cannot change the levels of the fixed factors. Thus, it describes a planning horizon of 1–3 years.

If q is defined as a vector describing the output supply and the negative of input demand, then according to production theory, the first derivative of the profit function with respect to the price of an input (or output) yields input demand (or output supply):

$$\frac{\partial \pi(p, z)}{\partial p_i} = q_i(p, z).$$

Young's Theorem states that the cross-partial second derivatives of a function are equal. Applying this rule to the profit function yields the following:

$$\frac{q_i(p, z)}{p_j} = \frac{\partial^2 \pi(p, z)}{\partial p_i \partial p_j} = \frac{q_j(p, z)}{p_i}.$$

To make use of these restrictions, Zellner's seemingly unrelated regression with cross-equation restrictions is used to ensure symmetry of price effects. The normalized quadratic profit function used is

$$\pi^* = a_0 + \sum_i a_i p_i^* + \frac{1}{2}\sum_i \sum_j b_{ij} p_i^* p_j^* + \sum_i \sum_k c_{ik} p_i^* z_k,$$

where the asterisks indicate that profits and prices have been normalized by dividing by the numeraire price, in this case the rental rate of machinery.

This profit equation is associated with input demand and output supply functions in the following form:

$$q_i = a_i + \sum_j b_{ij} p_j^* + \sum_k c_{jk} z_k.$$

One output supply function (wheat) and four input demand functions (hired labor, nitrogen-based fertilizer, phosphorus-based fertilizer, and machinery rental) are estimated. The vector of prices includes the price of wheat, the wage rate for hired labor, an index of the prices of urea and ammonium nitrate, the price of single superphosphate, and the rental rate of tractors. The prices are based on the village-level average unit value from observed transactions. If no unit value is available (because none of the households carried out that type of purchase or sale), higher levels of aggregation are used to obtain an average. As mentioned above, the prices are "normalized" by dividing each by a numeraire price—in this case, the rental rate for machinery. The vector of household characteristics includes variables representing the productive capacity of the household, including the size and composition of the household, total farm size, and ownership of several types of animals and agricul-

tural equipment. The analysis was carried out with Limdep software. Because the main interest of the study is on the impact of prices on wheat supply, only the results of the wheat supply function are discussed below.

Wheat Supply

The results of the regression analysis indicate that wheat supply is significantly affected by wheat prices, wage rates, nitrogen fertilizer prices, the education of the head of household, farm size, whether the farm is in the new lands, and buffalo ownership. Table 12 summarizes the price elasticities estimated from the model. The adjusted R^2 correlation coefficient for the wheat supply equation is 0.52, implying that approximately one-half of the household-level variation in wheat supply can be explained by the model. The coefficient on the price of wheat is statistically significant at the 10 percent level and corresponds to a price elasticity of wheat supply of 0.30.

Similar to any regression analysis, the results may be biased by the omission of relevant variables, such as technology and market access, that are difficult to quantify. However, the supply elasticity of about 0.3 is in line with regional time-series estimates from Egypt found in a previous study (Kherallah, Minot, and Gruhn 1999b). It is also consistent with estimates from other developing countries (Sadoulet and de Janvry 1995). Thus, a 10 percent increase in the price of wheat would induce farmers to allocate 3 percent more land for wheat cultivation. This suggests that farmers will react favorably to real and relative increases in rural wheat prices. (This is particularly relevant in Egypt because it is a wheat-deficit country and because the government seeks to purchase its wheat requirement for the *baladi* bread and flour subsidy program from domestic sources.)

Two of the three input prices are significant at the 5 percent level. The elasticity of wheat supply with respect to the wage rate indicates that a 10 percent increase in

Table 12—Elasticities of output supply and input demand with respect to prices

	Elasticity			
Price category	**Supply of wheat**	**Demand for hired labor**	**Demand for nitrogen fertilizer**	**Demand for phosphate fertilizer**
Price of wheat	0.301*	0.498**	1.577***	0.528
Wages	–0.021**	–0.422***	0.118*	0.216
Price of nitrogen fertilizer	–0.048***	0.118*	–1.53***	2.204**
Price of phosphate fertilizer	–0.002	0.216	0.258**	–1.874*

Note: * = significant at the 10 percent level.
** = significant at the 5 percent level.
*** = significant at the 1 percent level.
Number of observations: 800.

the wage rate would reduce wheat supply by 0.2 percent. Similarly, a 10 percent increase in the price of nitrogen fertilizer is associated with a 0.5 percent decrease in wheat supply. One implication of this finding is that a reduction in fertilizer price (due to a subsidy, for example) would have only a modest effect on wheat production.

The size and composition of the household have no significant effect on wheat production, but the education of the head of household appears to have a significant positive effect on wheat production, perhaps reflecting greater managerial capacity. As expected, the total farm size has a positive and significant effect on wheat production. For every 10 percent increase in total farm size, wheat production rises by 6.6 percent. In addition, being located in newly reclaimed lands is associated with higher wheat production, other things being equal.

The price of berseem, which normally competes with wheat, was tested in some alternative versions of the model but it was not statistically significant. Although a higher price of berseem would normally be expected to be associated with lower wheat production, this relationship may be weak or nonexistent in Egypt because most berseem is retained for domestic use rather than sold.

Conclusions

The agricultural and economywide reforms have had a significant impact on the wheat production sector in Egypt. The removal of area allocation and compulsory delivery, the increase in producer prices, and the introduction of higher-yielding wheat varieties have led to increased wheat crop area, yields, and production. As a result, the self-sufficiency ratio increased from about 21 percent in 1986 to 47 percent in 1996. In addition, the quantity of domestic wheat procured by the government for its subsidy program for *baladi* flour and bread has increased from less than 0.1 million metric tons in 1986 to 1.8 million metric tons in 1998.

Despite the increase in wheat production, the government has problems reaching its wheat procurement targets. The main reason for this is that most of the wheat produced is consumed in the rural areas. Half is retained by wheat farmer households, 29–32 percent is purchased by the government, and the remainder is consumed by rural households that do not farm wheat and, to a lesser extent, wheat farmers who are net buyers.

Given the high level of wheat consumption in rural areas, the cost of increasing deliveries of domestic wheat to the government are considerable. To do so, the government would have to increase the procurement price substantially above international prices. When procurement prices are above international prices, as they currently are, the government incurs the budgetary costs of subsidizing its wheat producers. In addition, increasing the incentive for farmers to sell the wheat they have set aside for home consumption will encourage them to purchase more subsidized flour and bread, resulting in higher costs to the consumer subsidy system.

Finally, wheat self-sufficiency is often cited as a goal of Egyptian wheat policy. The supply elasticity of wheat was found to be 0.3, implying that an increase in wheat self-sufficiency from 50 to 55 percent (that is, a 10 percent increase in wheat pro-

duction) would require an increase in wheat prices of roughly 30–35 percent in the short run. This finding supports conclusions from Chapter 6 that indicate that raising the wheat self-sufficiency rate from 47 percent to 60 or 70 percent through higher producer prices would involve increased subsidy costs of £E1.5 billion and £E3.3 billion (0.7 and 1.6 percent of gross domestic product, or GDP), respectively. This result highlights the difficulty in achieving, or even increasing, wheat self-sufficiency through price policy alone.

CHAPTER 4

Evolution and Structure of the Wheat Trading Sector under Reforms

The market reform programs in Egypt were expected to bring about private sector participation by encouraging new actors to enter the distribution system and by creating the incentives for existing traders to expand their activities. The results of a survey of about 2,000 wheat grain and flour traders were used to review the response of the emerging private wheat marketing system to the policy reforms initiated in 1987.

The main questions addressed in this chapter are:

- What is the structure of the private wheat marketing system?
- What are the characteristics of private traders involved in wheat marketing?
- How is the private trading sector performing following the reforms?
- What are the main constraints faced by private traders?
- How have reforms affected the investment behavior of private traders?

Survey and Sampling Methods

The survey of wheat traders in Egypt was conducted from August to December 1996. Since there are no records on the number and type of private traders operating in each market, the sample of wheat traders was chosen randomly. More specifically, in each of the 18 governorates[20] selected for the survey, enumerators were asked to go to the market and interview any trader with whom they came into contact. The targeted sample size of 2,000 domestic traders was chosen to be large enough to offer good degrees of freedom within the limited financial means of the project. As a result, the random sample included 1,984 wheat grain and flour traders covering markets in 141 districts. Table 13 shows the regional distribution of the traders. About half of the

[20] The governorates covered in the wheat traders' survey are Cairo, Alexandria, Matruh, Damietta, Dakahlia, Sharkia, Gharbia, Ismailia, Qalubia, Kafr El-Sheikh, Menufia, Beheira, Giza, Fayum, Beni Suef, Minia, Assiut, and Sohag.

Table 13—Regional distribution of sample wheat traders

Governorate category	Number of traders
Cairo	78
Alexandria	119
Lower Egypt	1,036
Upper Egypt	664
Matruh	87
Total	1,984

Source: IFPRI/MALR/MOTS (1997).

sample was located in Lower Egypt, and a third in Upper Egypt.[21] This regional distribution was not targeted, but reflects the fact that there are more traders in Lower than in Upper Egypt.

The questionnaire covered many topics, including the general characteristics of the traders; the patterns of their trading activities, including their volume of operation, area coverage, trade networks, marketing channels, marketing inputs and outputs; use of credit, costs, and margins; investment and asset accumulation behavior; and traders' perception about government policy changes.

Wheat Traders' Survey Results

General Characteristics of the Emerging Private Trading Sector

Table 14 shows the main characteristics of the wheat trader sample. About half of the almost 2,000 traders interviewed view themselves as wholesalers, while one-third consider themselves retailers. The remainder of the sample is composed of traders engaged in both wholesale and retail trading.

Private trader participation in wheat marketing has not occurred for more than 15 years. This is expected, because, except for small-scale village trading, intergovernorate trading in wheat products was prohibited until the beginning of the reforms in 1987. Private trader participation is particularly recent in Matruh, in the Frontier region, with an average length of experience of only 5 years. Wheat production in Matruh has only recently been developed on new reclaimed lands. This might also explain why wholesale trading is still not widespread in that region. Except for the case of wheat flour in Alexandria and Lower Egypt, the average length of experience

[21] The governorates included in the sample were grouped into five regions for analysis: the city governorates of Cairo and Alexandria, Lower Egypt (Damietta, Dakahlia, Sharkia, Ismailia, Qalubia, Kafr El-Sheikh, Gharbia, Menufia, and Beheira), Upper Egypt (Giza, Fayum, Beni Suef, Minia, Assiut, and Sohag), and Matruh in the Frontier region.

Table 14—General characteristics of wheat traders

Governorate category	Percentage of wholesalers vs. retailers[a]		Years trading in wheat or wheat flour		Percentage of traders who previously were farmers or traders[b]		Percentage of traders who are mainly traders or farmers		Percentage of traders who cited that the motivation for entering the wheat marketing business was profitability or inheritance		Percentage of traders who are male	Age category of the owner			
	Wholesalers	Retailers	Wheat	Wheat flour	Farmers	Traders	Traders	Farmers	Profitability	Inheritance		20–30	31–40	41–50	> 50
												(percent)			
Cairo	50	30	12	6	1	82	96	3	59	63	97	4	9	37	50
Alexandria	52	19	9	13	11	60	88	8	58	61	99	3	25	42	29
Lower Egypt	44	27	12	14	36	21	67	17	84	17	97	5	23	39	33
Upper Egypt	50	37	12	9	34	34	70	14	69	31	99	3	21	38	39
Matruh	6	91	5	9	36	20	91	5	77	10	100	20	29	31	21
Average	45	33	12	12	33	30	71	14	76	26	98	5	22	38	35

Source: IFPRI/MALR/MOTS (1997).

[a] The remaining respondents classify themselves as both wholesalers and retailers.

[b] The remaining respondents were either employees, students, or other.

of about 12 years indicates that private sector participation in wheat trading before the reforms was fairly limited.

Traders were also asked about their professional background before they entered the general trading business. Only one-third of the trader population had always been in the trading business; another third worked as farmers before becoming traders. There are, however, significant differences among regions. Not surprisingly, in the cities of Alexandria and Cairo, the majority of wheat traders had a background in general trading. In the more rural regions of Lower and Upper Egypt, a greater percentage of wheat traders were engaged in farming before becoming traders.

About three-quarters of the traders consider trading as their main occupation. The largest degree of specialization is found in the city governorates of Alexandria, Cairo, and Matruh, where about 90 percent or more of the traders in the sample define trading as their principal occupation. Lower and Upper Egypt have the largest farmer-trader population, where the share of traders whose main occupation is in farming reaches 14 and 17 percent, respectively.

The two main reasons cited for entering the trading profession were expected profits (75 percent of traders) and inherited business (26 percent).[22] A higher percentage of traders in Alexandria and Cairo (about 60 percent) have inherited their businesses, compared with an average of 26 percent for all regions. This explains why a larger percentage of traders in these two cities have had previous experience in trading before entering the wheat market. The share of first-generation traders is largest in Lower Egypt (84 percent of traders) and Matruh (77 percent), although in Lower Egypt, traders have been in the wheat marketing business longer than in any other region (between 12 and 14 years). Wheat traders are mostly male, and two-thirds are about 50 years old or younger.

Structure of Activities and Operations of the Private Trading Sector

Wheat trading represents, on average, one-fifth of the traders' total income from marketing activities (Table 15). The share of wheat flour in total trading income is 7 percent. The overwhelming share of trading activities, about one-half, is accounted for by trade in other grains. The income share of other grain trade is particularly high in Alexandria and Cairo (52 and 60 percent, respectively). In Matruh, on the other hand, income from other trade is higher than in any other region (36 percent versus 10–17 percent for other regions). The lack of specialized wheat traders is not peculiar to Egypt. Most agricultural commodity traders, even in industrialized countries, deal with several commodities at a time.

Tables 16 and 17 present the structure of clients and suppliers of wheat traders in individual regions. On average, four-fifths of wheat grain traders buy directly from farmers. There is no specialization yet in assembly compared with wholesaling and retailing of wheat grains. As expected, the share of direct procurement is particularly

[22] The motivation to become a trader refers to trading in general and is not specific to wheat.

Table 15—Income shares of major business activities of the traders, 1995–96

Governorate category	Income share from				
	Wheat trade	Wheat flour trade	Other grain trade	Other trade	Other
	(percent)				
Cairo	16	9	60	10	5
Alexandria	16	10	52	17	5
Lower Egypt	20	9	46	14	11
Upper Egypt	26	3	48	12	11
Matruh	11	11	33	36	9
Average	21	7	47	14	11

Source: IFPRI/MALR/MOTS (1997).

Table 16—Share of wheat and wheat flour purchased from different suppliers

Governate category	Wheat			Wheat flour				
	Traders	Farmers	Others	Traders	Public mills	Private mills	Importers	Others
	(percent)							
Cairo	64	35	1	17	60	23	0	0
Alexandria	41	58	1	48	3	27	22	0
Lower Egypt	12	87	1	34	59	2	4	1
Upper Egypt	16	83	1	36	60	2	0	2
Matruh	87	13	0	92	8	0	0	0
Average	19	80	1	44	46	5	4	1

Source: IFPRI/MALR/MOTS (1997).

Table 17—Share of wheat and wheat flour sold to different customers

Governorate category	Wheat				Wheat flour			
	Consumers	Traders	Millers	Others	Consumers	Traders	Bakeries	Others
	(percent)							
Cairo	34	61	5	0	77	13	9	1
Alexandria	18	23	43	16	35	21	21	23
Lower Egypt	14	12	55	19	80	13	6	1
Upper Egypt	25	18	35	22	74	18	7	1
Matruh	92	0	5	3	96	2	2	0
Average	21	17	44	18	77	13	7	3

Source: IFPRI/MALR/MOTS (1997).

high in the major production regions of Lower and Upper Egypt. The percentage is much lower in the city governorates of Alexandria and Cairo, and especially in Matruh.

A more varied regional structure emerges in the procurement of wheat flour by private traders. Whereas private traders procure a little bit less than half of their wheat flour quantities from public mills and an equal share from other traders, the sources of procurement differ significantly across individual regions. For example, private mills play a significant role in the procurement of wheat flour only in the city governorates of Alexandria and Cairo. Public mills, in contrast, appear to be marginal suppliers in Alexandria and Matruh. In Matruh, private traders procure wheat flour primarily from other traders. In Alexandria, private traders, followed by private mills and imports, are the most important sources of wheat flour supply to traders. The finding that private mills and imports are significant supply sources of wheat flour only in Cairo and Alexandria is explained by the concentration of private mills in these cities, and the fact that importers operate mainly from Alexandria, a large port city.

In terms of sales of wheat grain, private traders transact, on average, more with millers than with other groups of market participants. Here again, significant differences can be observed across regions. Traders in the two main producing regions of Lower and Upper Egypt and the import city of Alexandria, for instance, sell primarily to millers, whereas traders in Cairo sell primarily to other traders. In Matruh, on the other hand, the bulk of the sales goes to consumers (defined here as households). The share of sales to consumers is the next highest in Cairo, where it reaches one-third of total sales. In contrast, sales to millers in Cairo and Matruh are a mere 5 percent. Note, however, that the average volume of wheat grain sold in Cairo is substantially lower than in other regions. Therefore, the high share of wheat grain sales to consumers and low share of sales to public mills in Cairo should be interpreted with caution. Finally, close to 20 percent of wheat grain sales in Alexandria and Lower and Upper Egypt go to other clients, such as PBDAC and poultry farmers.

In contrast to wheat grain, the majority of wheat-flour sales by private traders goes to final consumers, which account for more than three-quarters of total sales. A noticeable exception is Alexandria, where only a third of wheat flour sales go to consumers. The remainder is distributed equally among sales to other traders, bakeries, and a group of unspecified other users. This is consistent with the fact that more than 80 percent of the traders interviewed in Alexandria were wholesalers, or both wholesalers and retailers.

Table 18 shows information on the factors that influence the choice of private traders over their purchase and sale area. According to the figures in this table, the most important reason for selecting the purchasing or sale area is dictated by the price, followed closely by the distance traveled between regions. Other less-important factors for the purchase area are the quality of the product (19 percent of traders) and government regulations (5 percent). For the choice of sale area, the size of the market was cited by 26 percent of traders and government regulations by 16 percent. Government regulations refer mainly to the unofficial local restrictions on

Table 18—Factors influencing private traders' choice of purchase and sale areas

Governorate category	Choice of purchase area				Choice of sales area			
	Price	Distance	Quality	Government regulations	Price	Distance	Size of market	Government regulations
	(percent of respondents)							
Cairo	74	76	17	4	68	65	22	8
Alexandria	74	64	38	2	28	66	38	2
Lower Egypt	68	67	24	7	65	54	23	21
Upper Egypt	66	62	30	4	70	44	29	13
Matruh	51	69	16	2	41	60	27	1
Average	67	65	19	5	64	52	26	16

Source: IFPRI/MALR/MOTS (1997).

the movement of wheat outside certain governorates to ensure delivery of the target wheat quota to the government at the harvest season.

Table 19 shows the response of traders concerning their desire to expand area coverage or trading volume. More than half of the traders would like to expand their area coverage, and as many as two-thirds would like to expand the volume of their marketing activities. In both cases, 90 percent of traders cite higher income as the reason for the desire to expand the level of trading activities. The majority of traders cite lack of capital as the main deterrent to expanding area coverage or raising activity levels.

Table 19—Factors inhibiting private traders' desire to expand area coverage and trading volume

Governorate category	Desire expansion of area coverage		Impediments to expansion of area coverage[a]			Desire expansion of trading volume		Impediments to expansion of trading volume[a]		
	Yes	No	Regulations	Lack of capital	Competition	Yes	No	Regulations	Lack of capital	Competition
	(percent of respondents)									
Cairo	39	61	47	43	0	68	32	38	55	9
Alexandria	45	55	11	55	8	37	63	11	57	11
Lower Egypt	53	47	8	71	4	72	28	3	75	9
Upper Egypt	58	42	19	70	1	70	30	6	78	9
Matruh	41	59	0	97	0	30	70	5	81	5
Average	53	47	14	70	3	67	33	7	75	9

Source: IFPRI/MALR/MOTS (1997).

[a] Other minor impediments include lack of transport or storage, and stagnant demand.

It is perhaps by looking at the differences across regions that more is learned about the relative role of regulations in determining the decision to expand trading activities. The share of traders assigning a greater role to distance in the choice of procurement and sales areas is higher than the sample averages in the main consumption region of Cairo (Table 18). In turn, almost half of the traders in Cairo cite regulations as the main deterrent to expansion of area coverage. About one-third of traders in Cairo also cite regulations as the main factor restraining the expansion of trading volume. Wheat trading in Cairo is more tightly regulated than in other regions because of high population density and the large concentration of *baladi* bread bakeries. This creates higher opportunities for diversion and leakage between *baladi* and *fino* flour and between domestic and imported wheat.

In cases where long-distance trading fails to develop, the lack of infrastructure and deficiencies in the transport sector are often among the principal explanatory factors. Given that Egypt does not have any severe infrastructure problems that might discourage long-term trading, traders were asked questions related to the access to and use of transport services to detect any constraints to the expansion of long-distance trading. The first group of questions asked concerned the degree of use and ownership of transport services. The second series of questions addressed problems with transport services, such as the presence of restrictions on the movement of wheat, problems faced with transporters, the existence of seasonal supply bottlenecks, and the degree of competition and market power in local transport markets that limit the ability of traders to chose among different transport companies or to negotiate transport fees. The results of these questions are reported in Tables 20 through 22.

Tables 20 and 21 show that more than 90 percent of traders use transport, the overwhelming majority among them using trucks. The only exception are traders in Matruh, where only slightly more than a third of traders use transport services because they are mostly retailers. Although the large majority of traders rent transport services, about 16 percent own transport vehicles. The portion of traders who own vehicles reaches 45 and 25 percent in Cairo and Alexandria, respectively.

Table 20—Access to and use of transport services

Governorate category	Use transportation for trade		Ownership of vehicle used		
	Yes	No	Own[a]	Rent	Own and rent
	(percent)		(percent of respondents)		
Cairo	88.5	11.5	45 (62)	48	7
Alexandria	99.2	0.8	25 (93)	70	5
Lower Egypt	95.4	4.6	16 (55)	80	4
Upper Egypt	93.5	6.5	9 (69)	84	7
Frontier governates	35.6	64.4	23 (47)	67	10
Average	92.1	7.9	16 (63)	79	5

Source: IFPRI/MALR/MOTS (1997).
[a]Figures in parentheses are usage share of own vehicle in wheat trading.

Table 21—Type and use of transport services

Governorate category	Method of transportation			
	Truck	Cart	Truck or cart	Others
	(percent of respondents)			
Cairo	94.2	1.4	4.3	0.0
Alexandria	99.2	0.8	0.0	0.0
Lower Egypt	89.1	4.3	3.8	2.8
Upper Egypt	78.1	7.7	9.0	5.2
Frontier governates	58.1	38.7	3.2	0.0
Average	85.7	5.7	5.2	3.4

Source: IFPRI/MALR/MOTS (1997).

Table 22 shows the transport problems faced by traders. About 42 percent of traders noted that there were occasional restrictions on the movement of wheat. This percentage is much higher in Cairo (93 percent) than anywhere else for the same reasons that were cited earlier. The other potential problems with transport do not appear to be as relevant. For example, only 6 percent of the traders noted problems with transporters. Moreover, more than 90 percent of traders had access to transport services throughout the year and were able to freely choose among transport companies.

In Table 23, the cost of transport is estimated. In total, the average cost of transport amounts to £E1.2 per metric ton per kilometer, which is not high by African country standards (see Ahmed and Rustagi 1987; Badiane et al. 1997).

These results suggest that there are no real supply-side constraints in the transport sector to the expansion of area coverage by local traders. Nevertheless, the average distance between purchase and sales areas covered by individual traders' trans-

Table 22—Problems with transportation

Governorate category	Percentage of traders who said yes to the following questions			
	Are there occasional restrictions on the movement of wheat or flour?	Does your business have problems with transporters?	Are there periods when it is difficult to transport wheat or flour?	Can you choose among different types of transport companies?
Cairo	93	4	20	91
Alexandria	30	3	13	98
Lower Egypt	36	6	10	97
Upper Egypt	50	9	10	96
Matruh	3	0	0	96
Average	42	6	10	96

Source: IFPRI/MALR/MOTS (1997).

Table 23—Cost of transport services

Governorate category	Distance between points of purchase	Average shipping time	Average quantity transported	Average cost per shipment	Average cost per ton per kilometer
	(kilometers)	(hours)	(tons)	(£E)	
Cairo	71.3	2.3	4.4	35	0.3
Alexandria	65.1	2.1	5.6	62	1.2
Lower Egypt	18.9	1.5	3.9	27	1.1
Upper Egypt	12.8	1.3	2.9	20	1.4
Matruh	34.3	1.1	4.7	60	3.4
Average	20.6	1.5	3.6	27	1.2

Source: IFPRI/MALR/MOTS (1997).

actions is about 20 kilometers (Table 23). The longest average distances covered by trader transactions within the study regions, observed in Cairo and Alexandria, barely exceed 70 kilometers. In the main production regions of Lower and Upper Egypt, which together account for 80 percent of the traders in the sample, the average distance covered by trader transactions is less than 20 kilometers. The table also shows that traders do not transact in markets that are, on average, more than two hours away. Therefore, it would seem that the spatial limitation of trading activities has more to do with the limited demand by traders for long-distance transport services rather than problems with the supply of transport services.

It is unlikely that the limited area coverage of trading activities is due to limited information of supply and demand conditions in local markets. According to the numbers in Table 24, more than 90 percent of traders collect market information while carrying out trading activities. Their main source of information is other traders, followed by newspapers and personal contacts. Furthermore, about 40 per-

Table 24—Access to and use of information

Governorate category	Collect information	Main source of information			Own telephone	Access to telephone	Own fax	Access to fax	Own computer
		News-papers	Other traders	Personal contact					
					(percent)				
Cairo	100	19	49	31	73	86	3.8	0.0	2.7
Alexandria	95	9	83	4	53	64	0.8	0.8	0.8
Lower Egypt	96	21	43	15	29	64	0.2	0.6	0.2
Upper Egypt	89	14	59	12	45	66	0.0	0.8	0.6
Frontier governorates	91	23	70	3	36	50	0.0	1.2	1.2
Average	93	18	52	13	38	65	0.3	0.7	0.5

Source: IFPRI/MALR/MOTS (1997).

cent of traders, on average, have their own telephone lines and 60 percent have access to a telephone. Local traders are thus sufficiently equipped to trace market conditions in distant areas.

Aside from spatial arbitrage, traders are usually engaged in temporal arbitrage (or storage) activities. In this case, traders make their profit by storing grain in a period of low prices (for example, at harvest time) and selling it when prices rise (for example, during the lean period). The amount stored and the length of the storage period are determined by several factors, including the elasticity of supply and demand, the costs of storage, interest rates, variability of production and imports, and availability of substitutes (Gardner 1979).

The survey results indicate that nearly 85 percent of Egyptian wheat traders use storage facilities and more than 70 percent use them to store wheat. Most traders own their storage facilities; only 10 percent rent storage space. The available storage capacities per trader are much larger in the production regions of Lower and Upper Egypt than in the city governorates.

Average annual storage rental costs are £E1.6 per *ardeb.* They are highest in Cairo and Alexandria, where they reach £E3.7 and £E3.4 per *ardeb,* respectively. Based on an average weight per *ardeb* of 140–150 kilograms, the average annual rental cost of storage space is less than 1 percent of the price of 1 *ardeb* of wheat. Despite low transport costs and the availability of relatively cheap storage, traders store an average of only 7.5 metric tons (50 *ardeb*) for a month. The low volume kept in storage is consistent with the short-distance nature of local arbitrage and the observed small shipments, which are recorded at an average weight of 3.6 metric tons. As is shown later in this report, in the analysis of local prices, seasonal price spreads range between 18 and 25 percent in urban markets and 15 and 19 percent in rural markets. To the extent that the rental cost of storage space is a good indicator of storage costs in the marketing sector, the prevailing seasonal price spreads should provide enough incentives for wheat storage. In addition to the availability and cost of storage space, the decision to store wheat will be affected by the factors listed earlier, such as the level of interest rates and the variability of supply. However, the failure of traders to undertake significant storage activities in Egypt is also unlikely to be related to the unwillingness of traders to engage in long-distance trading and the associated small shipments.

Operating Costs and Profitability in the Emerging Marketing Sector

The average operating cost components in the wheat marketing sector are presented in Tables 25 and 26. The figures represent the average of that particular cost item if incurred rather than the average cost per trader. Most of the dissimilarity in marketing costs is accounted for by differences in local labor costs. Labor costs in Cairo and Alexandria are three to four times higher than the average. The other important cost components are storage and transport costs. The category "other operating cost" in Table 26 sums up all costs other than transport, salary, and storage costs. The in-

Table 25—Structure of operating costs in the marketing sector, 1995/96

Governorate category	Average quantity purchased	Average transportation costs	Average rented storage costs	Average salary costs	Average other operating costs
	(*ardeb*)		(£E per *ardeb*)		
Cairo	368	1.1	3.7	21.3	3.2
Alexandria	806	2.0	3.4	16.5	3.7
Lower Egypt	1,211	1.1	1.6	1.8	0.6
Upper Egypt	1,056	1.1	1.1	6.0	0.8
Matruh	650	1.5	1.9	17.0	1.2
Average	1,086	1.1	1.6	5.4	1.0

Source: IFPRI/MALR/MOTS (1997).

dividual cost items that are included are calculated in Table 27. Given that traders engage in activities other than wheat trading, the cost of individual items accruing to wheat was calculated using the overall cost for each given cost item and the estimated share of wheat for that item.

It appears from the figures in Table 25 that there are some economies of scale in the marketing sector. Except for the cost of transport in Cairo, individual cost items show a decreasing trend with an increasing level of activities, as measured by the average quantity of purchased wheat. All cost categories are accordingly lower in the Lower and Upper Egypt regions, where average purchased quantities per trader are nearly two to three times higher than the levels recorded in other regions.

To test for economies of scale in the operations of Egyptian wheat and *fino*-flour traders, a translog cost function can be estimated. The translog cost function is a second-order Taylor approximation in logarithms of a general cost function and can be written as follows:

$$\begin{aligned}\mathrm{Ln}\, C = {} & \alpha_0 + \sum_{i=1}^{m} \alpha_i \ln y_i + \sum_{j=1}^{n} \beta_j \ln P_i + \sum_{k=1}^{o} \Phi_k \ln L_k + \frac{1}{2} \sum_{i=1}^{m} \sum_{j=1}^{m} \delta_{ij} \ln y_i \ln y_j \\ & + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln P_i \ln P_j + \frac{1}{2} \sum_{i=1}^{o} \sum_{j=1}^{o} \nu_{ij} \ln L_i \ln L + \sum_{i=1}^{m} \sum_{j=1}^{n} \rho_{ij} \ln y_i \ln P_j \\ & + \sum_{i=1}^{n} \sum_{j=1}^{o} \lambda_{ij} \ln P_i \ln L_j + \sum_{i=1}^{m} \sum_{j=1}^{o} \mu_{ij} \ln y_i \ln L_j,\end{aligned}$$

where
C = total costs,
y_i = outputs,
P_j = input prices, and
L_k = the quasi-fixed input factors.

Table 26—Structure of other operating costs in the marketing sector, 1995/96

Governorate category	Electricity		Other rent[a]		Taxes		Bag costs		Maintenance		Miscellaneous costs		Cost of wheat trading (£E)
	Cost[b]	Shares[c]	Cost	Shares	Cost	Shares	Cost	Shares	Cost	Shares	Cost	Shares	
Cairo	77	19	2	1	171	23	390	42	73	9	0	5	790
Alexandria	76	11	3	2	1,961	71	48	9	12	3	2	3	2,900
Lower Egypt	31	24	8	5	32	17	70	41	1	2	3	10	317
Upper Egypt	43	34	12	8	40	19	48	24	6	6	2	9	281
Matruh	57	30	58	24	55	28	0	2	1	3	1	13	335
Average	43	27	11	7	117	22	68	32	4	4	2	10	479

Source: IFPRI/MALR/MOTS (1997).

Notes: Transport, storage, and salaries are not included in cost.

[a] Other than storage space.

[b] Costs (in £E) incurred in wheat trading.

[c] Shares (in percent) in the other operating costs of wheat trading. Shares may not sum to 100 percent because of rounding.

Under the conditions of cost minimization, Shephard's lemma can be used to derive share equations for each input from the translog cost function above:

$$\sum_{i=1}^{m} \frac{\partial \ln C}{\partial \ln y_i} = S_i = \beta_i + \sum_{j=1}^{n} \gamma_{ij} \ln P_j + \sum_{j=1}^{m} \rho_{ij} \ln y_j + \sum_{j=1}^{o} \lambda_{ij} \ln L_j,$$

where S_i is the share of the i^{th} input in total cost, and where the cost shares sum to unity,

$$\sum_{i=1}^{m} = S_i = 1.$$

To ensure symmetry and linear homogeneity in factor prices, the following restrictions are imposed on the model:

$$\sum_{j=1}^{n} \beta_j = 1; \sum_{i=1}^{n} \gamma_{ij} = 0 \ (j = 1, 2, \ldots, n);$$
$$\sum_{j=1}^{n} \rho_{ij} = 0 \ (i = 1, 2, \ldots, m);$$
$$\sum_{i=1}^{n} \lambda_{ij} = 0 \ (j = 1, 2, \ldots, o);$$
$$\text{and } \delta_{ij} = \delta_{ji}; \gamma_{ij} = \gamma_{ji}.$$

As shown by Hanoch (1975), the scale elasticity is identical to the reciprocal of the elasticity of cost with respect to output. For the translog cost function, the scale elasticity can be computed as

$$SE = \left(\frac{\partial \ln TC}{\partial \ln Y} \right)^{-1} - 1 = \left(\alpha_y + \sum_{i=\text{k}}^{m} \delta_{iy} \ln y_i + \sum_{i=\text{k}}^{n} \gamma_{iy} \ln P_i + \sum_{i=\text{k}}^{o} \mu_{iy} \ln L_i \right)^{-1} - 1,$$

where
$SE > 0$ indicates positive economies of scale,
$SE = 0$ indicates no economies of scale, and
$SE < 0$ indicates negative economies of scale.

The specific model estimated for Egyptian wheat grain and flour traders is

$$\ln TC = \alpha_0 + \alpha_y \ln Q_s + \beta_1 \ln P_{tr} + \beta_2 \ln P_{st} + \beta_3 \ln P_{pl} + \phi_1 \ln L_{fl} + \frac{1}{2} \delta_{yy} (\ln Q_s)^2$$
$$+ \frac{1}{2} \gamma_{11} (\ln P_{tr})^2 + \frac{1}{2} \gamma_{22} (\ln P_{st})^2 + \frac{1}{2} \gamma_{33} (\ln P_{pl})^2 + \frac{1}{2} \theta_{11} (\ln L_{fl})^2$$
$$+ \gamma_{12} \ln P_{tr} \cdot \ln P_{st} + \gamma_{13} \ln P_{tr} \cdot \ln P_{pl} + \gamma_{23} \ln P_{st} \cdot \ln P_{pl}$$
$$+ \rho_{1y} \ln Q_s \cdot \ln P_{tr} + \rho_{2y} \ln Q_s \cdot \ln P_{st} + \rho_{3y} \ln Q_s \cdot \ln P_{pl}$$

$$+ \lambda_{1l} \ln L_{fl} \cdot \ln P_{tr} + \lambda_{2l} \ln L_{fl} \cdot \ln P_{st} + \lambda_{3l} \ln L_{fl} \cdot \ln P_{pl}$$

$$+ \omega_1 D_{cg} + \omega_2 D_{le},$$

where

TC = total costs, which include the cost of purchasing the raw material (*fino* flour or wheat), transport costs, information costs, storage costs, total labor costs (permanent and temporary), other operating costs, and credit costs for the year;
Q_s = the quantity of *fino* flour or wheat sold;
P_{tr} = the price of rented transport;
P_{st} = the rental rate for storage;
P_{pl} = the wage rate of permanent labor;
L_{fl} = the quasi-fixed input of family labor; and
D_{cg} and D_{le} = regional dummy variables for Cairo/Giza and for Lower Egypt.

In addition to total cost, all prices have been normalized by the purchase price of the particular commodity (wheat or *fino* flour).

Scale elasticities are computed using the following equation:

$$SE = \left(\frac{\partial \ln TC}{\partial \ln Y} \right)^{-1} - 1$$

$$= (\partial_y + \rho_{1y} \ln P_{tr} + \rho_{2y} \ln P_{st} + \rho_{3y} \ln P_{pl} + \mu_1 \ln L_{fl})^{-1} - 1.$$

The normalized cost function and the three input share equations (transportation, storage, and permanent labor) are estimated simultaneously. An error term, assumed to be normally distributed, homoskedastic, and uncorrelated within but contemporaneously correlated across equations, is applied to each equation. The system is estimated with Zellner's seemingly unrelated regression method using STATA. Homogeneity in prices is imposed through normalization of the system by the price of the purchased raw material (wheat or *fino* flour), and symmetry is imposed. The equation for raw-material purchase is omitted from the system because it is redundant and its parameters can be recovered through homogeneity (Huffman and Evenson 1989).

The estimation results for the cost function and the share equations are reported in Tables 27 and 28, respectively. A majority of the coefficients are not significant, except in the labor share equation, where all the parameters are statistically significant at the 1 percent level. The nonsignificant results are related to the characteristics of cross-section data from the trader survey. For example, about 92 percent of the traders did not report storage costs and another 20 percent did not incur any transport costs. For these traders, average storage and transport costs were computed at the district level and the averages were used to fill in the missing storage and transport information. This was done to avoid losing too many observations for the econometric estimation. However, this limits the variability of these costs by trader

Table 27—Parameter estimates of translog cost function for wheat and *fino* flour traders

Parameter	Wheat trader			*Fino* flour trader		
	Coefficient	z	$P > \|z\|$	Coefficient	z	$P > \|z\|$
α_0	0.4242	4.086	0.000	3.0771	2.289	0.022
α_y	0.9266	35.304	0.000	0.7257	6.200	0.000
β_1	–0.2006	–0.649	0.517	–0.0546	–0.830	0.407
β_2	0.0126	0.670	0.503	0.1740	1.450	0.147
β_3	–0.0204	–0.484	0.628	–0.5198	–1.358	0.175
ϕ_1	0.1693	2.078	0.038	1.1075	2.051	0.040
δ_{yy}	0.0043	0.970	0.332	0.0223	2.870	0.004
γ_{11}	–0.0136	–2.655	0.008	0.1374	2.016	0.044
γ_{22}	–0.0025	–0.802	0.423	0.0045	0.390	0.696
γ_{33}	0.0132	1.688	0.091	0.0988	1.614	0.107
θ_{ll}	–0.0426	–0.549	0.583	0.8187	1.361	0.174
γ_{12}	0.0052	1.934	0.053	–0.0038	–1.173	0.241
γ_{13}	0.0091	1.281	0.200	0.0108	1.041	0.298
γ_{23}	0.0052	1.374	0.169	0.0022	0.098	0.922
ρ_{1y}	–0.0004	–0.073	0.942	0.0023	0.619	0.536
ρ_{2y}	–0.0028	–1.176	0.240	–0.0152	–1.879	0.060
ρ_{3y}	0.0050	0.708	0.479	–0.0007	–0.034	0.973
λ_{1l}	0.0212	1.524	0.127	–0.0399	–2.202	0.028
λ_{2l}	0.0062	0.849	0.396	0.1078	3.305	0.001
λ_{3l}	0.0056	0.293	0.769	0.0707	0.752	0.452
μ_{yl}	–0.0089	–0.743	0.458	–0.1471	–4.046	0.000
ω_1	–0.0778	–4.206	0.000	–0.0968	–1.695	0.090
ω_2	–0.0516	–4.171	0.000	–0.1491	–2.922	0.003
Number of observations	939			104		
R^2	0.9837			0.9881		
RMSE	0.1504			0.1882		
Economy of scale	0.0391			0.0748		

Source: IFPRI/MALR/MOTS (1997).
Note: RMSE stands for root mean squared error.

and reduces the ability of these unit costs to explain changes in total costs. An added difficulty is that wheat grain prices also do not vary much by trader.

Using the cost-estimation results, economies of scale are estimated for both wheat and flour traders. The positive but small numbers (0.039 and 0.075) indicate that wheat trading may have some economies of scale, particularly for the more freely traded *fino* flour. Although the nonsignificant cost-estimation results and the small magnitude of the scale indicator make it hard to derive any conclusive statement regarding scale economies in the Egyptian wheat trading sector, commodity trading in general is characterized by positive economies of scale, and this is likely to hold true for Egyptian grain traders. The existence of economies of scale would

Table 28—Parameter estimates of share equations for wheat and *fino* flour traders

	Wheat trader			*Fino* flour trader		
Parameter	**Coefficient**	**z**	***P*** **> |z|**	**Coefficient**	**z**	***P*** **> |z|**
Transport						
β_1	–0.0020	–2.420	0.016	–0.0090	–0.140	0.889
ρ_{1y}	0.0004	2.835	0.005	0.0061	1.574	0.115
γ_{11}	–0.0001	–0.692	0.489	0.0041	1.853	0.064
γ_{12}	–0.0001	–1.045	0.296	0.0036	1.031	0.302
γ_{13}	–0.0001	–0.552	0.581	–0.0095	–0.940	0.347
λ_{11}	–0.0006	–1.619	0.105	–0.0288	–1.376	0.169
Number of observations	939			104		
R^2	0.0135			0.0804		
RMSE	0.0046			0.0638		
Storage						
β_2	0.0111	4.723	0.000	0.0969	2.671	0.008
ρ_{2y}	–0.0015	–4.215	0.000	–0.0064	–2.918	0.004
γ_{12}	0.0002	0.551	0.582	0.0014	1.156	0.248
γ_{22}	0.0000	0.053	0.958	–0.0010	–0.493	0.622
γ_{23}	0.0002	0.348	0.728	–0.0042	–0.726	0.468
λ_{21}	0.0002	0.184	0.854	0.0014	0.119	0.905
Number of observations	939			104		
R^2	0.0217			0.1075		
RMSE	0.0128			0.0362		
Hired labor						
β_3	0.1100	9.343	0.000	0.0958	3.249	0.001
ρ_{3y}	–0.0152	– 8.338	0.000	–0.0044	–2.432	0.015
γ_{13}	–0.0091	–4.157	0.000	–0.0006	–0.640	0.522
γ_{23}	0.0038	3.339	0.001	0.0029	1.797	0.072
γ_{33}	–0.0086	–3.124	0.002	–0.0076	–1.636	0.102
λ_{31}	0.0099	1.78	0.075	–0.0074	–0.763	0.445
Number of observations	939			104		
R^2	0.0959			0.1001		
RMSE	0.0654			0.0294		

Source: IFPRI/MALR/MOTS (1997).
Note: RMSE stands for root mean squared error.

indicate that an expansion of activities in the marketing sector, following a continuation of reforms, would cut the unit costs in the distribution sector, benefiting both producers and consumers.

Table 29 presents the ex post evaluation of trader perception of profitability in local trading activities (that is, before and after the reforms in 1987). It provides some ideas about the perceived direction of past and expected changes in the level of profitability. On average, the number of traders who felt that profitability was low fell from 23 percent before 1987 to 4 percent after 1987. The sharpest decline was detected in Cairo and in the Upper and Lower Egypt regions. At the same time, the percentage of traders who perceived high profitability levels in local wheat marketing fell from 30 percent prereform to 17 percent postreform. The largest drop was noted in Cairo and Alexandria, where the share of traders who perceived profitability as being high fell from 34 and 10 percent to 6 and 1 percent, respectively.

The trend above suggests that there has been a convergence in the perceived profitability of wheat trading after the reforms. About 80 percent of traders perceived their profits as being either average or fair after the reform, compared with less than 50 percent before the reforms. This may indicate that the increased competition following the reforms has reduced the possibility for high profits, but it has also provided for a more stable and fair market.

More recent changes and expected changes in the near future provide a more accurate picture of how traders judge profitability in the sector. The remaining columns of the table present the results for the season when the survey was carried out, and for the immediate preceding and following seasons. The figures show that the share of

Table 29—Perceived changes in absolute profitability of wheat trading, before and after 1987

Governorate category	Profitability level									
	Before 1987		After 1987		Last season (1994/95)		Current season (1995/96)		Expected profitability in season (1996/97)	
	High	Low	High	Low	High	Low	High	Low	High	Low
	(percent)									
Cairo	34	30	6	0	22	0	27	0	55	0
Alexandria	10	56	1	22	6	12	9	4	24	3
Lower Egypt	33	18	21	2	30	3	38	4	52	3
Upper Egypt	29	23	14	3	12	6	20	5	32	3
Matruh	26	48	27	18	2	12	0	28	89	0
Average	30	23	17	4	21	5	28	5	44	3

Source: IFPRI/MALR/MOTS (1997).

Note: The figures correspond to the percentage of respondents citing their perception on the level of profit, either good or bad. The response of the remaining respondents is either average or fair.

Table 30—Relative profitability of wheat trading

Governorate category	Wheat trade	Rice trade	Maize trade	Agricultural input trade	Other agricultural and livestock trade	Other activities[a]
				(percent)		
Cairo	1	28	9	3	52	7
Alexandria	3	6	6	8	59	18
Lower Egypt	8	38	9	7	22	16
Upper Egypt	11	1	14	3	58	13
Matruh	2	0	0	0	53	45
Average	8	22	10	4	40	16

Source: IFPRI/MALR/MOTS (1997).

Note: The figures correspond to the percentage of traders citing the corresponding activity as the most profitable.

[a] These include productive activities in agriculture, mining, and the service sector.

traders who feel that the profitability in wheat trading is high increased throughout the three-year period, from 21 percent for the 1994/95 season to 44 percent for the 1996/97 season. The low-profitability numbers, in contrast, remain around the same level as for the post-1987 period. It is interesting to note that the high-profitability numbers are higher for the 1996/97 season than any other period for all regions.

As shown in Table 15, wheat trading accounts, on average, for only one-fifth of private traders' marketing activities. Table 30 illustrates how private traders judge profitability in the wheat sector with respect to other activities. Less than 10 percent of traders indicated wheat trading to be the most profitable activity. Three-quarters of the traders surveyed find trading in other agricultural commodities, including livestock, to be more profitable than trading in wheat. Under the current circumstances, traders would be more likely to invest in trading in commodities other than wheat. If the level of relative profitability is used as an indicator, the lowest propensity for investing in wheat trading is observed among traders in Cairo, Alexandria, and Matruh.

Investment Asset Accumulation and Access to Credit

An important indicator of whether the recent reforms have encouraged the participation of the private sector in marketing activities is reflected through their investment and asset-accumulation behavior.

In Table 31, the average real value of assets purchased by traders is calculated for the prereform and postreform periods. The numbers indicate that the level of investment has dropped during the postreform period of 1987–96. This suggests that traders may be hesitant to invest further in wheat trading despite the reforms. On the other hand, the long-term responsiveness of private-trader investment to isolated changes in the wheat marketing sector might be quite limited. Given that wheat is

Table 31—Investment and mode of financing in private trading sector, 1977–96

Governorate category	Average real value of purchased assets (in 1990 £E)		Mode of financing (since 1987)			Sources of credit (since 1987)				
	1977–86	1987–96	Cash	Credit	Inheritance	Family or friend	Other traders	PBDAC	Commercial bank	Others
					(percent of respondents)					
Cairo	144,522	24,781	85	10	5	0	100	0	0	0
Alexandria	85,888	41,377	85	15	0	43	57	0	0	0
Lower Egypt	15,255	6,161	85	4	11	25	36	19	17	3
Upper Egypt	27,599	14,657	77	8	15	3	23	49	23	3
Matruh	11,043	6,783	63	18	19	33	67	0	0	0
Average	32,446	10,751	82	7	12	17	39	27	15	2

Source: IFPRI/MALR/MOTS (1997).

Table 32—Sources of finance for marketing activities

Governorate category	Primary source of finance			Received credit in 1995/96 agricultural year
	Own funds	Credit	Own and credit	
			(percent of respondents)	
Cairo	97	0	3	3
Alexandria	87	0	13	10
Lower Egypt	80	1	19	21
Upper Egypt	78	2	20	21
Matruh	100	0	0	5
Average	81	1	18	19

Source: IFPRI/MALR/MOTS (1997).

marketed with other commodities and represents a small share of trader activities, improvements in the policy environment of other agricultural markets will likely contribute more to capital formation in wheat trading.

Table 31 also shows that the great majority of wheat traders used their own resources to fund their asset investment. Furthermore, a large share of the credit received was raised outside the formal banking sector, primarily from other traders. The limited access to the formal banking sector is not only restricted to the funding of investments but also is observed with respect to the financing of other regular marketing. Table 31 indicates that more than 80 percent of traders usually rely on their own resources to fund their marketing activities.

The figures in Table 32 suggest that traders in Lower and Upper Egypt have relatively greater access to credit than their counterparts in the urban centers of Cairo and Alexandria. Although at lower levels of investment, 20 percent of traders in

Table 33—Details of average credit obtained by the traders in 1995/96

Governorate category	Amount borrowed	Amount repaid	Loan period	Share of credit used in trade	Interest rate
	(£E)		(days)	(percent)	
Cairo	60,000	67,200	365	45	12
Alexandria	105,129	112,129	102	50	11
Lower Egypt	10,515	11,284	165	67	15
Upper Egypt	12,045	13,448	249	59	16
Matruh	47,056	47,057	5	60	4[a]
Average	16,229	17,558	192	63	15

Source: IFPRI/MALR/MOTS (1997).

[a] The low interest rate in Matruh is due to the fact that three out of the four traders that used credit in that region paid no interest rate. The credit was obtained from friends and family or other informal sources for a short period of time (five days on average).

Lower and Upper Egypt secured credit to finance their trading activities compared with 3 and 10 percent for the latter. The higher access to credit among traders in Lower and Upper Egypt may be due to the stronger presence of PBDAC in these regions. In fact, Table 26 indicates that only in these regions have traders been using PBDAC to finance their investments. Since the introduction of the 1987 reforms, PBDAC has financed 20 and 50 percent of the investment by traders in Lower and Upper Egypt, respectively. The absolute level of credit received in the 1995/96 agricultural year by the average trader is, however, much larger in Cairo and Alexandria (Table 33). It ranges between £E60,000 and £E105,000 in Cairo and Alexandria, respectively, compared with less than £E50,000 in each of the remaining regions. The average interest rate paid for these loans is 15 percent, which is moderate by developing-country standards (see Badiane et al. 1997).

Determinants of the Investment Behavior of Wheat Traders

To determine the factors that may have influenced the investment behavior of local private traders following the reforms of 1987, a probit model was used. In this model, the propensity to invest is approximated by the likelihood of purchasing a warehouse after 1987. A warehouse is the most common asset that a trader usually purchases to effectively conduct his marketing activities. Following Feder and Onchan (1987); Place and Hazell (1993); and Hayes, Roth, and Zepeda (1997), who analyze investment in farmland and land improvement, it is assumed that investment is a function of individual trader characteristics, access and use of credit, initial wealth, and regional or location-specific variables. It is also conjectured that perceptions regarding the policy environment have an important effect on the willingness to invest in a certain sector.

The probit model is specified as follows:

$$\begin{aligned} WAREPO87 = (&INTEDUC, HIEDUC, YTRD5T10, YRTRDGR10, INHERIT,\\ &NONTRAD, WHTRAD, OGTRAD, INPTRAD, OWNFUND,\\ &HAVEFUND, RTASPR87, AREAEXP, VOLEXP, PRF87GD,\\ &PRF87AVG, WAREPR87, LACKSTOR, CAIROGIZ, ALEX,\\ &EDELTA, UEGYPT). \end{aligned}$$

The dependent variable *WAREPO87* is equal to 1 if the trader has invested in a warehouse after 1987 and 0 otherwise. The individual characteristic variables include measures of the following: Levels of education (*INTEDUC* is equal to 1 if the trader has attained intermediate education, and *HIEDUC* is equal to 1 if he or she has a high level of education); experience (*YTRD5T10* is set to 1 if the trader has been in the trading business between 5 to 10 years and *YRTRDGR10* is set to 1 if the trader has more than 10 years of experience in trading); the trader's motivation for entering the wheat trade (*INHERIT* is equal to 1 if the business was inherited); the trader's main occupation (*NONTRAD* is a dummy if the trader's main occupation is not trading); and whether the trader conducts trading activities in wheat (*WHTRAD*), other grains (*OGTRAD*), or agricultural inputs (*INPTRAD*).

Since the level of credit use may be endogenous to investing in a warehouse and no adequate instruments are available to predict credit use, exogenous variables that approximate the use of credit are used in the model. These include whether traders generally use their own funds to finance their trading operations (*OWNFUND*) and whether they responded "yes" to the question "do you have enough funds to conduct your trading operations?" (*HAVEFUND* is set to 1 if the answer is "yes")

Initial wealth is measured by aggregating the real value of all assets purchased or owned before 1987 (*RTASPR87*). The policy variables include the traders' perceptions about their levels of profitability before 1987; *PRF87GD* is one if this was ranked as good and PRF87AVG if it was average. The variables *AREAEXP* and *VOLEXP* are set to 1 if the traders expressed an interest in either expanding their area or volumes of operations, respectively. These approximate the traders' positive response to the changes in the wheat policy environment.

To control for whether the supply of storage is a constraint for investing in a warehouse, the variable *LACKSTOR* is set to 1 if the trader noted a problem in access to storage space. The variable *WAREPR87* is equal to 1 if the trader owned a warehouse before 1987. This controls for the fact that a trader who already owned a warehouse before 1987 is less likely to purchase one afterward. The regional dummies are for Cairo–Giza (*CAIROGIZ*), Alexandria (*ALEX*), the Eastern Delta (*EDELTA*), and Upper Egypt (*UEGYPT*). These approximate unobserved supply-side characteristics that may influence the propensity to invest.

The results from the probit analysis are shown in Table 34. As expected, the estimated parameters suggest that the propensity to invest in marketing activities is positively associated with education levels. The level of experience in trading has a nonlinear effect on the likelihood to invest. Some level of experience is likely to encourage investment, but beyond 10 years of experience the effect is not significant. This could also be explained by the fact that traders with more than 10 years of experience have already invested in a warehouse before 1987. Traders who have inherited their business are less likely to have bought a warehouse after 1987, most probably because they would have inherited it from their relatives. Whether or not the primary occupation of the respondent is trading does not seem to affect investment behavior. However, compared with being engaged in other trading or nonagricultural activities, trading in wheat decreases the probability of warehouse investment. On the other hand, trading in agricultural inputs, which were only recently liberalized, increases the probability of investing in a warehouse. This finding supports the earlier argument that investing in wheat marketing activities is influenced by policy factors outside the wheat area and related to the agriculture sector in general.

The coefficients on the credit variables are significant. They suggest that traders that finance their operations with their own funds are less likely to invest in a warehouse. This underscores the general finding that lack of access or use of credit is a major investment constraint. If traders have enough funds (cash or credit) to conduct their trade, the propensity to invest is positive. The initial wealth variable is not sig-

Table 34—Probit analysis of trader investment in wheat marketing

Variable	Coefficient	Standard error	*z*	*P* > |z|
INTEDUC	0.2730*	0.1104	2.473	0.013
HIEDUC	0.5725*	0.1496	3.826	0.000
YTRD5T10	0.2415*	0.1235	1.955	0.051
YTRDGR10	0.0722	0.1577	0.458	0.647
INHERIT	–0.2578*	0.1293	–1.993	0.046
NONTRAD	–0.1304	0.1123	–1.161	0.246
WHTRAD	–0.3703	0.2048	–1.808	0.071
OGTRAD	0.2579	0.1997	1.292	0.196
INPTRAD	0.2534*	0.1277	1.984	0.047
AREAEXPD	0.2173*	0.1118	1.943	0.052
VOLEXPD	–0.1257	0.1193	–1.054	0.292
LACKSTOR	0.0059	0.1133	0.052	0.959
OWNFUNDS	0.5464*	0.1307	–4.181	0.000
HAVEFUND	0.3021*	0.1176	2.569	0.01
PRF87GD	–0.3476*	0.1585	–2.193	0.028
PRF87AVE	–0.4483*	0.1620	–2.767	0.006
RTASPR87	–9.48 e–09	1.68 e–07	–0.056	0.955
WAREPR87	–1.5532*	0.1984	–7.832	0.000
CAIROGIZ	–0.5166*	0.1937	–2.667	0.008
ALEX	–0.0318	0.2415	–0.132	0.895
EDELTA	0.3487*	0.1259	2.771	0.006
UEGYPT	–0.2941*	0.1292	–2.276	0.023
CONSTANT	–0.6958*	0.2130	–3.267	0.001

	Predict warehouse purchase		
	No	Yes	Total
Owned warehouse post–1987			
No	1,363	8	1,371
Yes	180	11	191
Total	1,543	19	1,562

Number of observations = 1,562
Likelihood ratio = –463.45086
$\chi^2_{22} = 233.48$
Probability > $\chi^2 = 0.0000$
Pseudo $R^2 = 0.2012$

Note: * significant at the 5 percent level.

nificant, nor is the lack of supply storage space. In fact, as found from the traders' survey, access to storage does not seem to be a major impediment in Egypt.

The policy perception variables show some unusual results. If the traders' perceptions about their profit levels were good or average for the period before 1987, they seemed less likely to invest in warehouses after 1987. One plausible explana-

tion is that traders who did fare well before 1987 did not see the need to invest in warehouses after that period, whereas poorly performing traders hoped to improve their performance by investing in warehouses. Moreover, the traders that responded positively to the desire to expand their areas of operation were also more likely to invest in warehouses. However, the desire for volume expansion does not have a significant impact on warehouse investment.

As conjectured, if traders owned warehouses before 1987, they were less likely to invest in another warehouse after 1987. That effect is large and significant. This finding may also indicate that reforms have contributed more to the entry of new traders in wheat marketing than to the expansion of existing operations. Finally, the regional dummies suggest that, compared with the Western Delta, the propensity to invest in a warehouse in Cairo-Giza or Upper Egypt is lower. In contrast, the likelihood of investing is higher in the Eastern Delta. For the Cairo-Giza regions, this is because storage costs are higher (see Table 25) and storage space is more difficult to obtain. The Eastern Delta is considered the main wheat producing region of Egypt. Therefore, this result is not surprising. Upper Egypt, on the other hand, does not have a well-developed infrastructure relative to the Delta region.

Conclusion

There is some indication that market reforms have increased the number of participants in wheat marketing, which has resulted in more competitive markets. However, there is no indication that the reforms have led to an expansion of existing trading operations. The survey findings suggest that wheat marketing is a small-scale activity, often not the most important one for local traders. As in many other countries, limited access to capital is the most important constraint to the area or volume expansion of private traders.

Some evidence also suggests that traders are hesitant to engage in long-distance trading or in long-term storage. Despite widespread access to transport, storage, and information infrastructure, the area coverage of spatial arbitrage seems to be determined both by price differences between these markets, as well as by the physical distance of markets. This finding is partly related to the occasional restrictions on wheat movement between governorates and the fact that a large segment of the wheat distribution and processing subsectors are still regulated by the government. This should have significant implications for the performance and efficiency of local wheat markets, which is the focus of the following chapter.

CHAPTER 5

Price Behavior and Adjustment in the Egyptian Wheat Markets

An important yardstick in assessing the impact of policy changes on the domestic marketing system is to evaluate their effects on the level and stability of local prices and on the performance of rural and urban markets. While the preceding chapter evaluated changes in market structure in terms of market competition, this chapter focuses on changes in market performance and efficiency by analyzing marketing margins and the extent of integration between local markets.

Expected Impact of Market Reforms on Wheat Prices

The impact of market reforms on the behavior of prices will depend largely on the prereform pricing regime and the response of the private and public sectors to the reforms. Because wheat farm prices in Egypt were heavily taxed before the reforms of 1987 (see Chapter 2), producer prices would be expected to rise to reach international price levels following price liberalization. In contrast, because consumer prices are subsidized in Egypt, elimination of the subsidy could result in higher consumer prices. However, if marketing costs also decline because of the participation of a more cost-efficient and competitive private marketing sector, the increase in consumer prices could be substantially dampened. This was observed, for example, in Kenya, where the liberalization of the milling sector resulted in lower consumer prices for maize meal, despite the fact that the consumer price subsidy for maize meal was eliminated (Jayne and Argwings-Kodhek 1997).

Changes in price variability following the reforms are hard to predict because market prices are determined by several factors, including local supply and demand conditions, international prices, improvement in productivity, changes in marketing and processing costs, and extent of competition and efficiency of the emerging private sector. In general, if market prices were fixed by the government during the prereform period, price deregulation should result in higher price variability. However, if local market prices were not effectively controlled by the government, price variability could decline. The more rapid response of the private sector to changes in sup-

ply and demand conditions, coupled with the freer flow of wheat between surplus and deficit regions following the reforms, should dampen regional price swings. In addition, the ability to store wheat to conduct temporal arbitrage should smooth out interyear price variability.

Price seasonality following the reforms could either increase or decrease. If market prices were effectively fixed before market liberalization, seasonality would be expected to increase after the reforms to reflect the local supply conditions that vary with the natural cycle of wheat production. However, if markets were not well connected (because of various infrastructural weaknesses or government regulations) and the government did not effectively control prices in local markets, seasonality in the prereform period could be more pronounced than in the postreform period. When markets are not well integrated, surplus regions cannot efficiently supply deficit regions, resulting in higher seasonal price swings within each market. In other words, if one region has a deficit and that region cannot rapidly import wheat from another area, the increase in the price in that region will be higher than normal, reflecting limited supply.

The efficiency of markets is usually measured in empirical research by analyzing time-series data on producer and consumer prices to examine either marketing margins or the extent of market integration. Marketing margins are the difference or spread in prices between two pertinent market levels. Commonly calculated as the price spread between nodes along the vertical marketing channel—farm to wholesale to retail, across regions (spatial margins), and across time (intertemporal)—marketing margins measure the price of a collection of services rendered by market agents in bringing commodities from one market point to another. These marketing services include transportation, storage, milling, product transformation, packaging, and all other relevant postharvest marketing services. These activities are required to move products from the farm to their final destination, the consumer, across space and over time. They also often result in a change in the attribute of the commodity with respect to form. Marketing margins are expected to decline with market reforms, reflecting the lower marketing costs of private traders and a more competitive trading environment.

Market integration can be measured in terms of the strength and speed of price transmission between markets across various regions of a country (Goletti and Babu 1994). If markets' are not well integrated, this often indicates the presence of either government policies or infrastructural and institutional bottlenecks that interfere with the efficient flow of goods and prices between markets. With market reforms, market integration is expected to increase, reflecting a more rapid and effective transmission of price signals between markets.

Price Data Used

The analysis in this chapter used monthly retail prices of wheat grain and flour in the city governorates of Cairo and Alexandria and in six governorates in Lower Egypt and four governorates in Upper Egypt. The governorates in Lower Egypt included

Beheira, Dakahlia, Gharbia, Kafr El Sheikh, Qalubia, and Sharkia; and the governorates in Upper Egypt included Fayum, Giza, Minia, and Sohag.

Retail prices of wheat grain, in piastres[23] per kilogram, were reported by CAPMAS for both rural and urban markets in each of the governorates where wheat is actively traded.[24] While rural prices were collected bimonthly, urban prices were reported on a monthly basis. Because retail prices of wheat grain for some governorates were incomplete, the analysis only included the period January 1976 to December 1995 for urban prices, and 1983 to 1995 for rural prices.

Where real prices were used in the analysis, prices were deflated by the monthly consumer price index (CPI) in Egypt, using 1995 as the base year. The CPI was obtained from the *International Financial Statistics* CD-ROM (IMF 1999). To convert local retail prices in Egypt to their U.S. dollar equivalent, appropriate monthly black market exchange rates were obtained from *Pick's Currency Yearbook* (ICA various issues) and the *World Currency Yearbook* (ICA various issues). Information on the procurement price for wheat grain from 1970 to 1985 and from 1986 to 1995 were from Dethier (1989) and from MOTS (1997) in Egypt, respectively. For the 1970–85 period, annual producer prices of rice, maize, and berseem (calculated as the weighted price of long and short berseem) were from Dethier (1989). Supplementary farm prices of rice, maize, and berseem for 1986–95 were collected from the United States Department of Agriculture's (USDA's) *Attache Report: Grain and Feed Annual* reports for 1995–98.

Monthly international prices of wheat grain are for No. 2 hard winter wheat (f.o.b. U.S. Gulf) in U.S. dollars per ton, obtained from the International Financial Statistics CD-ROM (IMF 1999). These were deflated using the monthly world food commodity price index collected from that CD-ROM, with 1995 as the base year.

The analysis of local retail prices of wheat grain in this chapter covered the period 1983–95. The choice of the period was dictated by the availability of price data and the desire to cover both the prereform and postreform years. The comparative analysis of local and international wheat grain prices is for the period 1983–95. To determine the impact of reforms on the price behavior and performance of the Egyptian wheat market, this period was subdivided into two periods: the prereform period, from January 1983 to June 1987; and the postreform period, from July 1987 to December 1995.

The Impact of Market Reforms on Price Behavior

As discussed in Chapter 1, before the reforms in 1987, the government maintained tight control over all aspects of the wheat sector—production, imports, marketing, processing, and local distribution. During this period, consumer prices for bread and

[23] 100 Egyptian piastres are equivalent to 1 Egyptian pound.

[24] Although CAPMAS data are usually rated as reliable, there is no cost-effective way to test for the accuracy of their price series.

flour were subsidized and wheat grain prices at the producer level were set at a fixed rate, which was generally below international prices. (Refer to Chapter 2 for a history of the relationship between domestic and international wheat prices.) The reforms of 1987 relaxed some of these controls over the wheat sector. Currently, the government pursues a two-pronged approach in the pricing of wheat. At the farm level, the government sets a procurement price at which it will buy wheat from farmers. The procurement price is a guaranteed floor price that was brought closer to international prices following the reforms (see Chapter 2). At the consumer level, the government subsidizes *baladi* flour and bread prices, while prices of other types of bread and flour are now market determined.

Level of Domestic Real Wheat Prices

The average real retail price of wheat in selected urban markets in Egypt were estimated to examine the evolution of real wheat prices since 1976, as shown in Table 35. The table shows that average real retail prices of wheat were generally higher in the postreform period than in the prereform period, except in Alexandria and Gharbia. This could be the result of an increase in domestic wheat farm prices, higher

Table 35—Monthly urban real retail prices of wheat, 1976–95

Region	Average price			Growth rate[a]		
	Prereform period, 1976–87	Postreform period, 1988–95	All periods, 1976–95	Prereform period, 1976–87	Postreform period, 1988–95	All periods 1976–95
	(piastres per kilogram)			(percent)		
Cairo	130.45	164.77	147.88	0.17	–0.47	0.14
Alexandria	109.83	107.42	109.06	0.08	–0.11	0.00
Lower Egypt						
Beheira	89.18	98.04	92.73	0.14	–0.31	0.07
Dakahlia	102.09	106.29	103.77	0.12	–0.47	0.02
Gharbia	100.28	93.18	97.45	0.17	–0.47	–0.04
Kafr El Sheikh	90.37	96.41	92.79	0.29	–0.48	0.08
Qalubia	92.89	99.10	95.37	0.17	–0.53	0.03
Sharkia[a]	86.60	109.52	91.29	0.17	1.13	0.22
Upper Egypt						
Fayum	89.40	95.41	91.80	0.18	–0.40	0.05
Giza	121.20	128.46	124.10	0.38	–0.35	0.10
Minia	95.04	98.94	96.60	0.10	–0.53	0.01
Sohag	95.95	112.46	102.56	0.20	–0.13	0.13

Source: CAPMAS, *Consumer retail prices, Egypt,* various issues.

Note: Real prices were deflated using the CPI, Egypt (1995 = 100), obtained from various issues of *International Financial Statistics Yearbook* (IMF 1996).

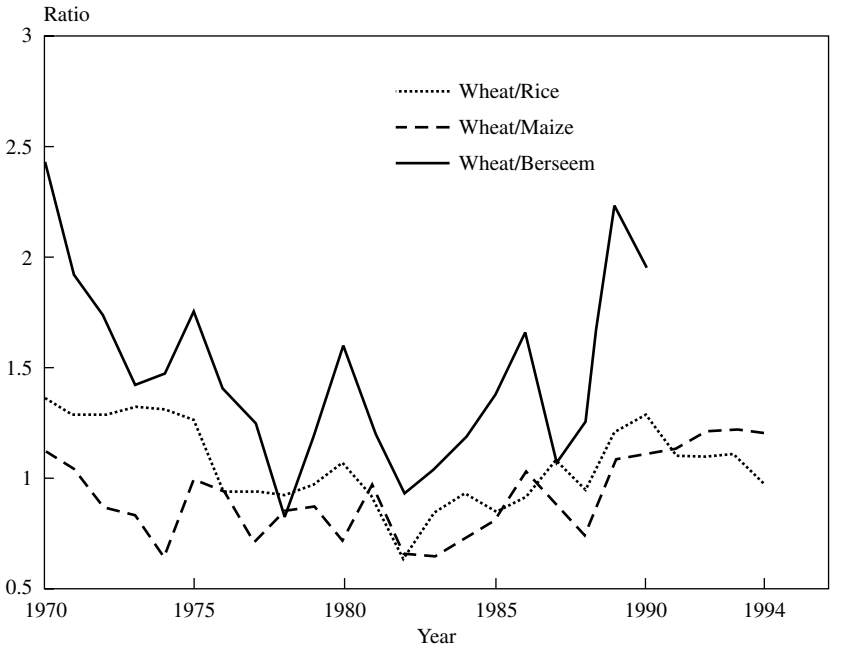
[a] Calculated using $\ln y = a + b(t)$ where y is the deflated monthly urban real wheat prices, t is the time trend, and b is the estimated annual growth rate.

world wheat prices, and the elimination of the consumer subsidy on certain types of bread and flour. On the other hand, the annual growth rate of real retail wheat prices declined after 1987 and became negative during the postreform period 1988–95. In general, over the entire 20-year period of 1976–95, real domestic wheat prices across urban markets exhibited a small upward trend.

Wheat Prices Relative to Competing Crop Prices

Wheat normally competes with berseem in terms of land use, and with rice and maize in terms of final consumption. For this reason, the analysis of changes in wheat prices relative to prices of competing crops is important. Figure 7 shows the evolution of nominal wheat prices at the farm level relative to that of competing crops over the 1970–94 period. It depicts two major phases in the growth of producer prices of maize, rice, and berseem relative to those of wheat. The first phase, covering the period from 1970 through 1982, is characterized by falling wheat farm prices relative to the farm prices of rice, maize, and berseem. In the second phase of 1983–94, farm prices of wheat rose in relation to other crops.

Figure 7—Price ratios of nominal producer prices of selected cereal grains, Egypt, 1970–94



Sources: For Egypt producer prices of wheat, rice, and maize, 1970–85, Table C.1 in Dethier (1989); 1986–95 producer prices of rice and maize, Khedr et al. (1996). The Egypt producer price for berseem is the weighted price of short and long berseem, 1970–85, from Table C.6, Dethier (1989); and the 1986–90 producer price is from USDA, *Attache Report: Grain and Feed Annual* (various issues).

The rise in wheat prices relative to all three crops following 1982 is due to several factors. First, the liberalization of wheat prices in 1987 and the increase in the procurement price of wheat to international levels resulted in higher wheat farm prices in general. With respect to berseem, because its prices were never controlled by the government, rotations with berseem rather than wheat were more profitable before the reforms. This partly explains why berseem area and production were higher in the prereform period, while wheat area started to displace berseem area after 1987. Maize farm prices were less taxed than wheat before the reforms[25] and were liberalized in 1987. Similar to wheat, since 1987, maize prices have gotten closer to international levels. In general, world wheat prices are higher than maize prices, which explains why the wheat–maize price ratio has increased after liberalization. Rice prices were heavily taxed—by about 50 percent (Khedr, Ehrich, and Fletcher 1996)—before 1987. They remained suppressed until 1991, when they were liberalized. Starting in 1992, rice prices started to increase, resulting in a slight decline in the wheat–rice price ratio after that period. In general, the current price ratios between wheat and its competing crops reflect a more liberal market environment where domestic prices are influenced by local supply and demand conditions as well as international price levels.

Price Variability

Another aspect of price behavior of interest here is the level of price instability and how it has changed with the reforms. To evaluate wheat price instability in Egypt, trend-adjusted coefficients of variation of real urban and rural wheat prices are compared with those of world wheat prices. Because rural wheat prices are not available before 1983, this analysis is restricted to price variability to the period after 1983 so that the basis of comparison between rural and urban markets is equal. Three periods are used for this comparative analysis: the entire period of 1983–95, the prereform period of January 1983 through June 1987, and the postreform period of July 1989 through December 1995. Usually, the immediate period that follows the reform is characterized by more price volatility as local markets adjust to the new trading environment. Therefore, to provide a more balanced comparison between the prereform and postreform period, the two-year period immediately following the reforms (June 1987 through June 1989) is excluded.

The first rows of Tables 36 and 37 show the estimated indices of instability for real international wheat prices for the three periods. Note that the index of instability for world wheat prices was around 8 percent for the entire 1983–95 period. World wheat prices seem to have become more volatile in the 1989–95 period (9 percent) compared with the pre-1987 period (almost 7 percent). In the rest of Table 36, indices of real wheat prices in 12 urban markets in Egypt are calculated. For all three

[25] While some studies show that domestic maize prices preceding the reforms were about 85–96 percent of world prices (Khedr, Ehrich, and Fletcher [1996]), other studies show that maize farm prices were higher than world prices during this period (Badiane [1994]).

Table 36—Instability of monthly real retail prices of wheat in urban markets, Egypt, 1983–95

Region	Prereform period, 1983–87			Postreform period, 1989–95			All periods, 1983–95		
	Minimum price[a]	Maximum price[b]	Index of instability[c]	Minimum price[a]	Maximum price[b]	Index of instability[c]	Minimum price[a]	Maximum price[b]	Index of instability[c]
	(piastres per kilogram)								
World									
(U.S. dollars)[d]	131.91	191.82	8.33	143.57	190.72	6.94	131.91	191.82	9.01
Cairo	101.08	167.09	10.83	120.32	202.29	8.99	101.08	220.63	16.94
Alexandria	85.92	175.07	13.18	77.22	145.94	16.24	77.22	175.07	14.46
Lower Egypt									
Beheira	71.17	137.43	14.09	71.06	140.28	9.50	71.06	165.99	17.51
Dakahlia	85.09	137.43	10.90	73.62	145.94	5.85	73.62	151.73	14.86
Gharbia	82.69	150.93	13.46	65.15	131.52	7.23	65.15	150.98	13.76
Kafr El Sheikh	60.65	160.33	17.66	66.10	136.95	8.34	60.65	165.99	20.73
Qalubia	82.24	137.43	11.07	65.15	137.71	11.33	65.15	163.59	18.24
Sharkia	70.58	119.33	11.93	99.75	131.18	6.90	70.59	142.28	13.26
Upper Egypt									
Fayum	77.32	146.93	11.95	67.11	136.95	8.95	67.11	146.93	16.01
Giza	119.47	202.53	13.81	96.26	186.48	11.37	96.26	202.53	14.29
Minia	68.84	144.81	12.91	66.10	136.95	8.17	66.10	165.99	21.23
Sohag	74.88	131.42	13.43	76.00	147.55	11.16	68.00	147.55	15.77

Source: CAPMAS *Consumer Retail Prices, Egypt,* various years.

Note: Real prices were deflated using CPI, Egypt (1995 = 100), obtained from the *International Financial Statistics* CD-ROM (IMF [1999])

[a] Lowest price recorded for the period.

[b] Highest price recorded for the period.

[c] Trend corrected coefficient of variation, in percent, calculated as follows: $I_x = CV\sqrt{(1-\overline{R^2})}$ where I_x is the index of instability, CV is the coefficient of variation, and $\overline{R^2}$ is the adjusted coefficient of determination of the linear trend regression. Cuddy and Della Valle (1978).

[d] No. 2 hard winter wheat, f.o.b. U.S. Gulf, obtained from *World Grain Statistics* (IGC various years), deflated using monthly Food Price Index for the World (1995=100) obtained from the *International Financial Statistics* CD- ROM (IMF [1999]).

Table 37—Instability of monthly real retail prices of wheat in rural markets, Egypt, 1983–95

Region	Prereform period, 1983–87			Postreform period, 1989–95			All periods, 1983–95		
	Minimum price[a]	Maximum price[b]	Index of instability[c]	Minimum price[a]	Maximum price[b]	Index of instability[c]	Minimum price[a]	Maximum price[b]	Index of instability[c]
	(piastres per kilogram)								
World (U.S. dollars)[d]	143.57	190.72	6.94	131.91	191.82	9.01	131.91	191.82	8.33
Lower Egypt									
Beheira	62.58	125.94	13.99	80.35	138.10	6.29	62.57	203.40	19.46
Dakahlia	75.09	126.21	12.41	70.01	118.24	8.67	70.01	126.21	14.98
Gharbia	75.09	118.73	10.61	68.05	127.82	6.90	68.05	155.10	16.50
Kafr El Sheikh	69.85	126.21	13.71	61.77	150.65	9.45	61.77	167.81	22.07
Qalubia	84.14	139.55	13.10	70.01	150.65	7.51	70.01	167.81	16.22
Sharkia	80.60	125.94	11.93	65.78	116.41	4.90	65.78	144.93	14.74
Upper Egypt									
Fayum	71.20	121.75	13.86	66.68	122.24	8.13	66.68	157.64	17.97
Giza	81.35	125.94	9.59	66.75	120.98	5.11	66.75	162.73	15.63
Minia	95.49	145.55	11.99	76.78	150.65	8.50	76.78	160.18	15.75
Sohag	91.35	125.33	8.26	71.77	145.08	9.96	71.77	160.18	14.92

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various issues.

Note: Real prices are deflated using the monthly CPI for Egypt (1995 = 100) obtained from the International Financial Statistics CD-ROM (IMF 1999).

[a] Lowest price recorded for the period.

[b] Highest price recorded for the period.

[c] Trend-corrected coefficient of variation in percent, calculated as follows: $I_x = CV\sqrt{(1 - \overline{R^2})}$, where I_x is the index of instability, CV is the coefficient of variation, and $\overline{R^2}$ is the adjusted coefficient of determination of the linear trend regression. Cuddy and Della Valle (1978).

[d] No. 2 hard winter wheat, f.o.b. U.S. Gulf, obtained from the various issues of the IGC's *World Grain Statistics* (IGC various), deflated using monthly Food Price Index for the World (1995 = 100) obtained from the *International Financial Statistics* CD-ROM (IMF [1999]).

periods, wheat prices in Egyptian urban markets seem to be more volatile than world wheat prices. However, the urban price instability index declined from a range of 10–17 percent prereform to 5–16 percent postreform. In addition, in the postreform period, domestic price instability is closer to world price instability than in the other periods. In the prereform period, domestic prices are almost twice as unstable as world prices. In the postreform period, the urban price instability index for most markets (except Alexandria) is between 6 to 11 percent, close to the average world price instability index of 9 percent.

The instability indicators for real retail prices in selected rural wheat markets are shown in Table 37. Similar to the case in urban markets, instability in rural markets seems to have declined after the reforms. The range in price instability indices declined from 8 to 14 percent prereform to 5 to 10 percent postreform. In addition, while in the prereform period wheat price instability in rural markets was higher than in world markets, in the postreform period, wheat price instability in many rural markets is close to (or even smaller than) international price volatility.

The figures in Tables 36 and 37 also suggest that the real price instability index in rural markets is, on average, lower than for urban markets. Because rural markets are supplied by domestic wheat and urban markets by imported wheat, this may be an indication that local supply and demand conditions and hence, local prices, are more stable than international wheat prices. A price stabilization scheme that the government could adopt to dampen the impact of world price shocks on domestic markets is discussed in Chapter 7.

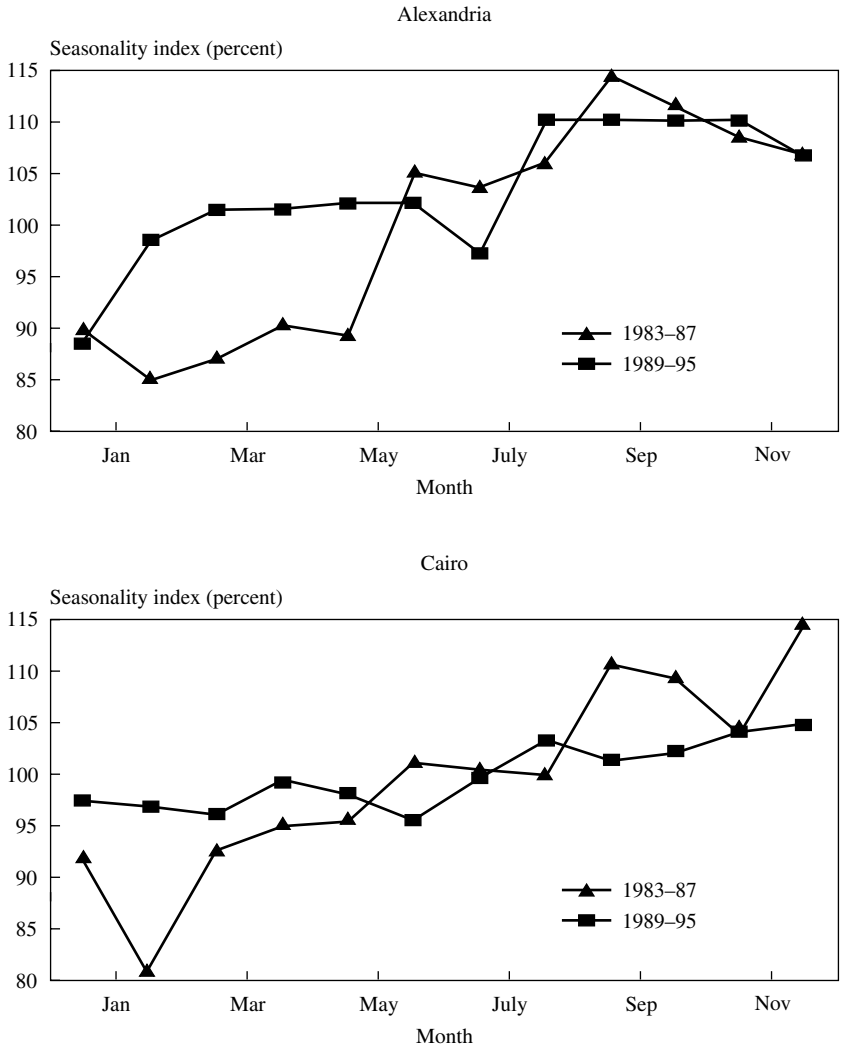
The decline in price volatility is a favorable outcome from the reforms. In Egypt's case, the reforms seem to have led to a decline in price instability for most markets, even though world price instability has increased during this period. The decentralized activities of the private sector result in a more flexible system that is better able to respond to changes in market conditions than a centralized government system. The more rapid response of the private sector and the freer flow of commodities between markets following the reforms tends to stabilize local price shocks.

Seasonality

Seasonality of wheat prices is the regular repeating pattern of price movements within a year. The intrayear fluctuations reflect the market response to the contraction and expansion of the wheat supply in domestic markets. It is normally linked to the biological nature of the production cycle of agricultural crops but also reflects the costs of moving goods over time. Thus, prices would be expected to be depressed during the harvest months, when wheat is abundantly available; and to be inflated during the lean months, when supply of wheat is relatively tight.

The patterns of seasonality in wheat prices are analyzed separately for urban and rural markets over the prereform and postreform periods. Overall, the seasonal pattern of price movement of local wheat differs between urban and rural markets. Figure 8 illustrates the typical seasonality of urban prices, using the examples of Cairo and Alexandria. The examples of Giza and Kafr El Sheikh in Figure 9 are used to

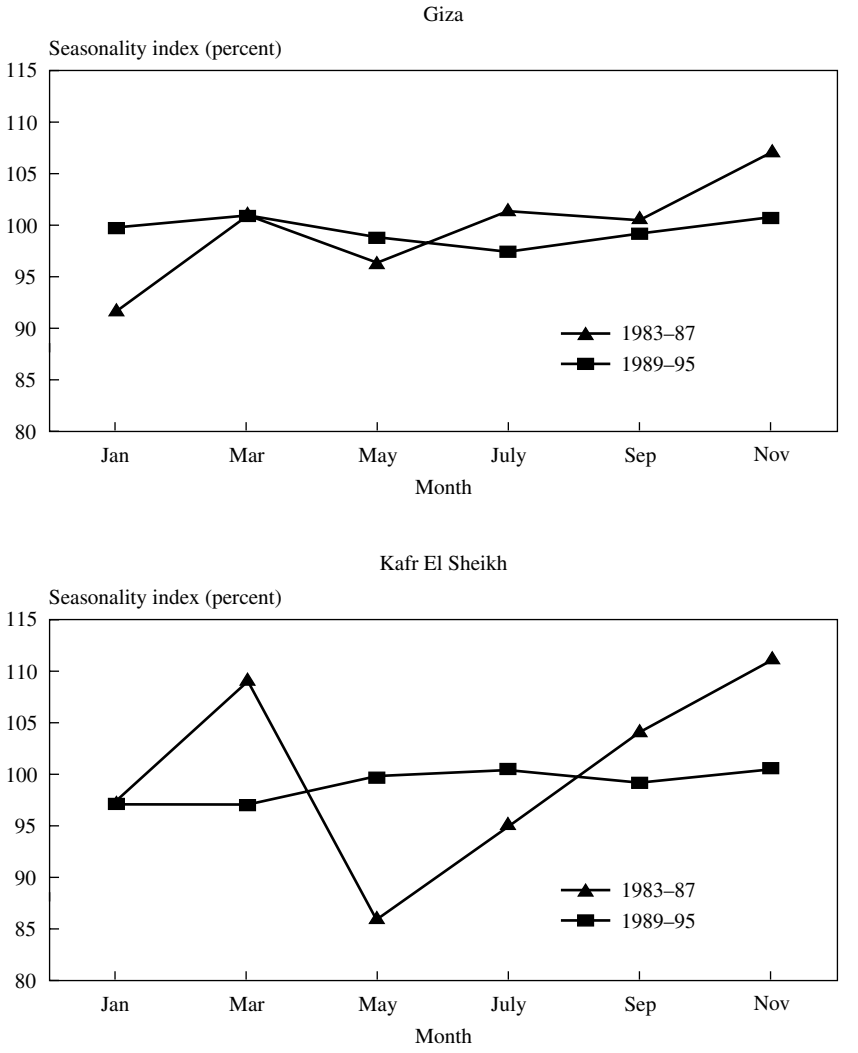
Figure 8—Seasonality in urban retail prices of wheat, Egypt, 1983–95



Source: CAPMAS *Consumer Retail Prices, Egypt,* various years.
Note: Seasonal indices are calculated using the average-percentage method. The calculation involves two steps. In step 1, the prices for each month are divided by the average price for each year multiplied by 100. In step 2, the percentage of monthly averages in step 1 are then averaged over the number of years for each period to obtain the seasonal index for that period (Merril and Fox [1970]).

illustrate the typical price seasonality patterns observed among rural markets. As illustrated in Figure 9, intrayear fluctuations in retail wheat prices in rural markets show a relatively smooth trend. In comparison, the seasonality indices for urban markets in Figure 8 show more erratic behavior. This is perhaps because urban markets depend more on imported wheat, which exhibits more intrayear price swings, while

Figure 9—Seasonality in rural retail prices of wheat, Egypt, 1983–95



Source: CAPMAS *Consumer Retail Prices, Egypt,* various years.
Note: Seasonal indices are calculated using the average-percentage method. The calculation involves two steps. In step 1, the prices for each month are divided by the average price for each year multiplied by 100. In step 2, the percentage of monthly averages in step 1 are then averaged over the number of years for each period to obtain the seasonal index for that period (Merril and Fox [1970]).

rural markets rely more on domestic wheat, which is characterized by more stable prices (see previous section on price variability). In general, prices are lowest during the months of May to July, which coincide with the harvest season, when wheat is more plentiful. During the planting season, which occurs around November to January, wheat becomes less available and its price increases.

Comparing the seasonality patterns in the prereform and postreform periods shows that intrayear fluctuations of retail prices in both rural and urban markets have declined considerably after the reforms. However, intrayear price movements are still much smaller for rural than for urban markets. This difference in price seasonality suggests that the two market groups may be effectively segmented. The disconnection of local wheat markets in Egypt can be explained by the fact that urban markets are primarily supplied by imports, while rural markets rely mainly on domestic wheat supply. Therefore, once wheat grain imports and trading are no longer under government control, more price convergence would be expected between rural and urban markets, as private sector marketing of imported and domestic wheat becomes more integrated. The decline in the seasonality of the retail price of wheat grain in the postreform period supports this report's earlier hypothesis that seasonality might decrease if the reforms contribute to a better integration of markets.

The Impact of Market Reforms on Price Spreads

The evolution of marketing margins is an aspect of price behavior that is important in the evaluation of market performance during reforms. Marketing margins are a concern to policymakers, particularly if they have become unjustifiably large over time and if cost increases in the delivery of products are being charged to consumers in the form of higher prices or translated as lower prices to farmers, or both. Market liberalization is expected to result in the narrowing of margins between market points, reflecting the reduced marketing costs of a more competitive and efficient distribution process.

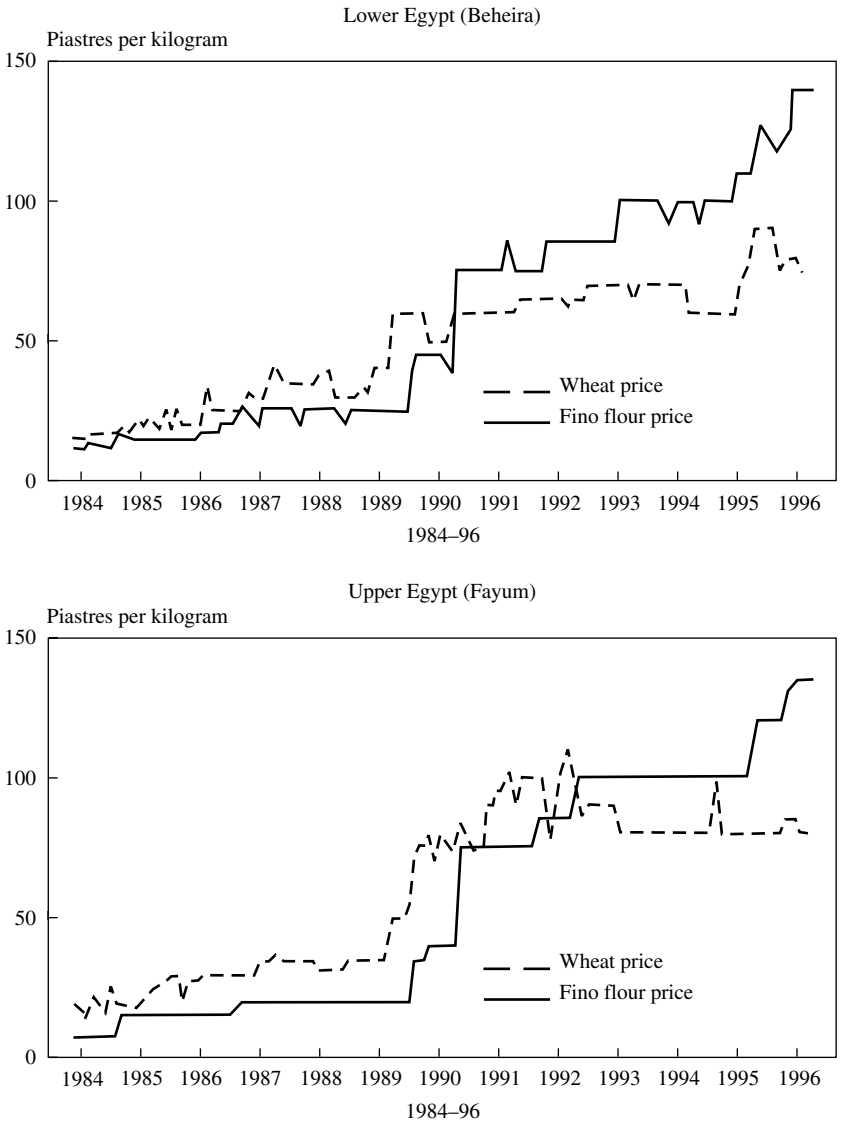
Wheat Grain and Flour Prices

Before 1992, the government subsidized *fino* flour prices and absorbed the cost of processing wheat and distributing the flour. Therefore, the marketing margins during this period did not reflect the true costs of marketing wheat or flour. As will be seen in the following analysis, a consequence of the subsidy policy has been to disconnect the local wheat market from the flour market.

Figure 10 shows that until the early 1990s, 1 kilogram of *fino* wheat flour in the urban markets cost less than 1 kilogram of wheat in both urban and rural markets. The government enacted successive price increases during the second half of the 1980s, raising the price of the *fino* flour from 14 to about 95 piastres per kilogram in the 1991/92 agricultural year. These sharp increases brought flour prices above the level of wheat prices for the first time around 1990. Because of the higher cost of local wheat, the flour price in Upper Egypt (Fayum) did not rise above the price of local wheat until 1992. As expected, after its liberalization in 1992, the price of *fino* flour surpassed the price of wheat grain for the remaining period.

The pricing and subsidy policies in the wheat sector not only unlinked wheat grain prices from flour prices but also affected urban and rural wheat markets differently. As depicted in Figure 10, urban retail wheat prices have the typical appear-

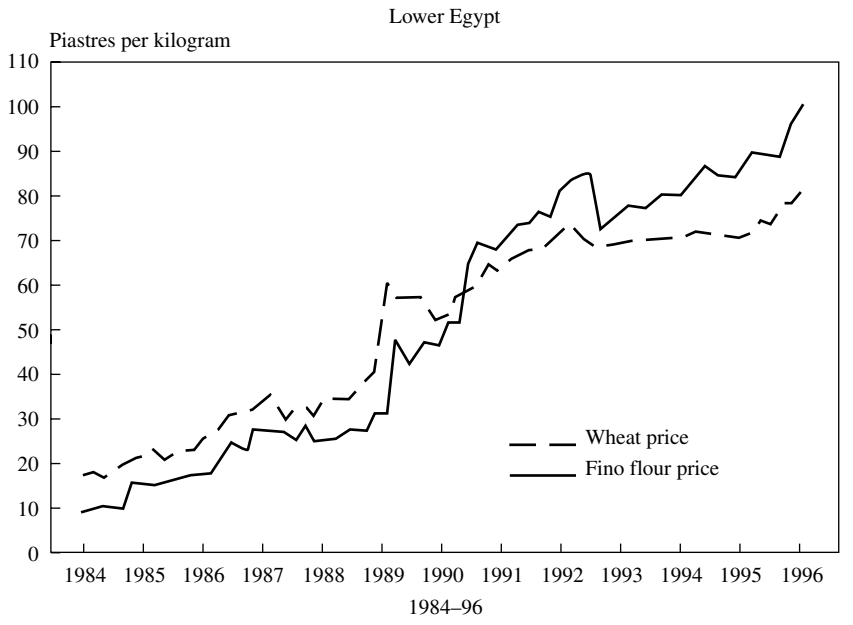
Figure 10—Nominal retail prices for wheat grain and *fino* flour in urban markets, Egypt, 1984–96

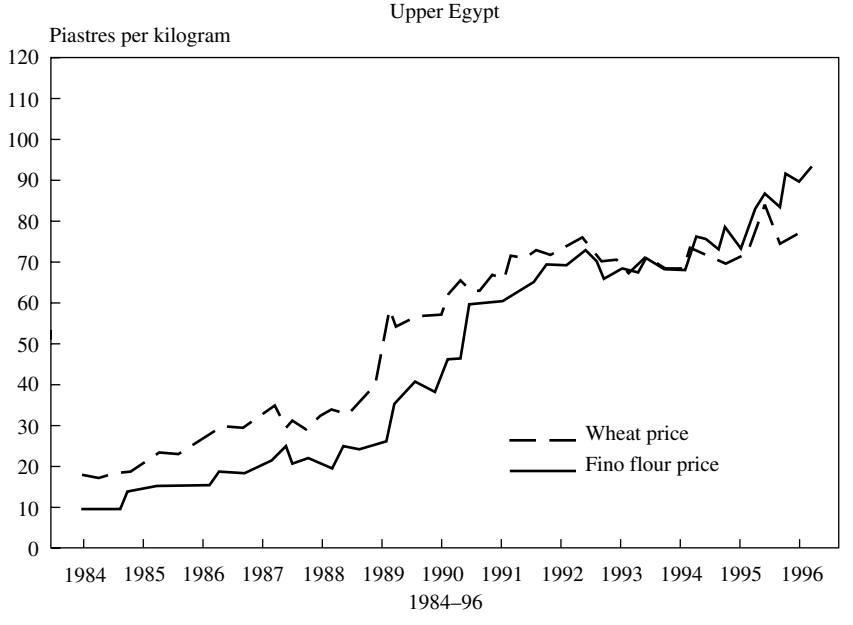


Source: CAPMAS *Consumer Retail Prices, Egypt,* various years.

ance of administered prices, with relatively constant prices that are interrupted by periodic and sudden jumps. In contrast, as shown in Figure 11, retail wheat prices in rural markets display smoother upward trend lines. This reflects the fact that prices in urban markets are more tightly controlled through government imported wheat. Farmers and traders in rural markets buy and sell small quantities of wheat outside the official government channel, resulting in smoother price changes.

Figure 11—Nominal retail prices for wheat grain and *fino* flour in rural markets, Egypt, 1984–96





Source: CAPMAS *Consumer Retail Prices, Egypt,* various years.

Spatial Margins

In general, wheat prices in rural areas, where most wheat is produced, would be expected to be lower than in urban areas, where consumption exceeds available supply. When spatial price spreads between rural and urban markets of the same governorates were analyzed, in 5 (Beheira, Qalubia, Sharkia, Minia, and Sohag) out of the 10 governorates selected for analysis, real rural wheat prices exceeded urban wheat prices during the prereform period (Table 38). Real wheat prices in urban markets were lower than real wheat prices in rural markets by less than 1 piastre per kilogram to as much as 18 piastres per kilogram. In the postreform period, urban–rural retail price spreads were negative for four markets (Beheira, Gharbia, Qalubia, and Minia), although the gap narrows to between 1 and 8 piastres per kilogram.

The reversal of rural–urban price spreads may be either because of the frequent reversal of trade flows or because rural and urban markets are effectively segmented. The case of reversing rural–urban trade flows is unlikely, given the stable nature of wheat production in Egypt. On the other hand, the explanation of market segmentation is highly likely. The separation of markets could result from the government's continued control of wheat import and distribution, and its prohibition of private sector involvement in imported wheat grain marketing. As a result, urban centers are primarily supplied from imports through the public sector, while rural markets rely mainly on domestic production. Consequently, rural prices are determined by changes in local market conditions and prevailing procurement prices, while urban prices depend primarily on world prices and the level of government subsidies. Thus, the changes in rural–urban price spreads described earlier would be a reflection not of changes in arbitrage activities across local markets, but of changes in government procurement and pricing policies for domestic and imported wheat.

Spatial spreads in wheat prices between Cairo, the largest urban consumption market, and other urban markets were analyzed. Normally market liberalization would be expected to encourage spatial arbitrage—the movement of products from a low price market to a high price market—which, in turn, may reduce price gaps between some markets while raising them between others. Thus, market liberalization and increased arbitrage should reduce intermarket price spreads. Table 39 shows the distance and evolution of price spreads for wheat transported between Cairo and other urban markets. For the entire period of 1983–95, interurban spreads of wheat prices range between 19 and 58 piastres per kilogram. Prices in Cairo remain higher than prices in other urban markets. The difference between average regional price spreads before and after the reforms in Table 39 indicates that, with the exception of the Cairo–Giza market pair, price spreads between Cairo and all other urban markets have increased from around 20–45 piastres per kilogram to about 30–67 piastres per kilogram after the reforms. These findings may suggest that intermarket arbitrage is taking place at higher costs during the reform period than in the prereform period. However, the more likely reason is that prereform prices did not reflect the real cost of transportation between Cairo and all the other urban markets. As the table shows, price spreads between Cairo and other urban centers hardly vary with the physical distance.

Table 38—Urban–rural real wheat retail price spreads, Egypt, 1983–95

Region	Rural			Urban			Urban-rural margin[a]					
	Prereform period, 1983–87	Postreform period, 1989–95	All periods, 1983–95	Prereform period, 1983–87	Postreform period, 1989–95	All periods, 1983–95	Prereform period, 1983–87		Postreform period, 1989–95		All periods, 1983–95	
	(piastres per kilogram)											
Lower Egypt												
Beheira	96.18	106.80	103.21	95.73	98.18	97.06	−0.71	(2.36)[b]	−8.39	(−7.86)	−5.77	(3.81)
Dakahlia	102.46	93.58	97.35	105.39	105.27	106.08	3.11	(5.96)	11.67	−12.47	8.67	(10.17)
Gharbia	97.10	93.28	95.96	112.44	91.46	99.86	15.60	(18.32)	−0.99	(−0.65)	4.26	(5.73)
Kafr El Sheikh	94.92	91.43	94.92	103.26	94.94	99.07	10.31	(12.48)	3.18	−4.36	4.96	(6.82)
Qalubia	115.08	99.79	108.47	98.28	97.37	98.80	−15.24	(10.71)	−2.13	(−1.88)	−8.82	(−6.62)
Sharkia	98.17	89.08	95.92	91.65	119.49	99.22	−5.14	(−4.31)	17.30	−17.45	−2.19	(−1.23)
Upper Egypt												
Fayum	92.81	92.41	93.04	96.19	93.77	96.20	5.37	(7.19)	1.71	−2.61	4.34	(6.14)
Giza	101.82	93.58	99.52	146.19	127.86	135.24	45.71	(47.39)	33.35	−36.69	35.95	(38.10)
Minia	117.66	100.48	108.52	98.10	97.60	98.40	−18.00	(−14.82)	−1.93	(−2.01)	−9.08	(−7.76)
Sohag	108.52	104.76	106.36	108.70	114.41	111.03	−0.97	(−0.21)	9.11	−10.46	3.78	(4.88)

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various years.

Note: Real prices are deflated using the monthly CPI for Egypt (1995 = 100), obtained from the *International Financial Statistics* CD-ROM (IMF [1999]).

[a] The urban–rural price margin is the difference between average urban prices and average rural prices in each governorate in each period. A positive margin indicates that average urban prices exceed average rural prices and a negative margin is indicated if otherwise.

[b] Figures in parentheses are the percentage of urban–rural price margins over rural prices in each governorate for each of the periods covered in the analysis.

Table 39—Real wheat price spreads between retail markets in Cairo and other urban markets, Egypt, 1983–95

Regional market pairs	Approximate distance between markets	Spatial margin—average			Spatial margin—growth rate		
		Prereform period, 1983–87	Postreform period, 1989–95	All periods, 1983–95	Prereform period, 1983–87	Postreform period, 1989–95	All periods, 1983–95
	(kilometers)	(piastres per kilogram)			(percent)		
Cairo–Alexandria	224	21.55	33.64	36.33	2.64	–1.69	–0.12
Cairo–Beheira	160	40.67	59.91	57.42	–0.04	–0.16	0.22
Cairo–Dakahlia	124	31.00	52.82	48.40	–0.23	0.25	0.40
Cairo–Fayum	105	40.21	64.33	58.28	–0.17	–0.30	0.35
Cairo–Gharbia	94	23.96	66.63	54.62	2.67	–0.08	0.96
Cairo–Giza	8	–9.80	30.23	19.23	–1.32	–0.55	0.53
Cairo–Kafr	134	33.14	63.15	55.41	–1.91	0.16	0.58
Cairo–Minia	248	38.29	60.50	56.08	–1.59	0.24	0.35
Cairo–Qalubia	48	38.11	60.72	55.68	–0.03	0.26	0.40
Cairo–Sharkia	85	44.74	52.62	55.81	–0.47	2.85	0.45
Cairo–Sohag	479	27.70	43.68	43.45	0.07	–1.25	0.16

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various issues.
Note: Real prices are deflated using the monthly CPI for Egypt (1995 = 100) obtained from the *International Financial Statistics* CD-ROM (IMF [1999]).

Table 40—Temporal real retail price spreads in local wheat markets, 1983–95

Year	Cairo	Alexandria	Lower Egypt		Upper Egypt	
			Urban	Rural	Urban	Rural
1983	49.54	14.41	55.25	46.70	42.14	32.32
1984	57.00	82.07	23.00	37.83	37.04	19.24
1985	54.25	29.65	54.18	34.68	33.39	28.19
1986	15.05	15.15	35.13	20.81	43.41	23.80
1987	42.36	30.71	34.59	48.29	38.92	40.68
1988	40.06	37.29	35.87	16.77	48.97	20.22
1989	32.46	67.86	56.25	58.09	41.32	55.08
1990	40.56	2.58	22.79	15.19	17.08	15.82
1991	18.89	n.a.	19.08	16.10	35.08	24.45
1992	16.45	n.a.	20.99	20.53	23.76	20.24
1993	14.05	n.a.	23.92	9.87	23.62	9.65
1994	11.72	11.72	20.78	13.61	25.17	18.54
1995	6.96	57.85	12.79	17.81	23.82	27.01
1983–87[a]	43.64	34.40	40.43	37.66	38.98	28.84
1989–95	18.11	24.05	20.05	15.52	24.75	19.28

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various years.

Notes: Real prices are deflated using the monthly CPI for Egypt (1995 = 100) obtained from the *International Financial Statistics* CD-ROM (IMF [1999]). Price spreads are calculated as the ratio of the difference between the maximum (highest) price and the minimum (lowest) price over the minimum price in each year multiplied by 100. n.a. indicates data not available for market to allow calculation.

[a] Calculated as average temporal price spread over the period specified.

Temporal Price Spread

Contrary to interurban price spreads, seasonal wheat price spreads within individual regional markets have declined during the postreform period (Table 40). The seasonal price spread of the intertemporal price margin for wheat is calculated as the difference between the highest price (which typically occurs during the lean season) and lowest price (which occurs during the harvest season) within a year, as a percentage of the latter price. In the last two rows of the table, an average temporal price spread is calculated for the prereform and postreform periods, 1983–87 and 1989–95, respectively. These numbers indicate a decline in the average intertemporal price spreads following the reforms. In Cairo and Lower Egypt, temporal price spreads decline by about 50 to 60 percent. The decline is less pronounced in Alexandria and Upper Egypt (30–40 percent). The narrowing of intertemporal price spreads after the reforms suggests that the emerging marketing system has tempered intertemporal price swings.

Market Integration in the Prereform and Postreform Years

The main interest in the study of price integration among local wheat markets is to find out whether price shocks or economic events in one market are transmitted to

other markets. If price signals are rapidly and fully transmitted between markets, this implies a better flow of commodities between surplus and deficit regions. This in turn contributes to stabilizing markets and improving food security. The impacts of the reforms on market integration in Egypt is determined by estimating a time-series model of wheat grain prices across several governorates.

Market Integration Model

Before describing the market integration model, the basic theoretical concepts used in the model are defined.[26] If two markets are integrated, some sort of "causality" must link one market to the other. The concept of causality is interpreted with the limited meaning that past movements of prices in one (set of) markets contribute to the predictability of prices in other markets. If the causation is unidirectional, then, technically, past prices in one market can be used to forecast the prices in the other market—the principle of Granger causality (Granger 1969). If the analysis can identify a market whose prices can be used to systematically predict prices in the remaining markets, that specific market is considered a *central* market.[27] A causation that runs in both directions would indicate a bidirectional causality or "feedback" relationship between two connected markets. This would occur, for example, if both markets are important regional markets where trade flows between them go in both directions. Market *segmentation* would occur if price movements in individual markets are completely irrelevant in predicting price movements in other markets. In reality, however, markets for the same commodity are rarely segmented.

Before market integration is tested, the retail-price series is tested for nonstationarity.[28] Unit roots in retail prices of Egyptian wheat are tested statistically using the test (Dickey and Fuller 1979) estimated as

$$DF : \Delta e_t = \alpha - \beta\, e_{t-1} + v_t \qquad (1)$$

where e is the residuals obtained from the least squares estimation of the first difference in prices at market level i against their lagged levels. Findings of nonstationarity validate the use of the first differences of the natural logarithms of prices in the analysis.

Besides the existence of causation between regional markets, it is important to have information on the magnitude of market interdependence and the speed by which information about market events are transmitted across individual markets.

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[26] See Badiane and Shively (1997), Mendoza and Rosegrant (1995), Goletti and Babu (1994), and Goletti (1993).

[27] See Ravallion (1986) for the implication of cases where only one central market affects prices in other markets, which suggests a radial model of price formation.

[28] The presence of unit roots would imply nonstationarity in the series, indicating that the variances are infinite and thus explode with time. Ignoring unit roots has serious statistical consequences in subsequent model estimation because it renders the conventional least squares estimation procedure invalid and inferences derived from its results highly suspect (Dickey and Fuller [1979]).

This knowledge enables a better interpretation of the implications of changes in the central market on price behavior in distant markets. In the process of intermarket price transmission, the impact of immediate shocks should be distinguished from their cumulative impact, which builds up over time. This is because the process of price transmission occurs over time, involving complex dynamic adjustments among individual markets. The analysis of the price adjustment process over time using the convergence of dynamic multipliers enables a study of the speed of price transmission, that is, the number of days, weeks, or months it takes for changes in prices in one subset of domestic wheat markets to be transmitted fully or partially to another subset of markets. Information on the magnitude and speed of market adjustment to shocks is key to understanding the operation of local markets and is useful in the design of stabilization programs, market information systems, and planning of food security reserves.

Market integration for Egyptian wheat is investigated using a bivariate autoregressive representation of retail prices between several pairs of markets in Egypt, and is specified as follows:

$$\Delta p_{i,t} = \sum_{k=1}^{k=m_i} \alpha_{i,k} \Delta p_{i,t-k} + \sum_{h=0}^{h=n_i} \beta_{i,h} \Delta p_{j,t-h} + X_{i,t}\gamma_i + \varepsilon_{i,t} \qquad (2)$$

where

$\Delta p_{i,t}$ = the percentage change in the retail price of wheat in market i at time t;

$\Delta p_{j,t}$ = percentage change in the retail price of wheat in market j in previous months time, $t–h$;

$X_{i,t}$ = exogenous variables, such as seasonal dummies and time trend;

m_i and n_i = the number of lags in retail price changes identified by the Akaike information criteria (Akaike 1969);

$\alpha_{i,k}$, $\beta_{i,h}$, and γ_i = the coefficients to be estimated; and

$\varepsilon_{i,t}$ = the error term.

The direction of information flow between markets is determined by the Granger causality test and is formulated on the basis of equation (2):

$$H_0: \beta = \beta_2 = \beta_3 = \ldots = \beta_h = 0,\ h = 1, 2, \ldots, n_i. \qquad (3)$$

The test above is used to establish the existence of a *central market,* defined as a market whose prices have a one-way influence on prices in other markets. A weaker version of centrality would involve causation within a certain region, so that a *regional center* is defined as a market whose prices affect prices in all the other markets within that region but without, in turn, being affected by them. Granger causality testing is done for all possible market pairs for Egyptian wheat.

Technically, simultaneity may be encountered in estimating equation (2), a problem that is related to the use of contemporaneous prices in markets i and j. Since prices in any given pair of markets may be affected by the same type of shocks concomitantly, the error term $\varepsilon_{i,t}$ is expected to be correlated with the percentage price change

variable $p_{j,t}$. To overcome this problem, an instrumental variables estimation of $p_{j,t}$ has been used, taking lagged values of the prices of all markets included in the study. Thus, equation (2) is a reduced-form representation of price changes in one market as a function of historical price changes in this market and those in other markets.

As pointed out earlier, an indicator that combines both the magnitude and speed of price adjustment is used to measure the actual degree of integration among food-grain markets. The magnitude of price adjustment is quantified using average dynamic multipliers based on equation (2). The dynamics of the adjustment process involves a series of interim multipliers, as initial shocks originate in one market and are transmitted from this market to another, before converging to a steady state. On the basis of the model formulation in equation (2), the cumulative effect of an exogenous shock to changes in retail prices of wheat in market j on changes in retail prices of wheat in market i after k periods is calculated as in equation (4):

$$\mu_k^{i,j} = \sum_{h=0}^{k} \frac{\partial E[p_i(t)]}{\partial p_j(t-h)} \tag{4}$$

The full adjustment of the dynamic process described by the model is given by the long-run dynamic multiplier, which corresponds to the following:

$$\mu^{i,j} = \lim_{k\to\infty} {}^{\mu i,j}{}_k, \tag{5}$$

where $\mu^{i,j}$ is considered a long-run multiplier because it allows for the market to fully absorb the shock and adjust to its new equilibrium level.

Although the Akaike information criteria give a parsimonious representation of the dynamics of pricing relationships between markets, the order of the autoregressive process in equation (1) tends to either overestimate or underestimate the length of time it actually takes for markets to attain full adjustments. The speed of price adjustment, $\Gamma^{i,j}$, to shocks originating in another market is then calculated by computing the time it takes for the intermediate multipliers to converge within a certain range of the long-run multiplier given in equation (5). Ngenge (1983) provided two approaches for measurement: adjustment period I refers to the length of time it takes for all but 5 percent of the impact from a shock to be reflected in prices, and adjustment period II refers to the length of time it takes when the full impact of the shock has dissipated. The minimum time of the two measures were used; that is, the reaction time is measured when percentage deviations of the interim multiplier from the long run multiplier are small enough. This tolerance limit, θ, is calculated for every $k > \Gamma^{i,j}$ as

$$\left| \frac{\mu_k^{i,j} - \mu_\infty^{i,j}}{x_\infty^{i,j}} \right| < 0. \tag{6}$$

The minimum tolerance limit is equal to 1 percent. Price responses achieved within the shortest possible time would suggest markets are efficient in processing

new information relayed from the other market. An extended response period would indicate a sluggish market and the existence of impediments unwarranted by those that naturally exist.

The extent of market connectedness measured can range from perfect market integration to complete market disconnection or segmentation. *Perfect integration,* $\mu^{i,j} = 1$, occurs if the price in one market is an exact translation of the price in another market, implying that price changes are fully transmitted between the two markets. The transmission factor can in this case be interpreted as an indicator of transfer costs between the two markets. Absence of any price relationship between markets would indicate segmented markets, that is, $\mu^{i,j} = 0$. However, as neither has been observed in real markets, perfect integration or segmentation are only extreme cases, with intermediate degrees of integration, $0 < \mu^{i,j} < 1$, being the normal situation.

Generally, the speed of cross-market price responses is determined by the efficiency of the distribution system and by the structural characteristics of local markets. Rapid adjustments would reflect sufficient flexibility and responsiveness of the domestic market mechanism. Furthermore, given the magnitude of price adjustment between two markets, better-integrated markets would tend to require less time to adjust quickly to shocks originating in another market. Accordingly, both indicators of magnitude and speed of price adjustment are used to measure the actual extent of market integration in retail wheat markets in Egypt.

Discussion of Results

The data used to estimate the above model are monthly retail wheat grain prices in 11 urban markets in Egypt.[29] The 1976–95 period is divided into a prereform period (1976–86) and a postreform period (1987–95). The bivariate autoregressive model is applied first performing the Dickey-Fuller test to test for nonstationarity of the individual price series. The results show that each series should be first-differenced to impose stationarity. Next, lags between market pairs are identified using the Akaike information criteria. In cases where zero lags are obtained, this means that adjustment to price changes in another market are instantaneous, at least within a month. In this case, long-run multipliers cannot be estimated and the analysis stops here. For other market pairs where lags are identified, the next step uses the nonzero lags to estimate the long-run multipliers. Finally, the speed of price transmission (measured in months) is estimated using the formula defined in equation (5).

The discussion of the model results begins with the market integration between Cairo and other urban markets in Egypt. The analysis is conducted between Cairo and 10 other urban markets. First, it is assumed that the Cairo market leads all other urban wheat markets so that the direction of price movement is from Cairo to other

[29] The Sharkia market was dropped from the analysis because of a significant number of missing values in the price series totaling 41 percent of the total 240 observations.

Table 41—Price transmission across urban wheat markets during the prereform period (1976–86)

Regional market pairs[a]	Long-run multipliers	Reaction time
		(months)
Cairo→Dakahlia	–0.15**	5
Alexandria→Cairo	–0.12*	0
Cairo→Alexandria	–0.30*	9
Cairo→Minia	0.22**	8

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various years.
Note: Sharkia was dropped from the analysis because retail prices for 1992–95 are missing. Only significant estimates are presented.
[a] The arrow indicates that the market on the left leads or "Granger causes" the market on the right.
* Significant at the 5 percent level.
** Significant at the 1 percent level.

markets. Then the reverse causation between the 10 other markets and Cairo is also tested. This gives a total of 20 market pairs corresponding to trade flows to and from Cairo.

As summarized in Table 41,[30] results of the estimates of cross-market, long-run multipliers before the reforms of 1987 show that only 20 percent of the total of 20 pairs produced significant multipliers. However, except for the Cairo–Minia pair, all the significant market pairs have the wrong sign. The negative correlation between Cairo and Dakahlia, and between Cairo and Alexandria, contradicts a priori expectations and cannot be explained. The significant positive long-run multiplier of 0.22 between Cairo and Minia indicates the market leadership role played by the Cairo market in the local discovery of wheat prices. However, the causality relationship between these markets is weak. The estimated long-run multiplier is 0.22. This means that a 1 percent increase (or decrease) in Cairo prices only leads to a 0.22 percent increase (or decrease) in wheat prices in Minia. A change in price in Cairo takes 8 months to be reflected as a change in price in Minia, which is much longer than the normal travel time between these markets. Overall, the results show that urban wheat markets are not affected by changes in market conditions in Cairo, and vice versa. The segmentation of local urban wheat markets is not surprising considering that, during the years before 1987, the interregional movement of wheat was prohibited by the government and producer and consumer prices were set independent of changes in market conditions. In this case, prices in different markets could be expected to be uncorrelated with each other.

Subsequent computations of the bivariate time-series model were conducted to test for a change in market behavior after the introduction of reforms. The results presented in Table 42 indicate that the transmission of price changes between Cairo

[30] Only the significant estimates are presented in this table.

Table 42—Price transmission across urban wheat markets in the postreform period (1987–95)

Regional market pairs[a]	Long-run multipliers	Reaction time
		(months)
Cairo→Dakahlia	0.17*	5
Dakahlia→Cairo	0.31**	8
Cairo→Kafr	0.19*	1
Cairo→Gharbia	0.24**	8

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various years.
Note: A zero lag structure between a pair of markets indicates an instantaneous price relationship between these markets. Sharkia was dropped from the analysis because retail prices for 1992–95 are missing. Only significant estimates are presented.
[a] The arrow indicates that the market on the left leads or "Granger causes" the market on the right.
* Significant at the 12–15 percent level.
** Significant at the 5 percent level.

and other urban markets has improved during the postreform period. Of the 20 long-run multipliers, 3 are significant and of the correct, positive sign. In addition, 5 out of the 10 market pairs exhibit no lags, indicating that adjustment to changes in Cairo prices occur very quickly—within a month. These pairs include Cairo–Alexandria, Cairo–Beheira, Cairo–Fayum, Cairo–Minia, and Cairo–Sohag. As mentioned earlier, for these market pairs, long-run multipliers cannot be calculated and therefore are not shown in Table 42.

The Cairo–Dakahlia market link, for which the previous estimates over the prereform years yielded significant but incorrectly signed multipliers, exhibits significant and positive long-run multipliers over the postreform years. The multiplier estimates are significant from Cairo to Dakahlia and for the reverse case, indicating a feedback causality relationship between these markets, with Dakahlia exerting a larger effect on Cairo (0.31 percent) than Cairo on Dakahlia (0.17 percent). This result may be because Dakahlia is one of the largest wheat-producing governorates in Lower Egypt, and therefore, some wheat could be flowing from Dakahlia to Cairo, influencing prices in Cairo. The results for the market pairs of Cairo–Kafr El Sheikh and Cairo–Gharbia support the market leadership of Cairo, although the price relationship is weak. The cross-market, long-run multipliers between Cairo–Kafr El Sheikh and Cairo–Gharbia only range from 0.19 to 0.24. Overall, market adjustment to local changes in supply and demand takes considerable time, 1–8 months.

The same model has been computed for urban markets in Lower and Upper Egypt before and after reforms. In Lower Egypt, significant multipliers were obtained in the prereform period for 3 out of 38 pairs that were estimated. The estimated coefficients range between 0.06 and 0.23, with market adjustment taking as much as 20 months (Table 43). About 26 percent showed instantaneous relationships, suggest-

Table 43—Price transmission across urban markets in Lower Egypt (1976–86)

Regional market pairs[a]	Long-run multipliers	Reaction time
		(months)
Dakahlia→Beheira	0.22*	5
Beheira→Qalubia	0.06*	11
Qalubia→Beheira	0.23*	20

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various issues.
Note: Instantaneous relationships were found for the market pairs of Qalubia–Kafr El Sheikh, Qalubia–Ismailia, Qalubia–Damietta, Damietta–Kafr El Sheikh, Damietta–Beheira, and Damietta–Ismailia.
[a] The arrow indicates that the market on the left leads or "Granger causes" the market on the right.
* Significant at the 1 percent level.

ing that response time occurs within a month. (These latter results are not shown in Table 43 because no long-run multipliers can be calculated for these market pairs.)

In comparison, long-run multiplier estimates in Upper Egypt for the same period are significant for 6 out of 24 pairs with values ranging between 0.07 and 0.21 (Table 44). It appears from these results that markets in Upper Egypt were better integrated over the prereform period than markets in Lower Egypt. The frequency of interconnected markets is higher in the first region, although the magnitude of integration is comparable in both regions. However, market adjustment seems to occur more rapidly within Lower Egypt than Upper Egypt. Comparing these results with those shown in Table 41, it seems that markets in these two regions are better integrated with each other than with the Cairo markets, despite being influenced by the latter market. No single market could be identified as a market leader from within the two

Table 44—Price transmission across urban markets in Upper Egypt (1976–86)

Regional market pairs[a]	Long-run multipliers	Reaction time
		(months)
Qena→Beni Suef	0.10**	0
Beni Suef→Giza	0.08*	0
Giza→Beni Suef	0.07*	3
Beni Suef→Fayum	0.16**	8
Minia→Beni Suef	0.21**	6

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various years.
[a] The arrow indicates that the market on the left leads or "Granger causes" the market on the right.
* Significant at the 10 percent level.
** Significant at the 1 percent level.

regions, leaving the Cairo market as the single lead market in the formation of local prices for wheat in Egypt.

Results of long-run multiplier estimates within Lower and Upper Egypt show an improvement in market connection in the postreform era. Within Lower Egypt, 50 percent of the 38 market pairs have significant long-run multipliers (Table 45). The importance of Dakahlia as a lead market is also implied by the results of the analysis of integration among markets in Lower Egypt during the postreform period. The results shown in Table 45 seem to indicate that Dakahlia prices lead prices in almost all other markets in the region. The only prices influencing Dakahlia prices, in turn, are Beheira and Kafr El Sheikh prices, but the level of associated multipliers are low, around 0.1. Both Beheira and Kafr El Sheikh are significant wheat producing governorates, which might explain this reverse causality. For the Lower Egypt region as a whole, the degree of market interdependence seems to have increased after the reforms. The number of market links with significant multipliers has increased with

Table 45—Price transmission across urban markets in Lower Egypt in postreform years (1987–95)

Regional market pairs[a]	Long-run multipliers	Reaction time
		(months)
Dakahlia→Damietta	0.34***	1
Damietta→Kafr	0.24*	0
Damietta→Beheira	0.36**	0
Dakahlia→Qalubia	0.13*	0
Kafr→Dakahlia	0.11**	2
Dakahlia→Kafr	0.26**	2
Dakahlia→Gharbia	0.12*	5
Beheira→Dakahlia	0.09**	1
Dakahlia→Beheira	0.16*	0
Kafr→Qalubia	0.36***	4
Qalubia→Kafr	0.14***	10
Gharbia→Qalubia	0.15*	8
Qalubia→Gharbia	0.05*	0
Beheira→Qalubia	0.28***	3
Ismailia→Qalubia	0.39***	1
Qalubia→Ismailia	0.06*	0
Gharbia→Kafr	0.34***	7
Kafr→Gharbia	0.25***	8
Beheira→Gharbia	0.20***	3

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various years.

Note: Instantaneous relationships were detected between Kafr El Sheik and Beheira, Kafr and Ismailia, and Ismailia and Beheira.

[a] The arrow indicates that the market on the left leads or "Granger causes" the market on the right.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

*** Significant at the 1 percent level.

Table 46—Price transmission across urban markets in Upper Egypt in postreform years (1987–95)

Regional market pairs[a]	Long-run multipliers	Reaction time
		(months)
Minia→Giza	0.27*	1
Minia→Fayum	0.29*	1
Fayum→Sohag	0.83*	6
Sohag→Qena	0.01*	4

Source: CAPMAS, *Consumer Retail Prices, Egypt,* various issues.
Notes: Instantaneous relationships were detected between Minia and Sohag, Beni Suef and Giza, Fayum and Giza, Sohag and Giza, Fayum and Beni Suef, Minia and Beni Suef, and Sohag and Beni Suef.
[a] The arrow indicates that the market on the left leads or "Granger causes" the market on the right.
* Significant at the 1 percent level.

reforms compared with the estimates in the prereform period. Instantaneous reaction time is observed between more market pairs. Furthermore, the average level of multiplier estimates is higher than those obtained in the prereform period.

The results for Upper Egypt, on the other hand, show more cases of instantaneous intermarket price relationships within the region (Table 46). Out of the 24 pairs estimated, 7 exhibited immediate market response. In addition, estimates of the cross-market, long-run multipliers are larger in values in the postreform period ranging from 0.01 to 0.83 percent compared with 0.07 to 0.21 in the prereform years. The period of market adjustment also tends to occur rather quickly in the postreform years, about 3 months on average, compared with 3.4 months in prereform period. These findings suggest that markets in Upper Egypt are better connected. It also indicates that market information was conveyed and processed more quickly and more efficiently following the reforms.

Conclusions

Results of the price analysis in this chapter suggest that market reforms have led to some improvements in market performance. Domestic wheat prices are now more responsive to international price levels and local supply and demand conditions. Wheat retail price volatility and seasonal price spreads have declined in both rural and urban markets, suggesting that the participation of the private sector in marketing activities is contributing to improving market stability. Although marketing margins between wheat grain and flour and between Cairo and other urban markets have increased, this indicates mainly that marketing spreads in the prereform period did not reflect marketing costs, such as transport and milling, because these costs were borne by the government. The market integration analysis also suggests an increase

in the magnitude and speed of price transmission between markets, resulting in better-integrated and more efficient markets following the reforms.

Despite this progress in market performance, some inefficiencies remain. Wheat markets in Egypt remain isolated from one another; in many cases, they function rather independently of changes that occur in other markets. Estimates of the spatial and temporal marketing margins for domestic wheat markets reveal that economic incentives are adequate to engage in long-distance trading and in storage. However, despite this and the presence of the necessary infrastructure, storage, market information, and other market support services in Egypt (see Chapter 4), barriers still exist that impair the low cost and free flow of wheat between regions. Although the participation of the private sector has increased significantly during the reform period, its expanded participation remains encumbered by existing institutional constraints. The government still exerts control over some aspects of the marketing for wheat (such as a monopoly on imports and sale of imported wheat grain, and restrictions on the movement of wheat grain between some governorates). For this reason, the expected reduction in marketing costs and improvements in market efficiency are not fully realized.

CHAPTER 6

The Wheat Milling Sector: Structure, Performance, and Future Prospects

The study of the wheat milling subsector is based on a survey of 524 public and private wheat mills. The results of the survey are analyzed to determine the characteristics of the wheat milling subsector and to assess its performance following the partial liberalization of the wheat processing industry. The survey and the analysis were designed to address several pertinent issues regarding the wheat milling subsector, including the following priority questions:

- What are the characteristics and comparative performance of public and private mills?
- What is the milling capacity of both the public and private sectors? Is it fully used or is there idle capacity?
- What are the remaining constraints in the wheat milling subsector?
- What are the future prospects of the wheat milling industry in Egypt?

Structure and Organization of the Wheat Milling Sector

Wheat mills in Egypt can be classified into two main categories of mills depending on their type of ownership. The first category includes all public mills that were reorganized in 1993 under two holding companies: HCRWM, which manages five milling companies, which in turn control 94 wheat mills; and FIHC, which manages two additional milling companies, which in turn control 37 mills. Holding-company mills are usually medium- to large-scale industrial mills with a milling capacity greater than 50 metric tons of wheat grain per day. They play a critical role in the execution of the Egyptian government's food subsidy program by milling wheat into *baladi* flour and selling the flour at subsidized prices to designated bakeries and warehouses. They produce about 86 percent of the total amount of subsidized *baladi* flour produced in the country. They also produce *fino* flour and sell it at free-market prices in competition with the private sector.

The second major category of mills are those that belong to the private sector. These can be further disaggregated into local village mills that usually mill for a fee

for rural households; and industrial mills where wheat is purchased, processed, and the wheat flour is sold on a commercial basis. More than 5,000 village mills exist in Egypt. Their daily milling capacity ranges between 1 and 50 metric tons of wheat. They can produce different types of flour depending on the final degree of sifting. Their most common product is 100 percent (or raw) flour. Private industrial mills have a capacity that ranges between 50 and 500 metric tons per day. Among these mills, about 34 have contracts with the GASC to produce *baladi* flour. Therefore, they act almost like public mills and are heavily regulated by the government. The other type of medium to large private mills are those mills that have been newly built to produce *fino* flour on an industrial scale and that are independent of the government.

Public Sector Mills (HCRWM and FIHC)

Following the 1991 economic reforms, all public organizations, including milling companies, were transformed into holding companies. The change occurred in two stages. In stage one (May 1992), under the new Public Enterprise Law 203 of 1991, the name of the existing Public Company for Silos, Mills, and Bakeries was transformed into the Holding Company for Silos, Mills and Bakeries, with all its affiliated companies left unchanged. In the second stage (February 1993), this holding company was merged with the Holding Company for Rice Mills to become one holding company, the Holding Company for Rice and Wheat Mills. Its affiliated companies now include five of the seven public wheat milling companies, the Public Company for Silos and Storage, and the six rice milling companies of the Holding Company for Rice Mills. The other two public milling companies were reassigned to FIHC, which controls 17 other food-related companies in such areas as the cooking oil, confectionary, and sugar industries. The management of both HCRWM and FIHC falls under the jurisdiction of the Ministry of Public Enterprise.

To date, HCRWM has sold 61 percent of the shares in three of its five affiliated wheat milling companies to the public. With the sale of more than 50 percent of the shares to the private sector, regulation of these three milling companies transferred from Public Enterprise Law 203 of 1991 to the Private Sector Companies Law 159 of 1981. The remaining companies under HCRWM and FIHC are only 40 percent privatized and therefore continue to operate under Law 203.

The seven milling companies are located and named after the various geographical regions that they cover. The total wheat grain milling capacity of the milling company mills is equal to about 22,000 metric tons per day, of which 28 percent produce *fino* flour, and 72 percent mill *baladi* flour. Table 47 shows the structure and organization of the seven milling companies, their geographical coverage, the number of mills they own, their total milling capacity, and their specialization.

Contracted Private Mills that Mill **Baladi** *Flour*

In addition to the 7 milling company mills, GASC has negotiated contracts with 34 private sector millers to produce 82 percent wheat flour for the *baladi* bread and flour subsidy program. All these private sector mills are stone mills with an average pro-

Table 47—Structure and organization of holding companies' wheat mills at the beginning of 1998

Holding company	Geographic distribution of mills	Percent private shares	Total number of mills			Total milling capacity[a]		
			Fino mills	*Baladi* mills	All mills	*Fino* mills	*Baladi* mills	All mills
						(metric tons of wheat grain per day)		
HCRWM								
Alexandria Flour Mills	Alexandria, Beheira	40	2	14[b]	16[b]	750	1,845	2,595
East Delta Flour Mills	Sharkia, Dakahlia, Damietta, Port Said, Ismailia, Suez, North and South Sinai	61	1	17[b]	18[b]	500	2,325	2,825
Middle and West Delta Flour Mills	Gharbia, Menoufia, Qalubia, Beheira, Kafr El Sheikh	61	4	14	18	1,200	2,520	3,720
South Cairo Flour Mills	Cairo, Giza	40	2	16	18	750	1,517	2,267
Upper Egypt Flour Mills	Sohag, Qena, Aswan, the Red Sea	61	3	21	24	600	3,066	3,666
Total			12	81	94	3,800	11,273	15,073
FIHC								
Middle Egypt Flour Mills	Fayoum, Beni Suef, Minia, Assiut, New Valley	41	3	20[b]	23[b]	600	2,470	3,070
North Cairo Flour Mills	Cairo, Qalubia	41	4	10[b]	14[b]	1,650	1,970	3,590
Total			7	28	37	2,250	4,440	6,660
Grand total			19	109	131	6,050	15,713	21,763

Source: Compiled by the authors based on Abdel-Latif (1998) and other sources.

[a] Total capacity excludes mills that are not currently operating because their capacity is being upgraded.

[b] Total number of mills includes mills that are currently off production for renovation and upgrading.

duction capacity of 85 metric tons per day. They are, on average, smaller than the public sector *baladi* flour mills, which have an average milling capacity of 144 metric tons of grain per day. Forty percent of these mills are located in the greater Cairo–Giza area, the rest are spread out in several governorates. They follow specific government guidelines regarding the quantities of wheat milled and the distribution of the 82 percent wheat flour to *baladi* bakeries and warehouses.

Private Sector Mills that Mill Fino *Flour*

When the *fino* flour market was liberalized in the 1992/93 agricultural year, only the public milling companies were equipped with mills that could generate *fino* flour. Therefore, to encourage the private sector to mill wheat domestically rather than import ready-made flour, which is more expensive, the Ministry of Supply gave permission to the private sector to rent the mills of HCRWM and FIHC. It is, in general, more expensive to import flour rather than import wheat and mill it into flour domestically. This is because wheat grain can be shipped at lower costs than flour, the locally produced bran can be marketed profitably to feed livestock and poultry, and milling is not a technically complicated process (Carman and French 1988).

In September 1993, several private entrepreneurs signed contracts with HCRWM and FIHC to rent their mills for a specific fee that varied with the volume of operation. Realizing the substantial profits made by the private renters, the holding companies increased the milling fee and demanded a share of the profits of the private sector renter in subsequent contracts in 1994 and 1995 (USDA 1995, 1996). The new fee and profit-sharing structure—coupled with fees charged by the Public Company for Silos and Storage to discharge, store, and transport the wheat grain, flour, and bran—resulted in lower private sector profits. By late 1995, with international wheat grain and 72 percent wheat flour prices increasing rapidly, the government instructed the public milling companies to produce *fino* flour and sell it in competition with the mills they rented to the private sector.

Because of the expensive fees that the public milling companies ended up charging and the relative profitability of milling wheat, the private sector started to build its own storage and milling facilities and ended its rental contracts with the public milling companies. By the end of 1997, 9 private mills had started producing *fino* flour. By the end of 1998, the total number of private mills producing *fino* flour was projected to reach 18. Since the contracts with the private sector ended, the public sector also increased production of *fino* flour by using the previously rented mills for that purpose. As discussed below, this has contributed to the accumulation of overcapacity in the *fino* flour sector.

Contribution of Private and Public Sector Industrial Mills to Total Fino *Flour Production*

In 1997, 19 public mills produced *fino* flour. Their combined total daily wheat capacity was 6,050 metric tons. At the same time, 9 private sector mills, with a total

capacity of 2,510 metric tons per day, had started operating by the end of 1997. This brought the total daily milling capacity of public and private mills in early 1998 to 8,560 metric tons per day, producing the equivalent of 160,243 metric tons of *fino* flour per month.[31] Peak monthly consumption, which usually occurs during the school year (September through April), is estimated at 125,000 metric tons. This means that during these months, there is an excess monthly capacity of 35,243 tons (or 22 percent). During the rest of the year, monthly consumption does not exceed 100,000 tons, resulting in a higher monthly overcapacity of 60,243 metric tons (or 38 percent). This phenomenon has resulted in the fact that in the 1997/98 agricultural year, many private *fino* flour mills were operating at 50 to 70 percent capacity while, on average, public *fino* flour mills were operating at about 70 to 80 percent capacity.

Private Village Mills

Another category of private mills are small-scale, rural-based or village mills, that typically mill wheat into 100 percent raw flour. The main source of wheat for the production of raw flour is domestic wheat, which is brought by rural households and farmers to the mills for processing. Some village mills also produce *baladi* and *fino* flour, following customer specifications. For the most part, these mills, have a capacity of up to 50 metric tons per day. Unlike industrial-sized mills, village mills do not purchase wheat grain or sell wheat flour. Rather, the customer brings the wheat to the mill and pays a fee for the amount of wheat milled. The resulting flour is often further sifted by rural households and used for bread making and home baking. Most rural mills also mill other grains, especially maize. In 1996, about 5,260 village mills were spread throughout Egypt.

Milling Technology

Three principal types of milling technology are used in Egypt to grind the wheat grain into flour: stone mills, old cylinder mills, and new cylinder mills. In stone mills, wheat grain is fed between two heavy, grooved, flat stones, which crack and grind the wheat kernel to release the flour. Mills of this type vary in size and milling capacity, from several to a couple hundred metric tons per day. Instead of millstones, cylinder mills use two corrugated-steel, cylindrical rollers to crack and grind wheat grain. This results in the extraction of a cleaner, more uniform, and larger quantity of flour. Besides being superior for milling hard wheat that produces a higher-quality flour, maintenance of the rollers is both less time-intensive and cheaper than the regrooving and repairing necessary on millstones. Compared with the older models, new cylinder mills operate on a larger scale (typically 250 metric tons per day per processing line) and employ additional and successively finer rollers and sifters.

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[31] Monthly capacity of *fino* flour production is usually estimated by multiplying daily capacity of wheat milling by 72 percent and by 26 days per month (that is, $8,560 \times 0.72 \times 26 = 160,243$ metric tons per month).

New cylinder mills are both more technically efficient and more environmentally friendly than stone mills, which are associated with intensive dust emissions and larger flour losses.

The 131 public mills in Egypt are almost evenly split between stone and cylinder mills. Mills producing *fino* flour, whether public or private, typically use new cylinder mills, since they are more efficient at producing finer-quality wheat flour on an industrial scale. These mills use relatively little unskilled labor and rely mainly on computerized machinery. Their capacity usually ranges between 150 and 500 metric tons per day, while the capacity of stone mills in Egypt does not exceed 235 metric tons per day.

The mills that produce *baladi* flour use all three of the technologies listed above. The production of *baladi* flour relies more heavily on stone mills than the more advanced technologies. Of all the milling companies, North Cairo Flour Mills is the best equipped and most technically advanced because it uses the lowest percentage of stone mills (39 percent) and the highest percentage of new cylinder mills (27 percent). Proportionately to their total number of mills, Alexandria and South Cairo flour mills have the largest percentage of old cylinder mills (47 and 43 percent, respectively), whereas South Cairo and Middle and West Delta flour mills have no new cylinder mills. Many companies are upgrading their stone mills to transform them into cylinder mills.

Contracted private sector mills that produce *baladi* flour are all stone mills, as this type of mill is one of the oldest existing mills in Egypt. These mills have no incentive to upgrade their machines into cylinder mills as long as they are not free to purchase and sell their wheat and flour at market prices and their milling fees remain determined by the MOTS. The government is not allowing new industrial stone mills to be built; all new mills must have cylinder machines. Finally, small privately owned village mills usually have stone grinding machines to produce both raw and finer types of flour that are sifted by hand. Few village mills own old cylinder mills.

Privatization of Public Milling Companies

The partial privatization of the seven public milling companies is part of a larger program, announced in January 1993, for privatizing many of Egypt's state-owned enterprises. In the milling sector, with the creation and assignment of the wheat mills to HCRWM and FIHC through Public Enterprise Law 203, the seven affiliated milling companies were first converted into joint stock companies. The companies' shares were 100 percent owned by the holding companies but were subsequently listed on the stock exchange.

Rather than selling the milling companies or the individual mills to domestic or foreign investors, the holding companies decided to privatize the milling companies through a public offering of shares. The privatization was implemented in this fashion mainly because it would not have been feasible to sell each individual public mill separately. First, public stone mills are an outdated technology that are not worth investing in. Second, most public mills sit on large and valuable pieces of land that are

expensive. Therefore, it would have been hard to sell these mills, with the accompanying land, to prospective private millers.

Partial privatization, through public share offerings, has not resulted in a significant change in the companies' management structure. As the majority shareholder, the public holding companies continue to appoint the members of the management teams of the milling companies. Furthermore, the milling companies are still expected to implement the government's socioeconomic objectives in terms of production and distribution of wheat flour. The government's resistance over complete privatization of this sector is ostensibly because of the strategic nature of wheat and the belief that the continuation of the subsidy program necessitates that the management of the milling companies' remain in the hands of the public sector.

Descriptive Analysis of Survey Results

Description of the Survey Design and Sample

To understand the structure of the milling sector, a wheat miller survey was implemented in 18 Egyptian governorates.[32] In total, 524 public and private sector mills were interviewed from June to September 1997, covering the operations of the mills through the end of 1996. The questionnaire asked the surveyed millers a broad range of questions on the general characteristics and flour production of the mill: their marketing, transport, and communication networks; operating costs; perceived profitability, assets, and investment activities; and the role that they envision for the government in regulating and setting policy in the wheat milling sector. To be able to compare the operations and performance of different mills, the same questionnaire was used to interview all types of mills.

While an attempt was made to interview all public mills, the final survey sample included 91 of the 131 public mills.[33] The private mills interviewed fell into two major categories: medium to large private mills that have contracts with GASC to mill 82 percent wheat flour, and village mills that process wheat for local consumption by farmers and rural households. In the survey, 25 of the 34 contracted private mills (74 percent) were included in the final sample and millers from 408 randomly selected village mills from 18 governorates were interviewed. The village mills were classified as either large village mills (capacity between 10 and 50 metric tons per day) or small village mills (capacity less than 10 metric tons per day). All the new, large cylinder mills in the private sector that mill *fino* flour on an industrial scale did not start operating until 1997. Therefore, because of a lack of complete information on their

[32] The governorates that were not covered in the survey include Port Said, Suez, Red Sea, New Valley, North and South Sinai, Qena, and Aswan.

[33] The reasons for this gap are as follows: a few mills were shut down for renovation, eight governorates were not included in the original study for logistical reasons, some mills did not give complete information about their operations and were dropped from the final sample, and some mill officials were unavailable or refused to answer questions. A less-structured interview was also conducted with six of the seven milling companies.

operations before and during 1996, they were excluded from the sample. Some informal interviews were conducted, however, with a few of the millers from these mills.

General Characteristics of the Milling Sector

Table 48 displays the distribution of the sample by type and size of mills and the main type of flour produced in 1996. All of the contracted private mills and 99 percent of the village mills in the sample are stone mills. In 1996, all industrial-sized cylinder mills were owned by the public milling companies. Average daily capacity for the public mills is 178 metric tons per day, while in contracted private mills it is 126 metric tons per day and in village mills it is only 6 metric tons per day.

Of the 91 public mills in operation in the sample, 82 percent mainly produced *baladi* flour, 14 percent mainly produced *fino* flour, and the remaining 3 percent mainly produced *shami* flour. *Fino* flour was produced mostly in cylinder mills that are larger and more technologically advanced, while *baladi* flour was produced mostly by medium-sized public mills. All the 25 contracted private mills in the sample produced *baladi* flour for GASC. Seventy-two percent of the village mills mainly produced raw flour, while the rest sifted it to produce finer-quality flour. Of the private village mills, production of raw flour is more highly concentrated in small village mills with milling capacities of less than 10 metric tons per day.

Marketing Channels and Geographic Network for Wheat Flour

The next few paragraphs describe the marketing channels and the geographic network of the milling sector along with a delineation of the roles of the different institutions involved. Because there are major differences between *baladi, fino,* and raw flour, the analysis is done separately for the three types of flour. Figure 2 illustrates the marketing channels related to the wheat milling sector.

Baladi Flour. Both domestic and imported wheat are used in the production of 82 percent wheat flour. GASC is the main government body responsible for procuring and supplying all the necessary (domestic and imported) wheat quantities to produce the subsidized *baladi* flour and bread. In 1996, GASC purchased approximately 1.05 million metric tons of domestic wheat (about 18.3 percent of total estimated production), and nearly 4.6 million metric tons of imported wheat, to be milled into *baladi* flour. After being sold by farmers or traders to cooperatives and the PBDAC branches, domestic wheat is stored in *shounas* (storage sheds) ready for delivery to or pick up from public mills that produce *baladi* flour. Public mills also receive domestic wheat directly from farmers, traders, and cooperatives. PBDAC and the public mills purchase wheat at the procurement price on behalf of GASC.

All marketing costs associated with getting the wheat to the *baladi* flour mill are borne by GASC. GASC allocates funds to each of these institutions to procure domestic wheat. Some cooperatives also contract with GASC to purchase wheat from farmers and deliver it to the mills. Contracted private mills receive the wheat grain directly from GASC. They do not purchase domestic wheat on GASC's behalf.

Table 48—Characteristics of the wheat mills sample: average capacity, milling type, and flour type produced by mill category, 1996

Mill category	Average total capacity	Type of milling		Principal type of flour produced				Total number of mills
		Stone	Cylinder	*Baladi*	*Shami*	*Fino*	Raw	
	(metric tons per day)							
Public mills	178	46[a](50.6)[b]	45(49.4)	75(82.4)	3(3.3)	13(14.3)	0	91
Large (capacity: > 250 metric tons per day)	345	2 (11.8)	15(88.2)	8(47.1)	1(0.2)	8(1.5)	0	17
Medium (capacity: 50–250 metric tons per day)	141	44 (40.5)	30(59.5)	67(90.5)	2(0.4)	5(1.0)	0	74
Contracted private mills	126	25 (100)	0	25(100)	0	0	0	25
Large (capacity: > 250 metric tons per day)	248	6 (100)	0	6(100)	0	0	0	6
Other (capacity: < 250 metric tons per day)	87	19 (100)	0	19(100)	0	0	0	19
				Sifted raw flour				
Private village mills	6	402 (98.5)	6(1.5)	193(27.7)			295(72.3)	408
Large (capacity: 10–50 metric tons per day)	12	123 (96.9)	4(3.1)	67(52.8)			60(47.2)	127
Small (capacity: < 10 metric tons per day)	4	279 (99.3)	2(0.7)	46(16.4)			235(83.6)	280
Total sample	42	473 (90.3)	51(9.7)					524

Source: IFPRI/MALR/MOTS (1998).

[a] Number of sample mills in the category.

[b] Numbers in parentheses are the percentage of the total sample in the category.

GASC calculates the wheat grain price at which it will sell the wheat to mills on the basis of a negotiated milling fee that varies depending on the estimated cost of production of the mills.[34] The average purchase wheat grain price from GASC is about £E446 per metric ton. This price is a subsidized price, since wheat grain market prices in 1997 were around £E640 per metric ton. The lower wheat price is meant to cover the costs of operations of the mills (or their milling fee), including a margin for profit. The milling fee for *baladi* flour ranges from £E30 to £E46 per metric ton for the public mills, while the milling fee received by the contracted private millers ranges between £E25 to £E35 per metric ton, with an average of about £E32 per metric ton.[35] The profit margin for any particular mill can be computed as the milling fee times the quantity of wheat grain processed less all labor, storage, energy, and other operating costs. Most mills interviewed claimed that the milling fee is too low (milling fees have not changed since 1991) and that it should be increased to £E60 per metric ton to cover the cost of operations of the mills.

Baladi flour is sold to bakeries at £E290 per metric ton and to warehouses at £E500 per metric ton. GASC specifies the quantities of flour sold to each designated bakery and warehouse. In addition, the mills receive from GASC £E210 for each metric ton of wheat delivered to the bakeries. Therefore, in total, the mills receive £E500 per metric ton of *baladi* flour, whether sold to bakeries or warehouses. The GASC budget thus bears the cost of the 82 percent wheat flour and bread subsidy at two levels: at the level of the mills and at the level of bakeries. At the mill level, it sells wheat grain at below-market prices to the public and contracted private mills despite paying world wheat prices for imported and domestic wheat. The level of the subsidy, therefore, varies with international wheat prices.[36] At the bakery level, it bares the cost associated with selling *baladi* flour to bakeries at £E290 per ton instead of £E500 per metric ton and the cost of reimbursing the mills £E210 per metric ton for all the wheat flour sold to bakeries. In addition, it pays for the transportation, handling, and storage costs of wheat before it is delivered to the mills.

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[34] GASC sells the wheat at different prices according to mill ownership, technology category, and age of the mill. For public mills, average subsidized wheat prices are approximately £E453 per metric ton for stone mills, £E446 per metric ton for old cylinder mills, and £E439 per metric ton for new cylinder mills. For contracted private mills, wheat prices range between £E440 and £E455 per metric ton. Prices are more expensive for stone mills, followed by old cylinder mills, and then by new cylinder mills. This is because it is assumed that stone mills have lower costs of production than old cylinder mills, which in turn are cheaper to operate than new cylinder mills. It is also assumed that contracted private mills have lower costs of operations than public mills because of lower fixed and labor costs.

[35] For example, from 1 metric ton of wheat grain, the representative mill produces 0.825 metric ton of *baladi* flour and 0.19 metric ton of bran. Therefore, from the ton of wheat grain, it receives £E412.5 for the *baladi* flour (= 500 × 0.825), and £E76 for the bran (= 400 × 0.19), for a total of £E488. Subtracting the wheat purchase price from the sale price of bran and wheat flour, the milling fee for a representative miller is approximately £E42 (that is, £E488 – £E446). Therefore, since wheat flour and bran prices are officially fixed, the actual price paid by the mill for the wheat will vary with the milling fee negotiated with GASC. If the milling fee is higher, the price of the wheat grain sold by GASC would be lower.

[36] For example, in 1997, the average price of imported wheat was about £E640 per metric ton (including cost, insurance, and freight; custom duties; tariffs; and unloading), and therefore the level of the subsidy was around £E640 – £E446 = £E194 per metric ton for the mills. In 1996, however, the average imported wheat price was around £E800 – 850 per metric ton, increasing the cost of the subsidy to between £E354 and £E404 per metric ton.

Wheat flour is usually picked up by neighboring bakeries and warehouses from the mills' storage facilities. In turn, bakeries use the *baladi* flour to bake *baladi* bread and sell it at £E0.05 per loaf. Warehouses sell the wheat flour in 25 kilogram bags at the equivalent of £E550 to £E600 per metric ton. Bakeries pick up their flour on a daily basis, whereas warehouses pick up their orders once a week. This operation is closely monitored by a resident MOTS controller in each mill to make sure that each bakery and warehouse receives its exact quota of flour.

Bran is supposed to be sold at £E400 per metric ton and only to feed factories and poultry and livestock producers. However, in 1996, most mills were selling the bran in the black market at rates higher than the price suggested by the government (£E400 per metric ton).

Table 49 shows the distribution of *baladi* flour in the period 1997 to its different outlets by region as well as the concentration of these outlets within each region. The table indicates that, with the exception of Upper Egypt, where the majority of flour is distributed to warehouses (71 percent goes to warehouses), bakeries receive the bulk of *baladi* flour in all regions (73 percent of all flour on average). The table also demonstrates that bakeries tend to be concentrated in urban areas (Cairo, Alexandria, Giza, and the Delta regions), while warehouses are more common in the more rural areas of Middle and Upper Egypt, where households bake their own bread. In Cairo, the total quantity of *baladi* flour received by bakeries is 24 percent of the total received by all regions, while in Upper Egypt, it is only 7 percent. In Cairo, all the *baladi* flour produced in 1997 was sold to bakeries as all *baladi* flour warehouses were shut down.

In 1996, with a production average of more than 157 metric tons per day, public mills operated at 87 percent capacity and exceeded their quota for the production of *baladi* flour by a small margin. Besides milling an additional 5 metric tons per year of *baladi* flour above the quota, public mills, on average, distributed 68 metric tons per mill to local farmers and mill employees. *Baladi* flour is mainly picked up by bakeries and warehouses within the governorate of the mill, although some of the flour makes its way to adjacent and more distant governorates. In 1996, the contracted private millers met their contracted *baladi* quota. Although operating below capacity, the millers were not able to increase production of *baladi* flour because of their limited quota of wheat set by the government.

Private village mills mill wheat into *baladi* flour for a fee. Unlike the milling companies and the contracted private mills, the private village mills that mill *baladi* flour do so for local consumption. They use grain brought to the mill by the customer and mill it into the type of flour desired by the customer at the negotiated milling fee. The average fee charged for milling *baladi* flour was £E35 per metric ton, and in general, was lower in the Delta region than in Upper Egypt, where the average fee charged to consumers was £E48 per metric ton. Of the large village mills (capacity between 10 and 50 metric tons per day), 53 percent produced mainly or solely mechanically sifted flour, while only 16 percent of the small village mills (capacity less than 10 metric tons per day) produced the sifted flour in 1996.

Fino Flour. Both the public and the private sector compete in the production of *fino* flour. However, none of the new industrial mills in the private sector that pro-

Table 49—Regional distribution of 82 percent wheat flour to different outlets in 1997

Region	Bakeries				Warehouses			
	Total quantity	Number of bakeries	Distribution to bakeries within region[a]	Regional distribution of bakeries[b]	Total quantity	Number of warehouses	Distribution to warehouses within region[a]	Regional distribution of warehouses[b]
	(thousands of metric tons)		(percent)		(thousands of metric tons)		(percent)	
North Cairo	819.4	1,480	100.0	23.9	0.0	0	0.0	0.0
South Cairo and Giza	335.6	754	79.8	9.8	85.0	1,842	20.2	6.8
Alexandria	314.7	943	94.8	9.2	17.3	405	5.2	1.4
Middle and West Delta	535.0	2,516	86.1	15.6	86.7	4,683	13.9	6.9
East Delta	658.4	2,170	71.7	19.2	259.9	1,508	28.3	20.7
Middle Egypt	499.7	1,841	69.0	14.6	224.4	2,980	31.0	17.9
Upper Egypt	241.7	989	29.3	7.1	582.0	9,578	70.7	46.4
Total	3,424.5	10,693	73.2	100.0	1,255.2	20,996	26.8	100.0

Source: MOTS, unpublished data, 1997.

[a] Calculated as the percentage ratio of total quantity of each outlet respectively to total quantity of both outlets.

[b] Calculated as the percentage ratio of the related cells in the total quantity of each outlet to the last cell of that column.

duce *fino* flour could be included in the sample, because they had just started operating in 1997 and did not have sufficient historical data to fill out the questionnaires. Therefore, the following analysis focuses on data gathered from *fino* flour public mills and some notes derived from informal interviews with the new *fino* flour private mills.

Unlike *baladi* flour, the production and trade of *fino* flour is almost free of government intervention, except for a few restrictions. As mentioned earlier, the most important restriction imposed on *fino* flour millers is that they can only use imported wheat. Moreover, to prevent subsidized wheat grain slated for *baladi* flour production from being diverted for *fino* flour production, the government only allows one type of flour to be milled in each mill. Any importer of wheat grain also has to show proof of either owning or renting a mill, because imported wheat grain may not be traded as grain or used for other purposes except for the production of *fino* flour.

The *fino* flour public mills receive all their imported wheat grain through their affiliated holding companies. Importation is done at the level of the holding company and not at the level of the milling company to take advantage of economies of scale. Through informal interviews, it was revealed that in a number of cases, the private mills import wheat in cooperation with other private millers or with FIHC to reduce unit import costs.

In 1996, 13 out of the 91 public mills in the sample produced *fino* flour for part or all of the year. At least 2 or 3 public mills in each region produced *fino* flour. The largest average annual production per public mill occurred in the main wheat consumption and production regions of Metropolitan Cairo and the Western Delta. *Fino* flour production by private village mills was produced only in Alexandria and the Delta regions, with Alexandria producing the greatest quantity of flour per mill. In 1996, *fino* flour public mills operated at 81 percent capacity. The main reason stated for operating below capacity was the unavailability of imported wheat grain, followed by equipment problems.

Fino flour (whether from private or public mills) is sold in the free market to *fino* bakeries, warehouses, pasta and food processing factories, and private traders. It is sold primarily during the school year and holiday periods. Competition between the private and public sectors in the *fino* flour market is growing rapidly because of the fast entry of new private mills. Average imported wheat prices in 1996 were around US$240–US$250 per metric ton (£E810–£E850 per metric ton), while average *fino* flour sale prices were about £E1,200 per metric ton. At the beginning of 1998, however, international prices were down to about US$165 per metric ton (£E558 per metric ton), and *fino* flour prices declined to between £E900 and £E950 per metric ton.

Raw Flour

Raw (100 percent extraction rate) flour is typically produced by private village mills that mill locally grown wheat for consumption by farmers and other rural households. The average milling fee is around £E42 per metric ton. The average fee is lowest in the Nile Delta (£E38 per metric ton) and tends to rise as one moves up the Nile to

reach £E45 per metric ton in Upper Egypt. Fees charged by small village mills with capacities of less than 10 metric tons per day are in general £E5 to £E6 per metric ton higher than those in village mills with capacities of 10–50 metric tons per day. The lower fees for the latter are in part a consequence of higher milling capabilities, volumes, and economies of scale.

More than 99 percent of the wheat grain milled by village mills was brought to the mill by the customer on a need basis. In both 1992 and 1996, only three mills had contracts with farmers to mill wheat. The customer is responsible for transporting the wheat grain to the mill and transporting the flour back. The operation of village mills is more seasonal than for larger mills. Of the total quantity of wheat milled by village mills, 47 percent was milled during the four months after the harvest season—typically from May to August, or June to September, depending on location. The village millers also mill other grains such as white maize.

Unlike industrial mills that operate 20 to 24 hours per day, village mills typically operate 5 to 6 hours per day. Mills in the Eastern Delta typically operate only 3 hours per day, while in Upper Egypt they operate 9 hours per day on average. In 1996, village mills processed an average total of 407 metric tons of wheat grain. More than 81 percent was converted into raw flour. In addition, some village mills produced higher-quality flour. This sifting was either done using mechanical sifters or by hand.

Bran

With the production by the milling companies and the industrial-sized private sector mills of some 4.8 and 1.3 million metric tons of *baladi* and *fino* flour, respectively, approximately 1.6 million metric tons of wheat bran was produced in Egypt during 1996. As described previously, wheat bran from the production of subsidized *baladi* flour is supposed to be sold at GASC-determined price of £E400 per metric ton to authorized users, while bran from *fino* flour production can be sold at free-market prices. During 1996, as world wheat grain prices soared, free-market bran prices reached £E600 per metric ton, and many *baladi* flour mills were unofficially selling their bran at these market prices rather than at £E400 per metric ton. In the 1997/98 agricultural year, because of the excess supply of *fino* flour, bran market prices had fallen to below the rate of £E400 per metric ton set by the MOTS. Bran prices are also seasonal and tend to fall during the berseem (its major competitor) harvest period.

Bran is mainly used as livestock feed in Egypt. Of the public mills in the sample, 74 percent sold wheat bran to feed factories, 20 percent sold it to animal producers directly, and 70 percent sold it to bakeries or warehouses. Although 50 percent of the mills producing *fino* flour sold bran to traders, somewhat surprisingly, 17 percent and 31 percent of the public mills and contracted private mills, respectively, producing *baladi* flour sold bran to traders. This means that either a number of traders are authorized users of subsidized wheat bran or the government does not strenuously enforce prohibitions on the sale of bran to traders at market prices.

Transport, Information, Communication, and Storage

In general, millers do not seem to face major problems in access to transport, information, communication, or storage. The extent of use of each of these services largely depends on the size of the mill and the type of flour produced. However, 22 percent of the milling company and private sector mills reported that the domestic movement of wheat grain or flour was occasionally monitored by the traffic police and, to a lesser extent, by the MOTS police. This monitoring is usually done to detect any illegal use of domestic wheat for the production of *fino* flour and to reduce the leakage of subsidized *baladi* flour to nontargeted entities. Most affected by the restrictions on the movement of goods were the contracted private mills, 15 percent of which indicated that restrictions had increased over the past five years.

One problem that arises in comparing cost items between different types of mills is that public mills do not report all their costs. For example, most transport costs are borne by the milling company rather than by the individual public mill. Therefore, reported transport costs seem much lower for public mills than for their private sector counterparts. For the public mill, average reported transport costs are 4 piastres per ton per kilometer, while it costs the average contracted private mill 12 piastres per ton per kilometer. As a result, transport cost figures for the public mills should be considered as underestimates.

The costs of obtaining information on prices, regulations, and supply and demand conditions vary by type of mill technology and mill size. In 1996, the milling companies spent more than £E48,000 to obtain information to run their companies. In addition, individual public mills spent on average £E3,300 in 1996 to obtain additional information. Mills producing *fino* flour spent £E2,299 to gather information, while their counterparts producing *baladi* flour spent only half as much (£E1,195). Mills that owned a telephone spent on average £E2,100 on information costs, while those without a telephone spent less than £E5 in 1996.

Investment, Capacity Development, and Credit

The main assets of a mill include land, the mill itself (building and machines), transport vehicles (such as trucks, vans, and cars), and storage facilities (silos, warehouses, and *shounas*). Table 50 presents the average real investment[37] in Egyptian pounds per metric ton of processed grain for both public and private mills for the three periods 1978–87, 1988–92, and 1993–96. As many of the investment decisions are made by the milling company rather than at the mill level, many mill managers do not know the value of some past investments. In addition, many of the numbers are not precise estimates because of the difficulty of recalling the value of investments back in time. The table thus only gives an idea of the evolution of investment

[37] Real investment is calculated by dividing the purchase value of the investment asset by the GDP deflator, with 1987 as the base year (that is, the 1987 GDP deflator is equal to 100).

Table 50—Average annual real investment per metric ton of processed grain in transport, storage, and buildings over time

Investment category	Public mills			Contracted private mills			Large, private village mills			Small, private village mills		
	1978–87	1988–92	1993–96	1978–87	1988–92	1993–96	1978–87	1988–92	1993–96	1978–87	1988–92	1993–96
	(£E per metric ton)											
Transport	3.63	2.02	0.00	3.54	13.30	13.68	0.00	0.19	0.00	0.00	2.07	0.00
Storage	10.83	6.01	0.03	1.69	3.43	0.00	1.07	0.33	4.88	1.63	5.95	0.00
Mill	20.84	147.03	0.00	16.99	6.33	5.42	14.68	29.57	26.97	18.36	91.03	13.71
Land	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.30	0.31	0.00

Source: IFPRI/MALR/MOTS (1998).
Note: Average annual real investment is deflated using the GDP deflator for Egypt, 1987 = 100 (World Bank [1998]).

Table 51—Average capacity and capacity utilization over time by mill category, 1991–96

Mill category	Capacity in 1991		Capacity in 1994		Capacity in 1996	
	Metric tons per day	Utilization rate	Metric tons per day	Utilization rate	Metric tons per day	Utilization rate
		(percent)		(percent)		(percent)
Public mill	151	86	155.5	87	164.3	88
Contracted private mill	116	48	118.2	49	124.4	54
Private village mill	6	36	6	33	6.1	30
Large mill	9.9	35	10.1	31	10.2	30
Small mill	3.9	37	3.9	33	3.9	30

Source: IFPRI/MALR/MOTS (1998).
Note: Capacity utilization is defined as the actual quantity of wheat grain processed divided by the maximum capacity of wheat grain the mill can process.

in the mills. The largest investments are usually made in the mill itself.[38] In the public mills, the largest investments were made in the mill during 1988–92, whereas during 1993–96, no significant investments were made.

Excluding all new mills built since 1992, both the public mills and the contracted private mills have undertaken investments to upgrade the milling capacity of their older mills. From 1991 to 1996, milling capacity of the public mills built before 1992 grew by 8.8 percent over the period, an increase of 1.8 percent per year (Table 51). These investments, coupled with a 0.5 percent annual improvement in capacity utilization, led to a 20.7 percent increase in the average quantity of wheat grain processed by the public mills, from 41,323 metric tons in 1991 to 49,894 metric tons in 1996. The increase in capacity and capacity utilization was most pronounced in the public mills producing *fino* flour, where the average quantity of *fino* flour grew by 40 percent from 1991 to 1996, while the quantity of *baladi* flour rose by 13.8 percent during the same period (Table 52).

As shown in Table 50, investments by the contracted private mills were more evenly distributed over the three periods. During the 1978–87 period, most investments were in upgrading or building new mills. In the 1988–92 and 1993–96 periods, however, most investments were made in transport vehicles. In general, new investments by the contracted private mills to upgrade their mills were relatively low. As a result, their average annual increases in milling capacity lagged behind the public mills'. However, the little investment in greater capacity, coupled with a 6 percent improvement in capacity utilization, led to a 33 percent increase in the quantity of *baladi* flour produced over 1991–96 (Table 52).

The relatively low level of investment in upgrading the efficiency and output of the contracted private mills is not particularly surprising. Rather than upgrade their stone mills that produce lower-quality flour, many private sector millers opted to invest in modern cylinder mills that produce the more profitable *fino* flour.

Table 50 indicates that, for the village mills, little is invested in transport or storage facilities. The bulk of the investment by village millers is in the mill itself. As seen in Table 50, investments in the mill peaked during 1988–92, especially for small mills, and declined significantly during 1993–96. This may reflect the fact that, after the agricultural reforms of 1987, which resulted in a significant boost in domestic wheat production, village mills started to expand. However, with the liberalization of the *fino* flour milling sector in 1992, village mills faced increased competition from large mills and therefore, investment in village mills decreased.

The low level of investment and the effect of increased competition is reflected in Table 51, which shows that average village mill capacity has remained around 6 metric tons per day over the period. Capacity utilization declined from 36 percent in

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[38] As an example of the costs involved for investing in a new mill, according to the United States Wheat Association (1997), a new private *fino* flour cylinder mill with a capacity of 500 metric tons per day would cost about US$20 million, or £E68 million. The equipment would cost about US$30,000 per metric tons of daily capacity (for a Buhler machine, which is considered the best and most expensive) and US$10,000 per metric ton for the land, building, trucks, and all other assets.

Table 52—Average quantity of wheat flour produced over time by mill category and flour type, 1991–96

Flour type	Year			Change from 1991–96
	1991	1994	1996	
	(metric tons)			(percent)
Baladi flour				
Public mills	29,577	30,989	33,677	13.8
Contracted private mills	14,521	15,748	19,325	33.1
Fino flour				
Public mills	47,704	58,737	66,798	40
Contracted private mills				
Village mills				
Raw flour	705	584	486	–31
Mechanically sifted flour	1,654	1,652	1,603	–3

Source: IFPRI/MALR/MOTS (1998).

1991 to 30 percent by 1996. Moreover, the average quantity of raw flour produced declined by 31 percent during this period (Table 52). In response, village mills have increased their investments locally in sifting equipment to produce higher-quality *fino* and *baladi* flour, albeit with only limited success.

Wheat mills in Egypt use a variety of means to fund their milling and wheat-purchasing operations. Because the public milling companies provide the financing for their affiliated mills, public mills do not request credit on an individual basis. Decisions regarding maintenance and upkeep of the mills are determined and prioritized by the milling company, with input from the individual mills. Funds for investments in new equipment and wheat grain purchases are generated from milling company profits, working capital, and through loans.

The majority (56 percent) of contracted private mills rely only on their own funds to finance their milling activities. About 16 percent also used bank loans to finance their operations and another 28 percent obtained additional funds by raising capital from existing or new partners. Of those mills that used credit to finance their operations, approximately 60 percent used the loan to fund their purchases of wheat grain, while 40 percent used the loan to purchase new equipment and improve the operations of their mills.

As private village mills typically mill the wheat grain that is brought to them by the farmer or the consumer, the mill does not require funds to purchase wheat grain itself. Between 95 and 97 percent of village millers used their own funds to finance their milling activities. Since many small village millers are also involved in farming, most of the loans taken out by the remaining 3 percent were used to purchase inputs such as fertilizers, pesticides, machinery, and seeds. On the other hand, most loans taken out by the large village mills were used to upgrade or purchase new milling equipment.

Access and cost of credit do not seem to be major problems or constraints for the milling sector in Egypt. On the contrary, interviews with the new, private, industrial-sized mills mentioned that access to capital to finance their mills was not hard to get, and that banks have been awash with cash and keen to provide loans to investors.

Cost and Profit Margin Analysis

Structure of Operating Costs

Wheat mills have a number of costs associated with their operations. Table 53 shows the unit operating costs disaggregated by component and type of mill. Unit costs are obtained by dividing total costs by the quantity of wheat grain processed. The operating costs are underestimates of the real milling costs because of the absence of depreciation costs, costs of the initial investment in the land and the mill, and other non-reported costs. Operating costs are especially underestimated for public mills because their finance, tax, depreciation, and transport costs are borne mainly by the milling companies. Obtaining detailed financial costs from the milling companies, broken down by mill, is almost impossible. Therefore, one has to use these operating cost figures as indicative measures. They are mainly used to illustrate reported costs by different types of mills, rather than as absolute measures of real operating costs. In general, costs and profits between the different types of mills should be compared with caution, as the cost figures are incomplete.

Despite these data shortcomings, the reported operating costs of the different types of mills are disaggregated by cost category. As Table 53 shows, by far the largest cost components for all mills are labor and energy costs, followed by equipment and maintenance costs. The table also indicates that public mills that are still majority owned by the holding companies (that is, under Law 203) have the largest unit costs of operation. Their average unit processing cost is £E28 per metric ton of wheat grain. Public mills operating under Law 159 have unit operating costs equal to £E17 per metric ton, or £E10 lower than their Law 203 counterparts. Labor costs and equipment and maintenance costs are more than 50 percent lower in the mills under Law 159 than those under Law 203 (£E8 per metric ton and £E2 per metric ton versus £E14 per metric ton and £E4.5 per metric ton, respectively). This may suggest that the partially privatized public companies have been able to reduce operating costs.

Labor costs were obtained by asking for the total number of workers (per family, temporary and permanent workers), as well as the total number of person-months and the wage bill for each category of labor used. A breakdown of labor costs shows that the annual wage rate for each worker is on average higher in the larger, industrial-sized mills. The average wage rate is more than 45 percent higher in a public mill than in a private sector mill. Furthermore, public mills employ more than 4.5 times as many workers as contracted private mills. As with many other public companies, public mills have excess labor. The workforce in public enterprises is characterized by redundancies (Dittrich 1998). Therefore, it is not surprising that public mills have a higher number of workers per mill and a higher wage bill than private mills.

Table 53—Structure of operating costs by mill category, 1996

Operating cost	Public mills						Contracted private mills		Private village mills					
	Under Law 159[a]		Under Law 203[b]		All				Large (between 10–50 mt per day)		Small (less than 10 mt per day)		All	
	Total costs	Percent	Total costs	Percent	Total costs	Percent	Total costs	Percent	Total costs	Percent	Total costs	Percent	Total costs	Percent
	(Egyptian pounds/mt of wheat grain)													
Transport	0.16	0.94	0.14	0.51	0.15	0.62	1.65	10.96	0.00	0.00	0.00	0.00	0.00	0.00
Equipment and maintenance	2.06	12.10	4.53	16.35	3.75	15.40	1.43	9.50	5.04	35.59	5.16	24.80	5.14	26.39
Rent	0.02	0.12	0.01	0.04	0.01	0.04	0.23	1.53	0.17	1.20	0.29	1.39	0.26	1.33
Taxes and licenses	0.19	1.12	0.43	1.55	0.35	1.44	0.39	2.59	1.03	7.27	1.31	6.30	1.24	6.37
Labor	8.30	48.74	14.01	50.56	12.22	50.18	3.44	22.86	3.93	27.75	6.24	29.99	5.69	29.21
Energy and communication	2.93	17.20	4.23	15.27	3.83	15.73	4.89	32.49	3.68	25.99	6.77	32.53	6.08	31.21
Bag costs	2.54	14.91	1.97	7.11	2.15	8.83	1.75	11.63	0.02	0.14	0.11	0.53	0.10	0.51
Finance	0.48	2.82	2.33	8.41	1.75	7.19	1.19	7.91	0.22	1.55	0.60	2.88	0.70	3.59
Other	0.35	2.06	0.06	0.22	0.15	0.62	0.07	0.47	0.07	0.49	0.33	1.59	0.27	1.39
Total	17.03		27.71		24.35		15.05		14.16		20.81		19.48	

Source: IFPRI/MALR/MOTS (1998).

[a] Under Law 159 refers to mills that belong to the milling companies that are 61 percent private, and therefore fall under Private Sector Law 159.

[b] Under Law 203 refers to mills that belong to the milling companies that are less than 50 percent private, and therefore fall under Public Enterprise Law 203.

Contracted private mills are cheaper to operate than public mills. Their average operating costs are estimated at £E15 per metric ton. Their major cost saving compared with public mills is their labor costs, which are only £E3.44 per metric ton on average. The largest costs for the contracted private mills are energy and communication costs, which are about £E5 per metric ton or 33 percent of total unit costs. Since the public mills may be paying energy prices at subsidized rates or obtaining bulk discounts, their energy costs are lower as a share of operating costs than their private sector counterparts. Another major expense for the contracted private sector mills is the cost of transporting wheat to the mill. Transport costs account for about 11 percent of operating costs of the average contracted private mill, while for the public mills, they are less than 1 percent of operating costs. For the milling companies, transport costs account for about 6 percent of operating costs. In addition to higher energy and transport costs, the contracted private mills also have relatively higher tax and financing costs. However, as noted earlier, comparison of transport and finance costs between private and public mills should be interpreted with caution because these costs are not adequately reported by the public mills.

In the private village mills, most unit costs are also absorbed by energy and communication, labor, and equipment and its maintenance. Small village mills are actually more expensive to operate than large village mills per unit of wheat grain. The total unit costs of operations for these small mills are £E21 per metric ton compared with £E14 per metric ton for the large village mills and £E15 for the contracted private mills. Unit labor and energy costs of small village mills are between 40 and 45 percent higher than the large village mills. Increased operation capacity of small village mills could possibly reduce their unit costs.

Cost Comparison by Processing Technology and Type of Flour Produced

Table 54 shows the total unit operating costs per metric ton of processed wheat by type of processing technology for the large, industrial, public mills. The numbers indicate that, within public mills, old cylinder mills are the cheapest to operate, followed by stone mills, and then new cylinder mills.[39] The major cost difference among the three technologies is related to labor, equipment and its maintenance, and energy costs. Compared with old cylinder mills, stone mills are expensive to operate because they require more labor and more frequent equipment maintenance because of the old technology. They also require more energy than old cylinder mills. The new cylinder mills have the lowest percentage of share for labor costs among the three technologies because, as mentioned earlier, they use less labor than the other types of mills. However, new cylinder mills are more expensive to operate in general because of the high costs of the sophisticated computerized equipment and the associated maintenance expense.

[39] This finding does not follow GASC's estimates that the operating costs are lowest in stone mills, followed by old, and then new cylinder mills.

Table 54—Average public mill operating costs per metric ton of grain processed by processing technology, 1996

Cost item	Stone mills		Old cylinder mills		New cylinder mills	
	(£E per metric ton)	(percent)	(£E per metric ton)	(percent)	(£E per metric ton)	(percent)
Transport	0.19	0.73	0.01	0.05	0.22	0.82
Equipment and maintenance	4.48	17.28	1.20	6.54	4.47	16.72
Rent	0.01	0.04	0.02	0.11	0.01	0.04
Taxes and licenses	0.61	2.35	0.07	0.38	0.06	0.22
Labor	13.86	53.47	10.46	57.00	10.6	39.66
Energy and communication	3.33	12.85	2.80	15.26	5.18	19.38
Bag costs	1.55	5.98	1.56	8.50	3.58	13.39
Finance and depreciation	1.77	6.83	1.22	6.65	2.33	8.72
Other	0.12	0.46	0.10	0.55	0.28	1.05
Total	25.92		18.35		26.73	

Source: IFPRI/MALR/MOTS (1998).

This latter finding seems counterintuitive, as one would expect that new mills should invest in cost-minimizing technologies. However, perhaps the comparison between the two is not appropriate. New mills have higher up-front costs, such as financing and depreciation, which have already been amortized by the older mills. Furthermore, the new mills produce a higher-quality product (*fino* flour) that cannot be directly compared with *baladi* flour, which is of much lower quality.

Profit Margins and Performance

Table 55 shows the estimated per-unit milling fee and profit margins for the different categories of mills and types of flour produced. The milling fee is the difference between the sale price of the wheat flour and bran and the purchase price of the wheat grain. It includes both the costs of milling the wheat and the profit margin. The profit margin is therefore equivalent to the per-unit milling fee minus the per-unit operating costs. As mentioned earlier, the reported operating costs are underestimated, particularly for the public mills, because of unreported transport, finance, and depreciation costs. To calculate profit margins, transport costs for the public mills were adjusted to represent approximately 5 percent of total operating costs. Therefore, although the profit margins reported in Table 55 may be overestimated, especially for the public mills, profit margins between the different types of mills can still be compared.

For *baladi* flour, the average milling fee of a public mill is about £E42 per metric ton, which is close to the average milling fee negotiated between the milling com-

Table 55—Price and profit margins by flour type and mill category, 1996

Flour and mill type	Price margin	Profit margin
	(£E per metric ton)	
Baladi flour		
Public mills	42.2	19.1
Law 159 mills	32.2	16.7
Law 203 mills	46.5	20.2
Old cylinder mills	41.1	22.0
Modern cylinder mills	57.8	35.3
Stone mills	39.2	14.4
Large mills	41.1	30.3
Medium mills	42.3	17.8
Contracted private mills	30.9	15.8
Large mills	28.9	14.3
Other mills	31.5	16.3
Fino flour—public mills	223.4	193.7
Law 159 mills	228.2	200.5
Law 203 mills	220.4	189.5
Large mills	226.8	203.8
Medium mills	215.7	171.2
Raw flour—village mills	37.4	18.2
Large mills	31.9	17.5
Small mills	39.4	18.4

Source: IFPRI/MALR/MOTS (1998).

panies and GASC. This translates into an average profit margin of £E19.1 per metric ton. Surprisingly, this margin is lower for public mills under Law 159 than public mills under Law 203, even though the latter have higher operating costs, as was discussed earlier. This result is due to the milling fee, which is, on average, higher for Law 203 public mills. For *fino* flour, on the other hand, public mills under Law 159 perform better than those under Law 203.

These findings suggest that privatization of the public mills by selling more than 50 percent of their companies' shares to the public did not result in better performance in terms of profit margins. The fact that North Cairo Flour Mills, which is considered the best-performing company, is only 41 percent private seems to support this result.[40] As mentioned earlier, privatization has only changed the ownership of the milling company shares; management and operations are still controlled by the public sector through the holding companies. Better performance seems to be closely associated with higher production of *fino* flour and more modern and larger mills, than with the extent of privatization. This is confirmed by the rest of Table 55, which

[40] For example, in January 1997, the average monthly share price of North Cairo Flour Mills was £E196, compared with £E119 for West and Central Delta Flour Mills, £E86 for East Delta Flour Mills, £E62.5 for Central Egypt Flour Mills, £E94 for Upper Egypt Flour Mills, and £E105 for South Cairo Flour Mills (HSBC [2000]).

shows that new cylinder mills have higher profit margins than old cylinder or stone mills, and that large mills perform better than smaller scale mills. Furthermore, profit margins for *fino* flour are five to six times as large as those for *baladi* flour.

Comparing the contracted private mills with the public mills indicates that the private mills make less profits (£E15.8 per metric ton versus £E18.4 per metric ton).[41] Since they do have lower operating costs, the lower profit margins of contracted private mills are attributed to the fact that, on average, their purchase price for wheat is higher than for public mills. GASC charges higher wheat prices to contracted private mills because they are stone mills and are supposedly cheaper to operate. Comparing the contracted private mills, which are all stone mills, with the public stone mills alone indicates that their profit margins are closer (£E10.4 per metric ton versus £E14.4 per metric ton). The difference between the two is because contracted private mills are on average smaller than public stone mills, and smaller mills are, in general, associated with lower profits.

For the village mills that mainly produce raw flour, profit margins are about £E18.2 per metric ton. They seem to be higher for smaller mills than for larger mills (£E18.4 per metric ton versus £E17.5 per metric ton). This is mainly because smaller village mills charge a higher milling fee.

Economies of Scale

According to Harwood, Leath, and Heid (1989), the wheat flour milling industry is characterized by economies of scale in "processing, procurement, finance, and transportation." This means that operating costs per unit tend to drop as quantity processed increases. Apart from the savings in per-unit transport, procurement, and finance costs due to larger volumes traded, per-unit labor costs also decline with size because the additional amount of labor needed to operate a large plant is marginal compared with a smaller plant. In addition, larger mills may have better access to information and credit than smaller mills, particularly if they are part of a larger corporate structure. This statement holds true for the public mills in Egypt, which belong to large milling companies and thereby have better and cheaper access to credit than private sector mills. (See Table 53 for the difference in finance costs between public and contracted private mills.)

The presence of economies of scale in the wheat flour milling sector would explain why the development trend in the industry is to see a drop in the number of mills and an increase in mill capacity. While the *fino* flour milling industry in Egypt, for example, is still in its early stages of development, all new industrial mills have on average much larger capacities than the existing mills. The new private mill capacities range between 200 and 500 metric tons of wheat grain per day, compared with the average total milling capacity of 181 metric tons per day in the existing public industrial mills.

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[41] This difference is not tested for significance because unreported public mill costs may make absolute comparison between public and private mills unreliable.

To test for economies of scale in the wheat flour milling industry in Egypt, a translog cost function is estimated. The benefits of using a translog is that it is a flexible functional form with minimum a priori restrictions on the structure of production or costs (Brown, Caves, and Christensen 1979). It can be thought of as a second-order Taylor's series approximation of an arbitrary cost function. It permits an explicit account of multiproduct firms and allows determination of both product-specific and overall economies of scale that can vary with the level of outputs and factor prices (Gilligan, Smirlock, and Marshall 1984). The translog cost function is specified in natural logarithmic form (ln) as follows:[42]

$$\text{Ln } C = \alpha_0 + \sum_{i=1}^{m} \alpha_i \ln y_i + \sum_{j=1}^{n} \beta_i \ln P_j + \frac{1}{2} \sum_{i=1}^{m} \sum_{j=1}^{m} \delta_{ij} \ln y_i \ln y_j$$
$$+ \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln P_i \ln P_j + \sum_{i=1}^{m} \sum_{j=1}^{n} \rho_{ij} \ln y_i \ln P_j,$$

where C is defined as total costs, y_i are the m outputs, and P_j are the n input prices.

To ensure symmetry and linear homogeneity in factor prices, the following restrictions are imposed during estimation:

$$\sum_{j=1}^{n} \beta_j = 1, \sum_{i=1}^{n} \gamma_{ij} = 0 \ (j = 1, 2, \ldots, n), \sum_{j=1}^{n} \rho_{ij} = 0 \ (i = 1, 2, \ldots, m); \text{ and } \delta_{ij} = \delta_{ji}; \gamma_{ij} = \gamma_{ji}.$$

Scale economies, defined as the relative increase in all outputs resulting from a proportional increase in all inputs, can be computed as follows:

$$SE = \left(\frac{\partial \ln TC}{\partial \ln Y} \right)^{-1} - 1 = \left(\alpha_y + \sum_{i=\text{k}}^{m} \delta_{iy} \ln y_i + \sum_{i=\text{k}}^{n} \gamma_{iy} \ln P_i \right)^{-1} - 1$$

where $SE > 1$ indicates positive economies of scale, $SE = 0$ indicates no economies of scale, and $SE < 0$ indicates negative economies of scale.

The following translog cost function is estimated for the Egyptian industrial milling sector using the ordinary least squares (OLS) method:

$$\text{Ln } C = \alpha_0 + \alpha_1 \ln WF + \alpha_2 \ln BRAN + \beta_1 \ln WGP + (1 - \beta_1) \ln WAGE$$
$$+ \frac{1}{2} \delta_{11} (\ln WF)^2 + \delta_{12} \ln WF. \ln BRAN + \frac{1}{2} \delta_{22} (\ln BRAN)^2$$
$$+ \frac{1}{2} \gamma_{11} (\ln WGP)^2 + \gamma_{12} \ln WGP. \ln WAGE + \frac{1}{2} \gamma_{22} (\ln WAGE)^2$$

[42] See Jorgenson (1986) for a detailed review of the translog cost function used in production analysis. On the measurement of scale economies using the translog cost function, see Brown, Caves, and Christensen (1979) for an application to U.S. railroad services; Murray and White (1983), Shaffer (1984), and Gilligan, Smirlock, and Marshall (1984) for studies on the banking industries; and Omoregie (1995) for the oilseed processing sector in Nigeria.

$$+ \rho_{11} \ln WF. \ln WGP + \rho_{12} \ln WF. \ln WAGE + \rho_{21} \ln BRAN. \ln WGP$$

$$+ \rho_{22} \ln BRAN. \ln WAGE + \varepsilon .$$

Total costs (C) are computed as the sum of material, labor, energy, equipment, financial, and other miscellaneous operating costs. The two main outputs are wheat flour (*WF*) and bran (*BRAN*). The variable input prices include wheat grain prices (*WGP*) and wages (*WAGE*). Because of difficulties in determining the value and rental rate of the mills capital stock, particularly for the mills owned by the public sector, the price of capital is excluded from the equation.

The equation uses cross-sectional data on the public and private sector mills that produce either 82 or 72 percent wheat flour. The sample is composed of the 25 contracted private mills that mill *baladi* flour for GASC, 10 public and modern cylinder mills that produce the *fino* flour, and the 70 remaining stone and old cylinder public mills that produce *baladi* flour.

The estimation results are presented in Table 56. Only 4 out of the 14 parameters are statistically significant.[43] This is perhaps because of problems with the underlying cost data. First, wheat grain and flour prices vary little for a majority of the mills, since they buy wheat grain and sell flour at fixed prices. Second, there are no data on the costs of capital and energy prices that could provide more cost variability among the mills. Third, given that most of the mills in the sample are not free to choose the optimum quantity of input or output to minimize costs, it is hard to extract meaningful results from this estimation.

Despite these data shortcomings, the SE is computed at the mean of the quantities and prices. The estimated SE is positive but small (0.0096), indicating that the milling industry could have some economies of scale. Although this result is not conclusive, it could give some indication of the direction of the scale economies.

To determine whether a relationship exists between per unit milling costs and the characteristics of the different mill types, an OLS regression is estimated where the dependent variable is the operating costs per-unit of wheat grain processed and the independent variables are related to mill size and characteristics. The results from the OLS regression are presented in Table 57. The adjusted R^2 equals 0.19 and the F-value of the regression is significant at less than 1 percent. This indicates that, although the variables used do not account for most of the changes in per unit operating costs, they do contribute to explaining some of this variation. Most of the variables used are individually significant and have the expected signs as discussed below.

The dependent variable in the regression is defined as the total operating cost per metric ton of grain processed. The first two variables in Table 57 (mill capacity, and capacity utilization rate) measure the design capacity of a mill in metric tons of wheat

[43] A stochastic frontier cost function was also estimated to determine the level of inefficiencies in the mills. However, the results were also not significant.

Table 56—Parameter estimates of translog cost function with symmetry and linear homogeneity restrictions

Parameters	Coefficient	*t*	*P* >|*t*|
α_0	–0.240	–0.21	0.83
α_1	1.273	2.12	0.04
α_2	–0.159	–0.34	0.74
β_1	1.057	7.87	0.00
β_2	–0.057	–0.43	0.67
δ_{11}	0.025	0.30	0.76
δ_{12}	–0.079	–2.04	0.04
δ_{22}	0.127	4.02	0.00
γ_{11}	0.012	0.66	0.51
γ_{22}	0.012	0.66	0.51
γ_{12}	–0.012	–0.66	0.51
ρ_{11}	0.013	0.27	0.77
ρ_{12}	–0.013	–0.27	0.77
ρ_{21}	–0.022	–0.53	0.60
ρ_{22}	0.022	0.53	0.60

Number of observations = 105
R^2 = 0.99
Scale economies (SE) = 0.0096

Table 57—Relationship between per unit milling costs and mill characteristics: dependent variable is operating costs per metric ton of wheat grain processed

Parameters	Coefficient	*t*	*P* >|*t*|
Constant	60.161	11.578	0.000
Mill capacity (metric tons per day)	–0.036	–2.050	0.041
Capacity utilization rate (percent)	–29.110	–6.071	0.000
72 percent wheat flour mill	5.889	1.689	0.092
Raw flour mill	–0.280	–0.116	0.908
City governorate (Alexandria and Cairo)	–10.694	–3.054	0.002
Middle Egypt	4.682	2.439	0.015
Upper Egypt	13.209	4.532	0.000
Public mill under Law 159	–19.308	–4.336	0.000
Contracted private mill	–24.134	–5.519	0.000
Large village mill	–41.322	–8.728	0.000
Small village mill	–37.155	–7.593	0.000
Old cylinder mill	4.823	1.245	0.214
New cylinder mill	8.412	1.824	0.069

Notes: Number of observations = 514
R-squared = 0.2126
F (13, 500) = 10.39
Adjusted *R*-squared = 0.1922
Probability > *F* = 0.0000
Root mean squared error = 16.284.

grain processed per day and the actual percentage of capacity used. Both variables are significant and negative, indicating that per-unit operating costs tend to decline with greater design capacity and volumes processed. Although not conclusive, this finding may support the presence of economies of scale in the Egyptian milling industry. This may indicate that, as the industry moves toward greater concentration and larger mills, per-unit milling costs should decrease, increasing competition in the sector and benefiting the consumers because of lower flour prices.

The rest of the exogenous variables are binary variables used for determining the relationship between the per-unit operating costs and the mill characteristics, such as type of flour produced by the mill, location of the mill, ownership status, and milling technology. The positive and significant coefficient of the dummy variable for *fino* flour shows that, relative to *baladi* flour, it is more expensive to produce *fino* flour. The insignificant coefficient of the raw flour variable indicates that there is no significant cost difference between producing raw or *baladi* flour.

Regional dummies representing the city governorates of Cairo, Alexandria, Middle Egypt, and Upper Egypt, respectively, were used and compared with the Delta region. The coefficients for these variables suggest that, compared with the Delta region, per-unit operating costs are lower around the large population centers and higher in the more rural areas of Middle and Upper Egypt. One explanation for this finding is that the most efficient mills are located in the Metropolitan Cairo and Alexandria areas, while mills in Middle and Upper Egypt, which have a higher proportion of smaller-sized mills, do not perform as well,.

Binary variables were also used to differentiate public mills that fall under Law 159 (that is, those with more than 50 percent of their shares privatized), contracted private mills, large village mills, and small village mills, from public mills that fall under Law 203 (that is, less than 50 percent privatized shares). The regression results indicate that, relative to the public mills under Law 203, all these mills have lower per-unit operating costs. These results are consistent with Table 53, which shows that Law 203 public mills have the most expensive per-unit costs of operation, because of their excessive labor costs.

Finally, binary variables were used to distinguish old and new cylinder mills from stone mills. The insignificant coefficient on the old cylinder mill variable demonstrates that old cylinder mills are not significantly cheaper to operate than stone mills. On the other hand, new cylinder mills are more expensive to operate because they have higher equipment, maintenance, and energy costs, as shown in Table 53.

Perception about Profitability and Policy Changes

A major determinant of the wheat millers' performance over time is reflected in changes in their level of profitability. Changes in policies also have an important impact on profit levels. However, since no accurate data can be collected on past profitability levels, millers were asked about their perception regarding their levels of profits before the milling sector reform of 1992, between 1992 and 1996, and their

expected profits for 1997. The intention here was not to approximate profit levels, but to get an idea of how millers perceive the profitability of their business. Although perceptions can be tainted by the inability to precisely recall past profits or by the general pessimism or optimism regarding the economic or political environment, they have an important effect on the willingness of millers to invest and expand their activities in this sector. The interviewed millers were requested to rate their profitability as good, average, fair, or bad.

Before 1992, profit levels for the milling companies were categorized as fair. The main reasons cited were low wheat volumes and high operating costs. With the regulatory changes that liberalized the wheat milling sector, overall profitability of the milling companies improved over the 1992–96 period. Furthermore, at the time of the survey, profit levels for 1997 were projected to be good for both the North and South Cairo Flour Mills companies, while only fair profit levels were projected for the Middle and West Delta Flour Mills and the Upper Egypt Flour Mills Companies. Overall improvement in 1997 profitability was expected because of higher volumes of wheat and lower operating costs. Of the six milling companies interviewed, wheat milling was by far their most profitable activity. Overall, their least profitable activity was baking and other activities related to food processing.

Despite these answers, in 1998, it seems that both HCRWM and FIHC had accumulated huge debts because they were selling a major portion of their *fino* flour on nonguaranteed credit to reduce excess supply. The combination of debts, overcapacity, and a general decline in the stock market led to a 75–85 percent decline in their share price from 1997 to 1999 (HSBC 2000). According to a bank source, total milling companies outstanding debt had reached £E91 million in 1997 alone.

In terms of the profitability rankings at the mill level, while a majority of the public mills rated their profits as fair for the years before 1996, 75 percent expected good profits in 1997. Of the public mills and the contracted private mills that indicated their profits as average or below average before 1992, the reasons enumerated included relatively high operating costs and insufficient availability of wheat. With the liberalization of the wheat milling sector, during the 1992–96 period, public mills were able to achieve good or average profitability through competition, regulatory changes, lower operating costs, and the processing of larger volumes of wheat.

For the contracted private mills, 43 and 35 percent of the contracted private millers had an average or a fair level of profitability, respectively, before 1992. During 1992–96, the share with average profitability rose to 64 percent, while those with only fair profits shrunk to 20 percent. The reasons for this improvement in perceived profitability were similar to the ones reported by the public mills. Expected profits in 1997 for contracted private mills were not different from those for 1992–96, mainly because the policy environment regarding *baladi* flour had not changed during the period.

While profitability for the large industrial-sized mills has improved since 1992, village mills have been less fortunate. In the period before 1992, 68 percent and 44 percent of the large and small village mills, respectively, were highly profitable.

Good village mill profits were associated with little competition and relatively low operating costs. In addition, large imports of wheat grain for the industrial-sized mills made more domestic wheat available for local consumption. This raised both the utilization rate and the quantity of wheat grain processed by the village mills, which in turn helped increase their profits.

Profitability expectations for 1997 worsened for the village mills. With numerous more-efficient, industrial-sized private mills scheduled to begin producing *fino* flour in 1997 and 1998, the majority of the small village mills (64 percent) and about half of the large ones expected that still greater competition and their relatively higher operating costs would lead to poor or, at best, fair profits for the year.

Millers were also asked about their desire to expand their activities to other areas. Sixty-four percent of the contracted private mills and 38 percent of the public mills answered positively, while only 8 percent of the village mills were interested. Most village millers are engaged in other activities in their villages and are either personally involved in the mill or use family labor to run the mill, so that they are not very interested in expanding their milling activities outside their own village. These mills also stated that they did not desire to expand their activities because it was not profitable. This coincides with their perceived decline in profitability levels in recent years. More than two-thirds of the large village mills were constrained from expanding because of government regulations and restrictions, followed to a lesser extent by a lack of credit.

Most industrial mills (96 percent of the contracted private and 75 percent of the public mills) confirmed that they are not allowed to produce more than one type of flour in their mill. Private village mills, on the other hand, are not restricted on the type of wheat flour they produce for a fee, since they are not involved with the subsidized *baladi* flour program. In addition, 88 and 72 percent of the public and contracted private mills, respectively, noted that the government controls their bran sales. More than three-quarters of these mills noted that the restrictions on bran sales had a negative impact on their profitability. Private village mills faced no restrictions on bran sales.

The major technical problem that a mill faces is electricity shortages, followed by breakdown of machines and shortages of wheat. Millers were asked about the kind of regulatory changes needed to improve their milling business. The most significant response, which cut across all types of mills, was the need for better infrastructure (for example, reducing electricity shortages and increasing water availability) and improving the quality of wheat. Domestic wheat is of poor quality because it is generally the wrong type of grain, not very clean, and has a high foreign-matter content.

For public mills, other important regulatory changes needed were increasing the availability of equipment spare parts, followed by raising the supply of wheat. Contracted private mills were also interested in seeing an increase in the quota of wheat allocated to them. On the other hand, village mills preferred a reduction in taxes, followed by increasing the availability of wheat and equipment spare parts. The request to increase wheat availability reflects the overcapacity status of all mills.

Future Prospects for the Wheat Milling Sector in Egypt

Excess Capacity in Fino *Flour Mills*

The results of this study have shown that, in 1996, profit margins for *fino* flour were fairly high (Table 54). Consequently, starting in the 1996/97 agricultural year, these high profit margins encouraged many entrepreneurs to invest in new large-cylinder mills to produce *fino* flour. By 1998, the buildup of new capacity to produce *fino* flour led to a highly competitive market and a dramatic fall in prices for 72 percent wheat flour and bran prices. (The price of *fino* flour declined from about £1,200 in 1996 to about £E950 in 1998; bran prices declined from about £E600 to £E400 in that same period.) As a result, anecdotal evidence suggests that profit margins had eroded considerably in 1998 and 1999. Declining profitability in the *fino* flour sector is further confirmed by the dramatic decline in the share prices of all public milling companies between 1997 and 1999. For example, the share price of North Cairo Flour Mills declined from an average of £E196 in January 1997 to £E36 in December 1999 (HSBC 2000). Similarly, all the other public milling companies witnessed a 75–85 percent decline in their share prices during the two-year period.[44]

Eventually, unless demand catches up with supply, many mills may go out of business, creating instability in the milling sector for the next few years, as employees have to be laid off and large investments are not recovered. In the long run, the sector may become much more concentrated, with a few strong companies capturing a major share of the market.

In the late 1880s and after 1948, the United States also witnessed excess capacity in its wheat flour industry, resulting in a highly competitive industry, low profit margins, and eventual closure of many old and inefficient mills (Dahl 1993). Unfortunately, in Egypt, the excess capacity may not force the closure of the old and inefficient public mills but of new and more efficient private mills. As inefficient public mills are supported and subsidized by their respective milling and holding companies, which are state-owned enterprises, they are not forced to shut down because of losses. This means that the performance of the milling sector in Egypt will stagnate, as the private sector is forced to absorb the brunt of the adjustment process, while the public mills are artificially kept in business.

Privatization Prospects for the Public Milling Companies

Of the seven existing public milling companies, three have sold 61 percent of their shares to the private sector, while the rest have only privatized about 40 percent of their shares. The privatization of the public milling companies has not, however, led to substantial changes, as these mills are still managed and operated by the public

[44] None of the private milling companies in Egypt are publicly traded. They are usually family-held businesses.

sector. As the chairman of the People's Assembly Economic Committee is reported to have said "privatization in Egypt has proved to be a transfer of ownership rather than a policy aimed at raising productivity and investment rates" (Essam El-Din 1997, 10). At this point, the decision has been made by the government not to further privatize any of the mills. The main reason is the strategic nature of wheat and the belief that the subsidy program necessitates that the management of these companies remain in the hands of the public sector. As long as the subsidy on *baladi* flour and bread persists, privatization of the milling companies does not seem likely to proceed further. Moreover, as the share prices of all public milling companies have declined rapidly since 1997, it is perhaps not the right time for the government to sell the remaining shares of its companies to the public.

Another important political issue in the privatization program is its impact on labor. It has been estimated that between 30 and 40 percent of the labor force in state-owned enterprises is redundant (Abu-Ismail 1996). To prevent large-scale unemployment after privatization, the government extracted commitments from many of the privatized companies to limit the downsizing of employees. The government also developed incentive packages, such as early retirement schemes, small-business loans, and retraining programs to encourage civil servants to begin new careers and leave the public sector labor force (Abu-Ismail 1996).

The public milling companies that will be privatized will probably have to reduce their labor force to become more cost-efficient, either through complete buy-outs of the most redundant employees, reassigning employees to other organizations, or training and assisting employees in finding better-paying jobs elsewhere. If public milling companies were fully privatized following the liberalization of the *baladi* flour market, these companies would be able to raise money and improve their performance by selling off the expensive pieces of land on which the public mills stand. For example, the old and inefficient stone and cylinder mills could be demolished and sold for the land value, and the salvageable mills could be dismantled and moved to smaller and cheaper land.

Prospects for the Contracted Private Mills and the Village Mills

The future prospects of the contracted private mills and the village mills are uncertain. Contracted private mills are relatively old and have outdated technology. They have no incentive to invest in new and bigger equipment as long as they are producing the subsidized *baladi* flour under GASC's payment terms. If the wheat milling industry is completely liberalized, these mills will have to invest in new machines and bigger capacity to survive the competition with larger and better-equipped new mills. Some may even have to shut down and sell their property for the land rather than the mill itself.

The analysis above has shown that the profitability of village mills has been declining as they face greater competition from ready-made flour and bread. As some of these mills are valued by their customers because they produce fresh flour and are more geographically available than retail stores or bakeries in small rural villages,

some will create a niche market for themselves, especially in remote areas. Others, especially those that are located near urban centers, will either have to shut down or mill other commodities, especially if the wheat flour and bread market is completely liberalized.

Prospects If **Baladi** *Flour Marketing and Milling Is Liberalized*

If the *baladi* flour market were liberalized, what would happen to the milling sector in Egypt? Given that Egypt has a comparative advantage in producing wheat flour locally rather than importing it, the milling sector could be expected to become competitive, as happened in the *fino* flour market, resulting in low profit margins and the closing of inefficient private mills. Old mills would have to be sold for their land value or be completely renovated and upgraded. New mills would have to reduce costs and develop strategies to market their products. Mills may have to differentiate their products and produce several wheat flour grades and qualities to expand their market. The sector would also become more concentrated, as only the most competitive mills would be able to survive. Mills would be fewer but bigger.

Furthermore, if the *baladi* flour market is liberalized, the government will no longer be able to justify its control over the milling companies. The fate of these companies is uncertain, as currently they have accumulated large debts and are not being managed as efficiently as the private sector mills. Although some milling companies have already started renovating and upgrading their mills, they will no longer benefit from the financing and tax benefits that they used to get when they belonged to the public sector. Therefore, under equal conditions, they may not be able to compete with the private sector and may also have to be shut down or sold at a loss.

CHAPTER 7

A General Equilibrium Analysis of Alternative Wheat Policy Scenarios for Egypt

As noted in the preceding chapters, Egypt's government pursues multiple goals in the wheat area. They include low and stable consumer prices for bread and flour, stable producer prices, and increased self-sufficiency. These goals are pursued at the same time as the government aims at maintaining macroeconomic balance (imposing strict controls on government spending and underlining the need to reduce the deficit in merchandise trade), growth in household incomes, and reduced unemployment. Simultaneously, the government is engineering a structural shift toward a more important role for the private sector and market mechanisms, as well as openness toward foreign trade with a closer alignment between domestic and international prices.

In this chapter, a CGE model is used to explore quantitatively the short-run equilibrium effects of changes in three areas that are critical to wheat policy—consumer subsidies on bread and flour; producer subsidies to raise self-sufficiency; and responses of the domestic economy to changes in international wheat prices under alternative settings, including a tariff-based mechanism for limiting domestic price instability. The analysis highlights not only the effects of policies on their most immediate target (for example, the impact of changes in bread subsidies on household welfare), but also on other targets (for example, the government budget balance) as well as the tradeoffs involved.

Egypt's Economy, Wheat, and Wheat Policies

Table 58 briefly summarizes the role of wheat and subsidies on wheat products in the Egyptian economy on the basis of data for the 1994/95 agricultural year, the base year for the model-based analysis in this report. The numbers indicate that the wheat crop sector generates a modest share of total factor income, in part a reflection of the declining importance of agriculture. Nevertheless, in terms of area, wheat is the ma-

Table 58—Subsidies for agriculture, wheat, and bread flour in the Egyptian economy, 1994/95

Indicator	Value	Share of	Percent
Wheat area (millions of *feddans*)[a]	2.5	Total winter area	33
Wheat production (millions of metric tons)	5.7	Wheat total use (self-sufficiency rate)	48
Agricultural value-added (£E billions[b])	27	GDP at factor cost	15
Wheat crop value-added (£E billions)	4	Agricultural value-added	15
Wheat and wheat flour imports (£E billions)	3.1	Total merchandise imports	8.3
Bread and flour subsidy costs (£E billions)	1.6	Current government spending	3.1
Bread and flour per capita subsidy for low-income household (£E)[c]		Total per capita consumption	
Rural	18	Rural	2
Urban	38	Urban	2.1

Sources: Crop area from CAPMAS 1996a; production and trade data from CAPMAS 1996b; subsidy data from Ali and Adams (1996); government spending data from Central Bank of Egypt (1995); urban population share from World Bank (1993); and total population from IMF (1996).

[a] 1 feddan = 0.42 hectare

[b] U.S.$1 = £E3.39

[c] Low-income household = household representing the 33 percent of the population in each area (rural or urban) with the lowest per capita income.

jor winter crop, while wheat imports (including dwindling imports of wheat flour) are a substantial part of total merchandise imports. This reflects the fact that, relative to consumption, production remains limited.

The Wheat CGE Model: Structure and Data Sources

Background

CGE models may be defined as economywide models the solutions to which depict a simultaneous general equilibrium in all markets of the economy. This class of models, which has been widely applied to developing countries over the past 20 years, can be tailor-made to capture institutional features and policy mechanisms that are specific to the modeled economy. They have a comparative advantage in the analysis of domestic tax and subsidy policies and trade policy, in particular when there is a need to consider links between different producing sectors, links between the macro and micro levels, and the disaggregated impact of changes in policies and exogenous shocks on sectoral structure, household welfare, and income distribution. CGE analyses of the Egyptian economy has a relatively long history, with the first model dating back to 1976.[45]

[45] See Löfgren (1994b) for a survey of CGE models of Egypt.

This CGE model of Egypt, called the Wheat CGE model, starts from an earlier model of Egypt (Löfgren, Robinson, and Nygaard 1998) that in turn draws on Löfgren (1995) and on Robinson and Gehlhar (1996). It is in the tradition of trade-focused CGE models of developing countries described in Dervis, de Melo, and Robinson (1982). However, compared with this earlier generation of models, it includes a wider range of features that are tailored to the structure of the economy that is modeled.

The distinguishing features of the Wheat CGE model include a disaggregated treatment of agriculture (to capture seasonality in land use and links between crop and animal activities) and food processing (to capture links between wheat production, bread consumption, and government subsidy policies), as well as the policy regime for the wheat sector, including fixed subsidized prices for part of bread and flour consumption.[46]

Model Structure

Table 59 shows the disaggregation of institutions, factors, and activities in the model. Among the institutions, the households are divided into three rural and three urban categories, each of which represents one-third of the population in each region. Among the factors, labor and capital are used by all sectors, while water, summer land, and winter land are used only by agricultural crop activities.

In crop agriculture, it is assumed that, apart from some agronomic and institutional restrictions (described below), the factors land (summer and winter), water, and capital (primarily agricultural machinery) are mobile across crops and allocated so as to equalize the marginal returns to each factor in all relevant crops. In animal agriculture, the capital stock (primarily animals) is fixed and specific to this sector. For two factors, land and water, excess supply is possible; if so, the price is zero. The other factors—agricultural labor, crop capital, and animal capital—are fully used with flexible market-clearing wages and rents.[47]

Outside agriculture, the capital stocks are also sector specific and fully employed with flexible rents. The labor employed by nonagricultural activities forms a separate market; this labor force is mobile across the different nonagricultural activities. In this market, unemployment is allowed. The labor supply function is assumed to be infinitely elastic at the 1995 real wage (indexed to the CPI of the households that supply nonagricultural labor) until aggregate employment reaches 95 percent of the nonagricultural labor force (a 5 percent unemployment rate), at which point the supply curve becomes vertical and "full" employment is reached.

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[46] Upon request, the model equations are made available in computer-readable form. The discussion here uses no equations.

[47] Given that the quantity of water stored in the High Dam at Aswan currently is at record levels, the water supply is set at a level that is above the quantity demanded for any of the simulations presented in this chapter. Hence, land is always in scarce supply. For water, the model records consumption by crop at a scarcity value of zero.

Table 59—Disaggregation of factors, institutions, and activities

Set	Elements
Institutions (8)	Households (rural and urban, both divided into low-, middle-, and upper-income)
	Government
	Rest of the world
Factors of production (5)	Capital (disaggregated by sector in which it is installed)
	Labor (agricultural and nonagricultural)
	Water
	Summer land
	Winter land
Activities (28)	Winter crops (wheat, legumes, long berseem, short berseem, winter vegetables, other winter crops)
	Summer crops (cotton; rice; maize, including sorghum; summer vegetables; and other summer crops)
	Perennial crops (fruits and sugarcane)
	Animal agriculture
	Food processing (subsidized bread, unsubsidized bread, subsidized flour, unsubsidized flour, and other food processing)
	Other (oil, cotton ginning, textiles, other industry, electricity, construction, government labor services, transportation, and other services)

The model includes 28 activities, including 14 in agriculture. The crop activities are differentiated according to period of land occupation into winter crops, summer crops, and perennial crops. With a few important exceptions, activities (the producing sectors) map one-to-one to commodities (the outputs produced), that is, each activity produces only one commodity and it is the only producer of this commodity. The exceptions are the two berseem (clover) activities, which produce the same commodity (berseem), and fodder byproducts from several other crop activities. This disaggregation makes capturing direct links between crop and animal activities possible: crop outputs (most importantly berseem, maize, and various crop byproducts) are used as inputs in the animal activity; animal outputs (manure and animal labor) are used as inputs in crop activities.

The production technologies are as follows: Producers are assumed to maximize profits given their technology (specified by a nested constant elasticity of substitution value-added function, and Leontief intermediate input coefficients that are flexible inside agriculture but fixed for other sectors), and the prices of inputs and outputs. It is assumed that ex ante expected prices coincide with ex post prices actually received. This is a characteristic the model shares with the vast majority of equilibrium models, including, it is believed, all other existing agricultural sector or general equilibrium models of Egypt. The arguments of the value-added functions are labor, capital, and, for the crop sectors, a land and water aggregate. The latter is made up of land and water in fixed proportions. Thus, for crops, substitutability is possible among land, capital, and the land and water aggregate on the level of the value-added functions; there is no substitutability between land and water.

In several areas, the model structure has been tailor-made for Egyptian conditions. For land (summer and winter) and nonagricultural labor, the prices (the rents or the wages) are differentiated across the demanding sectors on the basis of fixed ratios (calculated from base-year data). This is a reflection of real-world phenomena that are not modeled explicitly.[48] When the aggregate price changes for either land type or nonagricultural labor, this is accompanied by proportional changes in the differentiated sectoral prices of the factor in question.

The model accounts for two major agronomic-area constraints: the area of short berseem (a crop that precedes cotton) is constrained to equal the cotton area, and the cotton area is limited to a maximum of one-third of the land not covered by perennial crops. Given the relatively short-run time frame of the analysis, the areas of perennial crops and, as noted above, the size of animal stock are fixed. Agricultural intermediate input coefficients are flexible in the context of producer minimization of intermediate input costs subject to a limited degree of input substitutability (given by a constant elasticity of substitution function) and a fixed *aggregate* input requirement per unit of the activity. Agriculture deviates from the more standard treatment for other sectors to avoid rigid links between crop and animal activities in Egypt's agriculture, as crop activities supply the animal activity with the bulk of its intermediate feed inputs.[49]

Two nonagricultural sectors are given special treatment. For the oil activity (which represents the production of crude oil and petroleum products), the quantities of output and factor use are fixed at the 1995 level; this was deemed preferable to the alternative assumption of profit-maximizing behavior. For electricity, a flexible capital supply (reflecting surplus capacity) ensures that the nontraded electricity commodity is sold at a fixed price. It should also be noted that the output of the activity for government labor services is, in effect, fixed—the government, the sole demander, demands a fixed quantity of the nontraded commodity produced by this activity.

The model captures the circular flow of incomes in the economy. Factor incomes generated by the production activities are split among the domestic institutions (households and government) in fixed, factor-specific shares. In addition to factor income, households receive transfers (labor remittances) from the government and the rest of the world (fixed in foreign currency). Total household income is used to pay direct taxes, to save, and to consume. Direct taxes and savings (the latter with one exception that is discussed below) are fixed shares of household income. Sectoral

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[48] For labor, sectoral wage gaps may be linked to differences in job security, educational requirements, status of job, and physical comfort. In agriculture, recorded monetary returns to land may differ as crops differ in required skills, monitoring, riskiness, and impact on soil fertility.

[49] For the animal activity, fixed intermediate input coefficients would generate rigid links between, on the one hand, the level of animal production and, on the other hand, the levels for crop activities producing fodder by-products, in particular given the fact that these by-products are not traded internationally. Similar rigidities would appear if intermediate crop demands for manure were a fixed coefficient.

consumption demand is determined by the linear expenditure system, derived from maximization of the Stone-Geary utility function subject to a spending constraint.[50]

Besides factor incomes, government revenue consists of transfers from the rest of the world (fixed in foreign currency) and taxes—direct taxes from households, indirect taxes from domestic activities, sales tax revenues, and import tariffs. All taxes are *ad valorem* (that is, imposed as fixed shares of the relevant values). Transfers from the government to households and aggregate government consumption are fixed shares of nominal GDP. After having paid for a fixed quantity of labor services, the government consumes remaining commodities in fixed-value shares. The government subsidizes part of household consumption of bread and flour, other processed food, transportation, and electricity. The subsidy rates for household consumption for the relevant types of flour and bread are flexible so as to ensure that the consumer prices are fixed. For other commodities, the subsidy is a fixed share of the variable price that is paid by the consumer.

The rest of the world supplies imports and demands exports. For vegetables and services, exports are demanded according to constant-elasticity demand curves; the lower the export supply price, the larger the quantity exported. For all other commodities, Egypt is able to export or import any quantity it desires at international prices that are fixed in foreign currency.

For grains (exported or imported) and oil exports, it is assumed that domestic output sold domestically and traded commodities are perfect substitutes. As a result, for these commodities, the domestic price is determined by the domestic currency export or import price (transformed from the foreign currency price through the exchange rate and adjusted for any taxes or subsidies) to the extent that trade takes place. For commodities other than grains and oil exports, imperfect substitutability or transformability is assumed. The Armington assumption is used to capture the choice between imports and domestic output under imperfect substitutability: to the extent that a commodity is imported, all domestic demands—household and government consumption, investment demand, and intermediate demands—are for the same composite commodity. The mix between imports and domestic output is determined by the assumption that domestic demanders minimize cost subject to imperfect substitutability, captured by an aggregation function of constant elasticity of substitution. Similarly, the allocation of domestic output between exports and domestic sales is determined on the assumption that domestic producers maximize profits subject to imperfect transformability between these two alternatives, expressed by a function of constant elasticity of transformation. These assumptions, imperfect substitutability and transformability, grant the domestic price system a cer-

[50] Implicitly, the model assumes that, for goods that are both produced and consumed by a household unit (applicable to a large part of agricultural production), the household faces a market price that it views as fixed. In the context of the overall goal of maximizing utility, it first makes a profit-maximizing production decision and subsequently makes a utility-maximizing consumption decision, influenced by the profits that are generated from agricultural production (Löfgren and Robinson [1999]).

tain degree of independence from international prices and dampen export and import responses to changes in the producer environment.

With the above-mentioned exceptions—partially fixing prices of bread, flour, and electricity and linking domestic grain and oil product prices to international levels—domestic prices of domestic outputs and composite commodities are all flexible, performing the task of clearing relevant markets in a competitive setting where both suppliers and demanders are price-takers.

The macro system constraints (or macro closures) determine the manner in which the accounts for the government, the rest of the world, and for savings and investment are brought into balance. Government savings (also called the current government surplus) is a flexible residual in the government balance.[51] Similarly, foreign savings clears the balance of the rest of the world while the real exchange rate (an index of the ratio between the prices of traded commodities and domestic outputs sold domestically) is fixed. On the spending side of the balance between savings and investment, aggregate investment is fixed in real quantity terms. On the savings side, the savings rate of the upper-income urban household is assumed to be flexible, varying to generate a level of total savings needed to finance aggregate investment.[52]

Data Sources

The bulk of the model data is based on a disaggregated social accounting matrix (SAM)[53]—a 94×94 matrix for the 1994/95 agricultural year, the most recent year for which a comprehensive macro database was available in early 1997. It was constructed on the basis of data from various official publications, including the most recent national-account government budget and trade data (Central Bank of Egypt 1995; CAPMAS 1996a,1996b; IMF 1996), available official SAMs and input–output tables (CAPMAS 1994, 1995), crop data (MALR 1994; CAPMAS 1996b), and the 1990/91 Household Income and Expenditure Survey (CAPMAS 1993). Information from these and other sources were brought together in one matrix, the disaggregation of which parallels the disaggregation of the current model. Underlying the construction of such a SAM is an attempt to make the best possible use of available scattered data. Inevitably imbalances appear when data from different sources and years are integrated in one framework; a SAM-Entropy program, developed at

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[51] Government savings is the difference between current reserves and current spending, that is, it excludes items on the government capital account. In the base simulation and the experiments of this report, its value is always positive.

[52] Savings from the other sources—government, other households, and the rest of the world—are not free to equilibrate aggregate savings and investment. Government and rest-of-the-world savings are the residuals that clear their respective accounts, while savings of other households are a fixed share of income after direct taxes. Savings from other households are specified as fixed-income shares.

[53] A SAM is a square matrix with identical column and row accounts. It provides a comprehensive and consistent depiction of economic interactions in a region (typically a country) during a time period (typically one year). Each SAM cell indicates the value of the payment from the column to the row account associated with the cell. (For additional information on SAMs, see Pyatt and Round [1985].)

IFPRI, was used to generate a balanced model SAM that retains as much as possible of the information contained in the original data set.[54] The SAM generator program constrained data for consumption of subsidized bread and flour so that the per-capita subsidy value in urban areas is approximately twice the value in rural areas, with urban areas receiving a higher per-capita bread subsidy but a lower flour subsidy (Ali and Abdel Rahman 1996). Moreover, it was assumed that, in each region (urban and rural), the different households had identical per-capita consumption values of subsidized bread and flour. As a result, there is an inverse relationship between household income and share of bread and flour consumption spent on subsidized commodities. This reflects findings from earlier IFPRI research that suggest that the income elasticities of demand for subsidized bread and flour are very low, possibly even negative.[55]

A macro version of the model SAM, identical to the disaggregated SAM except for the aggregated depiction of activities, commodities, and households, is shown in Table 60. A variety of sources were used for estimates of elasticities for the functions of Armington, constant elasticity of transformation, constant elasticity of substitution (production), linear expenditure system (household consumption), and export demand. (For a brief survey of elasticities of CGE models, see Löfgren [1994a].) Table 61 shows the relative importance of different types of factor incomes. Low-income households rely more heavily on labor income, in rural areas, from work in agriculture; high-income households receive the bulk of their incomes from capital and, in rural areas, land.

Mathematical Model Formulation, Base Run, Validity, and Time Frame

CGE models are typically formulated and solved as systems of simultaneous equations exclusively made up of strict equalities. However, to permit the inclusion of inequality constraints for resource markets, agronomic constraints, and a lower limit for nonagricultural wages, the Wheat CGE model is formulated and solved as a mixed complementarity problem, consisting of a set of simultaneous equations that are a mix of strict equalities and inequalities. The latter are linked to bounded (price)

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[54] The database for this chapter was generated in the spring of 1997 before the completion of IFPRI's Egypt Integrated Household Survey. The assumptions regarding the distribution of subsidized bread and flour consumption—different patterns in rural and urban areas and even per-capita consumption in each region across income groups—were close to the pattern indicated by the survey and by earlier IFPRI work (Alderman and von Braun [1984]). The results from the survey were incorporated into a later round of CGE-based analysis of subsidy issues on the basis of a SAM that is updated to 1996/97 (Löfgren and El-Said [1999]). For the entropy approach to SAM balancing, see Thissen and Löfgren (1998); and Robinson, Cattaneo, and El-Said (1998).

[55] Ali and Adams (1996, 1787) note that the alternative assumption that all households consume subsidized and unsubsidized bread and flour in identical shares "almost certainly" overestimates the shares of subsidized goods for households with higher incomes. Given that income elasticities of demand for subsidized bread and flour most likely are close to zero, the assumption of equal per-capita spending levels on these commodities irrespective of income level is a reasonable working assumption in the absence of better data. Recent estimates of income elasticities based on the Egypt Integrated Household Survey confirm that the income elasticities of demand for subsidized bread and flour tend to be very low or negative (Ahmed et al. [1999a]).

Table 60—Macro SAM for Egypt, 1994/95

	1. Activity	2. Commodity	3. Factors			4. Institutions			5. Savings and investment	6. Taxes, subsidies, and tariffs			
			3a.	3b.	3c.	4a.	4b.	4c.		6a.	6b.	6c.	6d.
						(billions of current £E)							
1. Activity		193											
2. Commodity						149	21.5	45.1	39.3		3.9		
3. Factors													
3a. Labor	51.5												
3b. Capital	123							0.9					
3c. Land	12.3												
4. Institutions													
4a. Household			51.5	113	12.3		18. 3	11.1					
4b. Government				10.4		5		3.1		14.8		12.1	7
4c. Rest of world		49.8		0.8		3.9	3.6						
5. Savings and investment						36.1	5.2	−2.1					
6. Taxes, subsidies, and tariffs													
6a. Indirect taxes	5.6	9.1											
6b. Subsidies							3.9						
6c. Direct taxes						12.1							
6d. Import tariffs		7											
7. Total	193	259	51.5	124	12	206	52.5	58.1	39.3	15	3.9	12	7

Note: Only column totals are shown. Except for rounding errors, row totals are identical to column totals.

Table 61—Structure of household factor incomes in base SAM

	Rural households			Urban households		
	Low-income	Middle-income	Upper-income	Low-income	Middle-income	Upper-income
			(percent)			
Capital						
Agriculture	6.8	8.5	10.5	0.8	0.8	0.8
Nonagriculture	38.6	44.9	52.4	46.5	54.8	72.9
Labor						
Agriculture	20.0	10.5	4.2	3.1	2.3	0.7
Nonagriculture	21.0	18.6	11.5	48.2	40.5	23.9
Land	13.6	17.4	21.3	1.5	1.6	1.6
Total	100	100	100	100	100	100

variables associated with agricultural resources and labor. The GAMS modeling software is used both to generate the disaggregated SAM and to implement the model. The model may be solved with PATH or MILES, two solvers for mixed complementarity problems.[56]

The base solution of the model is calibrated to exactly replicate the disaggregated SAM for the 1994/95 agricultural year. In the different simulations, the model is run in a comparative static mode. The results indicate the short-run equilibrium responses to changes in policies and exogenous shocks, comparing a new solution with the base solution. Each new solution represents a new equilibrium, since agents (producers and consumers) have fully adjusted themselves to new prices and incomes. It refers to the short run, since capital stocks outside crop agriculture are fixed by sector: the time span is too short for current investment to lead to changes in installed capital or for capital to move between noncrop sectors (Hazell and Norton 1986).

There is no clear-cut validity test or way of knowing how close the simulated model response is to the unobservable actual response.[57] The current model is viewed as valid for the purpose of this analysis—to explore short-run equilibrium effects of selected exogenous changes—given that its assumptions regarding agent behavior, elasticity values, and rules for market-clearing capture available knowledge about the functioning of the Egyptian economy. It also puts special emphasis on capturing government tools for wheat policy as well as the seasonal and agronomic constraints under which Egypt's farmers operate.

[56] For GAMS, see Brooke, Kendrick, and Meeraus (1988). Rutherford (1995) provides more information on PATH and MILES.

[57] Simulation models (such as CGE models, multimarket models, agricultural-sector mathematical programming models) are appropriate in data-scarce settings where full econometric estimation and validation of a sufficiently detailed model is impossible. In response to the need for policy analysis, these models are pragmatically constructed in the spirit of making the best possible use of available information, including relevant aspects of economic theory.

Given the importance of trade issues and the wheat sector to this analysis, the simulations reported in the next section were conducted under alternative assumptions for the elasticity of factor substitution in wheat production and the trade elasticities. All experiments were also redone with a 50 percent increase and a 50 percent decrease for the factor-substitution elasticity. All experiments were redone with a 50 percent increase and a 50 percent decrease for the trade elasticities (Armington, constant elasticity of transformation, and export-demand elasticities). The qualitative results that are addressed in the following analysis were not affected by these changes. The relative changes in the variables also remained close to the changes reported below.[58]

Simulations

In the first group of simulations, the impact of policy changes in two areas of wheat policy are explored—consumer subsidies on bread and flour, and producer subsidies to raise self-sufficiency. In these simulations, it is assumed that international wheat and flour prices remain at base-year levels. In a second group of simulations, a subset of these policy changes and a tariff-based mechanism for limiting domestic price instability are implemented under alternative levels of international wheat and flour prices.

Bread and Flour Consumer Subsidies

In Chapter 2, it was noted that, in 1994/95, bread and flour subsidies represented 0.8 percent of GDP (£E1.6 billion). The effects of selected changes in the current policy of permitting any household to purchase unlimited quantities at fixed subsidized prices are simulated here. The simulations are defined in Table 62 and the results are summarized in Table 63.

Targeting Subsidies to Low-Income Households (BFTAR)

The first simulation (BFTAR) explores the impact of targeting bread and flour subsidies to low-income households in urban and rural areas, that is, eliminating these subsidies for two-thirds of the population that belong to the middle- and upper-income households. The latter groups continue to have access to these commodities but at undistorted prices. In practice, this would require identification of the third in each region that is least well-off and the development of a system for providing this group with exclusive access to the subsidy (for example, distribution of subsidy access cards). (For an approach to food subsidy targeting in Egypt, see Ahmed et al. [1999b].)

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[58] The qualitative results were unchanged in the sense that the direction of change was reversed only in a couple of instances where the reported changes in Tables 62, 64, and 65 are close to zero (absolute values of reported changes from base of less than 0.3 percent). For values without any sign change, the maximum absolute deviation from any value reported in the same tables (typically percentage changes from the base) is less than 0.33, with few deviations exceeding 0.2. The major implications of the sensitivity analysis are spelled out later in this report.

Table 62—Alternative bread and flour subsidy policies: Parameter changes

	BFTAR	BFCUT	BFCUT-TC	MAIFLR
Percentage cut in bread and flour subsidy				
Rural household				
Low-income	0	−100	−100	0
Middle-income	−100	−100	−100	0
Upper-income	−100	−100	−100	0
Urban household				
Low-income	0	−100	−100	0
Middle-income	−100	−100	−100	0
Upper-income	−100	−100	−100	0
Compensation to household[a]				
Rural low-income	0	0	1	0
Urban low-income	0	0	1	0
Maize share in subsidized flour	0	0	0	20

Notes: BFTAR = targeting bread and flour subsidies to low-income households; BFCUT = 100 percent cut in bread and flour subsidies; BFCUT-TC = 100 percent cut in bread and flour subsidies with compensation to low-income households; and MAIFLR = 20 percent of subsidized flour from maize.

[a] One if full compensation for real income loss is paid; zero if no compensation is paid.

On the micro level, the major initial effect is that, in response to higher prices for previously subsidized wheat and flour and the associated decline in real incomes, middle- and upper-income households reduce consumed quantities, especially for commodities with high-income elasticities (such as vegetables and animal products). On the macro level, the surplus on the current account of the government (government savings) increases.

The equilibrium outcome, shown in Table 62, indicates that the economywide effects of the subsidy cut are quite minor; this should be expected, since the cut in subsidy spending only amounts to 0.5 percent of GDP. The most noteworthy changes are declines in the welfare of upper- and middle-income households by 0.6–0.7 percent and 1.4–1.6 percent, respectively, and an increase in the government surplus by 0.4 percent of GDP (since the government subsidy bill is reduced).[59] The decrease

[59] For the BASE, welfare is indicated by household consumption spending per capita. Changes in welfare are measured by the compensating variation as a percentage of the BASE value. The compensating variation shows what the household would be willing to pay (per capita) to enjoy the change that is implemented—a negative value for a change that is detrimental for the household, since in this case a payment to the household would be necessary (Varian [1992]). The compensating variation is computed at the BASE savings rate. As a result, changes in the savings rates of upper-income households (a decline in the simulation BFTAR) and related consumption changes are not permitted to influence the measure of household welfare.

The closure rule for the government account (flexible government savings) permits the model to capture tradeoffs between changes in household welfare and in the government surplus. Alternatively, the government may keep its savings unchanged and use the increased room in the government balance to reduce direct taxes. If so, subsidy cuts tend to generate a slight positive change in household welfare (see CGE-based simulations in Ahmed et al. [1999a]).

in agricultural factor incomes (indexed to the aggregate CPI) is primarily due to a decline in incomes from animal production, a sector that is particularly sensitive to lower incomes for households that are relatively well-off (because of high-income elasticities of demand for their outputs and quality differences between domestic and imported commodities). In crop production, there is a slight shift toward wheat, maize, and rice as a result of declining prices for competing crops, the prices of which to a significant extent depend on domestic (as opposed to international) market developments (in this case, a fall in domestic demand).[60] This is reflected in a limited increase in the self-sufficiency rate for wheat. The marginal increase in the unemployment rate is caused by an increase in the (CPI-indexed) nonagricultural wages, which raises the unit labor cost (paid by producers) relative to producer prices (received by producers) and, hence, reduces the profit-maximizing quantity of labor hired outside agriculture.

Removing Subsidies (BFCUT)

When bread and flour subsidies are also eliminated for low-income households, the magnitudes of the macro effects are approximately 50 percent stronger (which is proportional to the subsidy share of this group). Most importantly, compared to the BASE, the government surplus increases by 0.6 percent of GDP, which is less than the subsidy cut itself because of indirect effects. This leads to small unfavorable changes in various government items (including a decline in revenues from all kinds of indirect taxes as the level of aggregate economic activity declines). Welfare declines by 1.8–2.0 percent for low-income households, while the welfare loss is similar to that under BFTAR for other households. The differences between households reflect the importance of subsidized bread and flour in their budgets and how they are affected by declining incomes in agriculture. In the Egyptian economy, the general pattern is that the lower the household's income, the larger the budget share of subsidized bread and flour. Hence, if the households were more finely disaggregated, for example into deciles (groups with 10 percent each of the rural or urban populations), the welfare loss would most likely be much higher for the lowest income groups.

Combining Subsidy Removal with Targeted Compensation (BFCUT-TC)

The preceding simulation shows that, if bread and flour subsidies are eliminated, low-income households would suffer from the largest relative decline in welfare. Instead of protecting this group through targeted subsidies (as in BFTAR), subsidy cuts may alternatively be combined with other forms of assistance to the poor. This is im-

[60] The prices of the major grains—wheat, maize, and rice—are aligned with international prices and unaffected by domestic market developments (see Chapter 2). The prices of other crops, which are imperfectly substitutable with exports or imports of the same crops (for example, vegetables), have a weaker link to international prices; a decline in domestic demand will reduce domestic prices.

plemented in the simulation: removal of bread and flour subsidies is combined with targeted cash compensation to low-income households that is sufficient to maintain their initial welfare level.[61] In practice, the compensation for removal of *unrationed* quantities of subsidized bread and flour may be in the form of *rationed* food (or other consumer goods) quantities that are smaller than consumed quantities and, hence, are equivalent to a cash transfer (since no marginal price would be affected).[62]

Compared with subsidy targeting (BFTAR), the government surplus increases by £E180 million or 0.1 percent of GDP, primarily because the transfer payments needed to keep the lower-income households at their initial welfare levels are smaller than the cut in spending on food subsidies. The wheat self-sufficiency rate goes up (and the trade deficit declines), since the subsidy removal for low-income households reduces domestic use of wheat commodities that, on the margin, are imported. A more complete institutional analysis would also consider the feasibility and costs of subsidy targeting and targeted cash transfers (see Ahmed et al. [1999b]). An added advantage of targeting the subsidy is that it would eliminate the ostensible need for government intervention in wheat marketing and processing, with large potential for efficiency grains.

Maize–Wheat Flour Mix (MAIFLR)

As discussed in Chapter 2, in 1996 the government started an experimental program substituting a wheat–maize flour blend (with a 20 percent maize share) for all-wheat flour in the production of subsidized flour and bread. This program is aimed at reducing the costs of the bread and flour subsidy (since maize tends to be cheaper than wheat) and reducing Egypt's dependence on imported wheat. It has been implemented in a few bakeries in Cairo, and the government is considering its expansion to other areas. Using the CGE model, the experiment MAIFLR simulates the economywide impacts of the implementation of this program on a nationwide basis. Technically, the policy shift is represented by changed input coefficients in the production of subsidized flour so that 20 percent of the wheat grain is replaced by maize. It is assumed that households' demand behavior is not affected by the introduction of maize (that is, there is no significant difference in taste).

The higher maize-flour extraction rate and a lower maize price give rise to government savings. The initial effect is that 20 percent of the wheat demanded for use in production of subsidized flour is shifted to maize at 75 percent of the initial cost. This leads to reduced subsidy spending, reflecting a decline in the per-unit subsidy needed to maintain fixed prices for subsidized bread and flour. Given that Egypt is an importer of both wheat and maize, import spending is shifted from wheat to maize,

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[61] The compensatory cash transfer is determined by the compensating variation, that is, the payment that would keep household welfare at the same level before and after the change.

[62] In accordance with this interpretation, the (CPI-indexed) nonagricultural wage floor is not adjusted for the CPI increase that results from the subsidy cut for low-income households, given that compensation is paid to this group. This exception to indexing of the nonagricultural wage floor only applies to this simulation.

with some savings induced by the lower maize price. As shown in Table 62, the impact is moderate but positive according to all indicators except the wheat self-sufficiency rate, which climbs from 47.5 percent to 53.5 percent as imports fall. However, the fall in the aggregate trade deficit is limited to 0.1 percent of GDP because of the increase in maize imports. The government's current surplus goes up by £E166 million, or 0.08 percent of GDP.

Wheat Producer Subsidies for Increased Self-Sufficiency

As discussed in Chapter 3, one of the goals of the Egyptian government is to increase wheat self-sufficiency. In the absence of government controls on farmers' crop choice, the government's primary means of raising domestic wheat production is to improve incentives. In the following group of simulations, domestic farmers are paid the per-unit subsidy for wheat (raising the price they receive to above the international level) that is required to reach alternative target self-sufficiency rates in 2.5 percent increments from 50 percent to 70 percent.[63]

The assumptions underlying the simulations and the results are summarized in Tables 63 and 64, and in Figures 12 and 13, respectively. The subsidy increase (as a percentage of GDP) needed to raise the self-sufficiency rate from 50 percent to 60 percent is 0.7 percent of GDP (raising the producer price, including the subsidy, by 28 percent), while the additional subsidy needed to raise the self-sufficiency rate further to 70 percent amounts to 0.9 percent of GDP. Hence, under base-year conditions, the marginal subsidy cost of increasing the wheat self-sufficiency rate is quite substantial—the subsidy payment needed for the 60 percent self-sufficiency target is close to the value of total bread and flour subsidies in 1994/95. Moreover, according to World Trade Organization rules, domestic support is limited to 10 percent of the farmgate value of production. Given the production of wheat straw (representing around 25 percent of the grain value in 1994), this would allow a maximum subsidy of 12.5 percent per unit of grain produced (Konandreas and Greenfield 1997). Hence, wheat price support aimed at anything but marginal changes in wheat self-sufficiency would violate World Trade Organization rules.

The wheat subsidy policy leads to large changes in relative prices—prices increase strongly for winter crops (competing with wheat for the same land) and for food processing (since it uses crop products as intermediate inputs)—and large changes in crop areas, especially in the winter (Figure 13). The increase in agricultural factor incomes reflects that the policy boosts the value added of all agricultural factors except animal capital (since this sector suffers from higher prices for fodder inputs, especially berseem). Production, employment, and factor incomes outside agriculture suffer when value added per unit of output declines as a result of higher prices of inputs from agriculture.

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[63] In practice, instead of paying a subsidy per unit produced, it may be administratively easier to pay a subsidy per *feddan* planted in wheat. Although the microeconomic incentive structure would be different, the impact is likely to be similar.

Table 63—Alternative bread and flour subsidy policies: Summary of results

	BASE	BFTAR	BFCUT	BFCUT-TC	MAIFLR
		(percentage change from BASE[a])			
Real GDP at factor cost (billions of 1995 £E)[a]	187.13	–0.08	–0.13	–0.08	0.01
Agricultural factor incomes (CPI-deflated, billions of 1995 £E)	27.25	–0.33	–0.78	–0.51	0.17
Nonagricultural factor incomes (CPI-deflated, billions of 1995 £E)	159.88	–0.02	0.01	0.01	0.14
Welfare per capita (£E)[b]					
Rural household					
Low-income	918.24	0.01	–1.99	0.00	0.09
Middle-income	1,336.45	–1.37	–1.44	–1.37	0.10
Upper-income	3,005.21	–0.69	–0.80	–0.70	0.10
Urban household					
Low-income	1,809.05	0.17	–1.76	0.00	0.09
Middle-income	2,122.12	–1.63	–1.53	–1.57	0.08
Upper-income	6,036.22	–0.60	–0.58	–0.57	0.09
All households	2,533.17	–0.70	–1.06	–0.70	0.09
		(change from BASE[c])			
Food subsidy (percent of GDP)[c]	1.22	–0.54	–0.80	–0.80	–0.11
Government surplus (percent of GDP)	2.56	0.41	0.62	0.50	0.08
Merchandise trade deficit (percent of GDP)	11.22	–0.08	–0.13	–0.11	–0.12
Unemployment rate (percent of labor force)	20.00	0.18	0.28	0.17	–0.01
Wheat (grain + flour) self-sufficiency rate (percent)	47.48	0.24	0.49	0.36	6.05
Wheat share of winter land area (percent)	32.82	0.06	0.14	0.08	–0.01

[a] For example, real GDP at factor cost declines by 0.08 percent from BASE to BFTAR (from 187.130 to 187.031).

[b] For non-BASE columns, the compensating variation concept is used to measure welfare changes. See footnote 59 for details.

[c] For example, the food subsidy declines from 1.22 percent of GDP for BASE to 0.68 percent for BFTAR (1.22 – 0.54 = 0.68).

The changes in factor incomes have a positive impact on the welfare of rural households, since they depend heavily on agricultural incomes. Urban households, by contrast, primarily rely on other sectors for their incomes and are negatively affected. In addition, changes in household welfare depend on their consumption patterns. As shown in Figure 12 and Table 65, the net results are welfare increases for rural households and decreases for urban households. On the aggregate level, household welfare increases (by 0.4 percent for 60 percent self-sufficiency), with a tradeoff in the form of a decline in the government surplus (by 0.8 percent of GDP for 60 percent self-sufficiency).

Table 64—Wheat producer subsidies for self-sufficiency: Parameter changes

	SSW50	SSW60	SSW70
Wheat self-sufficiency rate (percent)	50	60	70

Notes: SSW50 = 50 percent self-sufficiency rate in wheat (grain + flour); SSW60 = 60 percent self-sufficiency rate in wheat (grain + flour); and SSW70 = 70 percent self-sufficiency rate in wheat (grain + flour).

Figure 12—Wheat subsidies for self-sufficiency: Household welfare and subsidies

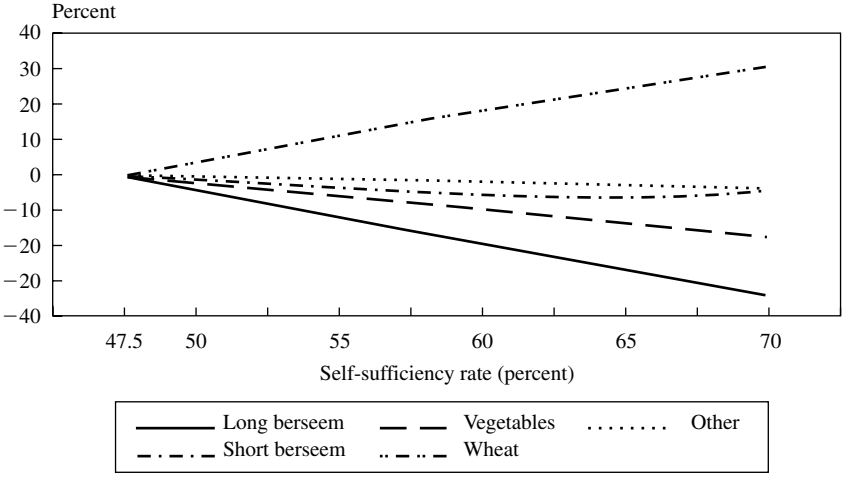

Figure 13—Wheat subsidies for self-sufficiency: Winter crop areas

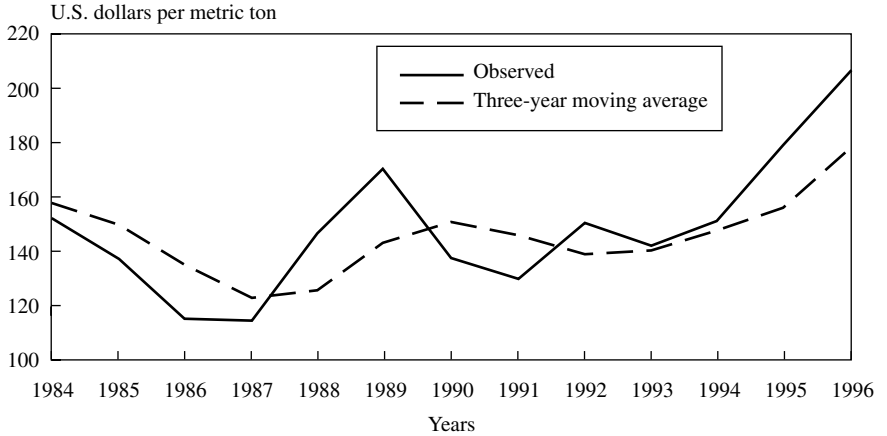

Table 65—Wheat producer subsidies for self-sufficiency: Summary of results

Indicator	BASE	SSW50	SSW60	SSW70
		(percentage change from BASE[a])		
Real GDP at factor cost (billions of 1995 £E)[a]	187.13	0.02	0.04	–0.07
Agricultural factor incomes (CPI-deflated, billions of 1995 £E)	27.25	1.81	9.72	19.90
Nonagricultural factor incomes (CPI-deflated, billions of 1995 £E)	159.88	–0.23	–1.32	–2.79
Welfare per capita (£E)[a]				
Rural household				
Low-income	918.24	0.47	2.34	4.50
Middle-income	1,336.45	0.40	2.06	4.11
Upper-income	3,005.21	0.43	2.33	4.85
Urban household				
Low-income	1,809.05	–0.09	–0.55	–1.24
Middle-income	2,122.12	–0.10	–0.62	–1.37
Upper-income	6,036.22	–0.11	–0.65	–1.40
All households	2,533.17	0.08	0.38	0.71
		(change from BASE[a])		
Food subsidy (percent of GDP)[a]	1.22	0.00	0.00	0.00
Government surplus (percent of GDP)	2.56	–0.12	–0.75	–1.73
Merchandise trade deficit (percent of GDP)	11.22	–0.11	–0.50	–0.81
Unemployment rate (percent of labor force)	20.00	0.07	0.38	0.78
Wheat (grain + flour) self-sufficiency rate (percent)	47.48	2.52	12.52	22.52
Wheat share of winter land area (percent)	32.82	1.32	6.16	10.36
Wheat producer price (including subsidy)[a]	100.00	5.17	27.82	56.93
Wheat producer subsidy (percent of GDP)	0.00	0.11	0.71	1.63

[a] See Table 63 for explanation.

International Wheat Prices and Domestic Wheat Policy

The level and variability of international wheat prices are major concerns to Egyptian policymakers, in particular given a large import bill and the policy of keeping subsidized bread and flour at fixed prices. Moreover, the effects of the policies simulated previously are influenced by international wheat prices. In this section, the CGE model is used to simulate the impact of changes in international wheat and flour prices under a subset of the settings covered above: the policies of 1994/95 (the BASE scenario), full removal of bread and flour subsidies, partly maize-based subsidized flour, and wheat producer subsidies generating a 60 percent self-sufficiency rate. In addition, a tariff-based mechanism for limiting domestic price instability is tested. The simulations and their results are summarized in Tables 66 and 67.

In a first set of simulations, the world prices of wheat and flour are increased by 30 percent and 20 percent, respectively. The price change for flour reflects the approximate share of wheat in flour production costs (assuming the prices of other inputs and factors do not change). After the mechanisms through which these inter-

Table 66—Domestic policy and increased world wheat prices: Parameter changes

	BASE+30	BFCUT+30	MAIFLR+30	SSW60+30	FLXTAR+30
Percentage cut in bread and flour subsidy					
Rural household					
Low-income		–100			
Middle-income		–100			
Upper-income		–100			
Urban household					
Low-income		–100			
Middle-income		–100			
Upper-income		–100			
Percentage increase in import price[a]					
Wheat	30	30	30	30	30
Flour	20	20	20	20	20
Wheat self-sufficiency rate (percent)				60	
Flexible import tariff for wheat					1
Maize share in subsidized flour			20		

Notes: BASE+30 = 30 percent increase in wheat world price+basic policy; BFCUT+30 = 30 percent increase in wheat world price +100 percent bread and flour subsidy cut; MAIFLR+30 = 30 percent increase in wheat world price +20 percent maize flour; SSW60+30 = 30 percent increase in wheat world price +60 percent wheat self-sufficiency rate; and FLXTAR+30 = 30 percent increase in wheat world price +flexible wheat import tariff.

[a] Import price in foreign currency.

national price increases affect the domestic economy have been analyzed, a second set of simulations is used to provide a more general perspective by testing the consequences of gradual international price changes from –30 percent to +30 percent for wheat and –20 percent to +20 percent for flour.[64]

Base Scenario with Higher World Wheat Price (BASE+30)

In this scenario (BASE+30), the initial changes, increases in international wheat and flour prices, are translated into equivalent increases in domestic prices. To maintain a fixed real exchange rate in the face of an increase in international prices, the domestic currency appreciates (for this and other scenarios with a rise in international

[64] Sensitivity analysis indicates that, compared with the results reported in Table 66, rural households would do slightly better (improvement in per capita welfare by 0.1–0.2 percent) if the elasticity of substitution in wheat production is increased by 50 percent (the analysis uses a value of 0.3) or if trade-related elasticities are reduced by 50 percent, and vice versa.

Table 67—Domestic policy and increased world wheat prices, summary of results

	BASE	BASE+30	BFCUT+30	MAIFLR+30	SSW60+30	FLXTAR+30
			(percentage change from BASE)			
Real GDP at factor cost (billions of 1995 £E)	187.13	–0.23	–0.43	–0.20	–0.23	–0.06
Agricultural factor incomes (CPI-deflated, billions of 1995 £E)	27.25	6.93	5.80	7.26	5.53	2.30
Nonagricultural factor incomes (CPI-deflated, billions of 1995 £E)	159.88	–3.13	–3.11	–2.85	–2.94	–1.03
Welfare per capita (£E)						
Rural household						
Low income	918.24	–0.32	–3.66	–0.14	–0.64	–0.10
Middle income	1336.45	–0.60	–2.98	–0.39	–0.89	–0.21
Upper income	3005.21	0.07	–1.21	0.27	–0.27	–0.01
Urban household						
Low income	1809.05	–2.20	–5.15	–2.02	–2.11	–0.76
Middle income	2122.12	–2.01	–4.56	–1.84	–1.91	–0.68
Upper income	6036.22	–2.15	–3.11	–1.96	–2.06	–0.73
All households	2533.17	–1.45	–3.20	–1.26	–1.50	–0.50
			(change from BASE)			
Food subsidy (percent of GDP)	1.22	0.57	–0.80	0.34	0.57	0.19
Government surplus (percent of GDP)	2.56	–0.28	0.77	–0.13	–0.17	–0.28
Merchandise trade surplus (percent of GDP)	–11.22	0.47	0.68	0.67	0.39	–0.11
Unemployment rate (percent of labor force)	20.00	0.75	1.16	0.72	0.69	0.25
Wheat (grain+flour) self-sufficiency rate (percent)	47.48	14.18	14.94	22.60	12.52	5.00
Wheat share of winter land area (percent)	32.82	6.21	6.37	6.21	5.48	2.35
Wheat producer price (including subsidy)	100.00	30.00	30.00	30.00	26.04	10.00
Wheat producer subsidy (percent of GDP)	0.00	0.00	0.00	0.00	–0.10	0.00

prices). The government subsidy cost increases as it maintains fixed consumer prices for subsidized bread and flour.

In response to this shift in incentives, wheat production expands while domestic output levels decline and prices increase for crops competing with wheat. Non-agricultural sectors are affected negatively by higher agricultural prices (as they reduce household purchasing power and raise the cost of intermediate inputs) and increased real wages (since nonagricultural producer prices decline relative to CPI-driven non-agricultural wages).

On the aggregate level, the final results are negative: there are declines in real GDP (by 0.2 percent), the government surplus (by 0.3 percent of GDP), and household welfare (by 1.5 percent) while unemployment grows. The wheat self-sufficiency rate increases sharply (from 47.5 percent to 61.7 percent), an indication of a strong response in crop production to changed relative prices, facilitated by the fact that lower household welfare reduces demand and prices for crops that compete with wheat. In combination with the economic contraction (reducing imports), this leads to a decline in the trade deficit relative to GDP. On a more disaggregated level, losses are registered for all households except upper-income rural households who are largely unaffected. The losses are more significant for urban households. The loss for rural households is smaller since their loss as consumers is partly balanced by gains on the production side (as they earn much of their incomes from agricultural factors). The negative impact on upper-income rural households is minimal since they benefit strongly from higher incomes from fixed crop factors (land and capital), and depend less on animal incomes.

Consumer Subsidy Removal with Higher World Wheat Price (BFCUT+30)

The scenario BFCUT+30 combines the international price increases for wheat and flour with removal of bread and flour subsidies for all household groups (the subsidy policy change being identical to BFCUT). Compared with the preceding scenario (BASE+30), the main difference is that most of the burden of higher international prices, instead of being absorbed by the government, now directly affects the households. As a result, the government surplus is largely unaffected by the international price changes (see scenario BFCUT in Table 63), while aggregate household welfare falls strongly (to 3.2 percent below the BASE level). The wheat self-sufficiency rate climbs slightly higher, to 62.4 percent, reflecting the combined impact of changes in incentives for producers (higher wheat prices) and consumers (higher bread and flour prices). Among the households, in both urban and rural areas, those with lower incomes suffer the most (that is, the regressive distributional impact of subsidy cuts is reinforced by the international price hike).

Maize-Wheat Flour Mix with Higher World Wheat Price (MAIFLR+30)

The positive effects of shifting to the maize–wheat flour mix are more pronounced when world wheat grain and flour prices increase (MAIFLR+30). The basic reason

for the gains is that the cost advantage of substituting maize for wheat is amplified. Compared with BASE+30, factor incomes and household welfare improve across the board by around 0.2 percent. The increase in the government surplus and the decrease in the merchandise trade deficit (both expressed as shares of GDP) are at around 0.2 percent of GDP. In terms of wheat self-sufficiency, the increases resulting from the shift to maize–wheat flour (reducing domestic wheat consumption) and higher world wheat prices (discouraging wheat consumption and encouraging wheat production) are combined, raising the self-sufficiency rate to 70 percent.[65]

Subsidies for Higher Self-Sufficiency with Higher World Wheat Price (SSW60+30)

Under base-year conditions, the subsidies needed to raise wheat self-sufficiency to 60 percent were substantial (corresponding to 0.8 percent of GDP; cf. SSW60 in Table 65). Accordingly, the resulting changes in domestic incomes and prices were also significant. This reflects that the subsidies were used to generate an outcome that strongly deviated from the market outcome (a 47.5 percent self-sufficiency rate). In contrast, with a 30 percent increase in the world wheat price under base-year conditions, market mechanisms would on their own raise the wheat self-sufficiency rate to a level slightly above 60 percent (compare BASE+30). Hence, under these conditions, it would be expected that the additional subsidy (and the associated economic repercussions) needed to raise self-sufficiency to 60 percent is much smaller.

This is confirmed for the next simulation, where a wheat price subsidy for producers is used to generate a 60 percent self-sufficiency rate in a setting with a 30 percent increase in world wheat prices (simulation SSW60+30). The subsidy turns into a minor tax with predictable effects on factor incomes and household welfare. Compared with BASE+30, nonagricultural factor incomes and urban household welfare increased slightly, while agricultural factor incomes and rural household welfare decreased slightly. On the aggregate level, there is a negligible decline in household welfare and the merchandise trade deficit, while the government budget surplus decline (by 0.2 percent of GDP) is close to the additional spending on producer wheat subsidies.

Tariff-Based Price Stabilization with Higher World Wheat Price (FLXTAR+30)

In the stylized simulation of price stabilization through flexible tariffs (FLXTAR+30), an approach that was discussed in Chapter 2, the increases in domestic wheat and flour prices (incorporating the impact of the tariff change) are one-third of the increases in world prices (the latter increase by 30 percent and 20 percent,

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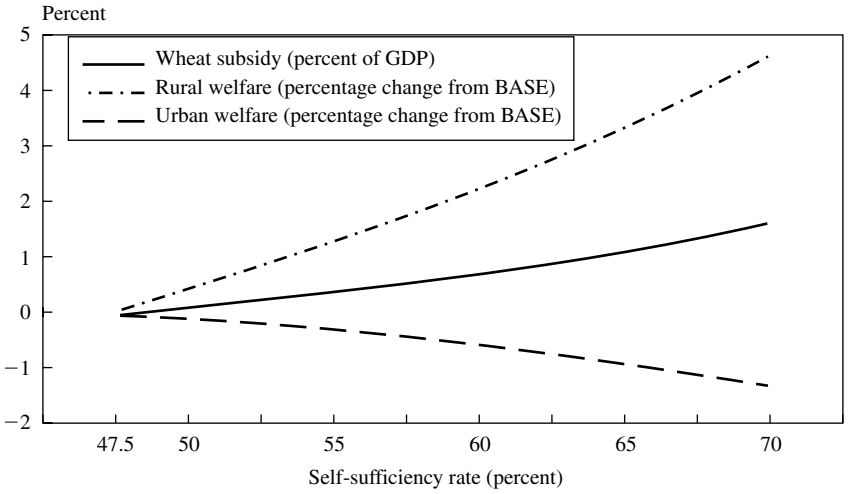
[65] The absolute levels of wheat production and the percentage changes in production and consumption in response to higher world wheat prices are virtually identical for the BASE and MAIFLR scenarios. When the self-sufficiency rate is computed, the MAIFLR scenario realizes a larger increase in the rate of self-sufficiency for an identical increase in production because the denominator (total wheat consumption) is lower.

Figure 14—Wheat world price: Observed and three-year moving averages



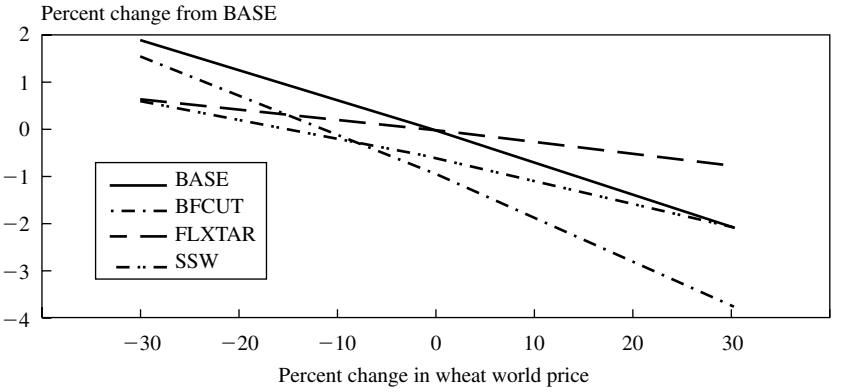
Source: IGC, *World Grain Statistics* (various years).
Note: Wheat world price is the price of No. 2 hard winter wheat, f.o.b. U.S. Gulf.

respectively). This would be the outcome if a policy of using a three-year moving average were followed in a setting where world wheat and flour prices remained unchanged for two years and increased in the third year (Figure 14).[66] Since the international price changes are reduced by two-thirds compared with BASE+30, most economic indicators (including losses in real GDP and household welfare, as well as the gain in the wheat self-sufficiency rate) are also reduced by two-thirds. The main exceptions to this are the trade deficit and the government surplus. Since the government now is subsidizing imports, the deficit increases. The surplus does not change significantly, since the tariff cuts (accompanied by a fall in tariff revenues) lower market prices for wheat and flour (both imported and domestic), thereby strongly reducing the explicit bread and flour subsidy. In effect, a substantial part of the government subsidy burden is transferred to the agricultural producers, reducing their gain from the international price rise.

The preceding simulations addressed the impact of *increases* in international wheat and flour prices. A second set of simulations provides a more general perspective by testing the consequences of gradual international price changes from –30 percent to +30 percent for wheat and –20 percent to +20 percent for flour. These price changes are applied to four scenarios: the base case (BASE), full removal of bread and flour subsidies (BFCUT), producer subsidies generating a 60 percent self-

[66] For example, if international prices (in domestic currency, before tariffs and taxes) of a commodity in 1993–95 were 100 and in 1996 increased to 130, tariffs would, *ceteris paribus,* be lowered (possibly becoming negative, turning into an import subsidy) to limit the domestic price increase from 100 in 1995 to 110 in 1996 (the average of the international prices in domestic currency in 1994–96).

Figure 15—World wheat prices and changes in the government surplus



sufficiency rate (SSW60), and the tariff-mechanism for limiting domestic price instability (FLXTAR).

The results, which generalize the above observations for a 30 percent increase in the world wheat price, are summarized in Figures 15 through 18. Taking as the point of departure the lowest world price, the results for the BASE scenario show that increases in international prices lead to a substantial decline in the government surplus (Figure 15) and significantly raise the wheat self-sufficiency rate (Figure 18), with a slight decline in rural welfare (Figure 17) and a stronger decline in urban welfare (Figure 16).

Compared with the BASE, BFCUT has a larger government surplus (since spending on food subsidies is lower), a slightly higher self-sufficiency rate (consumption of wheat products is discouraged by the absence of bread and flour subsidies), and lower rural and urban welfare (as household purchasing power is hurt by the subsidy cuts). The differences compared with the BASE tend to be fairly small, especially

Figure 16—World wheat prices and urban household welfare

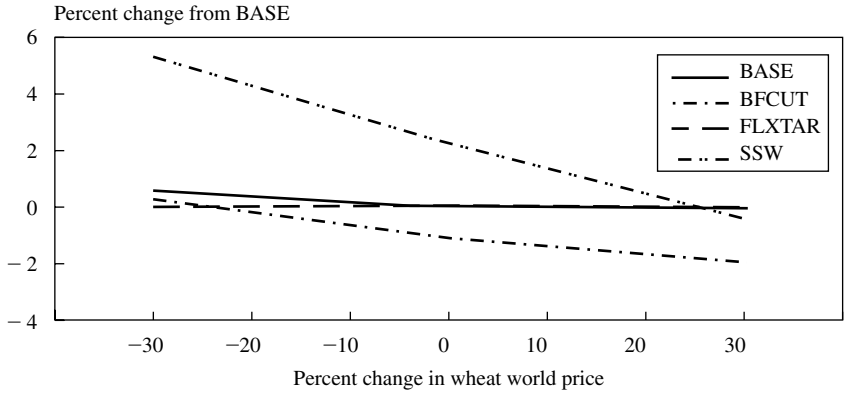
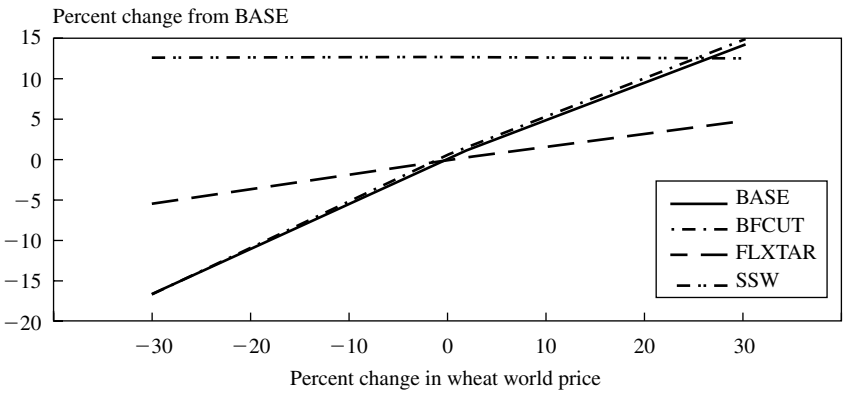


Figure 17—World wheat prices and rural household welfare

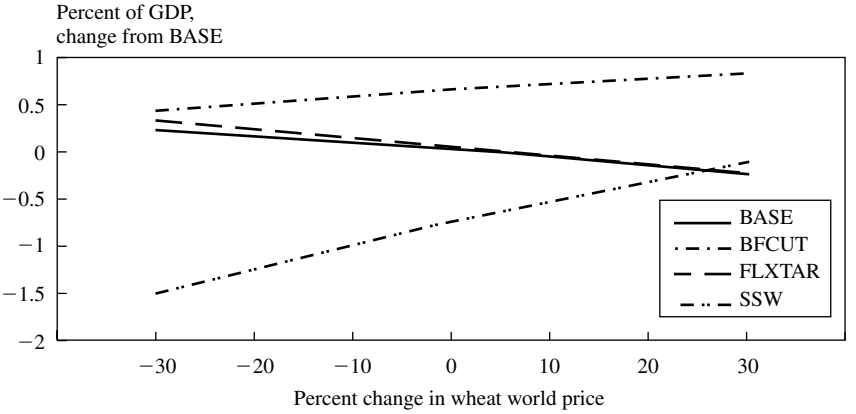


for wheat self-sufficiency, but are more pronounced the higher the level of the world wheat price. Overall, the scenario BFCUT sacrifices household welfare for a larger government surplus and a higher self-sufficiency rate.

The scenario SSW60 maintains a 60 percent self-sufficiency rate by subsidizing producer prices at a substantial budgetary cost—its budget surplus is lower than for any other scenario until the increase in the world wheat price is 26 percent, at which point the scenario is identical to BASE, since no subsidy is paid. Until this point, the subsidy supports agricultural incomes and rural welfare while having a negative impact (although much smaller in percentage terms) on nonagricultural incomes and urban welfare. The further the world price increase deviates from 26 percent, the larger the difference between SSW60 and other scenarios.

Finally, according to these indicators in the figures, FLXTAR significantly dampens the effects of international price instability on the domestic economy. The only exception is the current government surplus. The *changes* in this indicator are simi-

Figure 18—World wheat prices and changes in the wheat self-sufficiency rate



lar across the scenarios except for SSW; the *level* is higher for BFCUT. Compared with BASE, the policies under FLXTAR lead to declining net tariff revenues when the world wheat price increases. However, this is compensated for by lower costs of bread and flour subsidies as the variable tariff keeps domestic wheat price increases in check. The resulting implicit tax on agriculture is positively related to the wheat world price; hence, it contributes to increased stability in agricultural incomes and rural welfare.

Conclusion

After a gradual reduction in the food subsidy program since the early 1980s, the budgetary cost of bread and flour subsidies is now a more modest share of GDP (0.8 percent), while the budget deficit has been brought under control. This gives the government the opportunity to continue its gradual approach to subsidy reform, drawing on accumulating evidence on the impact of alternative reforms on different parts of the population. Given the priority attached to the protection of poor groups, it may be desirable to avoid a general removal of bread and flour subsidies in the absence of any alternative, effective social safety net. Nevertheless, improved subsidy targeting and the introduction of less-distorting forms of support to poor households would eliminate the ostensible need for government intervention in the wheat marketing sector, thereby raising economic efficiency and freeing government resources for more productive uses.

To the extent that the government wishes to reduce the transmission of fluctuations in world wheat prices to the domestic economy, a system of flexible tariffs would be compatible with reliance on market forces and an important private sector role in different areas, including grain trade. However, this scheme would require a renegotiation of Egypt's World Trade Organization tariff bounds for wheat grain and flour. The need for domestic price stabilization would be stronger if bread and flour subsidies were reduced. Over time, poverty reduction, the establishment of an effective social safety net, and the development of forward markets for wheat products would reduce the need for government price stabilization policies.

Using producer subsidies to increase wheat self-sufficiency rates in excess of what is generated by the market would be costly and is limited by World Trade Organization rules. However, the organization's rules do not limit public spending on "general services," including agricultural research, extension, and infrastructure—which may boost yields, raise farmer incomes, and reduce the agricultural trade deficit.

CHAPTER 8

Conclusions and Policy Implications

In 1987, the government of Egypt initiated market reforms in the agricultural sector to boost domestic production and reverse stagnation in the agricultural economy. This was followed in 1991 by structural adjustment and stabilization programs to reduce macroeconomic imbalances and convert Egypt from a state-controlled into a more market-oriented economy.

The objectives of this study are to analyze the structure and performance of the wheat marketing sector following the reforms in Egypt's economy and to evaluate the economywide impacts of alternative wheat policy scenarios. The study is based on market surveys of wheat producers, traders, and millers; an analysis of wheat prices; and a CGE model of Egypt's wheat economy. The main findings are summarized below.

Summary of Findings

Achievements

The wheat production sector in Egypt has undergone many changes since the beginning of the market reform programs in 1987. The removal of minimum wheat-area requirements, the elimination of compulsory delivery of wheat quotas, and the liberalization of producer prices have increased the profitability of wheat-based crop rotations and has led to the adoption of higher-yielding varieties and modern production technology. The result has been substantial growth in wheat crop area and yields, causing wheat production to increase from 1.9 million metric tons in 1986 to about 6 million metric tons in 1998, or 46 percent of total consumption. Furthermore, the quantity of domestic wheat procured by the government for its *baladi* flour and bread subsidy program has increased from less than 0.1 million metric tons in 1986 to 1.8 million metric tons in 1998. However, the continued growth in domestic consumption has kept wheat imports in the range of 6 to 7 million metric tons per year.

The partial liberalization of wheat grain marketing has also increased the participation of the private sector in wheat trading and resulted in more competitive markets. Because the private sector is more flexible than the government and responds more

quickly to changes in market conditions, this has contributed to stabilizing markets by reducing price volatility, seasonality, and intertemporal price swings. While domestic wheat prices in Egypt exhibited more instability than international prices before the reforms in 1987, they are now less unstable than the latter. Market integration has also improved because of better transmission of price signals and a less-restricted flow of wheat between surplus and deficit regions. Furthermore, while price spreads before the reforms did not reflect underlying marketing costs because of government subsidies, they now better represent the costs of transport, storage, and processing activities.

The liberalization of the *fino* flour market has induced new private investments in wheat milling. Starting in 1996, many new, modern, and more efficient mills have been built by the private sector. Public milling companies have also been partially privatized and have renovated and upgraded their facilities. This has resulted in greater domestic wheat flour production and reduced wheat flour imports. Consequently, although consumer *fino* flour prices are no longer subsidized, they have fallen sharply soon after liberalization because of increased competition in the *fino* flour milling sector.

Remaining Constraints

Despite these achievements, the performance of the wheat marketing sector in Egypt is limited by several constraints. All production, transportation, and distribution of *baladi* flour are under state control. *Baladi* flour and bread consumer prices are heavily subsidized. The government prohibits the use of domestically grown wheat grain for the transformation into *fino* flour and does not allow sale of imported wheat in grain form. Owing to balance-of-payment concerns and political considerations, procurement of domestic wheat by the government is favored over imported wheat. This increases the pressure on local officials to deliver larger quantities of wheat to the government and encourages some of them to restrict the movement of wheat outside their localities.

These restrictions have repercussions on the activities of the private sector. The wheat traders' survey indicates that the response to liberalization has been characterized more by the entry of new traders rather than the expansion of existing ones. It seems that private traders are hesitant to expand their activities in the wheat marketing sector beyond the entry level. For instance, despite low transport costs, nonexcessive interest rates, and storage costs that are below the observed temporal price spreads, the surveyed traders tend to keep stocks for as little as one month and the average distance between wheat purchase and sales areas is only about 20 kilometers. The limited storage activities are consistent with the short-distance nature of local trading and the observed low quantity of shipments, which tends to range between 3 and 5 metric tons. This hesitance to invest in wheat marketing is due to several factors, including limited access to capital, regulations in several segments of the wheat marketing sector, occasional restrictions imposed on intergovernorate movement of domestic wheat, and a wheat policy environment that is politically sensitive because wheat is considered a strategic food commodity.

The market integration analysis reveals that local wheat markets are quite segmented, even though the level of segmentation has declined since the 1987 reforms. The estimated measure of market interdependence indicates that only a fraction of price changes originating in individual markets is transmitted to neighboring markets, and that the transmission takes a relatively long time to occur. Overall, the level of integration between wheat markets in Egypt is low in comparison with other developing countries and lower than would be expected given the level of infrastructural development in the country.

The milling sector still faces many challenges. Public mills suffer from excessive and redundant labor and have higher per-unit labor costs than private mills. Fierce competition between the public and private sectors has resulted in overcapacity in the production of *fino* flour. The costs of overcapacity buildup will be borne by private millers, since public mills are supported by the state budget even if they record losses. Therefore, competition between the public and private sectors is not on a level playing field, resulting in a crowding out of private investment and inefficient allocation of state resources. The government's unwillingness to relinquish this industry to the private sector delays the transformation of many old and small mills into more efficient and cost-effective technologies that can benefit from economies of scale.

Policy Simulations

The CGE analysis in this study shows the economywide impacts of alternative policy options that the government may wish to adopt depending on its politico-economic priorities and goals. In particular, three critical areas of wheat policy are addressed: consumer subsidies on bread and flour, producer subsidies to raise self-sufficiency, and responses of the domestic economy to changes in international wheat prices. The following paragraphs summarize the findings from the CGE analysis.

Bread and Flour Consumer Subsidies. If the government is mainly interested in reducing the costs of the *baladi* flour and bread consumer subsidy without affecting the welfare of the poor, one option is to target the subsidy to low-income households. This could be done by identifying the poorest third of the households in urban and rural areas and targeting the subsidy toward them (see Ahmed et al. 1999b for an approach to food subsidy targeting in Egypt). In this scenario, subsidy spending would be cut by about £E1 billion (0.5 percent of GDP) and current government surplus would go up by £E0.9 billion (0.4 percent of GDP). Urban and rural welfare losses for middle- and upper-income households would be small, around 1.5 and 0.6–0.7 percent, respectively.

An alternative option for protecting the poor is eliminating the subsidy and compensating the poorest third of the households with cash transfers. This option results in higher cuts in subsidy costs and greater government savings. However, it may be more administratively difficult to implement. Complete removal of the subsidy without compensation for the poor would result in the highest cost savings for the government. However, the negative impact on the welfare of the poor, which declines by about 2 percent, reduces the political feasibility of this option.

Mixing maize flour with wheat flour to reduce the costs of the *baladi* bread and flour subsidy and the dependence on imported wheat does not lead to substantial cost savings or reduction in the trade deficit. Maize is only 15 percent cheaper than wheat and, in the absence of any immediate increases in maize yields or area, maize still needs to be imported.

Wheat Producer Subsidies for Increased Self-Sufficiency. Subsidizing wheat producer prices to achieve a higher rate of wheat self-sufficiency could be costly. Raising the rate from 47.5 percent to 60 percent or 70 percent would involve subsidy costs of £E1.5 billion and £E3.3 billion (0.7 and 1.6 percent of GDP), respectively, and would be in excess of the level of product-specific subsidies permitted according to the World Trade Organization agreement.

International Wheat Prices and Domestic Price Stability. The government may wish to stabilize domestic wheat prices in the face of international price fluctuations. It would be feasible to achieve this through a flexible import tariff that keeps the border price at a target level. Simulations with flexible tariffs, keeping domestic wheat and flour prices at the level of a moving three-year average of international prices, show that such a policy reduces the fluctuations in real household welfare and wheat self-sufficiency by approximately two-thirds compared with when the world price varies under the current fixed tariff system. At the same time, the variations in the current government surplus are similar, with and without flexible tariffs because of balancing changes in government revenues (from tariffs) and expenditures (on bread and flour subsidies).

Policy Implications for Egypt

The results above suggest that the government could consider several policies to further its reforms in the agricultural sector and promote sustainable economic growth in Egypt. These policies can be grouped into four main categories: domestic wheat procurement and self-sufficiency, design of the *baladi* flour and bread consumer subsidy, domestic wheat price stability, and public and private roles in wheat marketing.

Domestic Wheat Procurement and Self-Sufficiency Targets

Although Egypt's wheat production has grown substantially in recent years, the government has problems reaching its wheat procurement targets. A recurring question among policymakers is why such a small portion of national production is available for purchase by the government. The results of this study suggest that most of the wheat produced is consumed in the rural areas. Given this, the costs of increasing deliveries of domestic wheat to the government are considerable. To do so, the government would have to subsidize wheat producer prices above international levels, which could be costly. Furthermore, encouraging farmers to sell the wheat they have set aside for home consumption will increase their purchases of subsidized *baladi* flour and bread, resulting in a higher budgetary burden on the consumer subsidy system.

Wheat self-sufficiency is often cited as a goal of Egyptian wheat policy. This study shows that achieving this goal using price policy would be costly and ill-advised. Instead of subsidizing producer prices, the government would be better off investing in research and infrastructure. Government investment into research for the development of higher-yielding wheat varieties would not only increase wheat production, farmer productivity, and farm income but should also help make more wheat available for the *baladi* bread and flour subsidy program without increasing per-unit subsidy costs. Furthermore, as Egyptian agriculture diversifies into the production and export of higher-valued products, infrastructure investments would facilitate the marketing and export of these commodities.

Design of the Baladi *Bread and Flour Consumer Subsidy*

The present constraints in the wheat marketing sector are tightly linked to the existing design of the *baladi* bread and flour program. The subsidy system on *baladi* flour bread is set up so that the subsidy is distributed at all levels of the wheat marketing channels, including the milling, bread processing, and consumption levels. This subsidization scheme prevents the complete liberalization of the wheat marketing system. The policy implications of the general equilibrium analysis are that, given the priority attached to the protection of poor groups, it may be desirable to avoid a general removal of bread and flour subsidies in the absence of any alternative, effective social safety net.

Therefore, without giving up its commitment to subsidizing bread prices for the poor, Egypt can target the subsidy to *baladi* bread at the consumption level and remove all the restrictions at earlier stages in the process. Since the intent of the subsidy is to provide a cheap source of bread for the poor, an alternative and less distortionary option than the current universal price subsidy is to target the subsidy to consumers most in need with the help of ration cards, coupons, or magnetic cards that can be distributed to selected segments of the population. For example, the government could distribute a predetermined number of ration cards to the poorest households. These ration cards can be used to buy a limited amount of bread at subsidized prices from bakeries. Bakeries are then reimbursed the difference between the market and the controlled price from the government on the basis of the number of ration cards collected. In any of these programs, however, the political and administrative costs and the feasibility of implementation need to be studied very carefully.

The advantage of targeting the subsidy to the poorest consumers is that it would lead to potential savings in subsidy layouts. This study shows that, excluding the potential added costs of administering the new subsidy scheme, targeting the subsidy to the poorest third of the households would reduce subsidy costs by more than 50 percent. The negative welfare impacts on the middle- and high-income households would be moderate. More important, targeting the subsidy would decrease the leakage of subsidized flour into the free market and enable the complete liberalization of the wheat marketing and processing sectors, with a large potential for efficiency gains.

Domestic Price Stability

Results from the price analysis conducted in this study reveal that, before the reforms in 1987, price control by the government did not lead to more stable markets; price volatility decreased following the reforms and is now even lower than international price levels. However, once the *baladi* bread and flour subsidy is eliminated, concerns over the impact of price instability on poor consumers may increase. If the government wishes to reduce the effect of international fluctuations in wheat prices on domestic wheat prices, it would be more effective and compatible with market forces to use a flexible import tariff that keeps the border price at a target level. In the long run, as Egypt's economy grows and develops, the private sector's use of forward markets and appropriate safety nets for the poor would reduce the need for state intervention in price stabilization policies.

Public and Private Roles in Wheat Marketing

Presently in Egypt, the public and private sectors are both involved in the marketing and processing of wheat and flour. As mentioned above, the involvement of the public sector in wheat imports, trading, and processing are linked to the *baladi* flour subsidy program. However, experience elsewhere and in Egypt suggests that the private sector is usually more efficient than the state in the provision of production, marketing, and trading activities. In the *fino* flour market, for example, the private sector has proven that it can produce and market this product effectively. Given the post-liberalization response of the private sector in the production and distribution of *fino* flour, indications are strong that the private sector is sufficiently developed to take over the marketing of *baladi* flour once all wheat grain and flour marketing restrictions are removed.

In most cases, state-owned enterprises have been shown to be inefficient and to impose large budgetary burdens on the state. Therefore, in many countries undergoing market reform, these activities are increasingly being left to the private sector. Privatizing and dismantling state-owned enterprises is a difficult task because of entrenched interests and its impact on unemployment. However, given their limited budgetary resources, governments might well be advised to concentrate their spending on areas that create the highest social payoffs and that cannot be effectively provided by the private sector.

The areas where the government should play a role include:

- areas considered as public goods, such as agricultural research, extension, rural infrastructure, and a market information system—all of which can contribute to increase agricultural productivity and income;
- redistribution measures or safety nets for the poor, or for those who may be temporarily hurt by reforms; and
- provision of a legal and regulatory framework that facilitates private sector investment, including a functioning judicial system, regulations concerning market conduct (for example, antitrust law, contract law, consumer protection

law, bankruptcy law, and property rights law), a system of commodity grading and standards, and supporting institutions or organizations that could provide credit to small farmers and traders.

Continued emphasis on policy formulation in these three areas is important as Egypt seeks to accelerate growth and reduce poverty.

Policy Implications and Lessons for Other Countries

Many developing countries are currently in transition from a state-dominated to a more market-oriented economy where the private sector is expected to play a dominant role. Most of them are characterized by an agricultural sector where the state intervened heavily in providing inputs to farmers, in procuring output at fixed prices, and in controlling marketing and trade. These countries are now at a stage where their governments would like to increase the production of their main staple crops, while attempting to keep consumer prices low to protect the poor. The Egyptian experience with wheat policy reform provides seven useful lessons for other developing countries undergoing similar types of reforms.

The first of these lessons is that producers and the private sector do respond to changes in profit incentives, and often faster than the government expects them to. Second, the fear that liberalization would lead to more unstable markets is not well founded. The experience in Egypt indicates that, because the private sector is more quick to respond to changes in market conditions, it contributes more effectively in stabilizing prices and dampening market shocks. Third, the concern that eliminating consumer subsidies always leads to higher consumer prices is not warranted. Increased competition and a more cost-effective private sector often result in a reduction in marketing margins and lower retail prices. Fourth, if governments are worried about the impact of international price fluctuations on domestic price stability, many effective options are available which do not distort market mechanisms, including a flexible tariff regime.

Fifth, the consequence of partial liberalization should be studied carefully. Continued state intervention in certain market segments reduces the investment potential of the private sector. Evidence in Egypt and elsewhere in Africa shows that following partial liberalization, entry of the private sector in small-scale trading—which does not require a lot of investment—has been widespread. However, expansion into more capital-intensive activities, such as storage and transport, has been much more limited. This is partly because the private sector is hesitant to invest in a sector where government control is still pervasive. In addition, partial liberalization often leads to leakage of the controlled commodity into the free market. This is both costly and undermines the goal of government intervention.

Sixth, when the objective of a commodity subsidy is to protect the consumer, it is more efficient to target the subsidy directly at the consumption level rather than at all stages of the commodity production and marketing channels. Seventh, increasing self-sufficiency through producer price subsidies is usually costly. Current globalization trends are facilitating and reducing the cost of access to international com-

modity markets. Therefore, countries should increasingly rely on international trade to supplement domestic production. Furthermore, self-sufficiency does not guarantee food security; the latter is more a function of income and access to markets. Governments are better advised to focus on measures to promote food security rather than food self-sufficiency.

Finally, supporting inefficient state-owned enterprises delays the implementation of more cost-effective technologies and crowds out private sector investment. International experience shows that production and trading activities are better left to the private sector. The public sector should instead focus its resources on activities that have positive externalities and that tend to be either not provided or are underfunded by the private sector, such as research, extension, public market information, infrastructure, and a regulatory or legal environment conducive to further investment.

APPENDIX 1

Additional Data for Egypt

Table 68—Wheat area, yield, production, consumption, exchange rates, and consumer price index

Year	Area harvested	Yield	Production	Wheat and flour imports, (wheat equivalents)	Consumption (wheat equivalents)	Exchange rate	CPI (1995 = 100)
	(hectares)	(metric tons per hectare)	(metric tons)	(metric tons)	(metric tons)	(£E per U.S. dollars)	
1961	581,409	2.47	1,435,926	1,261,287	2,940,882	0.60	3.33
1962	611,226	2.61	1,593,098	1,569,216	3,156,166	0.81	3.23
1963	565,000	2.64	1,493,000	2,104,530	3,330,267	0.75	3.26
1964	544,393	2.76	1,499,881	1,888,481	3,369,682	0.80	3.38
1965	481,000	2.64	1,272,000	2,078,107	3,435,117	0.90	3.88
1966	542,000	2.70	1,465,000	2,276,076	3,616,127	0.92	4.23
1967	530,000	2.45	1,299,000	2,686,590	3,825,001	0.88	4.26
1968	602,000	2.53	1,526,000	2,284,547	3,810,479	0.84	4.19
1969	531,000	2.40	1,277,000	1,516,105	3,893,018	0.91	4.33
1970	551,145	2.76	1,519,000	1,232,434	3,951,051	0.92	4.49
1971	569,628	3.04	1,732,000	2,409,274	4,041,101	0.83	4.63
1972	523,420	3.09	1,618,000	1,685,870	4,103,539	0.81	4.73
1973	524,867	3.69	1,938,112	1,805,182	4,442,787	0.67	4.97
1974	577,000	3.27	1,886,000	3,488,940	4,673,824	0.64	5.47
1975	585,592	3.47	2,033,265	3,796,455	4,829,615	0.71	6.00
1976	586,000	3.34	1,960,000	3,888,410	5,146,407	0.74	6.62
1977	509,304	3.33	1,697,000	4,344,500	5,461,247	0.72	7.46
1978	579,710	3.33	1,933,000	5,119,423	6,148,435	0.72	8.29

1979	587,231	3.16	1,856,000	4,906,568	6,557,981	0.75	9.11
1980	556,995	3.12	1,736,440	5,423,105	7,009,116	0.76	10.99
1981	587,830	3.30	1,938,327	5,878,324	7,766,414	0.88	12.12
1982	576,917	3.50	2,016,992	5,503,095	8,070,024	1.04	13.92
1983	554,500	3.60	1,996,000	6,591,300	8,285,641	1.11	16.16
1984	495,034	3.67	1,815,176	7,034,090	8,498,395	1.23	18.92
1985	498,000	3.76	1,872,000	6,996,420	8,760,332	1.48	21.20
1986	507,000	3.80	1,928,000	6,333,327	8,860,509	1.80	26.26
1987	577,000	4.72	2,721,000	7,076,042	9,645,713	2.03	31.44
1988	597,350	4.75	2,838,000	7,239,380	9,947,286	2.25	36.99
1989	643,921	4.94	3,182,000	6,881,924	9,916,311	2.61	44.86
1990	821,301	5.20	4,268,049	6,439,468	10,361,444	2.66	52.37
1991	930,702	4.82	4,482,523	6,187,623	10,705,642	3.39	62.75
1992	878,846	5.25	4,617,997	5,683,217	10,704,344	3.37	71.27
1993	912,324	5.30	4,832,598	5,038,050	10,511,090	3.42	79.88
1994	886,950	5.00	4,437,055	7,125,006	11,012,612	3.39	86.40
1995	1,055,384	5.42	5,722,441	5,472,352	11,192,000	3.39	100.00
1996	1,017,192	5.64	5,735,367	6,086,572	11,410,444	3.39	107.19
1997	1,044,593	5.60	5,849,134	6,990,774	11,835,340	3.39	112.09
1998	1,017,282	5.99	6,093,151	7,532,828	13,625,979	3.39	116.83

Sources: Harvested area, yield, and production: Food and Agriculture Organization of the United Nations (FAO). 2000. FAOstat, Agricultural production domain. <http://faostat.fao.org>. Updated March 1 (accessed March 7, 2000). Imports and exports: FAO. 1999. FAOstat, Agriculture and FoodTrade Domain. <http://faostat.fao.org>. Updated November 11 (accessed March 7, 2000). Change in stocks: FAO. 1999. FAOstat, Commodity Balances Domain. <http://faostat.fao.org>. Updated June 21 (accessed March 7, 2000). Consumption: Imputed using FAO Production, Imports, Export, and Change in Stocks data. Exchange rates: (1960–79) International Currency Analysis, Inc., *Pick's Currency Yearbook,* various years. New York: Pick Publishers. (1980–99) International Currency Analysis, Inc. Various years. *World Currency Yearbook.* Brooklyn, N.Y., U.S.A.

APPENDIX 2

Stratified Random Sampling Method for the Egypt Wheat Producers Survey

The sample of 800 wheat farmers in the 1998 Egypt Wheat Producer Survey is designed to be representative of farm households growing wheat in the 1997/98 agricultural season. It is a four-stage stratified random sample that relies, in part, on lists of wheat farming households prepared by the Ministry of Agriculture and Land Reclamation (MALR).

In the first stage, 80 districts with probabilities proportional to wheat production in 1997 were selected. As a result of this method, the sample does not include any districts in governorates with little or no wheat production, such as Cairo, Port Said, Suez, the Red Sea, and the Sinai governorates. Another result of this approach is that districts with large wheat production (more than 486 thousand *ardebs*) were certain to be selected. The largest wheat producing district—Atsa, in Fayoum—was selected twice (Table 68).

Some adjustments in the selection process were made necessary by the nature of the production data. First, the data listed wheat production in the region of Nubaria as a separate category rather than according to the governorate and district. Thus, six administrative zones of Nubaria were, for the purpose of the sampling, treated as six districts. This adjustment may be beneficial in that it ensures that Nubaria, a new land farming area, will be represented proportionally in the sample.

Second, with regard to wheat production on new land outside of Nubaria, Matrouh, and New Valley, the data did not provide district-level figures but rather governorate totals. For the purpose of sampling, this production was allocated among districts in proportion to the old land production. Although not ideal, this adjustment has little effect on the selection probabilities, because this unallocated wheat production on new land accounted for just 4.7 percent of the total.

In the second stage, a number of "basin groups" were selected from each district with probability proportional to the arable land area. This selection was carried out by the Department of Sampling of the MALR as part of a larger survey carried out during 1997/98. A "basin" (or *hod*) is a subdivision of the farmland in

each village, and the basin groups were designed by the MALR to include 150–250 *feddans* of arable land.

In the third stage, two "basin groups" were selected from each district. One exception is the district of Atsa (Fayoum). Because Atsa was selected twice in the first stage, four basin groups from this district were selected. In all districts, each basin group was given equal probability of selection.

In the last stage, five wheat producing households were chosen from each selected basin group, making use of a complete list of wheat farmers compiled by the MALR as part of the larger survey. The households were selected with equal probability. Three replacement households were also selected from each basin group in case one or more of the five could not be interviewed.

Because each wheat farmer in Egypt did not have an equal probability of being selected for the sample, weights must be applied in the data analysis. The weights (also called expansion factors) are the inverse of the probability of selection. Thus, if wheat farmers in a region were underrepresented in the sample, the weights compensate for this by giving greater weight to these farms in the calculation of national averages and percentages. Because the sample was selected in a four-stage process, the calculation of the weighting factor involves four terms:

$$W_g = \frac{DP}{P_d} \frac{A_d}{SA_d} \frac{G_d}{SG_d} \frac{H_g}{SH_g}$$

where
W_g = the weighting factor for basin group g in district d,
D = the number of districts selected,
P = total wheat production in Egypt,
P_d = wheat production in the selected district d,
A_d = total arable land in district d,
SA_d = arable land in the MALR-selected basin groups of district d,
G_d = the total number of MALR-selected basin groups in district d,
SG_d = the number of IFPRI-selected basin groups in district d,
H_g = the total number of households in basin group g, and
SH_g = the number of selected households in basin group g.

The first term is a ratio of wheat production, because the probability of selecting districts was proportional to wheat production. Similarly, the second term is a ratio of areas, because MALR selected basin groups with probabilities proportional to arable land area. The third and fourth terms are the inverse of the proportion of units selected, reflecting the fact that the units (basin groups and households, respectively) were selected with equal probability.

APPENDIX 3

Administrative Divisions of Egypt (Governorates)

City
1. Cairo
2. Alexandria
3. Port Said
4. Suez

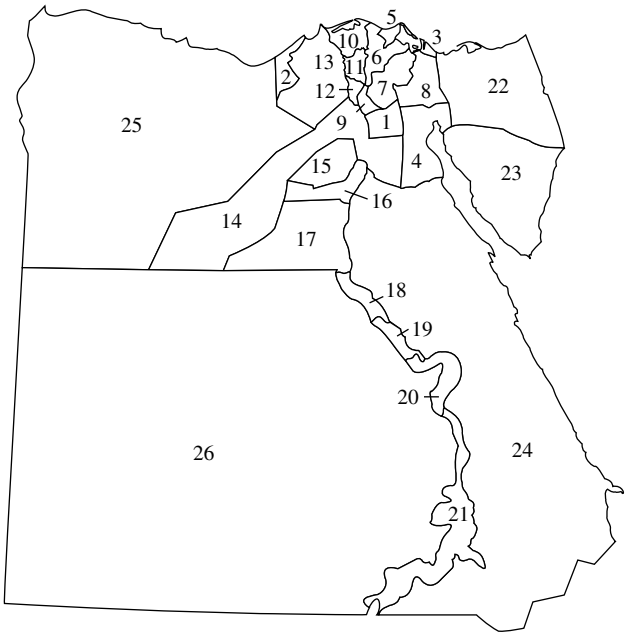
Lower Egypt
Eastern Delta
5. Damietta
6. Dakhalia
7. Sharkia
8. Ismailia
9. Qalubia

Western Delta
10. Kafr El Sheikh
11. Gharbia
12. Manufia
13. Beheira

Upper Egypt
Middle Egypt
14. Giza
15. Fayum
16. Beni Suef
17. Minia

Upper Egypt
18. Assiut
19. Sohag
20. Qena
21. Aswan

Frontier
22. North Sinai
23. South Sinai
24. Red Sea
25. Matruh
26. New Valley



APPENDIX 4

Glossary

baladi bread	bread made from 82 percent extraction (*baladi*) flour
baladi flour	a coarse flour made by extracting 82 percent of wheat grain
CAPMAS	Central Agency for Public Mobilization and Statistics (Cairo, Egypt)
CGE	computable general equilibrium
CPI	consumer price index
FIHC	Food Industries Holding Company
fino bread	bread made from 72 percent extraction (*fino*) flour
fino flour	a refined flour that made by extracting 72 percent of wheat grain
GASC	General Authority for Supply Commodities
GDP	gross domestic product
HCRWM	Holding Company for Rice and Wheat Mills
HCSMB	Holding Company for Silos, Mills, and Bakeries
MALR	Ministry of Agriculture and Land Reclamation
MOTS	Ministry of Trade and Supply
PBDAC	Principal Bank for Development and Agricultural Credit
SAM	social accounting matrix
shami bread	bread made from 76 percent extraction (*shami*) flour
shami flour	a flour that is coarser than *fino* flour and finer than *baladi* flour, made by extracting 76 percent of wheat grain

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