AN ANALYSIS OF COMMODITY PRICE VOLATILITY IN INDIA

by

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STATEMENT BY THE AUTHOR

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ABSTRACT

Fluctuations in prices of agricultural commodities can affect both consumers and producers adversely. Thus, price stabilization programs are an integral part of food policy in both developing and developed countries. Since India's independence in 1947, stability of the domestic prices has been one of the main objectives of the Indian food policy. This thesis analyzes price volatility of nine agricultural commodities in India using monthly wholesale price data. The study also analyzes the impact of market liberalization and other government policies on the price volatility in India and the effects of futures market on volatility of commodity prices. Various GARCH (Generalized Autoregressive Conditional Heteroskedastic) models are estimated for the analysis. Results show that devaluation of Indian Rupee and presence of futures market did not affect the domestic price variance of commodities. In case of wheat, sugar, groundnut oil, cotton and onion certain government policies did attain their stated objective of reducing price volatility. However, overall it can be said that most of the policies did not affect the price volatility.

CHAPTER 1
INTRODUCTION

Agricultural commodities play an integral part in the economies of most of the less developed countries (LDCs). FAO's State of Food and Agriculture (1995) reports forty-nine economies to be highly dependent on agricultural exports. In 1990, the share of agricultural exports in total exports exceeded 80 percent in ten of the 26 LDCs for which data are available. In another five countires the share exceeded 60 percent. In 1992, in a large number of these countries, more than 40% of total agricultural exports were comprised of only one or two agricultural commodities. For example, in case of Comoros vanilla and cloves contributed more than 90% to total agricultural exports. For the LDCs that are heavily dependent on a single export commodity, the volatility in commodity prices may impose very large costs (Newbery and Stiglitz 1981).

Even when a country's export earnings or import bill does not depend heavily on a single commodity, wide fluctuations in prices of agricultural commodities can be very costly for both producers and consumers. The consequence of price fluctuation is more severe for less developed countries as a large part of the financially improvised population earns its income mainly from agricultural sector. The fluctuations in prices affect both consumers and producers. Price variability leads to income instability for producers. The adverse effects that producers might suffer due to a price slump in the good harvest season can be much larger than the benefits that they reap due to higher prices in poor harvest season. Islam (1996) found that for producers in Bangladesh the adverse effect due to a price fall in absence of a price stabilization scheme was 47 percent

higher than the positive effects due to higher prices. Marginal farmers can become bankrupt due to steep price falls. Islam (1996) argues that producers benefit from price stabilization due to the role it plays in stabilizing their income.

Price instability imposes costs on consumers with more severe consequences for the poorer consumers. As the price of a commodity increases, consumers are obliged to search for cheaper and inferior alternatives. The search for cheaper alternatives not only involves transaction costs but also reduces utility (Islam 1996). The situation is worse for the poor consumers if the price of their staple food (for example rice and wheat in India) is volatile. Sharp price fluctuations can cause famine or a push towards starvation for poor consumers, as they cannot afford higher prices. For example, rice and wheat are the major source of calories in India and account for 20% of urban and 30% of rural per capita food expenditure. Thus a severe fluctuation in the price of wheat and rice can cause hardship for Indian consumers.

It is not possible for poor, undernourished consumers to decrease their food consumption and often have to sell their assets when the prices are high. Thus instability has asymmetrical effects because the negative welfare impact of high prices is larger then the positive welfare effect from lower prices. The short-run price volatility caused an increase in mortality by a little under 10 percent during famines in Madras, India and Bangladesh. The increase in deaths that occurred due to price stability accounted for about one-third of famine mortality (Islam 1996).

Apart from benefits to consumers and producers there are macro economic benefits from price stabilization that spill over to the rest of the economy (Islam 1996).

Thus it is hardly surprising that governments in most of the countries have been intensely concerned about the instability of agricultural commodity prices. The governments in many less developed countries are committed to ensuring food security to their poor population and use price stabilization programs extensively to meet this objective.

Countries use diverse instruments to attain price stabilization. The most commonly used price stabilization schemes in a developing country are buffer stocks and trade policies. Some countries (e.g. India, Pakistan) have used the public distribution system for providing food items to consumers at fixed prices. In different countries, government policy has focused on different groups while building price stabilization programs. For example, in Philippines policy favors producers over consumers but in Indonesia, Pakistan and Bangladesh, a high priority was given to food distribution to designated consumers. The experiences across countries have not been consistent. Some countries have been more successful than others in attaining the objective of price stabilization (Islam 1996). Islam says "the variation in degree of instability in domestic prices across different countries can be related to, among other factors, the variability in domestic production, the relative importance of public procurement and distribution of food grains, and the compensating variations in stocks and imports."

India has a well-documented historical record of placing importance on curbing price volatility and ensuring stable income to farmers. Since its independence in 1947, the focus of Indian food policy has been to stabilize the domestic prices, increase the availability of food grains and to ensure the equitable distribution of food grains. In the absence of price stabilization policies, farmer's incomes could fluctuate considerably due

to volatile prices and erratic monsoons and resulting fluctuations in agricultural output. Government protects consumer's interests by preventing prices from reaching exorbitant levels by using buffer stock operations and distributing selected commodities through public distribution system.

In order to meet its food policy objectives, the government of India intervenes heavily in the domestic food markets in various forms and degrees. The term "intervention" refers to all the activities of the government that influence quantity and prices. Intervention is not limited to wheat and rice markets, but is prevalent in almost all agricultural commodities under different rationales. The intervention takes the form of controls on movement, storage and access to trade credit and risk management instruments (futures markets), various import and export restrictions, canalization of imports and exports through governmental agencies, procurement operations through Food Corporation of India (FCI), and price support policies. Some of these restrictions have been relaxed in the recent years in order to meet the GATT agreement requirements.

Srinivasan and Jha (2001) point out that for rice and wheat, domestic production has been much more unstable as compared to the world production and in the absence of price intervention domestic prices could have been possibly more volatile than the world prices. Due to fears about the increased domestic price volatility caused by freeing of the international trade, most developing countries do not use international trade to smooth price fluctuations. Indian agriculture is gradually opening up to world markets. Price volatility and the ability to cope with it are major policy concerns that India faces. India

needs to adjust to the changing scenario and to devise new policies in order to meet its objectives.

During the last two decades many developing countries have been moving toward free-market oriented agricultural policies. The Indian government has also been actively pursuing this push towards market liberalization. Opening of domestic markets integrates them more closely with the international markets and hence domestic prices are subject to wider price fluctuations. On the other hand, freer domestic and international markets would reduce transactions costs, increase arbitrage opportunities, and free trade might compensate for fluctuations in domestic supply and demand. Hence market liberalization might have a dampening effect on price volatility. The effects of different government and market liberalization policies on commodity price volatility have not been studied in the Indian context.

Producers and consumers of agricultural commodities in more developed countries can use futures markets to hedge a part of price uncertainty. Futures markets can be effectively used to mitigate price risk. Such futures markets are not well developed in developing countries.

Futures markets are currently available for only a few agricultural commodities in India, including cotton, potatoes, pepper, turmeric, etc. Interestingly, futures markets are not licensed for more important crops like rice, wheat, sugar, oil seeds, pulses, etc. Futures markets have been viewed with suspicion in India. Although futures markets existed for cotton in early 1900s, they were banned in India until 1990s. There is a belief in certain segments in India that futures markets manipulate prices (World Bank 1996).

The effect of the presence of futures market on spot price volatility has not been studied in the Indian context.

Price volatility of nine agricultural commodities in India is analyzed in this thesis. The main objectives of the study are:

1. To describe volatility of wholesale agricultural prices in India overtime.
2. To analyze price volatility under different policy regimes.
3. To investigate the effects of futures market on volatility of commodity prices.

CHAPTER 2
LITERATURE REVIEW

Many countries adopt price stabilization program to decrease price volatility. This chapter reviews costs and benefits of price stabilization and various instruments that have been used by various countries to attain that end. This chapter also discusses the previous studies that analyzed price stabilization and presents the experiences from different countries especially in context of trade (liberalization). It concludes with a discussion of the Indian scenario.

In general, commodity prices show a pattern of high instability, with occasional high, short-lived peaks. Deaton and Laroque (1992) observed the behavior of commodity prices over the 1900-87 period, and noted that (i) commodity prices in U.S. have high autocorrelation coefficients of the first and second order, (ii) a current shock does not persist into the distant future, and (iii) positive shocks are more frequent than negative ones. This asymmetric pattern can be explained by the existence of storage, which cannot be negative.

2.1 A General Overview of Price Volatility (Stabilization)

2.1.1 Causes of Price Volatility

It is important to understand the causes of price variability because the underlying source of price variability affects the outcome of price stabilization schemes. Price variability can arise due to demand-side or supply-side variations (Newbery and Stiglitz 1981). In Indian context, Srinivasan (2002) says that instability in supply can also arise due to high dependence on monsoons. Volatility in agricultural food commodity prices

can be largely attributed to supply disturbances, whereas volatility in industrial raw materials, both agricultural and metallic, originates in demand disturbances (Claessens and Duncan 1993).

Demand variability can be categorized as *systematic demand variability* and *non-systematic demand variability*. In case of systematic demand variability the demand for a commodity varies over time in a regular and predictable way. Income variability and the variation in the price of other commodities are the main reasons giving rise to this kind of variability. Nonsystematic demand variability arises due to changes in tastes and changes in technology (Newbery and Stiglitz 1981).

Supply side variability can also be classified as *systematic supply variability* and *non-systematic supply variability*. Variability in rainfall and other production conditions, variability in prices of inputs and variability in price expectations of output are the main sources of systematic supply variability. The major source of non-systematic supply variability is technical change in production of commodities (Newbery and Stiglitz 1981).

2.1.2 Consequences of Price Volatility

Price volatility leads to increased uncertainty and risk and that has negative influence on the supply response (Srinivasan 2002). Price volatility also makes it difficult for farmers to forecast prices accurately while committing their resources (Hazell 1988). Food price volatility has adverse impacts on consumers, especially the poor, as a large share of their expenditure is on food (Srinivasan 2002). Price volatility not only makes

the food insecure population more vulnerable but also creates problems for formulation of macroeconomic and microeconomic policies (Deaton and Laroque 1992).

2.1.3 Benefits and Costs of Price Stabilization

As Timmer (1989) suggested, the benefits of stabilizing staple food prices can be categorized as benefits to consumers, benefits to producers, and finally macroeconomic benefits. Poor consumers benefit from stable staple food prices. Volatility in food prices can cause significant hardship for cash-constrained poor consumers. Producers (farmers) also benefit from price stability as their income is protected from wide fluctuations. Apart from these microeconomic effects, price stability also has significant macroeconomic impact on investment and growth, especially in developing countries where staple food crops form a large share of economic output (Dawe 2001). Knudsen and Nash (1990) say,

> " Stabilization of the prices of tradable goods may function to insulate the domestic macro economy from external shocks. If changes in the international price of a country's major exports, for example, were fully reflected in changes in domestic producer prices, then domestic production adjustment would tend to reinforce external price changes to generate greater instability in export earnings. This instability in export earnings would create uncertainty in budgeting, as well as causing fluctuations in macro economic variables".

Thus the objective of price stabilization is an integral part of food policy in both developing and developed countries (Jha and Srinivasan 1999).

Price stabilization also involves various costs. Newbery and Stiglitz (1981) claim that these costs have been underestimated. Islam and Thomas (1996) say

> "direct costs of price stabilization include interest costs of the financial capital required to purchase and sell food stocks, transport and handling charges, rent of physical storage facilities, and any wastage of food stocks that may occur in storage as well as the cost of management and organization of the agency. To the extent that the margin between selling and buying prices is not adequate to cover costs, then subsidies need to be paid; similarly there is need for the subsidy if there are losses in external trade."

According to Pinckney (1989) and Newbery and Stiglitz (1981) the price stabilization schemes lead to the substitution of public for private storage. The government cost of storage can be very high when we take into consideration the fact that the commodity prices are dynamic and stochastic in nature in certain cases. In that case the government needs to have enough in storage facility to take care of both the good and bad years (Newbery and Stiglitz 1981). There are some indirect costs also attached to the price stabilization that are imposed out of the food grain sector due to the possibility that excess expenditure on stabilization programs leads to budget deficits and reduces the availability of credit in the rest of the economy (Islam and Thomas 1996).

The debate over the benefits of price stabilization is heated and yet to be resolved. Newbery and Stiglitz (1981) maintain that the benefits of price stabilization are small as compared to the cost of operating the buffer stocks and are not essentially distributed in favor of producers. Gilbert (1997) found that the benefits of stable but lower producer

prices in African cocoa producing countries are lower relative to the cost of price stabilization. This finding was also confirmed by McIntire and Varangis (1999) for Cote d'Ivoire. Only modest potential gain from reduced price uncertainty was found by Hazell (1994) for coffee farmers in Costa Rica. Newbery and Stiglitz (1981) focused mostly on microeconomic benefits and paid very little attention to macroeconomic benefits. They emphasized that the microeconomic benefits have been overestimated not the total benefits. Kanbur and Vines (1984) show that larger benefits are possible from the stabilization schemes. If one explores the macroeconomic effects of food price instability beyond the agriculture sector, one can refer to the impact price stability has on inflation, investment and economic and political stability. These macroeconomic benefits of price stabilization need to be explored more (Islam and Thomas 1996).

2.1.4 Instruments Used for Price Stabilization

Although the costs sometimes exceed the benefits of price stabilization, few countries allow the market prices of food grains to fluctuate freely without some form of intervention. Policy makers in developing countries use different instruments to attain the objective of price stabilization and try to attain this end with different degrees of success and at different costs (Islam and Thomas 1996). However, the instruments used vary widely across countries and are not easily distinguishable from other schemes that have other purposes, for instance, taxation of producers and consumers (Knudsen and Nash 1990).

Stabilization schemes can be largely divided into two categories: those that require physical handling of the stocks of the commodity and those that do not. The former category includes buffer stocks and marketing boards, and the latter one includes various kinds of taxes and restrictions. The buffer stock scheme is generally used for basic consumption items- rice in Philippines, South Korea and Bangladesh; wheat and rice in India; corn and wheat in Mexico. In some South Asian and Latin American countries this scheme is supported by domestic procurement and in other countries like Indonesia through imports. The marketing boards are more common in African countries. They are also used for traditional tropical imports (Knudsen and Nash 1990). An appropriate combination of these mechanisms can be used to smoothen both inter-year and intra-annual price fluctuations (Islam and Thomas 1996). Pinckney (1989) suggested that for smoothing interyear fluctuations reliance on foreign trade is preferable to public stock policy due to cost considerations, whereas it is more appropriate to use buffer stocks for stabilizing seasonal fluctuations.

2.2 Previous Studies

During, past few years, there has been an increasing interest in the formation of a program for price stabilization for the macro, economy wide level and the micro sectoral level. Waugh (1944), Oi (1961) and Massell (1969, 1970) did the pioneering work on sectorial study of these policies within a partial-equilibrium framework. Hueth and Schmitz (1972) extended the model to open economy. In late seventies the attention shifted to trade and trade policies. Dasgupta and Stiglitz (1977) and Young (1979) carried

out the analysis and partial equilibrium model while some other studies concentrated on trade and trade policies under uncertainty. Newbery and Stiglitz (1981) evaluated the welfare effects of price stabilization under an entirely different analytical approach that does not suffer from the drawbacks of Waugh-Oi-Massell model. They discuss in detail the desirability of stabilizing agricultural commodity prices by using buffer stock scheme. They also discuss in passing a number of other proposed alternative schemes (Bigman 1985). Numerous studies also focused on policies with explicit price stabilization objectives under unstable external and internal conditions. Bigman (1985) examined in his book the effects of instability in agriculture and alternative stabilization policies on consumers and producers.

2.2.1 Studies on Impact of Trade on Price Stabilization

Free (international) trade has been unpopular in many regards in context of agricultural commodities in general and food grains in particular. Choudhury (1995) says "international trade has been able to introduce the widest possible fluctuations in the prices that have driven many commodities out of the market." Claessens and Duncan (1993) also say "because of their export revenue profile, many developing countries are highly exposed to fluctuations in world commodity prices. Not only export revenues in these countries are vulnerable but also government revenues, import expenditures, and the incomes and profits of state and private enterprises." Free trade has been criticized for depressing agricultural production in importing countries and increasing their dependence on exporters of these commodities. This high dependence further exposes these countries

to a higher risk arising out of supply shortages (Bigman and Reutlinger 1979). Bigman and Reutlinger say "free trade is presumed to import instability because of the growing dependence on surpluses that might be temporary."

During the last two decades many developing countries have gradually opened their agricultural sectors to the world markets. Thus, it is important to analyze the impact of free trade on domestic price volatility and any positive role that free (or international) trade can play in price stabilization. Bigman and Reutlinger (1979) developed a stochastic simulation model to examine the extent to which random fluctuations in a country's production and in international price of grain translate into instability in domestic grain consumption and prices. They also analyzed the role of buffer stocks in stabilization. They concluded that for most countries international trade is a good way of achieving greater price stability in the domestic market. Jha and Srinivasan (2001) found that allowing free trade in food grains in India would reduce domestic price variability. This would happen despite of the fact that the international prices are more volatile than domestic prices. In fact, freeing of trade by India would bring greater stability to world prices.

Considering commodity specific cases, Borrell and Duncan (1992) claimed that the policies designed by various countries to protect domestic sugar producers from price instability worsened world sugar price fluctuations. Due to economic and political dynamics, monthly sugar prices fluctuated between a low of 2.7 US cents per pound to a high of 41.1 U.S. cents per pound during the 1980s (Marks and Maskus 1993). If all interventions in domestic sugar markets by all countries are removed, world prices would

fluctuate much less and economic conditions would improve significantly in sugar exporting developing countries (Borrell and Duncan 1992).

Alderman and Shively (1996) focus on price trends in Ghana in the post-reform period. Ghana implemented an Economic Recovery Program (ERP) in 1983. ERP led to a rapid and massive currency devaluation and the Ghanaian government moved from a fixed exchange rate regime to a managed float between 1983 to 1985 (Shively 1996). Alderman and Shively (1996) analyzed the behavior of prices for six commodities in Ghana using data for 1970-1993 study period. They concluded that Ghana's ERP made only a small impact on the overall price level of food. The prices did not show any increase in volatility after the reform period.

Shively (1996) also found the same result in case of maize in Ghana. He used an Autoregressive Conditionally Heteroskedastic (ARCH) model to measure changes in maize price volatility in Ghana. He found that the immediate effect of reforms was lower but more volatile prices but price volatility declined subsequently. A post-reform price reduction was evident even when the production was incorporated as an explanatory variable.

However, the impact of removal of trade restrictions and other interventions on price volatility is not expected to be uniformly positive for all countries and commodities. According to Claessens and Duncan (1993) developing countries with export revenue profile are highly exposed to fluctuations in world commodity prices. In several developing countries the exports of a single commodity (for example, coffee for Burundi and Burkina Faso) account for more than 90 percent of total export earnings. Even in the

presence of domestic price stabilization schemes that can cause domestic commodity prices to diverge from international prices, uncertainty about international prices still often results in substantial uncertainty in local-currency prices for final producers.

Uncertainty about international commodity prices also affects developing countries that import basic consumer goods, including foodstuffs. Changes in international prices greatly affect consumer welfare and sometimes political stability. To cope with import price variability, these countries try to stabilize the domestic price of imported commodities by using different schemes like variable tariffs or trade restrictions (Claessens and Duncan 1993).

Hazell (1988) observed that over the period 1961-71 to 1974-81 price variability increased 400 percent for wheat and 59 percent for rice in world cereal markets. Similar patterns were observed in countries like the United States, Canada and Argentina, which had grain markets that were relatively open to international trade. Hazell (1988) further observes that many other countries with relatively closed markets were able to reduce the price variability despite the increased turbulence in the world markets. This was particularly true about EEC countries, as well as Japan, India, Pakistan, Burma, the Philippines, Colombia, Kenya, and, and Yugoslavia. Hamid, Nabi and Nasim (1991) find out that for Pakistan, government intervention in the form of commodity specific procurement and pricing policies, succeeded in stabilizing producer prices for wheat, rice (*basmati* and new variety IRRI), sugarcane and cotton in the 1961-87 time period. Moreover, the variation in consumer prices was observed to be considerably lower than that of free trade, nonintervention consumer prices.

Dawe (2001) pointed out that free trade in staple foods could make domestic rice prices more volatile in poor (specifically Asian) countries, as they will be exposed to unstable exchange rates. He further states that this instability due to exchange rates could be substantial in a world characterized by liberalized financial markets. He focuses on rice due to its importance in Asia. He says that most countries in Asia have been quite successful at stabilizing domestic prices relative to world prices, without consistent protectionism. That is, the difference between domestic and world prices has been limited on average. This has not always been the case. For example, Thailand maintained domestic prices below world prices in 1960s and 1970s and Philippines has offered consistent protection to its farmers since middle of 1980s.

Barrett (1997) found for Madagascar that the short-term impact of liberalization on the mean and the variance vary by region, commodity and season. There is not even a qualitative uniformity across sub-sectors on the effects of liberalization. But in the long-term, liberalization increases both the mean and the variance of the food prices. He conducted the analysis for five commodities using ARCH-M model. He says, "if policymakers looked to liberalization primarily for higher and more stable real food prices, the empirical evidence suggests reforms were generally ineffective." He further says "given that the net effect of government interventions was generally lower mean and variance of agricultural commodity prices (Krueger, Schiff and Valdes 1988), it is intuitive that the long-term effect of market-oriented reforms has been higher long-term means and variances". The debate on this issue is unresolved. The experiences from different countries will keep adding to the literature.

2.3 The Indian Case

Jha and Srinivasan (1999) say "stabilization of prices is an important element of food policy in India as in most other countries-both developing and developed." The Government of India (GOI) tries to meet its objective of price stabilization mainly by holding buffer stocks. Various studies have focused on the cost of these operations and emphasized that it can become fiscally unsustainable in the long run (Jha and Srinivasan 1999). According to a World Bank estimate, the cost of GOI's food grain policies was $2 billion per year in 1996-97. By 1998-99 food subsidies alone reached $2.2 billion.

Government intervention in Indian agriculture has been pervasive. On the one hand the government intervenes through its price support/ procurement policies and on the other hand it extends various kinds of subsidies to the farmers. Various government policies insulated the domestic market from external influences by imposing various quantity and/or price controls over exports and imports of commodities and by "canalizing" the import and export operations through public corporations (Gulati, Hanson and Pursell 1990).

Kotwal and Ramaswami (1999) call 1991 as the watershed year in Indian economy. A beginning was made in July 1991 with a devaluation of rupee by about 20%. Sustained changes were made in economic policies in the areas of industry, trade, exchange rates and taxation (Kotwal and Ramaswami 1999), though agriculture was not a part of liberalization measures taken in 1991 and 1992. Although liberalization has continued trade in agricultural commodities is still considerably regulated (Storm 1999; Pursell and Gulati 1995). Currently, the GOI must prepare for the elimination of quantity

restrictions and progressive reduction of tariffs under the Agreement on Agriculture. The prime concern that GOI faces is dealing with unstable world prices and its impact on domestic price volatility and hence food security.

The studies reviewed so far focus mostly on comparison in changes in price volatility pre-reform and post-reform. Very few studies have analyzed the impact of specific policies on price volatility. In case of India the focus has been mostly on the costs of GOI stabilization policy. This study tries to fill this gap by analyzing how successful government has been in attaining its objective of price stability and what are the major policies that affected price volatility over time.

CHAPTER 3
INDIAN AGRICULTURAL POLICIES: AN OVERVIEW

Traditionally, India has been an agricultural economy and even today agriculture is the backbone of the Indian economy, providing direct employment to 66% of working population. Agriculture provides raw material for many important industries in India, including the textile, jute, and sugar industries. Agriculture accounts for 25% of Indian GDP and about 25% of India's exports are agricultural products (Riceweb 2003).

A wide variety of tropical, sub-tropical and temperate crops are cultivated in the country. Food crops are grown on nearly 70% of the gross sown area. Food grains consist of cereals such as rice, wheat, millet, sorghum, and maize as well as pulses (Riceweb 2003). India is also among the leading producers of sugarcane, tea, cotton, and jute. Cashews, coffee, and spices are also important cash crops. Other crops include vegetables, melons, sorghum, millet, corn, barley, chickpeas, bananas, mangoes, rubber, and linseed. India is one of the world's largest producers of fruits and vegetables. The raising of livestock, particularly horned cattle, buffalo, horses, and mules, is a central feature of the agricultural economy of India (IndiaCore 2003).

3.1 Agricultural Commodity Policy in India

Since independence, the Government of India (GOI) has tried to ensure food security in the face of natural calamities and chronic energy deficiencies. Food security remains a critical issue for government with the population exceeding one billion including 300 million poor (Umali-Deininger and Deininger 2001). Since independence

the food policy of India has held three main objectives with varying degrees of importance (Chopra 1981):

a) Self-sufficiency in food grains production

b) Price stability of food grains and

c) Assurance of an equitable distribution of available food grains at reasonable prices

The GOI met the first objective of self-sufficiency in food grains by 1990s as a result of heavy investments in agricultural technologies, services and rural infrastructure (Jha and Srinivasan 1999). In order to meet the second and third objectives GOI created a public marketing system that parallels the private sector. The public system was created to safeguard the interests of low-income consumers, both in terms of food grain availability and prices and also guarantees a "fair" price to producers. The main instruments used by the GOI to achieve these goals are minimum support prices and procurement prices, procurement of rice and wheat by Food Corporation of India (FCI), and maintenance of buffer stocks. Further, GOI and state governments have imposed controls on inter-state grain movement, storage, exports and imports, and access to trade credit and risk management instruments to support the food grain distribution and price stabilization program (Umali-Deininger and Deininger 2001).

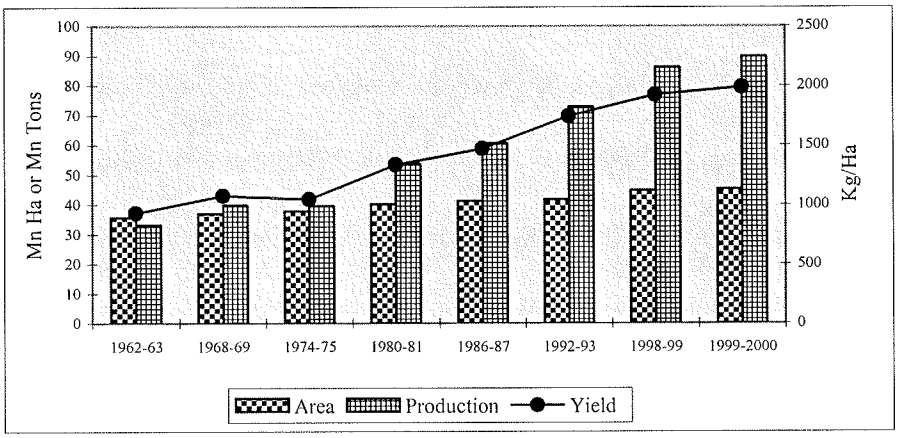
This chapter presents a brief background for nine commodities, their importance to the Indian economy and an overview of the main policies adopted by GOI.

3.2 Commodity-Specific Policies

3.2.1 Rice

Rice is the staple food of about 65% of the population in India (Riceweb, 2003). It constitutes about 42% of the total food grain production and 40% of total cereal production (Ministry of Agriculture 2003). Figure 1 shows the area, production and yield for rice in India from 1962-63 to 1999-2000. Rice production has exceeded 50 million tones annually since 1980; total production in 1999-2000 was almost 89.86 million tones, with an average yield of 1900 kg/ha.

Figure 3.1: Planted Area, Production and Yield of Rice in India



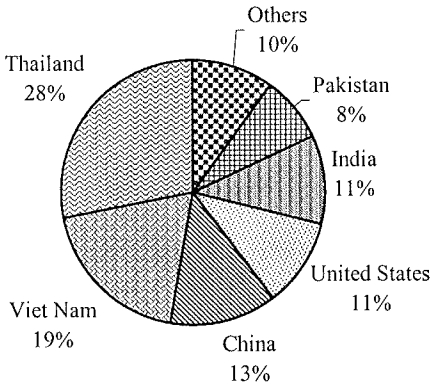
Source: Ministry of Agriculture, India

West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, Tamilnadu and Bihar states account for two-thirds of total Indian rice production and more than half of the area. Rice is grown mainly in two seasons in India (Kharif[1] and Rabi[2]), but in some states like Tamilnadu and Kerala three crops are harvested (Krishiworld 2003). Kharif crop accounts for about 86% total rice production (Ministry of Agriculture, 2003).

[1] Refers to crops that are harvested beginning of winter (October/November)
[2] Refers to crops that are harvested end of winter (March/April)

India is an exporter of high quality (basmati) rice. Figure 2 shows major rice exporting countries in the world. Indonesia, Bangladesh and Brazil are the main rice importing countries (FAO 2001-02c).

Figure 3.2: World Rice Exports by Volume (Million Tones) in 1999



Note: Others include Argentina, Australia, Myanmar, EC, and Uruguay
Source: FAO, 2001-02c

Rice, being the principal staple for consumers and a mainstay for the farming population, is an important crop for India. Most countries, where rice is a staple crop try to attain a high degree of self-sufficiency to ensure food security because of the thinness of the international rice market. Not surprisingly rice is one of the most protected commodities in India. The rice sector is subject to direct government intervention in domestic marketing through state trading agencies as well as high tariff and non-tariff barriers (FAO 1999-2000a).

The government also imposes various regulations on inter-state movement of rice and on private storage to restrict private-sector operations. The zoning policy under which inter-state or inter-zone movement of grains is restricted has been a controversial subject in India. The supporters of zoning policy say that this policy allows the

procurement at relatively lower prices as it prohibits the movement of grains from the surplus states. But the opponents have argued that this policy leads to a larger inter-state price dispersion (Raychaudhuri and Krishna 1979). These movement restrictions could be an important variable affecting price volatility of rice but due to the lack of information this variable could not be included in the model and used in this thesis.

For rice, the heaviest intervention results from a two-tiered pricing system known as the *State Levy Control Orders,* which have been in existence since 1964. Under these orders private rice mills are required to deliver 7% to 75% of their output to Food Corporation of India (FCI) and other state organizations to meet the requirements of Public Distribution System (PDS) and buffer stocks. Rice mills can sell in the open market only after meeting the levy requirements. These orders are not uniform across states. For example, in 1998, the government of West Bengal started imposing a 5 mt per year levy on rice hullers (World Bank 1999).

Throughout the period from 1963 to 1993, exports and imports of rice have been subject to various restrictions. The minimum export price was abolished for basmati rice in December 1993 and for non-basmati rice in October 1994 (FAO 1994-95a). The exports of rice were liberalized in 1994. Rice exports were again banned in 1996-97 and permitted subject to quota in 1997-98. Flour millers were temporarily allowed to import through the state-trading corporation in 1996 and in 1997, but private imports were insignificant. The GOI allowed private imports of high quality rice for short period because of the fear of consequences of declining government stocks; high domestic prices

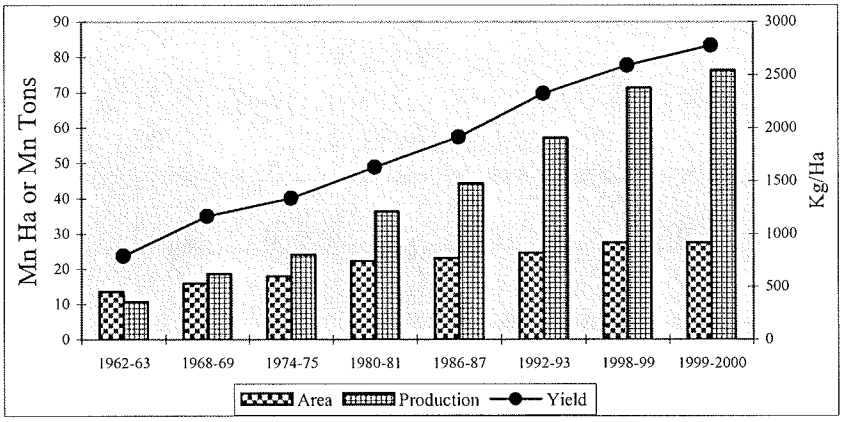
anticipated higher Targeted Public Distribution System (TPDS) requisitions (World Bank 1999).

It was announced by the GOI on 29 May 1997 that it would allow the free importation of common and coarse varieties of rice. Fine and superfine varieties can also be imported provided that the share of broken rice in these varieties does not exceed 50%. Imports of premium rice continue to be restricted. This announcement was made due to the fear of increase in price in local markets and to discourage hoarding among traders (FAO 1995-97a). In 1997 GOI abolished the Rice Milling Industry act, which required that rice be milled in small-scale operations.

3.2.2 Wheat

India produces about 12 percent of world production of wheat. Wheat has the second largest share in Indian food grain production at 35%. Figure 3.3 shows that the production of wheat has increased over eight-fold from less than 11 million tones in 1966-63 to 77 million tones in 1999-2000. This growth in production was attained from an expansion of area as well as an increase in yield. During the same time period (1966-2000) the area has expanded about 2 times from 13.59 million hectares to 27.4 million hectares. The growth in the wheat yield has been spectacular over the 38-year period. The growth in yields has been achieved principally through the green revolution technology package of high yielding varieties, fertilizers and irrigation.

Figure 3.3: Planted Area, Production and Yield of Wheat in India



Source: Ministry of Agriculture, India

Wheat production is mainly concentrated in northern India and to a lesser extent in Western India because wheat has a relatively narrow geographic land base of production. Even within many wheat-growing states the wheat areas are limited and only about 18 per cent of the net cropped area in India is planted to wheat. Uttar Pradesh, Punjab, Haryana, Rajasthan and Madhya Pradesh are the major wheat growing states in India. Wheat is also grown in Gujarat and Bihar. Uttar Pradesh contributes the largest share with 36 per cent of production, followed by Punjab with 19 per cent and Haryana with 11 per cent. These three states together account for two thirds of the production and three-fifths of the area (Ministry of Agriculture 2003).

India is not a major exporter or importer of wheat. GOI intervenes heavily in the wheat market and that influences prices, storage, processing and distribution of wheat. The "Takeover Scheme" was introduced in 1973-74 that essentially made the GOI a monopoly in the wholesale grain trade. The scheme was supposed to mitigate the problem of hoarding, cornering and profiteering by wholesale traders. The salient features of the scheme included: 1) imposition of ban on private wholesale traders in

wheat all over the country. 2) Institution of single state zones (from April 1973). In Bihar, Madhya Pradesh, Uttar Pradesh, and Rajasthan, the movement of wheat and wheat products was restricted within the states. The policy of wholesale wheat trade takeover did not pay off and was abandoned in one year in favor of new policy in 1974-75 (Chopra 1981).

Private wheat trade is also subject to inter-state or inter-zone movement restrictions. The movement restrictions have changed numerous times bth in terms of extent and geographical area of restrictions. Unfortunately data on these details are unavailable and movement controls could not be accounted for in the model used for this thesis.

The government maintained its foreign trade monopoly for wheat for a long time. The government no longer has a monopoly on foreign trade in wheat, but the policy has fluctuated substantially in the past few years ranging from full export liberalization to export bans and quotas. Exports of wheat and wheat products were liberalized in 1994, banned in 1996-97 and permitted subject to quota in 1997-98. In 1996 and in 1997 flour millers were temporarily allowed to import through the state-trading corporation, but private imports were insignificant (the flour milling industry was delicensed in 1986) (World Bank 1999). For common wheat an export quota of 500,000 tons was set up without any minimum export price (MEP) in 1994. This quota was valid up to the end of March 1995. For year 1995-96, the export quota for ordinary wheat was raised substantially to 2.5 mn tons, due to an expected bumper harvest, large carryover stocks and high storage costs (Cereal Policy Review 1994-1995). GOI imposed a ceiling of 150,

000 tons on exports of wheat products (mostly wheat flour) from October 1996 to March 1997. Previously, wheat flour exports had been open under general licensing without any limitations on volume. After the outstanding wheat export licenses carried over from the 1995-96 season expired on 30 September 1996, the GOI announced that it would not issue additional licenses beyond one million tons that had been issued at the start of the 1996-97 fiscal year (FAO 1995-97a). In August 1998, the importation of wheat was allowed under an open general licensing in an effort to check soaring prices. Moreover, in April 1999 the Indian trade policy was amended to bring India further in line with WTO disciplines. The amendments eliminated the import-licensing requirements for the cereals (FAO 1998-99a).

3.2.3 Pulses

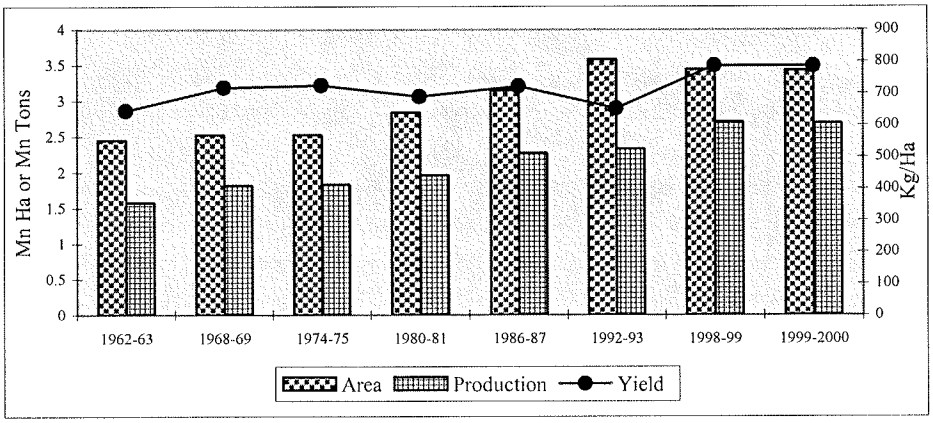
Pulses are the dried edible seeds of leguminous plants. Pulses hold special nutritional value for the millions of people worldwide as a low cost source of protein (Pulses have protein content 2 to 3 times higher than cereals) and also as an important source of energy. Additionally, they are a good source of minerals such as calcium and iron. They are, therefore, justifiably called "the poor man's meat". The developing countries account for about 90% of world human pulse consumption. In most low-income countries, pulses account for about 10 percent of the daily protein and about 5 percent of energy intakes in diets of people (FAO/GIEWS 2001).

India is the world's largest producer of legumes (peas and pulses) producing about 90% of total world production. Pulses are grown on about 18% of total area in

India but contribute less than 8% of total food grain production (Gupta 2003). World trade in this crop is very thin representing only 1% of total production. In recent years India has increased pulse imports from the East African countries (Ryan 1998).

Figure 3.4 shows that over the years the total area under pulses has not shown an upward trend but due to an increase in yield the production has gone up. But the increase in production has not been able to keep pace with the population growth; this has led to a decrease in per capita availability and a hike in prices. The net availability of pulses has come down to 36 grams in the 1990s as compared to 70.0 grams in the 1960s (Gupta 2003).

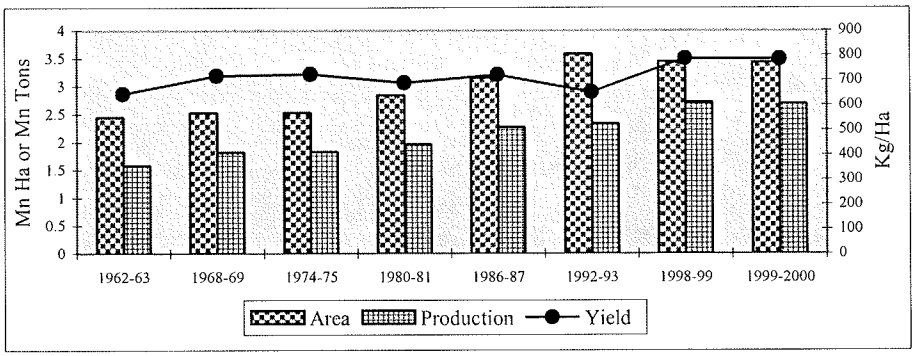
Figure 3.4. Planted Area, Production and Yield of Pulses in India



Source: Ministry of Agriculture, India

The major pulses grown in India are – pigeon peas (Arhar) and Tyson chickpea (Gram). Their share in total pulse production is about 21% and 33% respectively. Pigeonpea is a Kharif pulse and Chickpea is a Rabi pulse (Gupta 2003). The Figure 3.5 shows that the area under Pigeonpea and the production of Pigeonpea have gone up. The figure also shows an increase in the yield.

Figure 3.5: Planted Area, Production and Yield of Pigeon Peas in India



Source: Ministry of Agriculture, India

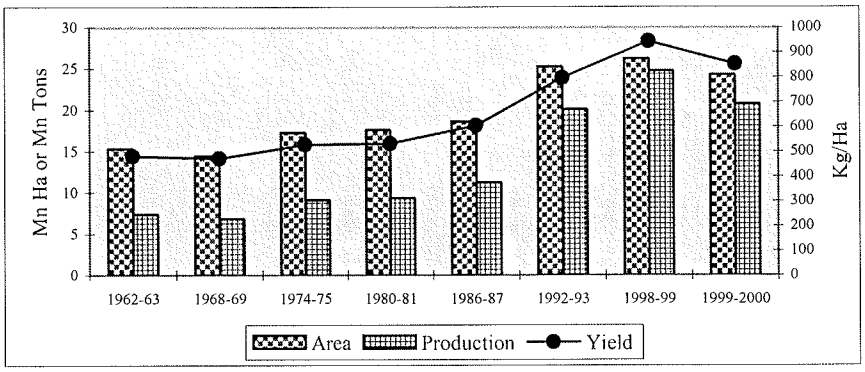
Imports of pulses are allowed freely at zero duty. However, the exports of pulses of all types including lentils, grams, beans and flour, except those in consumer packs upto 5 Kgs are subject to licensing (Ministry of Agriculture 2002).

3.2.4 Oilseeds

India has a prominent position, both in acreage and production on the oilseed map of the world. Groundnuts, rapeseed and mustard, soybeans, sunflower, sesame, castor, linseed, cottonseed and copra are the world's important oilseeds (Agrifare 2003).

Oilseeds are cultivated on about 16.5 million hectares- approximately one-tenth of the total cultivated area in India, with total production of 10 million tons (Krishiworld 2003). Figure 3.6 shows that the area under cultivation, production and yield of oilseeds has increased.

Figure 3.6: Planted Area, Production and Yield of Oilseeds in India



Source: Ministry of Agriculture, India

Groundnut Oil

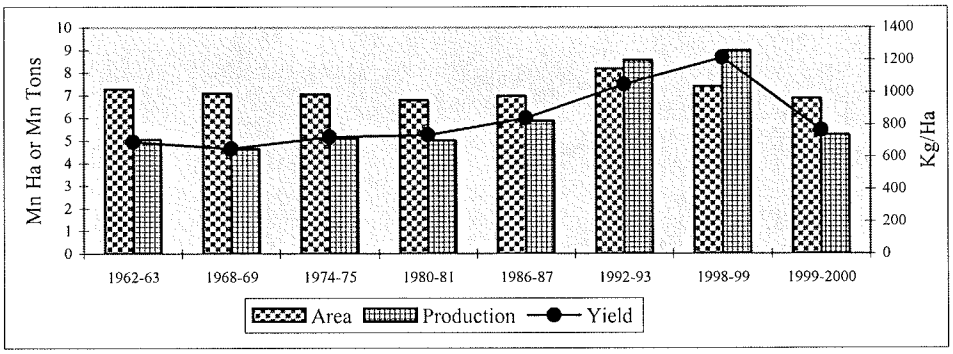
Groundnut is the most important domestically produced oilseed in India. Groundnut oil is used extensively as a cooking medium both as refined oil and *Vanaspati Ghee* (purified butter). Groundnut cake is an important protein supplement in cattle and poultry rations in India. As a legume with nitrogen fixing capabilities, groundnut plays an important role in crop rotations in India.

India, China, Nigeria, Senegal, Sudan, Burma and the USA are the major groundnut-producing countries of the world. These countries account for about 70% of world's production and area planted. Developed countries like UK, Holland, Germany, France, Canada and Japan account for 65 percent of world groundnut demand (Nautiyal 2003).

In India the area under groundnut cultivation has been more than 7 million hectares since 1990s and the production has fluctuated between 7-9 million tons (see

figure 3.7). Gujarat, Andhra Pradesh, Tamilnadu and Karnataka account for 70% of the groundnut area and 75% of production in India.

Figure 3.7: Planted Area, Production and Yield of Groundnut in India



Source: Ministry of Agriculture, India

Groundnut oil is thinly traded in international markets because the major producers like China, India and the United States consume substantial amounts of their domestic production. Edible groundnuts dominate world groundnut trade while groundnut oil is of minor importance. India does not trade much groundnut oil.

India was an exporter of handpicked, select (HPS) groundnuts to European countries in 1970s. The Indian Oil and Produce Exporters Association (IOPEA) was appointed as the canalization agency for exports of HPS groundnut in November 1974. The GOI banned the exports of HPS groundnut in 1977-78 and from December 1978, National Agricultural Cooperative Marketing Federation of India Limited (NAFED) became the canalization agency for HPS groundnuts. The GOI allowed private traders and cooperatives to participate in exports from 1982-83 but subject to various regulations. This relatively restrictive export policy regime emerged due to a growing deficit of edible oils at home (Gulati, Hanson and Pursell 1990).

The GOI decanalized the exports of HPS groundnuts from 1986-87 onwards. The exports of groundnut are allowed under Open General License (OGL) against contracts registered with Agricultural Products Exports Development Authority (APEDA) since January 1987 (Gulati, Hanson and Pursell 1990).

In May 1986, India formulated an integrated policy "Technology Mission for Oilseeds" (TMO) with the objective to harness the best of production, processing and management technologies to attain self-reliance (Dahiya 2001 2003). NAFED had been a nodal procurement agency for groundnuts since 1976-77. In 1985-86 it was appointed the nodal agency for the time period 1985-86 to 1989-90. In 1989, this system was again changed as a part of buffer stocks scheme for oilseeds and National Dairy Development Board was appointed the executing agency (Gulati, Hanson and Pursell 1990).

In July 1991, the processing of oilseeds was liberalized in a significant way by the fact that the *Vanaspati* and solvent extraction industries were made free from industrial licensing (Pursell and Gulati 1995). There have been periodic changes in import policy of edible oils. It was brought under that open general license in 1994-95; imports were canalized and restricted before this. The import duty on edible oils was reduced from 25 percent to 15 percent from July 1998 in order to moderate the domestic prices and increase the availability of edible oils (Ministry of Finance 1998-99).

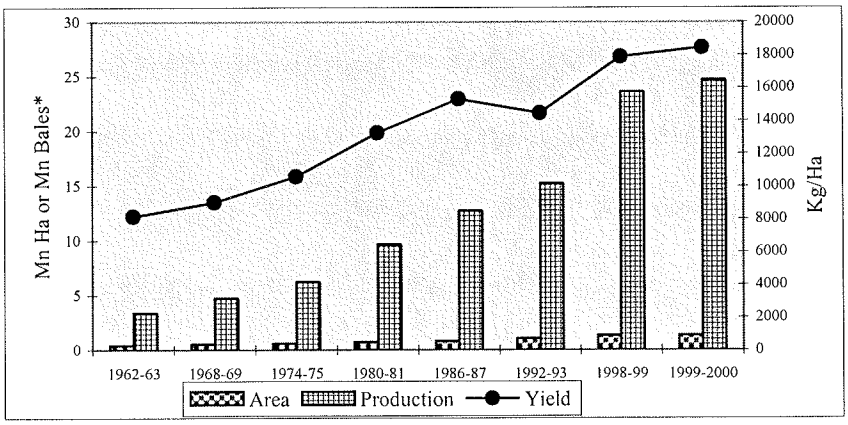
3.2.5 Cotton

India is the third-largest producer and second-largest consumer of cotton in the world. Cotton is an important cash crop and is among the five most important crops in

India in terms of area cultivated. Cottonseed is source of an important edible oil in India (Bartleby 2003).

Figure 3.8 shows that the area, production and yield for cotton have upward trends over the years. Maharashtra, Andhra Pradesh, Haryana, Punjab and Gujarat are the major cotton producing states and account for more than 75% of total cotton production in India. Maharashtra alone accounts for more than 35% of area cultivated and 25% of cotton production (Ministry of Agriculture 2003).

Figure 3.8: Planted Area, Production and Yield of Cotton in India



* 1 Bale = 170 Kgs. Source: Ministry of Agriculture, India

China, Pakistan, India, USA and Uzbekistan are the five largest cotton-producing countries in the world and account for 70% of total world production. Trade in cotton-related textile items contributes almost one third of Indian export earnings (FAO 2003b). In 1951-52 to 1977-78 period, India was an importer of cotton. Indian cotton experienced a technological breakthrough in 1968-69 with the release of hybrid varieties, but the impact of this breakthrough on exports was not felt until 1978-79. India became an exporter of cotton in the time period 1978-79 to 1987-88; GOI optimistically announced

a new cotton export policy beginning in 1986-87. But this policy was abandoned and exports were restricted due to the reduced production of cotton after the drought of 1987 (Gulati, Hanson and Pursell 1990).

During the 1990's, due to the reorientation of its economic development strategy, India has started to re-emerge as a player in the world cotton market (Mohanty, Fang and Chaudhary 2002). Net imports of cotton in 1999-2000 were estimated at 1.2 million bales. While not large on a global basis, these imports were the largest since India last steadily imported hundreds of thousands of bales during the 1960's, and were the largest in India's long history of producing and consuming cotton (USDA 2003).

In India, cotton sector policies have been historically oriented towards promoting and supporting the domestic textile industry (Mohanty, Fang and Chaudhary 2002). The government plays an important role in cotton production through its price support programs. Cotton Corporation of India (CCI), which was founded in 1970, is responsible for providing price support in all states except Maharashtra where there is procurement by monopoly. There are no zoning/movement restrictions in cotton marketing (Gulati, Hanson and Pursell 1990).

Trading in cotton (both domestic and international) continues to be subject to various government interventions. Exports of cotton are under government control. Government adopted this policy of trade control in order to strike a balance between the interests of cotton growers on one hand and the textile mills and the decentralized handloom and power loom weavers on the other hand (FAO 2003b). However, the imports of cotton were placed on Open General License (OGL) since April 1994 and no

license was required for cotton imports and there were no duties. Union budget 1998-99 imposed a duty of 5 percent plus a surcharge of 10% from March 1999 (Ministry of Agriculture 2002).

Cotton is an important raw material to textile industry, so it is important to discuss policies affecting the textile industry. The cotton textile order came into force in 1948 and remained more or less intact till 1985. The objective of this order was to protect handlooms and labor-intensive production (D'Monte 2002). Government had also introduced statutory price controls for certain commonly used varieties of cloth in 1964. This policy required all the composite mills to produce the stipulated minimum amount of cloth to be sold at government fixed prices. The mills were permitted to sell the non-controlled varieties of cloth in the open market. This policy underwent severe modifications and was finally abandoned in 1978 (Misra 1993 and Misra 2000).

The textile policy of 1978 explicitly envisaged a price-stabilizing role for CCI by the use of buffer stocks. The buffer stock concept was abandoned in 1981. Taking a more practical approach, new textile policy of 1985 largely removed the physical curbs on the growth of power looms. It also did away with the virtual freeze on weaving capacity of mills that had existed since 1956 (Misra 1993). An order in 1993 also removed the restrictions on them (Misra 2000). Since the inception of this policy, CCI started performing its price-stabilizing role through import-export interventions (Misra 1993).

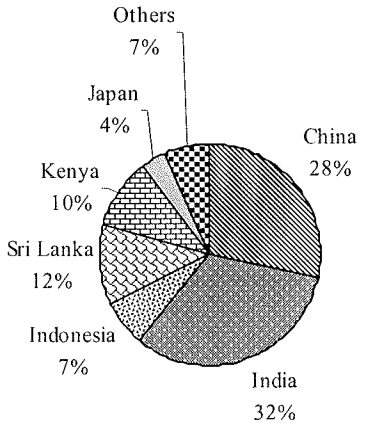
The change in policy in 1991, led to many changes and these changes affected the textiles industry immensely. A new long-term policy for the export of textile and

garments covered by the quota system was announced in 1996 for the time period 1997-99 (Ministry of Finance 1997).

3.2.6 Tea

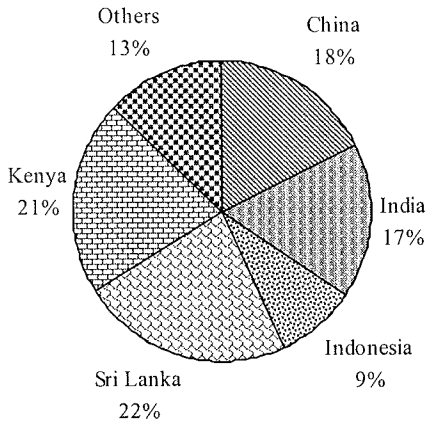
A member of the Camellia family, tea (*Camellia sinensis*, also known as Chinese Camellia) is an evergreen, tropical plant. Tea is the most widely drunk beverage in the world. India, Sri Lanka, China and Kenya are important tea growing countries. Tanzania, Indonesia, Bangladesh, Malawi, and Argentina also produce considerable quantities of tea. Figures 3.9 and 3.10 show world production, tea exports and tea imports. It can be seen that India holds an important position in world tea market both in terms of production and exports (FAO 2001-02c).

Figure 3. 9: Production of Tea by Country in 1999



Note: Others include Malawi, Tanzania, Argentina and Bangladesh
Source: FAO, 1999-2000c

Figure 3.10: Exports of Tea by Country in 1999



Note: Others include Malawi, Tanzania, Japan, Zimbabwe and Bangladesh
Source: FAO, 1999-2000c

Assam, West Bengal, Kerala, Karnataka and Tamilnadu are the major tea growing states in India. Tea is also grown in Tripura and Himachal Pradesh. In 1998, India produced about 870 million kilograms of tea with 4,00,000 hectares planted (Tea Sourcing Partnership 2003).

GOI does not impose restrictions on the export of tea but imports of tea into India are restricted. Imports against license are also allowed subject to the condition of re-export with blending and positive value addition. In August 1998 GOI allowed unrestricted imports from SAARC countries. SAARC countries include Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka (Ministry of Finance 2000-01 2003).

3.2.7 Sugar

India is the largest consumer and producer of sugar in the world (Ministry of Finance 2000-01, 2003). The economics of the Indian sugar industry is more complicated than that of other countries because of the co-existence of the centrifugal mill industry and a sugar producing cottage industry. The cottage industry produces open-pan sugar, specifically *gur* (solidified cane juice) and *khandsari* (semi white centrifugal sugar). White sugar both competes with and substitutes for the products of cottage industry (FAO 2003a).

According to FAO 2001-02, Brazil is the largest exporter of sugar in 1999 with exports of 12.5 million tons. Australia, Thailand and Cuba are other major exporters. The Russian federation, Europe, USA, Japan and Korea are main importers of sugar. In past few years Indian sugar imports have increased substantially. Sugar imports increased their share in the value of total agricultural imports from 0.1 percent in 1996-97 to 9 percent in 1998-99 and became third most imported commodity after vegetable oils and cereals (Ministry of Finance 2000-01, 2003).

Maharashtra contributes more than one-third (36 percent) of country's sugar output followed by Uttar Pradesh at 25 percent. Tamilnadu and Karnataka are also important sugar producing states (Ministry of Finance 1999-00, 2003).

The sugar economy in India is highly regulated. Government controls all aspects of the sugar industry, from raw sugarcane to refined sugar. The state governments regulate supply and distribution of sugarcane and are entrusted with the responsibility of announcing the State Advised Prices (SAPs) (FAO 2003a).

GOI has regulated the licensing of sugar factories; the purchase and distribution of levy sugar and the release of sugar to the open market since 1952, when GOI took over regulation of sugar industry from the states. Until early 1997, sugar was among the nine commodities requiring licensing. Some relaxation of state controls and simplification of procedures took place in early 1997 for domestic production (FAO 2003a). The Sugar industry was delicensed in August 1998 (IndiaInfoline 2003).

To assure supply of sugar to consumers at a reasonable price, the Government has followed a policy of partial control on sugar distribution since 1967. Under this two-tiered pricing system, the first tier applies to "levy sugar". For this, sugar mills supply quotas to the Food Corporation of India at prices set by individual State Governments (FAO 2003a). The remaining domestic supplies along with any imports are sold at free market prices except that the quantity for free sale is regulated by prescribing monthly quantities that each mill can sell as non-levy sugar (Ministry of Finance 1996-97, 2003). This policy was not functional in 1971-72 and 1978-79 as exceptional crop conditions made it impossible to implement dual pricing. The proportion of free-sale sugar has increased from 35% in mid-seventies to 60 % presently (FAO 2003a).

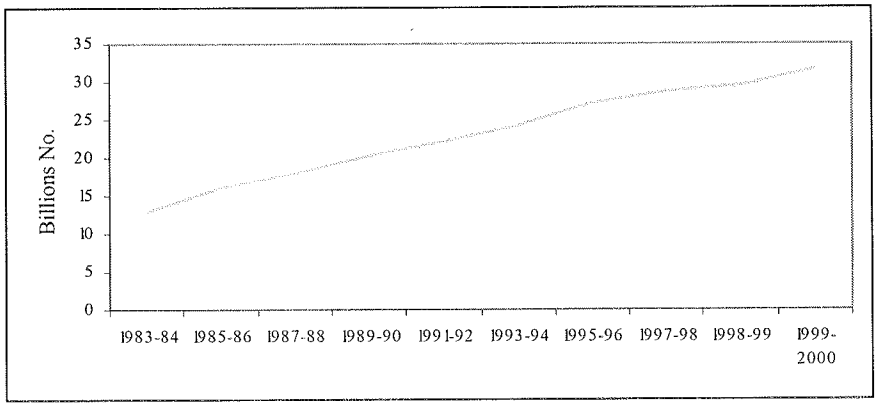
Until early 1997, when the sugar industry was decanalized, the Indian Sugar and General Export Import Corporation Limited, was the only agency handling exports and imports. The Government put sugar imports on open general license (OGL) in March 1994 and no import duty was charged until April 1998, when government imposed a 5 percent customs duty and countervailing duty of Rs 850 per ton. This was done to provide some protection to domestic producers (Ministry of Finance 2001-02, 2003).

This duty was raised to 20 percent along with the continuation of countervailing duty in January 1999. The customs duty on sugar was further revised to 25 percent along with a surcharge of 10% from February 28, 1999. The import duty on sugar was raised to 40 percent from December 30, 1999 but the 10 percent surcharge was done away with (Ministry of Finance 2000-01, 2003).

3.2.8 Eggs

India is the fourth largest producer of eggs in the world. Due to advances in production technology, the Indian poultry industry has shown spectacular progress during past few decades. Figure 3.11 shows that in 1999-2000 more than 30 billion eggs were produced and over the past few years egg production has been growing by 5-6% per annum.

Figure 3.11: Production of Eggs in India



Source: Ministry of Agriculture, India

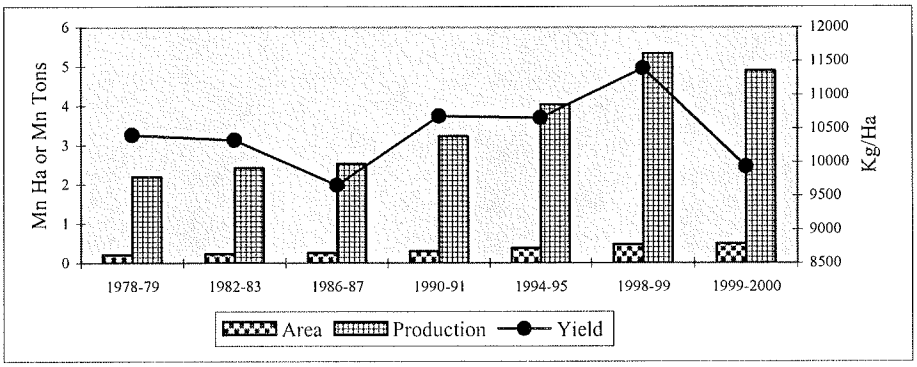
Andhra Pradesh, West Bengal and Tamilnadu account for more than 40% of total egg production in India. Annual per capita egg consumption in India is about 36 eggs. Indian poultry industry has little government intervention.

3.2.9 Onion

Onions are one of the most important vegetable crops grown in India accounting for around 8 per cent of the total vegetable area and 3 per cent of the production of vegetables in the country. India ranks first in the world in area growing onions and accounts for around 21 per cent of the world area planted to onions. Globally, the country occupies the second position after China in onion production with a production share of around 14 per cent.

Onion is cultivated over a large area spread almost throughout the country. Figure 3.12 shows that the area and production of onions has doubled over a 21-year period but the yield has not shown any considerable increase. Maharashtra, Karnataka, Uttar Pradesh, Andhra Pradesh and Tamilnadu are the important onion producing states.

Figure 3.12: Planted Area, Production and Yield of Onion in India



Source: Ministry of Agriculture, India

China, India, United States, Turkey and Iran are the leading onion producing countries in the world. Approximately 10 percent of the world onion production is traded internationally (Onions-usa 2003). India mainly exports onions to South East Asian and

Middle Eastern countries. Both the quantity and value of Indian onion exports have shown a positive trend (Mathur 2001).

Onion, being a foreign exchange earner has received considerable attention from GOI. The GOI has adopted a policy of restricted trade for onions. The exports of onions were canalized through NAFED (National Agricultural Cooperative Marketing Federation of India). NAFED got this responsibility in 1974-75. In January 1999, under the new export-import policy, GOI added Maharashtra Agricultural Marketing Board and the Gujarat Agro Industries Corporation as canalizing agencies. In December 1999, this list was further extended to include 5 more canalizing agencies. NAFED has a share of around 50% in total onion exports with rest being shared by the other co-canalizing agencies (Mathur 2001).

3.3 Futures Markets in India

Price risk is one of the major sources of risk for individuals involved in agricultural production. Futures markets are one instrument that can be used to manage price risk. Futures markets provide a vehicle for market participants to exchange risk and hedge away a part of commodity price risk. Futures markets are also a low cost, highly efficient and transparent mechanism for discovering prices in the future. The hedging and price discovery functions of futures markets help in promoting more efficient marketing performance (World Bank 1996).

Commodity futures markets were initially concentrated in a small number of developed countries, but are now being established in newly liberalizing, developing economies. Among developing countries commodity futures exchanges in Brazil and

China are among the largest. Many other developing countries are also considering the possibility of establishing the futures markets. There are two factors that contributed to this interest in commodity futures markets. First, commodity futures markets are the most efficient price formation mechanism. In contrast to a cash market, the futures markets are highly transparent and thus discourage price manipulation. They also have an interest as an institution to make their prices widely available, thus small market players are also provided with the information they require. Second, commodity production responsibility is presently shifting to the private sector form the State in more and more countries. This has exposed the private markets to more competitive world markets and its vagaries. In this situation futures markets assume a special relevance as price risk management instruments (World Bank 1996).

India has a long history of commodity futures markets, unlike many other developing countries. Futures trading started in India in 1921 for various types of cotton in Bombay Cotton Exchange and in 1926 for oilseeds and their products in Bombay Oilseeds and Oils Exchange. Several other exchanges were subsequently created in other commodities like raw jute, jute products, pepper, turmeric, potatoes, sugar, food grains and gold. Trading in futures and forward contracts was discouraged by the price controls imposed by government in 1940s. Government outlawed the futures and forward trading for certain commodities on the pretext of controlling inflation. These controls stayed in place till 1952, when the government passed the Forward Contracts Regulation Act. This law controls all the futures contracts even today (World Bank 1996).

The government's role grew even more intrusive in 1960s. In 1960s government suspended or banned futures trading in several commodities, including cotton, raw jute and edible oilseeds. In the 1970s futures trading in non-edible oilseeds like linseed and castor seed was also forbidden. The government took this action against the futures market, as it was believed that futures markets encourage speculation and hence drive commodity prices up. Government's stand softened somewhat in late 1970s and it allowed futures trading in *gur* (unrefined brown sugar). Futures for castor seed were reintroduced in 1982 and for potatoes in 1985. However, futures markets in India despite of their long history are not as developed as the ones in developed countries. This reason being that futures markets have been subject to prohibition from time to time and the participants have not been able to shrug off the scare of being banned anytime in future (World Bank 1996).

After the introduction of economic reforms in 1991, the Government of India appointed a committee under the chairmanship of Prof. K.N.Kabra on forwards markets in 1993. Accepting partially the recommendations of the committee, the government permitted the futures trading in a large number of commodities. In mid 1990s, the futures trading was allowed in a handful of commodities but now it is allowed in 94 commodities. Among the nine commodities studied in this thesis, futures market currently exists in India for cotton and groundnut oil.

CHAPTER 4
DATA SOURCES AND METHODOLOGY

4.1 Data Sources and Data Description

This thesis uses wholesale prices, the wholesale price indices (WPI) and the consumer price indices (CPI) for commodities studied. WPI is a fixed-weight Laspeyres index. These weekly data are not seasonally adjusted.

Monthly WPI data for wheat, rice, cotton, ground nut oil and pigeon peas for January 1963 to April 1971 and December 1979 to December 1999 were collected from various issues of agricultural prices in India. WPI data from April 1971 to March 1978 were collected from H L Chandhok, Wholesale Price Statistics, India 1947- 1978. Data for April 1978 to December 1979 period were collected from the Office of Economic Adviser, Ministry of Industry. Monthly data on wholesale prices for potato, onion and eggs collected from various issues of Agricultural Prices in India published by the Directorate of Economics and Statistics, Ministry of Agriculture, India for the entire study period. Auction prices for tea were collected from the Monthly Bulletin of Agricultural Economics and Statistics (later title FAO Quarterly Bulletin of Statistics), Food and Agricultural Organization (FAO). The wholesale price data used in the thesis is presented in Table B.1 in Appendix B.

The CPI for industrial workers is used to deflate all price series. Seasonally unadjusted monthly CPI for 1967 to 1999 were collected from the Labor Bureau, Ministry of Labor, India. The data prior to 1967 were collected from Yearbook of Labor

Statistics. Tables 4.1 and 4.2 list all the dependent variables and explanatory variables used in this study.

4.2 Empirical model

Time series data can exhibit different degrees of volatility at different points in time. For example, stock prices fluctuate more acutely in bad times than in good times. If such a phenomenon is an important feature of the data, then time series data should allow for the possibility of time-dependent volatility. The purpose of this study is to analyze the volatility of commodity prices overtime and to see if the volatility has systematically varied with respect to different variables like presence (or absence) of various policies, futures markets, exchange rates, devaluation etc. The Autoregressive Conditionally Heteroscedastic (ARCH) and Generalised Autoregressive Conditionally Heteroscedastic (GARCH) models have been extensively used to study the volatility of inflation, volatility of stock market returns etc. These models are a natural choice for the present study.

4.2.1 The GARCH and ARCH Models

GARCH models are used to model price series in this study. The simplest GARCH model is

(4.1) $$y_t = \gamma' \boldsymbol{x}_t + \varepsilon_t$$

where y_t is the dependent variable, $\boldsymbol{x}_t$ is a vector of independent variables which may include lagged values of y_t, γ a the vector of unknown parameters to be estimated and ε_t is a random variable with the following distribution:

(4.2) $$\varepsilon_t \mid \Omega_t \sim D(0, h_t)$$

Here, ε_t denotes a real valued discrete-time stochastic process; Ω_t is the set of all information available through time period t and D is the distribution usually a Normal distribution or Student's t distribution. The GARCH (p, q) process is given by

(4.3) $$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i}$$

where

$p \geq 0, \quad q \geq 0$

$\alpha_0 > 0, \quad \alpha_i \geq 0, \quad i = 1, \ldots, q$ and

$\beta_i \geq 0, \quad i = 1 \ldots, p$

If $p = 0$, then this process reduces to an ARCH (q) process. The conditional variance becomes constant if $p = q = 0$ and innovation ε_t reduces to white noise (Aradhyula and Holt 1988).

When the error term has a standard normal distribution, the log likelihood function is given by

(4.4) $$\ell = \sum_{t=1}^{T} \frac{1}{2}\left[-\log(2\pi) - \log(h_t) - \frac{\varepsilon_t^2}{h_t} \right]$$

where $\varepsilon_t = y_t - x_t'\beta$ and h_t is the conditional variance given in equation (4.3).

The dependent variables were tested for normality and in cases of non-normal errors, the error terms were assumed to have *t* distribution. If the errors have the standardized t distribution, the log-likelihood function is given by

$$(4.5)\quad \ell = \sum_{t=1}^{T}\left[\log\left(\Gamma\left(\frac{\nu+1}{2}\right)\right) - \log\left(\Gamma\left(\frac{\nu}{2}\right)\right) - \frac{1}{2}\log((\nu-2)h_t) - \frac{1}{2}(\nu+1)\log\left(1+\frac{\varepsilon_t^2}{h_t(\nu-2)}\right)\right]$$

where $\Gamma(.)$ is the gamma function and ν is the degrees of freedom (ν>2). In case of conditional *t* distribution, the additional parameter $1/\nu$ is estimated. As $1/\nu \rightarrow 0$, the log likelihood function of the conditional *t* distribution reduces to log likelihood function of the conditional normal GARCH Model.

4.3 Seasonality

Many economic time series data display pronounced seasonal patterns. Series of retail sales, unemployment and construction activity are some examples that exhibit monthly and quarterly fluctuations. This can happen due to institutional or climatic factors. For example, prices of agricultural commodities can exhibit seasonal pattern due to planting/harvesting cycles. If a time series displays a seasonal pattern, then the observations will be closely related to their counterparts in preceding season. If this aspect of the data is not taken into consideration while building time series models, then seasonality can induce a kind of autocorrelation (Greene 2000, pp. 788-789).

In case of series that exhibit seasonal behavior with known periodicity s, for example s= 4 for quarterly data, there are two time intervals that are of importance: (1) between successive observations and (2) between the observations s periods apart. There are a variety of techniques that can be used to describe both these relationships. A simple specification for a regular seasonal pattern is:

$$S(t) = \sum_{j=1}^{11} d_j D_{jt} \tag{4.6}$$

Here t is the number of observation, D_{jt} is the dummy variable for j^{th} month. The data series considered for analysis were analyzed for seasonality and monthly dummies were used for modeling seasonality in both the mean and the conditional variance equations.

4.4 Models Estimated

Two different specifications for conditional variance were estimated for each of the nine commodities. General form of the models estimated is:

$$\Delta^d p_t = \gamma_0 + \sum_{l=1}^{l} \gamma_l \Delta^d p_{t-l} + S(t) + \delta PD + \varepsilon_t \tag{4.7}$$

where $\varepsilon_t \mid \Omega_t \sim N(0, h_t)$ or it has a t distribution

$$\textbf{Model 1:} \quad h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i} + \exp(S_1(t)) + \omega PD \tag{4.8}$$

$$\textbf{Model 2:} \quad h_t = [\theta_o + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \lambda_i h_{t-i} + \exp(S_2(t))] \bullet (1 + \psi PD) \tag{4.9}$$

where $\Delta^d p_t = p_t - p_{t-d}$. $\Delta^d p_{t-l}$ refers to the relevant lags of the d^{th} difference of log prices that need to be included in the equation. PD is the vector for policy variables. γ_0, γ_l, d_j and δ are the parameters to be estimated in the mean equation.

$\alpha_0, \alpha_i, \beta_i, d_j$ and ω are the parameters to be estimated for conditional variance equation for Model 1 and $\theta_0, \theta_i, \lambda_i, d_j$ and ψ are the parameters to be estimated for Model 2 for conditional variance equation. In addition, seasonality terms $S_1(t)$ and $S_2(t)$ also contain parameters to be estimated.

Appropriate lag length was chosen for each commodity to correct for autocorrelation in the error terms. For example, if the model should include lags 2, 5 and 8, then the mean equation would include three lag terms- Δp_{t-2}, Δp_{t-5} and Δp_{t-8}. $S_1(t)$ and $S_2(t)$ are seasonality terms and are similar to $S(t)$ as described in equation 4.6. Subscripts 1 and 2 are used to distinguish between the seasonality terms for the mean and the conditional variance equation.

Policy variables included in each equation were chosen by taking into consideration whether a particular policy was important enough to affect the price volatility. Devaluation of the Indian Rupee was included as an explanatory variable for all commodities because devaluation is expected to have direct and indirect effects on all commodities. Tables 4.1 and 4.2 list the dependent and independent variables used for estimating the models.

Table 4.1: Dependent Variables Used for Different Commodities

Dependent Variable	
Wheat	Wholesale price index
Rice	Wholesale price index
Pigeon Pea	Wholesale price index
Groundnut Oil	Wholesale price index
Cotton	Wholesale price index
Sugar	Wholesale price index
Tea	Auction price in Kolkatta, West Bengal
Eggs	Whole sale price in Kolkatta, West Bengal
Onion	Whole sale price in Kanpur, UP

Table 4.2: Policy Variables Included in Different Models

Variable	Years of Policy	Description of Variable
DEVAL	July 1991 onwards =1, 0 otherwise	Devaluation of the Rupee in July 1991
Cotton		
FUTURE_C	Jan 63 –Aug 66 and Nov 98-dec 99 =1, 0 otherwise	Indicates presence of futures market for cotton
STATP_C	Jan 64 –Dec 64 = 0.45, Jan 65-Apr 68 = 0.5, May 68-June 78 = 0.25, 0 otherwise	Proportion of output that mills are required to supply to the government as a requirement.
TEXP_78	July 78-June 81=1, 0 otherwise	Month from which Textile Policy of 1978 came into force
TEXP_85	July 85-Dec 99 = 1, 0 otherwise	Month from which Textile Policy of 1985 came into force
DLICENDC	July 93-Dec 99=1, 0 otherwise	Months for which textile industry was not subject to licensing
LIBZ_1C	May 94-Dec 99 =1, 0 otherwise	Liberalization measure 1. Month from which cotton was on Open General License (OGL)
Sugar		
PCONT_SU	Apr 78-Mar 79 and Apr 71- Mar 72=0, 1 otherwise	Years sugar price was not controlled. Partial control of sugar prices

DLICENDS	Aug 98-Dec 99 = 1, 0 otherwise	Months for which sugar industry was not subject to licensing
LIBZ_1S	Mar 94-Dec 99 = 1, 0 otherwise	Liberalization Measure 1. Month from which sugar was on Open General License (OGL)
LIBZ_2S	Jan 97-Dec 99 = 1, 0 otherwise	Liberalization Measure 2. Months sugar exports/imports were not sold by a government agency
Onion		
LIBZ_2ON	Jan 63-Sept 74, Jan 99-Dec 99= 1, 0 otherwise	Liberalization Measure 2. Months onion exports/imports were not canalized through a government agency
Groundnut Oil		
TMO_GN	May 86-Dec 99 = 1, 0 otherwise	Technology Mission for Groundnut. Months TMO was in existence
LIBZ_2GN	Jan 63-Oct 74 and Feb 87-Dec 99 = 1, 0 otherwise	Liberalization Measure 2. Months groundnut exports/imports were not canalized through a government agency
MIO_GN	July 89-June 94 = 1, 0 otherwise	Market Intervention Operation (MIO) for groundnut, months MIO was operational
LIBZ_2EO	Apr 94- Dec 99 = 1, 0 otherwise	Liberalization Measure 2 for edible oils. Months edible oils exports/imports were not canalized through a government agency
FUTURE_G	Jan 63-Jun 65 and July 98- Dec 99 = 1, 0 otherwise	Presence of futures market in groundnut
Rice		
LIBZ_3RI	July 94-Mar 96, Apr 97- Dec 99 = 1, 0 otherwise	Liberalization Measure 3. Months rice exports were free
LIBZ_4RI	May 97- Dec 99 = 1, 0 otherwise	Liberalization Measure 4. Months rice imports were free
Wheat		
DLICENDW	July 86- Dec 99 = 1, 0 otherwise	Months for which Flour Mill Industry was not subject to licensing

LIBZ_3W	July 94-Mar 96, Apr 97 - Dec 99 = 1, 0 otherwise	Liberalization Measure 3. Months wheat exports were free
LIBZ_4W	Aug 98- Dec 99 = 1, 0 otherwise	Liberalization Measure 4. Months wheat imports were free
TAKO_W	Apr 73-Mar 74 = 1, 0 otherwise	Take Over Scheme. Months Take Over Scheme was in existence.

CHAPTER 5
EMPIRICAL RESULTS

This chapter presents estimated ARCH and GARCH models for wholesale prices for nine agricultural commodities in India. Monthly data for 1963-99 period are used for the estimation. These models characterize price volatility during various policy regimes. In addition, these models examine the impact of Rupee devaluation, presence the futures market, and seasonal cycle on price volatility. Two different specifications of the conditional variance equation given in equations 4.8 and 4.9 are used for estimating the ARCH (GARCH) models.

This chapter is organized as follows. Section 5.1 briefly reviews the price behavior of commodity prices overtime. Section 5.2 discusses the results from specification tests. Section 5.3 discusses estimated models. The chapter concludes with a summary of the results.

5.1 Price Behavior Over Time

Figures 5.1 – 5.3 display real prices for nine commodities over the sample period. It can be seen that the commodity real prices show no trend overtime with the exception of sugar, pigeon pea and eggs. Extreme volatility can be seen for the onion price in the late 1990s.

Figure 5.1: Real Wholesale Price Index for Rice, Wheat, Cotton and Groundnut Oil from 1963-99

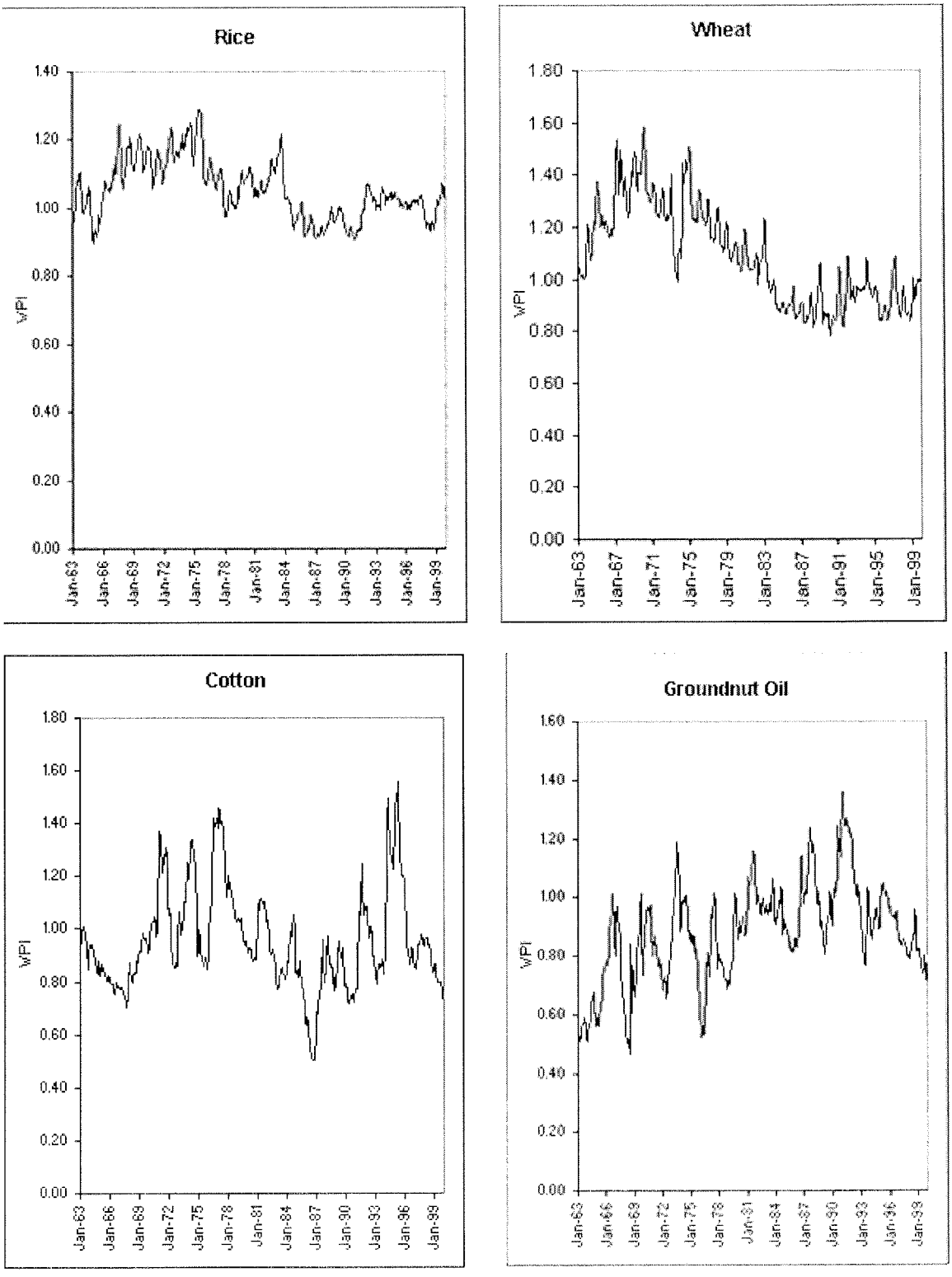


Figure 5.2: Real Wholesale Prices for Onion, Sugar, Tea and Eggs from 1963-99

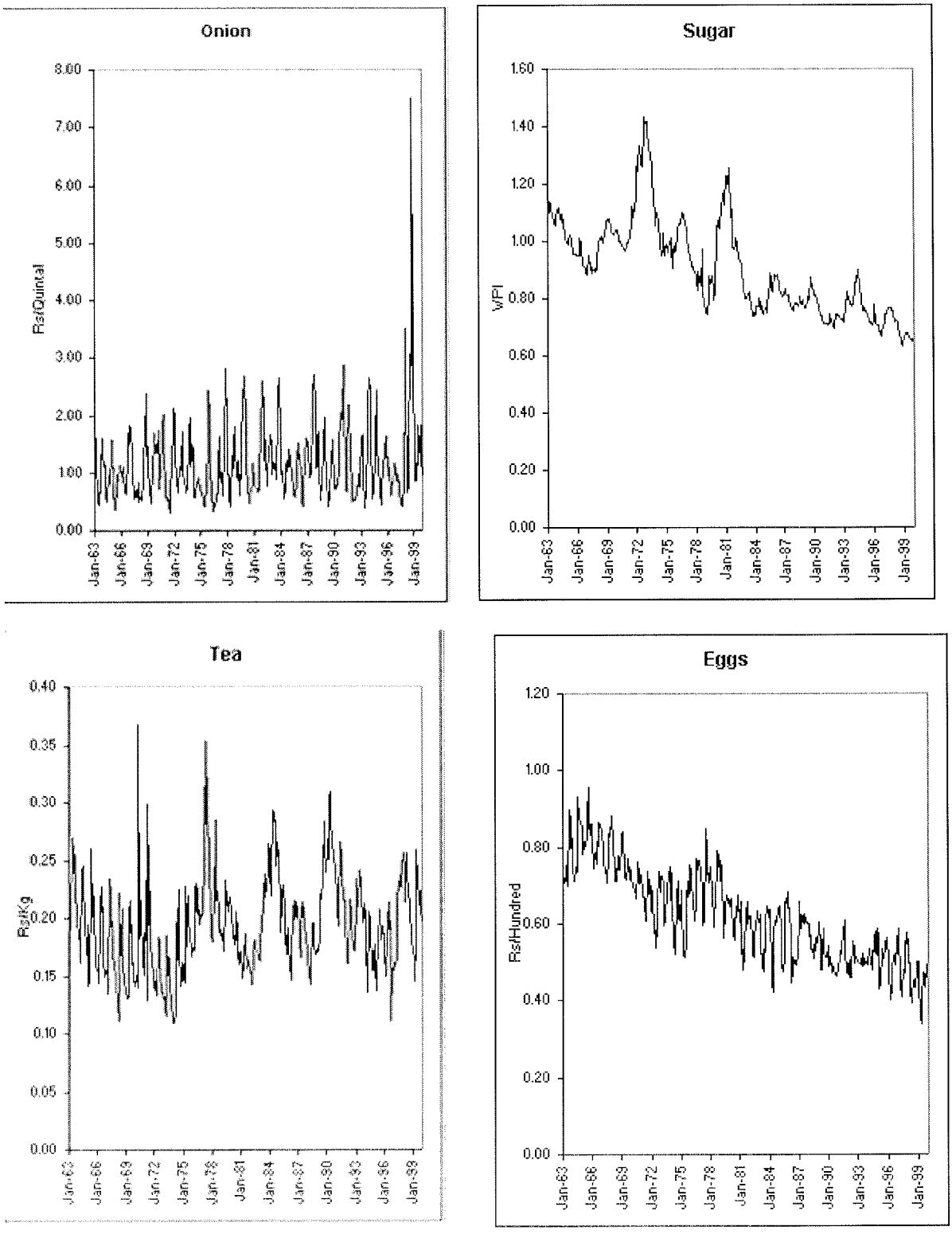
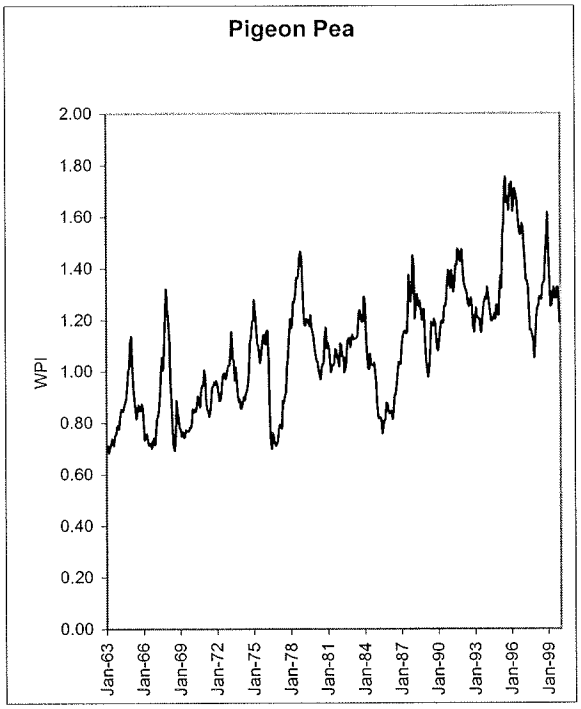


Figure 5.3: Real Wholesale Prices for Pigeon Pea from 1963-99



Figures 5.4 and Figure 5.5 show sample mean and sample standard deviation for the nine commodities during the decades included in this study. It can be seen that prices show no definite pattern across the decades. Furthermore, no single decade demonstrates higher volatility in prices, for all commodities.

Figure 5.4: Mean of Real Price Series from 1963-99

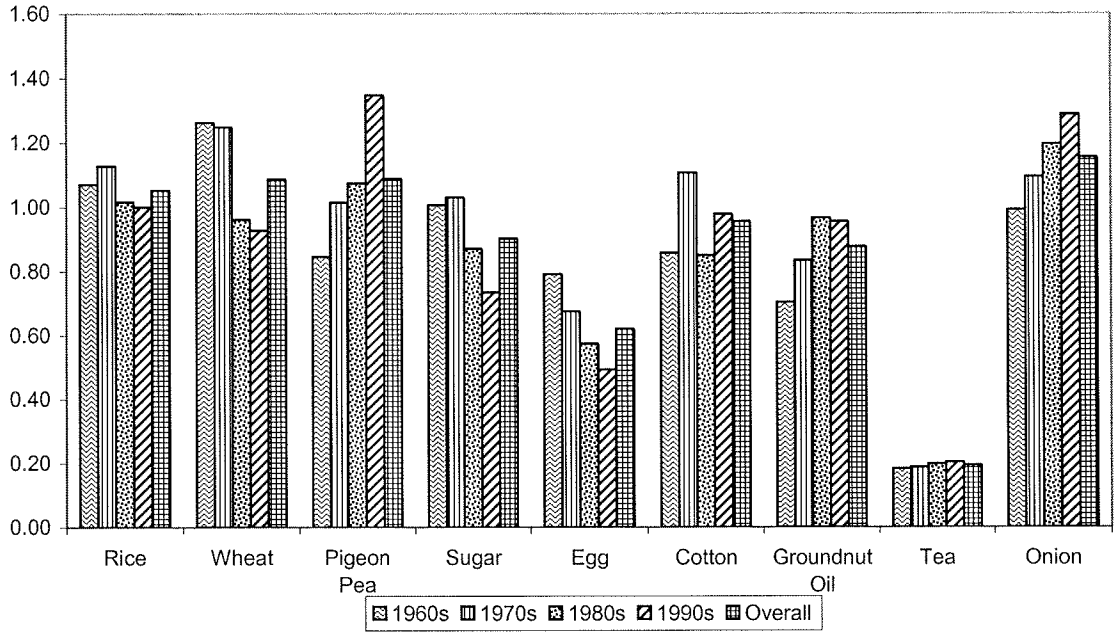
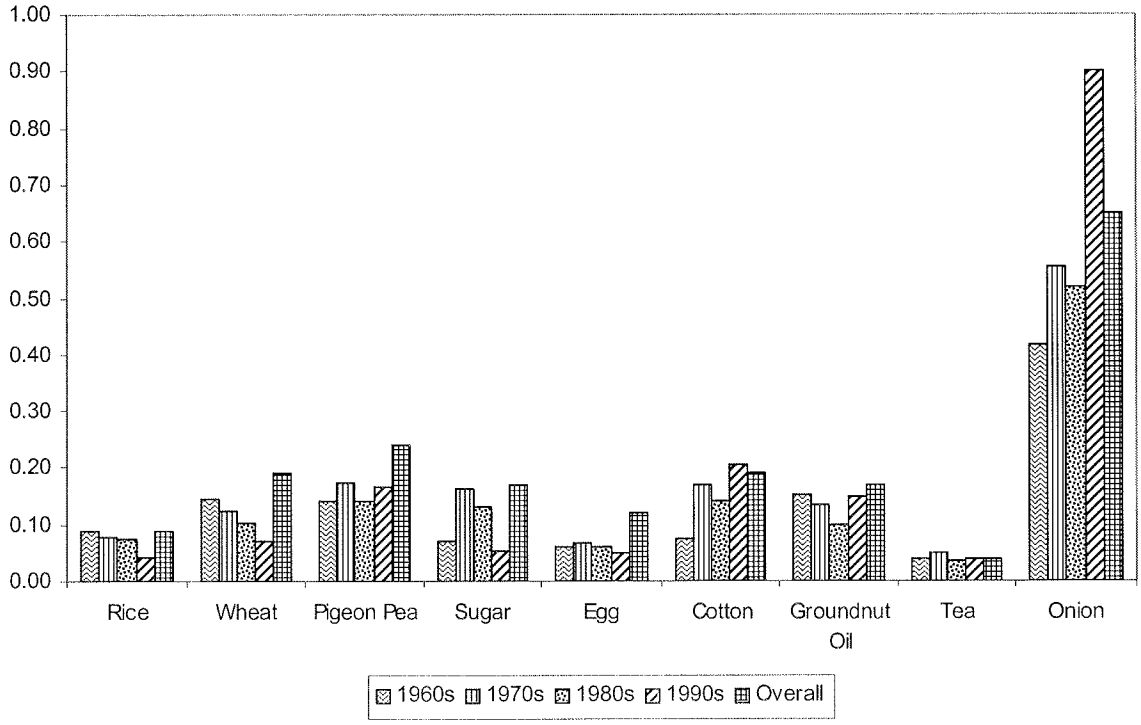
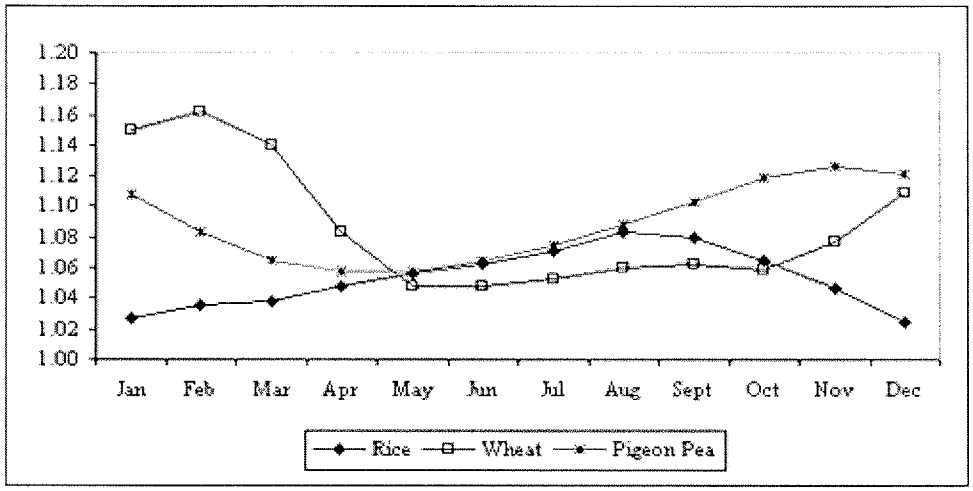


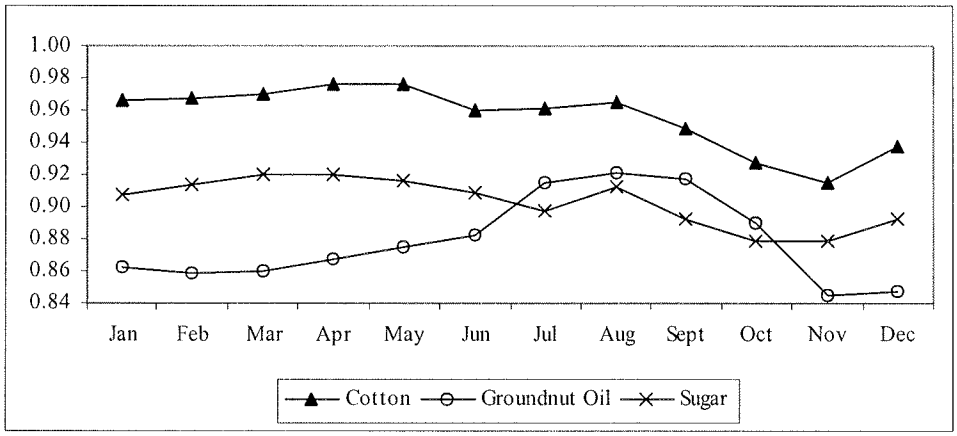
Figure 5.5 Standard Deviation of Real Price Series from 1963-99



Due to the seasonal nature of the agricultural production the mean commodity price is typically lowest during the harvest months. The price variance is generally the highest just before and during the harvest months due to uncertainty regarding supply. Figures 5.6 and 5.7 show intrayear monthly patterns for means and standard deviations for each commodity price over the study period. These graphs do not show any systematic seasonal variations in mean and standard deviations of prices for the nine commodities. Further analysis is needed if any of the seasonal moments are significant. This likely occurs due to geographic diversity of India and that the harvest seasons are not uniform across the country. Therefore, whole price index, being an aggregated measure across states, is less likely to exhibit seasonal variation.

Figure 5.6: Monthly Mean of Real Prices of Commodities, 1963-99





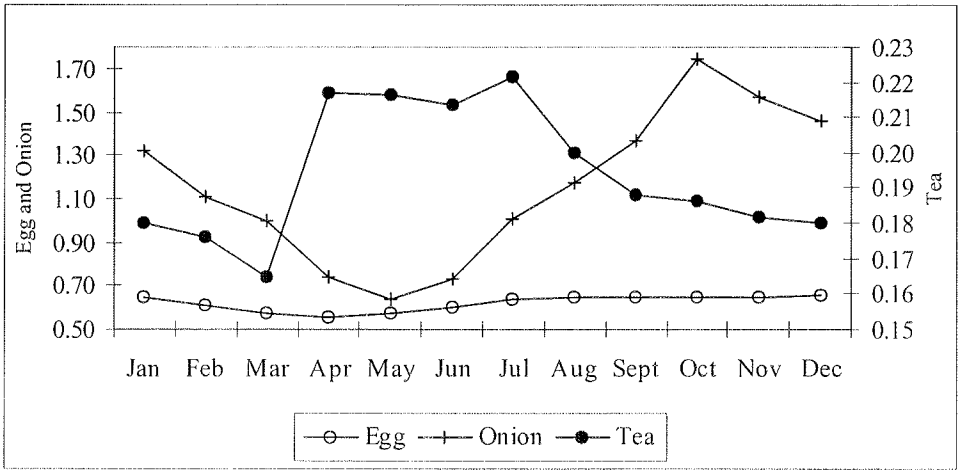
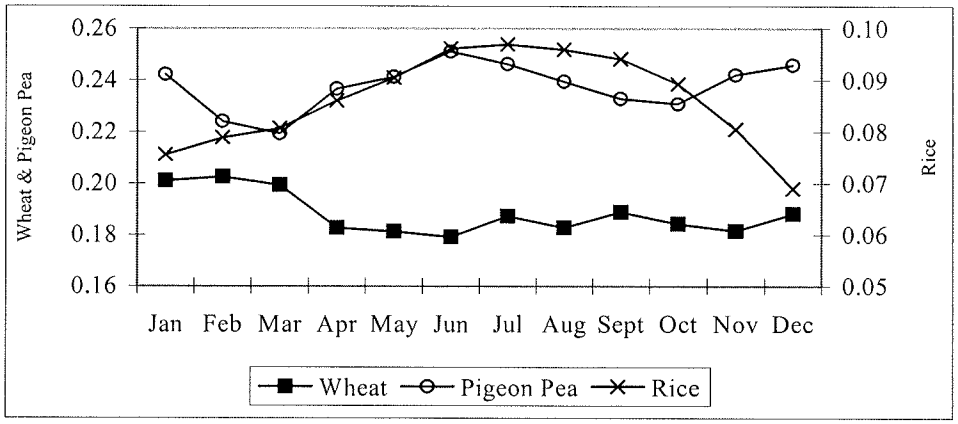
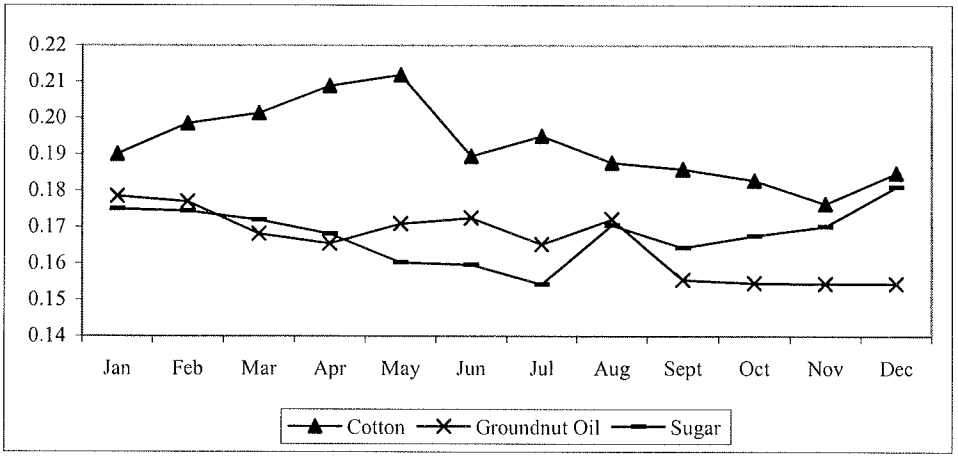
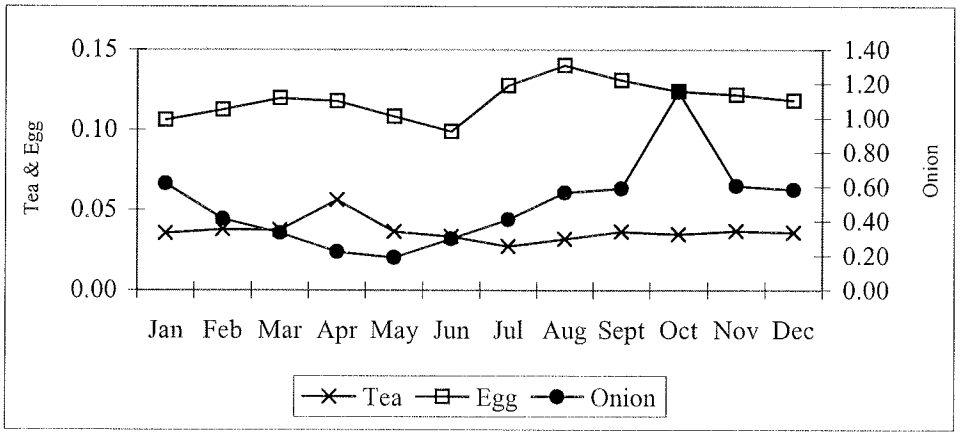


Figure 5.7: Monthly Standard Deviation of Real Prices of Commodities, 1963-99







5.2 Specification Tests Results

5.2.1 Test for Stationarity

All the real price series and their first (or twelfth) differences were tested for the presence of unit roots using Augmented Dickey-Fuller[3] tests and Phillips-Perron[4] tests. Augmented Dickey-Fuller test and the Phillips-Perron test both showed that all price series are non-stationary. The results from these tests are summarized in Tables A.1 and A.2 in Appendix A. In order to make the price series stationary, log prices were differenced once for rice, cotton, groundnut oil, sugar, pigeonpea, and onion. For wheat, tea and eggs log price series were differenced twice, once with one lag and then with 12 lags. It is these differenced series[5] that are used in all the subsequent analysis.

5.2.2 Test for Autocorrelation

In the case of time series data, ordinary regression residuals are usually correlated over time and it is important to take this into account. The violation of assumption of independent errors leads to inconsistent estimates of parameters and incorrect tests of significance for the parameters. The Durbin-Watson[6] test is the most widely used method of testing for autocorrelation. However, this test suffers from two limitations. First, it is strictly correct only if the matrix of independent variables is nonstochastic. Second, the autocorrelation coefficient is not truly indicative of the pattern of autocorrelation if the process is not an AR (1). However, there is another less restrictive test that can be used

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[3] For further discussion see Greene 2000 p 781-785.
[4] For further discussion see Phillips and Perron (1988).
[5] Differenced series are scaled by multiplying by 100.
[6] For further discussion see Greene 2000 p 538-542.

for testing for autocorrelation, it is the Breusch-Godfrey (1978) Test. It is a Lagrange multiplier test, where the null hypothesis states that no autocorrelation exists. The test can be carried out by regressing ordinary least squares residual $\hat{\varepsilon}_t$ on $X_t, \hat{\varepsilon}_{t-1}, \ldots\ldots\ldots \hat{\varepsilon}_{t-p}$ and calculating TR^2 from the regression (Greene 2000). The test statistic TR^2 (T is the number of observations) is asymptotically distributed as chi-squared with p degrees of freedom. This test is preferred over more widely employed standard Box-Pierce test (Q-statistic). Maddala (2001, page 528-529) discusses the inappropriateness of the Box-Pierce test and Ljung-Box test statistic for autoregressive models. He suggests the above-discussed Breusch-Godfrey Lagrange multiplier test as an alternative.

This test was performed on all the price series before and after fitting a candidate model. The results, summarized in Appendix A in table A.3, before fitting the model for original series indicate the presence of autocorrelation in all the commodities. The results in Table A.4 based on residuals from final models show that errors are white noise for all the models estimated.

5.2.3 Tests for GARCH (ARCH) Effects

Lagrange Multiplier Test

The original test for ARCH proposed by Engel (1982) is a Lagrange multiplier test. The null hypothesis assumes that the model is a standard dynamic regression model, given by

(5.1) $$y_t = X_t\beta + \nu_t$$

where x_t is the vector of weakly exogenous and lagged dependent variables and v_t is a Gaussian white noise process,

(5.2) $$v_t \mid I_{t-1} \sim N(0, \sigma^2)$$

The alternative hypothesis is that the errors are ARCH (q) as given in equation (4.4). The test statistic TR^2 is asymptotically distributed as a χ^2 with q degrees of freedom where R^2 is computed from the regression of $\hat{v}_t^2$ on a constant and $\hat{v}_{t-1}^2, \ldots\ldots, \hat{v}_{t-q}^2$. Values larger than the critical table value give evidence of the presence of ARCH effects (Bollerslev, Engle and Nelson 1994).

Q^2-Test

McLeod and Li (1983) reported that Q^2 test statistic based on squared residuals could be used for testing for the presence of ARCH effects. The test statistic is given by:

(5.3) $$Q(q) = T(T+2)\sum_{i=1}^{q} \frac{r(i;\hat{\varepsilon}_t^2)}{(N-i)}$$

where;

$$r(i;\hat{\varepsilon}_t^2) = \sum_{t=i+1}^{T} \frac{(\hat{\varepsilon}_t^2 - \hat{\sigma}^2)(\hat{\varepsilon}_{t-i}^2 - \hat{\sigma}^2)}{\sum_{t=1}^{N} (\hat{\varepsilon}_t^2 - \hat{\sigma}^2)^2}$$

$$\hat{\sigma}^2 = \frac{1}{T}\sum_{t=1}^{T} \hat{\varepsilon}_t^2$$

The test statistic is distributed asymptotically as a χ^2 with q degrees of freedom. This Q^2-statistic calculated from the squared residuals can be used for identifying the order of the GARCH process.

LM and Q^2 tests were conducted both before and after fitting a candidate model. The results from these tests from both before and after fitting the final models are summarized in Appendix A in Tables A.5 and A.6. The results from the two tests before estimating the models indicated the presence of ARCH effects for all the commodities. Similarly, the results from tests conducted after estimating the two models indicated that both the models 1 and 2 were well fitted for all the commodities.

5.2.4 Test for Normality

It is generally assumed that the residuals from the GARCH process are normal. If the residuals are not normal, the normal log-likelihood function is inappropriate. Bera and Jarque (1982) give a test for testing the normality assumption for the residuals. The test statistic is based on skewness and kurtosis and is given by:

$$J_T = \left[\frac{T}{6}b_1^2 + \frac{T}{24}(b_2 - 3)^2\right] \sim \chi^2_{(2)} \tag{5.4}$$

where;

$$b_1 = \frac{T\sum_{t=1}^{T}\hat{u}_t^3}{\left(\sum_{t=1}^{T}\hat{u}_t^2\right)^{3/2}} \quad \text{and} \quad b_2 = \frac{\sqrt{T}\sum_{t=1}^{T}\hat{u}_t^4}{\left(\sum_{t=1}^{T}\hat{u}_t^2\right)^2}$$

where T is the number of observations and $\hat{u}_t = \hat{\varepsilon}_t / \sqrt{\hat{h}_t}$ is the standardized residual. In case of GARCH (ARCH) the normality test is obtained using the standardized residuals.

The results from the normality test for nine commodities are summarized in Appendix A in Table A.7. The tests indicate that except for onion and pigeon pea all

other commodities have non-normal errors. If the null hypothesis of normal errors was rejected, errors were assumed to have a Student's *t* distribution.

5.3 Models Estimated

As discussed in Chapter 4, two models were estimated for each commodity using maximum likelihood method. As given in equation 4.8 and 4.9 these two models differ in the specification of conditional variance equation. The error term was assumed to have *t* distribution for all commodities except onion and pigeon pea. Results for each commodity are discussed separately in the next section.

5.4 Results from Models Estimated

5.4.1 Wheat

Maximum likelihood estimates of GARCH models for wheat are given in Table 5.1. ARCH (1) was found to be an adequate model for both Model 1 and Model 2 for wheat. ARCH0 and ARCH1 are significant in both the Models. LIBZ_3W, a policy variable that refers to the years in which wheat exports were free, is significant in the conditional variance equation of Model 1 and Model 2 at the 5% level of significance and 1% level of significance respectively. The negative sign on this variable indicates that this policy negatively affected the price volatility in the years it was in operation. Thus this policy attained its stated objective of reducing the price volatility. No other policy variable in the conditional variance equation is significant in either of the models for wheat. Figure 5.8 shows the seasonality in mean and variance of prices for model 1. It

can be observed that mean price is low in April; the harvesting month for wheat and the variance is highest in this month as is expected. Similar pattern is observed for Model 2.

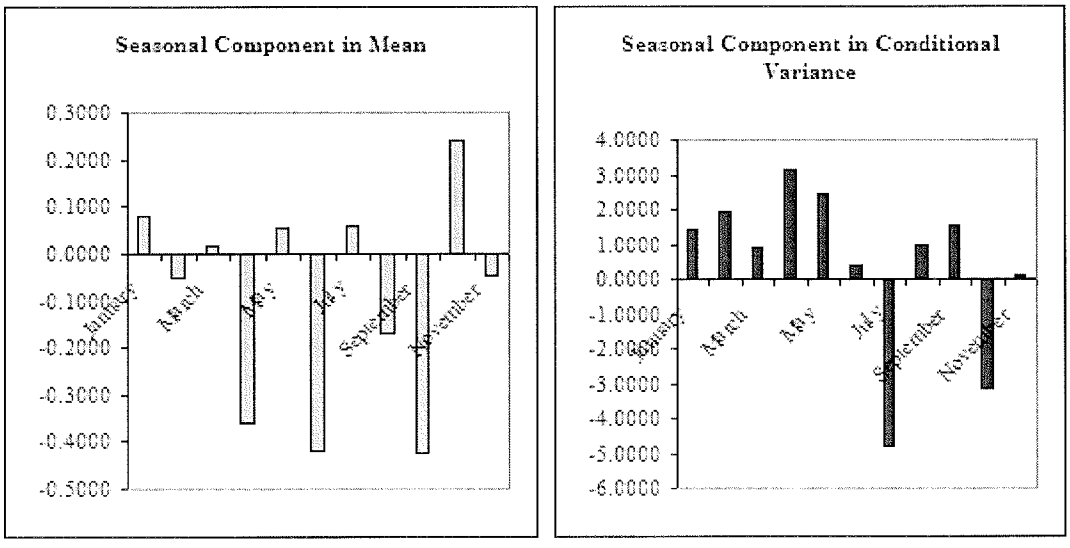
Table 5.1: Maximum Likelihood Results of GARCH Models for Wheat

	Dependent Variable: $\Delta^1 \Delta^{12}$ Log Price of Wheat					
	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**	**Estimate**	**t-Ratio**	**p-Values**
Intercept	0.0033	0.0082	0.9934	-0.0083	-0.0177	0.9859
DEVAL	0.3841	0.5886	0.5565	0.33177	0.5257	0.5994
LIBZ_3W	-0.5545	-0.8275	0.4085	-0.6122	-0.9489	0.3432
LIBZ_4W	0.3452	0.3808	0.7035	0.75933	0.8438	0.3993
DLICENSW	-0.0247	-0.0598	0.9523	-0.0597	-0.1441	0.8855
TAKE_OVER	-0.9250	-0.8304	0.4068	-1.1624	-1.1089	0.2681
January	0.0796	0.1249	0.9007	0.10065	0.1458	0.8842
February	-0.0515	-0.0719	0.9427	-0.0304	-0.0399	0.9682
March	0.0182	0.0296	0.9764	0.08236	0.1270	0.8990
April	-0.3603	-0.3882	0.6980	-0.318	-0.3330	0.7393
May	0.0538	0.0673	0.9464	0.06406	0.0771	0.9385
June	-0.4207	-0.6936	0.4883	-0.333	-0.5135	0.6079
July	0.0586	0.1115	0.9113	0.09735	0.1761	0.8603
August	-0.1710	-0.2876	0.7738	-0.1453	-0.2284	0.8195
September	-0.4257	-0.6653	0.5062	-0.3925	-0.5791	0.5628
October	0.2410	0.4579	0.6472	0.16259	0.2770	0.7819
November	-0.0488	-0.0884	0.9296	-0.0118	-0.0190	0.9848
AR1	**0.2804**	**5.1969**	**0.0000**	**0.28001**	**5.2393**	**0.0000**
AR2	-0.0503	-1.3538	0.1765	-0.0515	-1.4308	0.1532
AR12	**-0.4969**	**-10.7010**	**0.0000**	**-0.4956**	**-10.5690**	**0.0000**
AR13	**0.1153**	**2.3283**	**0.0204**	**0.10169**	**2.0853**	**0.0376**
ARCH0	**3.0613**	**3.4671**	**0.0006**	**0.09782**	**1.9039**	**0.0576**
ARCH1	**0.1300**	**2.1895**	**0.0291**	**2.06288**	**6.6633**	**0.0000**
January	**1.4407**	**2.3055**	**0.0216**	**2.28965**	**7.1485**	**0.0000**
February	**1.9372**	**3.9447**	**0.0001**	**1.68417**	**5.2443**	**0.0000**
March	0.9337	1.1686	0.2432	**3.19**	**10.6179**	**0.0000**
April	**3.1477**	**9.1392**	**0.0000**	**2.62999**	**8.5700**	**0.0000**
May	**2.4347**	**6.0279**	**0.0000**	**1.56572**	**4.2205**	**0.0000**

Table 5.1: Maximum Likelihood Results of GARCH Models for Wheat (Cont.)

	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	Estimate	t-Ratio	p-Values	Estimate	t-Ratio	p-Values
June	0.4201	0.3323	0.7399	**0.83025**	**2.5405**	**0.0114**
July	-4.7797	-0.4530	0.6508	**1.76759**	**5.6390**	**0.0000**
August	0.9613	1.2459	0.2135	**2.04612**	**6.8889**	**0.0000**
September	**1.5404**	**2.7936**	**0.0055**	**1.34608**	**3.6860**	**0.0003**
October	-3.1333	-0.1707	0.8645	**1.70288**	**5.1822**	**0.0000**
November	0.1084	0.0606	0.9517	**1.83053**	**6.1059**	**0.0000**
DEVAL	4.0710	1.1203	0.2632	0.54148	1.0593	0.2901
LIBZ_3W	**-6.7384**	**-1.9746**	**0.0490**	**-0.9125**	**-1.8221**	**0.0692**
LIBZ_4W	2.0604	0.6602	0.5095	0.24331	0.4610	0.6450
DLICENSW	1.9726	1.0324	0.3025	0.27001	0.8991	0.3691
TAKE_OVER	6.4730	0.9926	0.3215	0.66101	0.7102	0.4780
1/DF	0.0779	1.2715	0.2043	0.0772	1.2018	0.2301
	Log-Likelihood -799.15 N = 417			Log-Likelihood -798.47 N = 417		

Figure 5.8: Estimated Seasonality in Mean and Conditional Variance of Wheat from Model 1



5.4.2 Rice

Table 5.2 shows the estimation of parameters for rice. Model 1 failed to converge for rice and is thus not presented. Estimation results from Model 2 indicate that GARCH (1,1) was adequate to explain the conditional variance of the rice. Chand (1999) compared domestic wholesale prices with FOB world prices for rice and concluded that the relaxation of trade restrictions in case of rice would lead to an increase in export of rice and hence would lead to an increase in domestic price of rice. Thus it was expected that the liberalization measures would affect the mean price positively but none of these policy variables are significant in the mean or the variance equation. This may be due to the fact that these policy changes are very recent and their impact may not have been felt.

Table 5.2: Maximum Likelihood Results of GARCH Models for Rice

	Dependent Variable: Δ^1 Log Price of Rice		
	Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**
Intercept	**-1.2878**	**-3.0627**	**0.0023**
DEVAL	-0.0548	-0.2197	0.8262
LIBZ_3RI	-0.2117	-0.5772	0.5641
LIBZ_4RI	0.0937	0.2491	0.8034
January	**1.9755**	**3.6963**	**0.0002**
February	**2.0228**	**3.9233**	**0.0001**
March	**1.7242**	**3.9074**	**0.0001**
April	**1.8805**	**3.7020**	**0.0002**
May	**1.7847**	**3.6060**	**0.0003**
June	**1.6560**	**3.4358**	**0.0006**
July	**1.8452**	**3.7129**	**0.0002**
August	**2.5239**	**5.1023**	**0.0000**
September	0.6034	1.2608	0.2081
October	-0.0580	-0.1305	0.8963
November	-0.1819	-0.3241	0.7460
AR1	**0.2173**	**4.4716**	**0.0000**
AR12	0.0101	0.3068	0.7592
ARCH1	**0.1489**	**2.9051**	**0.0039**
GARCH1	**0.5855**	**4.6891**	**0.0000**
January	-4.1855	-0.1401	0.8887
February	-4.8558	-0.2250	0.8221
March	-6.1985	-0.3372	0.7361
April	-4.5401	-0.0693	0.9448
May	-12.5833	-0.1553	0.8766
June	0.1089	0.2340	0.8151
July	-8.4399	-0.1058	0.9158
August	0.0808	0.1483	0.8822
September	-0.7165	-0.5188	0.6041
October	-2.9036	-0.2359	0.8136
November	-1.0097	-0.7949	0.4271
December	**1.4577**	**5.1022**	**0.0000**

Table 5.2: Maximum Likelihood Results of GARCH Models for Rice (Cont.)

	Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**
DEVAL	0.0854	0.7869	0.4318
LIBZ_3RI	-0.0805	-0.4999	0.6174
LIBZ_4RI	0.0355	0.2084	0.8350
1/DF	0.0632	1.3150	0.1892
	Log-Likelihood -512.60		
	N = 430		

5.4.3 Pigeon Pea

The normality test for pigeon pea prices indicated that normality could not be rejected. When a GARCH model with *t* distribution is estimated, the estimated 1/DF parameter is found not to be significantly different from zero, confirming a normal distribution. Results reported in Table 5.3 are estimated under normality assumption.

ARCH (1) model was found to be adequate for both the models. ARCH0 and ARCH1 are significant in both the models. Chand (1999) had observed in the case of the chickpea that trade liberalization would not have any impact on domestic prices and imports would continue to fill the gap between domestic demand and supply. A similar pattern is expected in case of pigeon pea as the policy structure is comparable for both chickpea and pigeon pea. The results from estimation confirm this finding, as devaluation (DEVAL) is insignificant in both the models in the mean equation and the variance equation.

Table 5.3: Maximum Likelihood Results of GARCH Models for Pigeon Pea

	Dependent Variable: Δ^1 Log Price of Pigeon Pea					
	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**	**Estimate**	**t-Ratio**	**p-Values**
Intercept	-0.0488	-0.0521	0.9585	-0.6742	-0.5517	0.5814
DEVAL	0.1214	0.1092	0.9131	-0.3713	-0.3689	0.7124
January	1.1081	0.5551	0.5791	1.3526	0.6143	0.5393
february	-2.2070	-1.2309	0.2190	-1.5222	-0.8033	0.4223
March	-1.2858	-0.7073	0.4798	-0.7289	-0.3606	0.7186
April	-1.5475	-0.8304	0.4068	-0.8103	-0.4879	0.6259
May	-0.3373	-0.1951	0.8454	0.8414	0.4315	0.6663
June	0.5141	0.3030	0.7621	1.3965	0.7838	0.4336
July	1.1012	0.5743	0.5661	1.9282	0.9711	0.3320
August	1.0229	0.5977	0.5504	2.0013	1.0787	0.2813
September	1.0464	0.5900	0.5555	1.8771	0.9717	0.3317
October	1.8938	0.9345	0.3506	2.5018	1.1887	0.2352
November	0.2247	0.1109	0.9117	0.8624	0.4057	0.6851
AR1	**0.2616**	**2.4723**	**0.0138**	**0.2671**	**2.6808**	**0.0076**
AR4	0.0634	0.7201	0.4719	0.0747	0.8653	0.3873
AR10	0.0917	1.0495	0.2945	0.0796	0.8688	0.3854
AR12	-0.0884	-0.8758	0.3816	-0.1053	-0.9772	0.3290
AR13	-0.1521	-1.5288	0.1271	-0.1365	-1.3357	0.1823
ARCH0	**11.1491**	**4.5477**	**0.0000**	**13.5602**	**3.9789**	**0.0001**
ARCH1	**0.2066**	**2.3876**	**0.0174**	**0.1495**	**1.9627**	**0.0503**
January	**2.3786**	**2.5151**	**0.0123**	**2.5231**	**2.6883**	**0.0075**
February	**1.9287**	**2.0797**	**0.0381**	1.3375	0.8449	0.3987
March	0.2979	0.0853	0.9321	-0.1317	-0.0217	0.9827
April	0.4174	0.1518	0.8794	**1.7425**	**1.9573**	**0.0510**
May	0.6373	0.2877	0.7737	-0.1485	-0.0248	0.9802
June	1.0449	0.5345	0.5933	-0.0462	-0.0079	0.9937
July	1.0296	0.4546	0.6496	-0.5810	-0.0497	0.9604
August	0.4910	0.5020	0.6159	-0.2752	-0.0591	0.9529
September	0.5131	0.1595	0.8733	-0.1868	-0.0269	0.9785
October	0.5638	0.1682	0.8665	-0.7082	-0.0555	0.9558
November	0.1324	0.0229	0.9818	-1.7783	-0.0422	0.9663

Table 5.3: Maximum Likelihood Results of GARCH Models for Pigeon Pea (Cont.)

	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**	**Estimate**	**t-Ratio**	**p-Values**
DEVAL	1.2652	0.3676	0.7134	-0.1778	-1.1343	0.2573
	Log-Likelihood -169942.12 N = 429			Log-Likelihood -169938.08 N = 429		

5.4.4 Cotton

The estimation results for cotton are presented in Table 5.4. Model 1 failed to converge for cotton and results from Model 1 are not reported. The results from Model 2 indicate that the ARCH (1) model is adequate to explain the conditional variance. The significance of the degrees of freedom variable (1/df) indicates that *t* distribution is an appropriate specification for the error term. The Textile policy announced by the Indian government in 1978 (TEXP_78) is significant in both the mean and the variance equation and affects both mean and variance negatively. This policy appointed the Cotton Corporation of India (CCI) as the price stabilizing agency and CCI used buffer stocks to stabilize prices. This policy was successful in fulfilling its role of stabilizing prices but had to be given up due to high cost of maintaining the buffer stocks.

The delicensing of textile industry (DLICENDC) and liberalization measure for cotton (LIBZ_1C) are significant variables in the mean equation and affected the mean price positively and negatively respectively. These results are intuitive. The delicensing of textile industry facilitated the establishment of textile mills, increased the demand for raw material cotton and hence led to an increase in the mean price of cotton. The liberalization measure for cotton affected the mean price negatively as government

maintained the cotton prices artificially high and removal of restrictions brought the mean price down. Figure 5.9 shows estimated seasonal component of the mean and the conditional variance from Model 2. It can be seen that mean price is the lowest in the month of harvest (October) and the cotton price volatility is very high in harvest month of October.

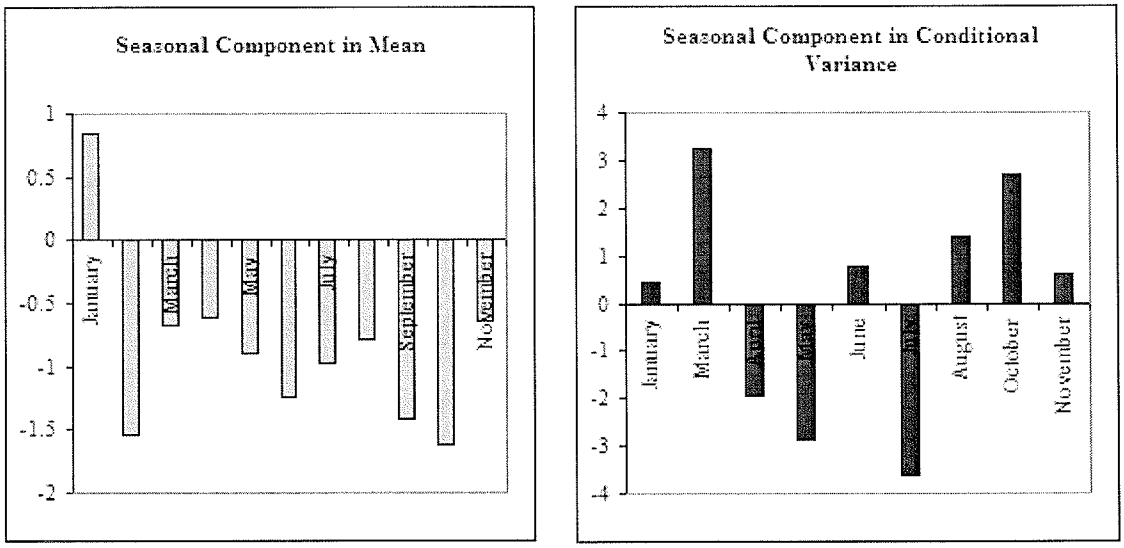
Table 5.4: Maximum Likelihood Results of GARCH Models for Cotton

	Dependent Variable: Δ^1 Log Price of Cotton		
	Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**
Intercept	**0.9057**	**1.7069**	**0.0886**
DEVAL	-0.2908	-0.3858	0.6999
FUTURE_C	0.1956	0.4965	0.6198
STATP_C	-1.5269	-1.4209	0.1561
TEXP_78	**-0.9100**	**-2.1891**	**0.0291**
TEXP_85	-0.5139	-1.0561	0.2915
DLICENDC	**2.7765**	**2.7915**	**0.0055**
LIBZ_1C	**-2.7642**	**-3.6259**	**0.0003**
January	0.8441	1.3211	0.1872
February	**-1.5416**	**-2.5653**	**0.0107**
March	-0.6814	-0.8897	0.3741
April	-0.6075	-1.1147	0.2656
May	-0.8947	-1.5769	0.1156
June	**-1.2427**	**-2.2058**	**0.0279**
July	**-0.9730**	**-1.9117**	**0.0566**
August	-0.7821	-1.3115	0.1904
September	**-1.417**	**-2.4164**	**0.0161**
October	**-1.6202**	**-2.1651**	**0.0309**
November	-0.6355	-0.9351	0.3503
AR1	**0.4182**	**8.6965**	**0.0000**
AR2	**-0.2018**	**-4.4392**	**0.0000**
AR10	0.0392	1.3614	0.1741
AR12	**0.0679**	**1.6653**	**0.0966**
AR13	**-0.1293**	**-3.7917**	**0.0002**
AR23	**-0.1191**	**-3.9850**	**0.0000**

Table 5.4: Maximum Likelihood Results of GARCH Models for Cotton (Cont.)

	Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**
ARCH0	**5.1312**	**2.2050**	**0.0280**
ARCH1	**0.7972**	**1.9390**	**0.0532**
January	0.4202	0.1724	0.8632
March	**3.2658**	**5.9743**	**0.0000**
April	-1.9444	-0.1479	0.8825
May	-2.8705	-0.2670	0.7896
June	0.7773	0.4842	0.6285
July	-3.6037	-0.3707	0.7110
August	1.4020	1.3128	0.1900
October	**2.7027**	**4.1516**	**0.0000**
November	0.6196	0.1634	0.8703
DEVAL	-0.0504	-0.0781	0.9378
FUTURE_C	-0.5227	-1.5318	0.1263
STATP_C	-0.1055	-0.1070	0.9149
TEXP_78	**-0.5619**	**-2.7574**	**0.0061**
TEXP_85	0.4550	0.85708	0.3919
DLICENDC	-0.4359	-0.4539	0.6501
LIBZ_1C	-0.1181	-0.1508	0.8802
1/DF	**0.2879**	**5.2651**	**0.0000**
	Log-Likelihood -849.66 N = 419		

Figure 5.9: Estimated Seasonality in Mean and Conditional Variance of Cotton from Model 2



5.4.5 Groundnut Oil

Table 5.5 shows estimated GARCH models for groundnut oil. Results show that ARCH (1) is appropriate for both the models. The variable for degrees of freedom is significant at 1% level of significance for both the models indicating that *t* distribution is an appropriate specification for the error term. Devaluation variable (DEVAL) is significant in the mean equation in both models and negatively affects the mean price. Groundnut Oil is mainly an imported commodity. Thus it is expected that devaluation would make imports more expensive and make the mean price go up over time. This unexpected negative sign could have occurred due to the fact that devaluation is assumed to have a long-term effect in these models. It is likely that devaluation had only a short-term impact instead.

In the conditional variance equation LIBZ_2GN (liberalization measure for shell groundnut) is significant in the Model 1. LIBZ_2GN, refers to the policy that removed the restrictions on exports of handpicked select groundnut. Indian government removed the restrictions on exports of groundnut in mid-80s. However, this policy change was made when international prices were very low and importing countries refused to take delivery of groundnuts from India due to suspected aflatoxin. These factors could have contributed to higher volatility in groundnut oil prices and thus a positive sign on LIBZ_2GN.

Table 5.5: Maximum Likelihood Results of GARCH Models for Groundnut Oil

	Dependent Variable: Δ^1 Log Price of Groundnut Oil					
	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	Estimate	t-Ratio	p-Values	Estimate	t-Ratio	p-Values
Intercept	0.5200	0.7266	0.4679	0.3856	0.5478	0.5841
DEVAL	**-1.8798**	**-2.0026**	**0.0459**	**-1.8756**	**-1.9735**	**0.0491**
TMO_GN	0.3137	0.4160	0.6776	0.2936	0.3875	0.6986
LIBZ_2GN	0.2650	0.4968	0.6196	0.2923	0.5473	0.5844
MIO_GN	0.0148	0.0182	0.9855	0.0094	0.0113	0.9910
LIBZ_2EO	1.1799	1.1689	0.2431	1.1646	1.1372	0.2561
FUTURE_G	-0.5959	-0.8157	0.4151	-0.5843	-0.8142	0.4160
January	1.1803	1.2210	0.2228	1.2362	1.2737	0.2035
February	-1.1081	-1.1474	0.2519	-0.7975	-0.8476	0.3971
March	-0.6034	-0.6759	0.4995	-0.4172	-0.4817	0.6303
April	0.7460	0.8611	0.3897	0.8503	1.0156	0.3104
May	-0.3009	-0.3433	0.7315	-0.1676	-0.1972	0.8438
June	-0.1347	-0.1505	0.8805	-0.0433	-0.0501	0.9600
July	**1.8048**	**1.8323**	**0.0676**	**1.8992**	**1.9927**	**0.0469**
August	**2.3857**	**2.4289**	**0.0156**	**2.4800**	**2.6464**	**0.0084**
September	-0.3148	-0.3169	0.7515	-0.2112	-0.2177	0.8278
October	**-3.8432**	**-3.8380**	**0.0001**	**-3.6678**	**-3.7998**	**0.0002**
November	**-5.7357**	**-6.0002**	**0.0000**	**-5.6041**	**-6.0342**	**0.0000**
AR1	**0.2380**	**4.5376**	**0.0000**	**0.2348**	**4.5580**	**0.0000**
AR10	**0.1166**	**2.7544**	**0.0061**	**0.1188**	**2.8344**	**0.0048**
AR12	**-0.1263**	**-2.7753**	**0.0058**	**-0.1234**	**-2.6986**	**0.0072**
AR13	**-0.1429**	**-3.3531**	**0.0009**	**-0.1387**	**-3.2852**	**0.0011**
AR14	-0.0538	-1.2397	0.2158	-0.0562	-1.3154	0.1891
AR24	**-0.0981**	**-2.3864**	**0.0175**	**-0.0946**	**-2.3076**	**0.0215**
ARCH0	**14.0511**	**5.3882**	**0.0000**	**14.0739**	**5.9438**	**0.0000**
ARCH1	**0.1863**	**1.9375**	**0.0534**	**0.1782**	**1.9650**	**0.0501**
DEVAL	-7.2275	-1.0925	0.2753	-0.5576	-1.327	0.1852
TMO_GN	-3.3698	-0.7725	0.4403	-0.1362	-0.4931	0.6222
LIBZ_2GN	**6.8841**	**1.8325**	**0.0676**	0.4382	1.5839	0.1140
MIO_GN	-0.0982	-0.0283	0.9774	-0.0029	-0.0125	0.9900
LIBZ_2EO	-6.7268	-1.2714	0.2043	-0.4849	-1.3804	0.1682
FUTURE_G	5.4665	1.2933	0.1966	0.3830	1.3821	0.1677
1/DF	**0.1278**	**2.5330**	**0.0117**	**0.1290**	**2.5494**	**0.0111**

Table 5.5: Maximum Likelihood Results of GARCH Models for Groundnut Oil (Cont.)

Model 1 (Additive)	Model 2 (Multiplicative)
Log-Likelihood -921.55 N = 429	Log-Likelihood -920.58 N = 429

5.4.6 Sugar

For sugar, the estimation results show that ARCH1 parameter is insignificant in both the models. However, if the variance is assumed to be constant, it would fail to take into account the impact of seasonality and policy variable PCONT_SU on conditional variance in Model 2. The variable for degrees of freedom (1/df) is significant for both the models indicating that error term has a *t* distribution. Devaluation (DEVAL) is significant in the mean equation in both the models and affects the mean price positively. Sugar has become a major import over the past few years. As reported by Ministry of Finance of India (2000-01), the share of sugar imports in total agricultural imports has increased from negligible to around 9% in 1998-99. Thus devaluation is expected to make the sugar imports more expensive and increase the mean price. Estimated positive coefficient on DEVAL in mean equation supports this.

In the conditional variance equation, PCONT_SU denoting the policy of partial price control for sugar is significant in Model 2 and affects the price variance negatively. Under this policy, the sugar mills are required to supply a percentage of their total production to the Food Corporation of India for distribution through the public distribution system. The remaining domestic supplies along with any imports can be sold at free market prices. The negative sign shows that this policy affected price volatility

negatively and government succeeded in curbing the volatility in prices by using this policy.

Table 5.6: Maximum Likelihood Results of GARCH Models for Sugar

	Dependent Variable: Δ^1 Log Price of Sugar					
	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	**Parameter**	**t-Ratio**	**p-Values**	**Parameter**	**t-Ratio**	**p-Values**
Intercept	0.0825	0.1090	0.9133	-0.1118	-0.1582	0.8744
DEVAL	**0.6155**	**1.9619**	**0.0504**	**0.6755**	**2.0539**	**0.0406**
PCONT_SU	-0.4872	-0.6544	0.5132	-0.3198	-0.4546	0.6497
DLICENDS	0.2420	0.5917	0.5544	0.2072	0.5518	0.5814
LIBZ_1S	-0.5438	-1.3073	0.1918	-0.6367	-1.4695	0.1424
LIBZ_2S	0.1085	0.2412	0.8095	0.1336	0.3178	0.7508
January	0.4731	1.3859	0.1665	0.4983	1.4152	0.1577
February	**0.6775**	**1.8032**	**0.0721**	**0.8052**	**2.0706**	**0.0390**
March	0.2161	0.6701	0.5032	0.2928	0.9110	0.3628
April	0.0090	0.0312	0.9751	0.0068	0.0234	0.9814
July	**-0.8621**	**-2.1836**	**0.0295**	**-0.8011**	**-2.0288**	**0.0431**
August	-0.1704	-0.5776	0.5638	-0.0962	-0.3299	0.7416
September	-0.2858	-0.9842	0.3256	-0.2345	-0.7645	0.4450
October	**-0.7309**	**-2.4271**	**0.0156**	**-0.7932**	**-2.5415**	**0.0114**
AR1	**0.1496**	**2.6905**	**0.0074**	**0.1513**	**2.7613**	**0.0060**
AR4	-0.0458	-1.2688	0.2052	-0.0369	-1.0049	0.3155
AR12	0.0280	0.7234	0.4698	0.0145	0.3702	0.7114
ARCH0	17.2686	1.5116	0.1314	**9.6227**	**1.9440**	**0.0526**
ARCH1	1.1634	0.4944	0.6213	3.7553	0.6085	0.5432
May	1.4536	1.5239	0.1283	**1.8861**	**1.8117**	**0.0707**
July	**2.0874**	**2.8211**	**0.0050**	**2.6384**	**3.3833**	**0.0008**
DEVAL	-1.1717	-0.4335	0.6649	-0.0396	-0.2101	0.8337
PCONT_SU	-12.8276	-1.2359	0.2172	**-0.4756**	**-2.4227**	**0.0158**
DLICENDS	-2.4209	-0.8387	0.4021	-0.0966	-0.5786	0.5632
LIBZ_1S	0.4850	0.1421	0.8871	0.0125	0.0493	0.9607
LIBZ_2S	-1.2584	-0.3523	0.7248	-0.2492	-1.0429	0.2976
1/DF	**0.3684**	**5.7504**	**0.0000**	**0.3527**	**7.0350**	**0.0000**
	Log-Likelihood -711.98 N = 430			Log-Likelihood -712.29 N = 430		

5.4.7 Onion

Table 5.7: Maximum Likelihood Results of GARCH Models for Onion

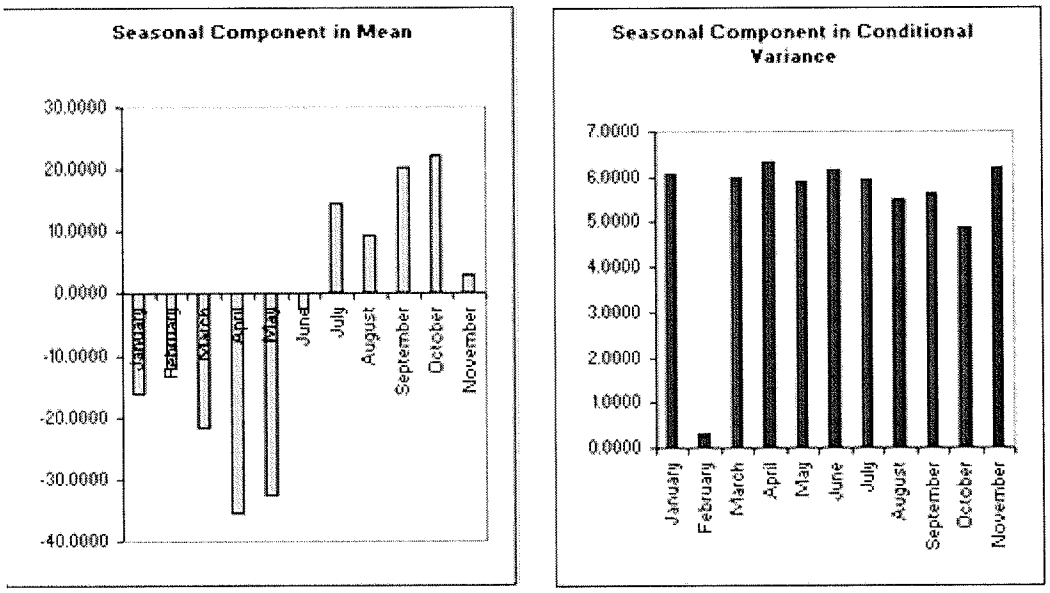
	Dependent Variable: Δ^1 Log Price of Onion					
	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	**Parameter**	**t-Ratio**	**p-Values**	**Parameter**	**t-Ratio**	**p-Values**
Intercept	4.1325	0.7006	0.4840	4.3710	0.8313	0.4063
DEVAL	-4.2492	-0.8141	0.4161	-2.8073	-0.5166	0.6057
LIBZ_2ON	-2.2194	-0.4535	0.6504	**-10.2795**	**-2.0181**	**0.0443**
January	-14.2514	-1.6325	0.1034	**-16.3897**	**-2.3480**	**0.0194**
February	**-17.2634**	**-2.1453**	**0.0325**	-11.9186	-1.4194	0.1566
March	**-21.2706**	-1.5410	0.1241	**-21.5445**	**-3.9912**	**0.0001**
April	**-39.4807**	**-3.6169**	**0.0003**	**-35.6211**	**-3.4522**	**0.0006**
May	**-27.4816**	**-2.1982**	**0.0285**	**-32.4790**	**-2.8848**	**0.0041**
June	-14.0680	-0.9782	0.3286	-2.4392	-0.1961	0.8446
July	14.4580	0.8686	0.3856	14.5100	1.0364	0.3006
August	15.8911	0.8167	0.4146	9.5175	0.5172	0.6053
September	**21.2438**	**1.7043**	**0.0891**	**20.2572**	**1.9337**	**0.0539**
October	17.1628	1.6046	0.1094	**22.4023**	**2.2360**	**0.0259**
November	**6.8084**	1.1118	0.2669	3.0400	0.5451	0.5860
AR2	**-0.2471**	**-2.9208**	**0.0037**	**-0.1640**	**-2.4083**	**0.0165**
AR3	**-0.1498**	**-1.7407**	**0.0825**	**-0.1256**	**-1.8994**	**0.0582**
AR5	**-0.2502**	**-2.6026**	**0.0096**	**-0.1967**	**-3.0559**	**0.0024**
AR6	**-0.2043**	**-2.4469**	**0.0148**	**-0.1892**	**-2.3470**	**0.0194**
AR12	-0.1193	-1.4675	0.1430	**-0.1505**	**-2.1810**	**0.0298**
AR14	**-0.1954**	**-1.8940**	**0.0590**	-0.1523	-1.6362	0.1026
AR16	0.0911	1.0472	0.2957	-0.0298	-0.3840	0.7012
AR15	-0.0648	-0.8949	0.3714	-0.0382	-0.6368	0.5246
AR48	0.0586	0.7627	0.4461	-0.0207	-0.2667	0.7898
ARCH0	**51.2023**	**1.6694**	**0.0958**	29.9625	0.9695	0.3329
ARCH1	**0.7738**	**4.7339**	**0.0000**	**0.8717**	**4.4806**	**0.0000**
January	**5.9252**	**11.7666**	**0.0000**	**6.0753**	**15.8697**	**0.0000**
February	**0.5979**	0.0128	0.9898	0.3040	0.0093	0.9926
March	**6.0686**	**11.2969**	**0.0000**	**5.9793**	**11.3501**	**0.0000**
April	**6.4244**	**15.0404**	**0.0000**	**6.3503**	**15.9827**	**0.0000**
May	**6.0888**	**10.8599**	**0.0000**	**5.9213**	**10.3446**	**0.0000**
June	**6.4463**	**18.7886**	**0.0000**	**6.1801**	**14.5206**	**0.0000**
July	**5.9824**	**14.1588**	**0.0000**	**5.9646**	**14.5978**	**0.0000**

Table 5.7: Estimation Results for Onion (Cont.)

	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	**Parameter**	**t-Ratio**	**p-Values**	**Parameter**	**t-Ratio**	**p-Values**
August	**5.6638**	**32.1625**	**0.0000**	**5.5230**	**30.2374**	**0.0000**
September	**5.6937**	**9.4760**	**0.0000**	**5.6276**	**10.8016**	**0.0000**
October	**5.0195**	**7.8158**	**0.0000**	**4.8677**	**8.7582**	**0.0000**
November	**6.3692**	**13.2341**	**0.0000**	**6.2158**	**13.6890**	**0.0000**
DEVAL	8.4632	0.1146	0.9088	0.2581	0.9491	0.3431
LIBZ_2ON	20.6835	0.2367	0.8130	0.1084	0.4390	0.6609
	Log-Likelihood -144150.67 N = 394			Log-Likelihood -144155.29 N = 394		

Normality test indicated prices for onion are normal and accordingly it was assumed that error has a standard normal distribution. Results indicate that ARCH (1) model is appropriate for both the models. The ARCH1 variable is significant in both the models. The LIBZ_2ON variable, referring to the years the exports (imports) of onion were free, is significant at 5% level of significance in Model 2. Onion mean price has increased over time. It can be observed from Figure 5.4 that mean price of onion has been highest in 1990s. It is possible that relaxing of trade restrictions increased the availability of onions and reduced the mean price. Thus the variable LIBZ_2ON has a negative sign. Figure 5.10 shows the seasonal component in mean and the conditional variance for Model 2. It can be seen that mean price is lowest in harvest month of April and price variance is highest in this month. A similar pattern can be observed in case of Model 1.

Figure 5.10: Estimated Seasonality in Mean and Conditional Variance of Onion for Model 2



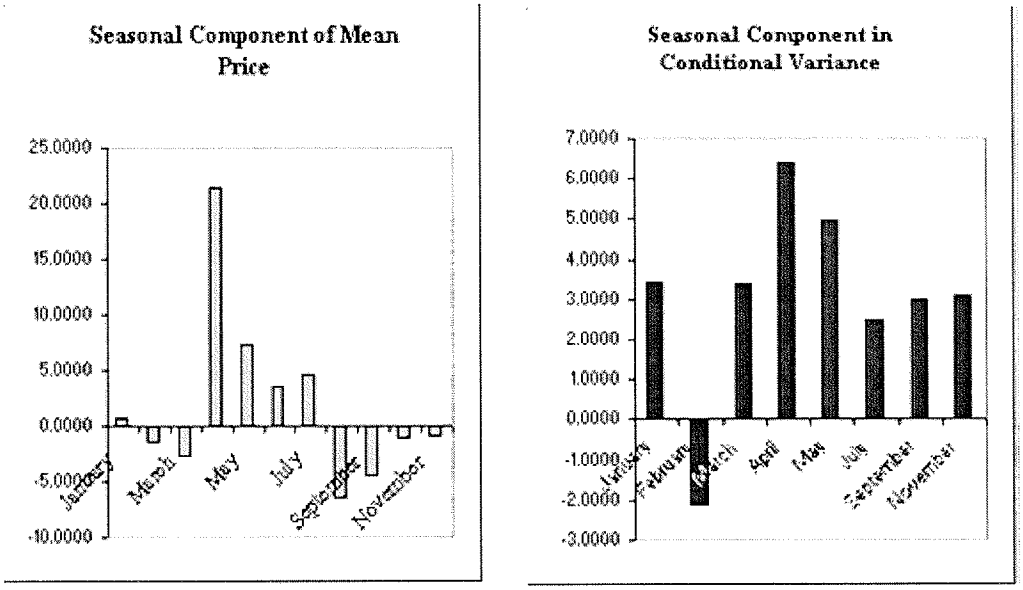
5.4.8 Tea

The estimation results for tea are presented in Table 5.8. Results show that ARCH (1) is appropriate for Model 1 and GARCH (1,1) is appropriate for Model 2. The *t* distribution is found to be a better specification for the error term for both the models. Tea has consistently remained one of the major exports from India. In 1998-99 it had a share of 9% in total agricultural products exports (Ministry of Finance, 2001-02). Devaluation (DEVAL) did not have any impact on mean and price variance. Tea bushes are plucked mostly in April, and Figure 5.11 shows that price variance is highest in that month.

Table 5.8: Maximum Likelihood Results of GARCH Models for Tea

	Dependent Variable: $\Delta^1\Delta^{12}$ Log Price of Tea					
	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**	**Estimate**	**t-Ratio**	**p-Values**
Intercept	**-2.1506**	**-2.5536**	**0.0110**	**-2.2282**	**-2.6891**	**0.0075**
DEVAL	0.0936	0.1160	0.9077	0.1114	0.1269	0.8991
January	0.7670	0.5907	0.5550	0.8605	0.6900	0.4906
February	-1.4644	-1.2536	0.2107	-1.4046	-1.1921	0.2339
March	**-2.6300**	**-1.9184**	**0.0557**	**-2.7222**	**-1.9885**	**0.0474**
April	**21.4235**	**6.0721**	**0.0000**	**21.1629**	**6.2581**	**0.0000**
May	**7.2624**	**2.6908**	**0.0074**	**7.4285**	**2.9815**	**0.0030**
June	**3.6169**	**1.9818**	**0.0482**	**3.7927**	**2.1006**	**0.0363**
July	**4.7252**	**3.4563**	**0.0006**	**4.6778**	**3.4439**	**0.0006**
August	**-6.3966**	**-5.0632**	**0.0000**	**-6.2793**	**-4.8692**	**0.0000**
September	**-4.4851**	**-3.2213**	**0.0014**	**-4.6488**	**-3.2922**	**0.0011**
October	-1.0708	-0.8106	0.4180	-1.0876	-0.7906	0.4296
November	-0.9465	-0.7909	0.4294	-0.9290	-0.7852	0.4328
AR1	-0.0790	-1.5026	0.1337	**-0.0999**	**-1.8950**	**0.0588**
AR2	**-0.0843**	**-2.3091**	**0.0214**	**-0.0840**	**-2.2902**	**0.0225**
AR12	**0.1221**	**2.9710**	**0.0031**	**0.1173**	**2.8435**	**0.0047**
AR13	-0.0320	-0.9833	0.3260	-0.0322	-0.9483	0.3435
ARCH0	**20.0756**	**1.8391**	**0.0666**	**21.7279**	**2.2049**	**0.0280**
ARCH1	**0.6905**	**2.7762**	**0.0057**	**0.6592**	**2.8089**	**0.0052**
GARCH	0.0721	1.1774	0.2397	**0.1163**	**1.9056**	**0.0574**
January	**3.4144**	**4.2546**	**0.0000**	**3.2176**	**3.4507**	**0.0006**
February	-2.1256	-0.1874	0.8514			
March	**3.3669**	**3.9871**	**0.0001**	**3.2022**	**3.3744**	**0.0008**
April	**6.4079**	**15.3504**	**0.0000**	**6.5334**	**16.0181**	**0.0000**
May	**4.9683**	**5.5576**	**0.0000**			
July	2.5150	1.3838	0.1672			
September	**3.0125**	**2.7271**	**0.0067**	**2.7342**	**1.9958**	**0.0466**
November	**3.0811**	**3.1834**	**0.0016**	**2.9380**	**2.6850**	**0.0075**
DEVAL	9.9394	0.7372	0.4614	0.1215	0.6065	0.5445
1/DF	**0.3117**	**6.6434**	**0.0000**	**0.3091**	**6.6069**	**0.0000**
	Log-Likelihood -1244.54 N = 417			Log-Likelihood -1246.01 N = 417		

Figure 5.11: Estimated Seasonality in Mean and Conditional Variance of Tea for Model 1



5.4.9 Egg

The estimation results for egg are summarized in Table 5.9. The results show that ARCH (1) is insignificant in both the models. However, it is important to maintain that variance is non-constant overtime to take into account seasonality. DEVAL is insignificant in both the mean equation and the conditional variance equation. Egg is not an internationally traded commodity suggesting devaluation does not have any influence on domestic egg prices. The degrees of freedom variable is insignificant in the Model 1 and significant in Model 2.

Table 5.9: Maximum Likelihood Results of GARCH Models for Eggs

Dependent Variable: $\Delta^1\Delta^{12}$ Log Price of Egg						
	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**	**Estimate**	**t-Ratio**	**p-Values**
Intercept	0.9639	0.9515	0.3419	0.7459	0.8944	0.3716
DEVAL	0.5063	0.7309	0.4653	0.2740	0.4295	0.6677
January	**-6.5479**	**-5.5267**	**0.0000**	-1.2234	-1.0475	0.2955
February	**-4.4799**	**-2.8028**	**0.0053**	**-3.1451**	**-2.2985**	**0.0220**
March	**-6.2731**	**-3.5544**	**0.0004**	**-5.7664**	**-3.4942**	**0.0005**
April	**-4.8425**	**-3.2221**	**0.0014**	**-4.8048**	**-3.6162**	**0.0003**
May	-0.2924	-0.1799	0.8573	-0.9589	-0.6560	0.5122
June	0.6428	0.4178	0.6763	1.0749	0.8134	0.4165
July	2.9078	1.5626	0.1189	3.6761	2.1500	0.0321
August	0.0096	0.0056	0.9955	0.4306	0.2935	0.7693
September	-1.6623	-1.0271	0.3050	-1.3556	-1.0073	0.3144
October	-1.5332	-1.1058	0.2694	-1.9224	-1.5664	0.1180
November	-1.1888	-1.0032	0.3163	-1.4288	-1.4465	0.1488
AR1	**-0.3338**	**-6.6061**	**0.0000**	**-0.2984**	**-6.1632**	**0.0000**
AR2	**-0.1775**	**-3.6249**	**0.0003**	**-0.2019**	**-4.6753**	**0.0000**
AR3	**-0.2605**	**-5.2647**	**0.0000**	**-0.2469**	**-4.9410**	**0.0000**
AR4	**-0.2335**	**-4.6539**	**0.0000**	**-0.1902**	**-3.8325**	**0.0001**
AR5	**-0.2504**	**-5.2448**	**0.0000**	**-0.1663**	**-3.9992**	**0.0001**
AR6	**-0.2130**	**-4.2650**	**0.0000**	**-0.1999**	**-4.3199**	**0.0000**
AR7	**-0.2144**	**-4.2501**	**0.0000**	**-0.2676**	**-5.3514**	**0.0000**
AR8	**-0.1969**	**-3.9187**	**0.0001**	**-0.1727**	**-3.4861**	**0.0005**
AR9	**-0.2695**	**-5.6300**	**0.0000**	**-0.2329**	**-5.2097**	**0.0000**
AR10	**-0.2297**	**-4.7886**	**0.0000**	**-0.1958**	**-4.5462**	**0.0000**
ARCH0	**16.3784**	**4.1212**	**0.0000**	**18.7634**	**2.9733**	**0.0031**
ARCH1	0.0435	0.6081	0.5435	0.0847	0.8563	0.3923
January	**3.4691**	**6.4754**	**0.0000**	1.8822	1.0731	0.2838
February	**3.2575**	**6.6728**	**0.0000**	**3.4551**	**5.7294**	**0.0000**
March	**3.5752**	**8.7447**	**0.0000**	**4.0477**	**8.8067**	**0.0000**
April	1.4352	0.7998	0.4243	2.1119	1.4248	0.1549
May	**2.9006**	**5.1490**	**0.0000**	**3.3560**	**5.3255**	**0.0000**
June	**2.6402**	**3.8555**	**0.0001**	**2.9959**	**4.1274**	**0.0000**

Table 5.9: Maximum Likelihood Results of GARCH Models for Eggs (Cont.)

	Model 1 (Additive)			Model 2 (Multiplicative)		
Variable	**Estimate**	**t-Ratio**	**p-Values**	**Estimate**	**t-Ratio**	**p-Values**
July	**3.8289**	**10.3531**	**0.0000**	**4.2254**	**9.6715**	**0.0000**
August	**2.3218**	**2.7226**	**0.0067**	**2.6531**	**2.7741**	**0.0058**
September	**2.3944**	**3.0720**	**0.0023**	**2.5937**	**2.7604**	**0.0060**
October	0.7601	0.2672	0.7895	2.0216	1.3448	0.1794
DEVAL	0.1915	0.8383	0.4023	1.8766	0.1366	0.8914
1/DF	0.0592	1.3031	0.1932	**0.2567**	**5.7581**	**0.0000**
	Log-Likelihood -1083.47 N = 420			Log-Likelihood -1089.44 N = 420		

The Figures 5.12-5.14 show the conditional variance for Model 2 for all nine commodities. The graphs for conditional variance for Model 1 and Model 2 look very similar, hence only the graphs for Model 2 are presented here. It can be observed from the figures that conditional variance is indeed not fixed overtime. In Figure 5.13 the conditional variance of onion shows greater fluctuations in late 1990s. This is the time period when onion crisis happened in India. This crisis saw onion price sky-rocketing in India.

Figure 5.12: Estimated Conditional Variance for Rice, Wheat and Pigeon Pea for Model 2

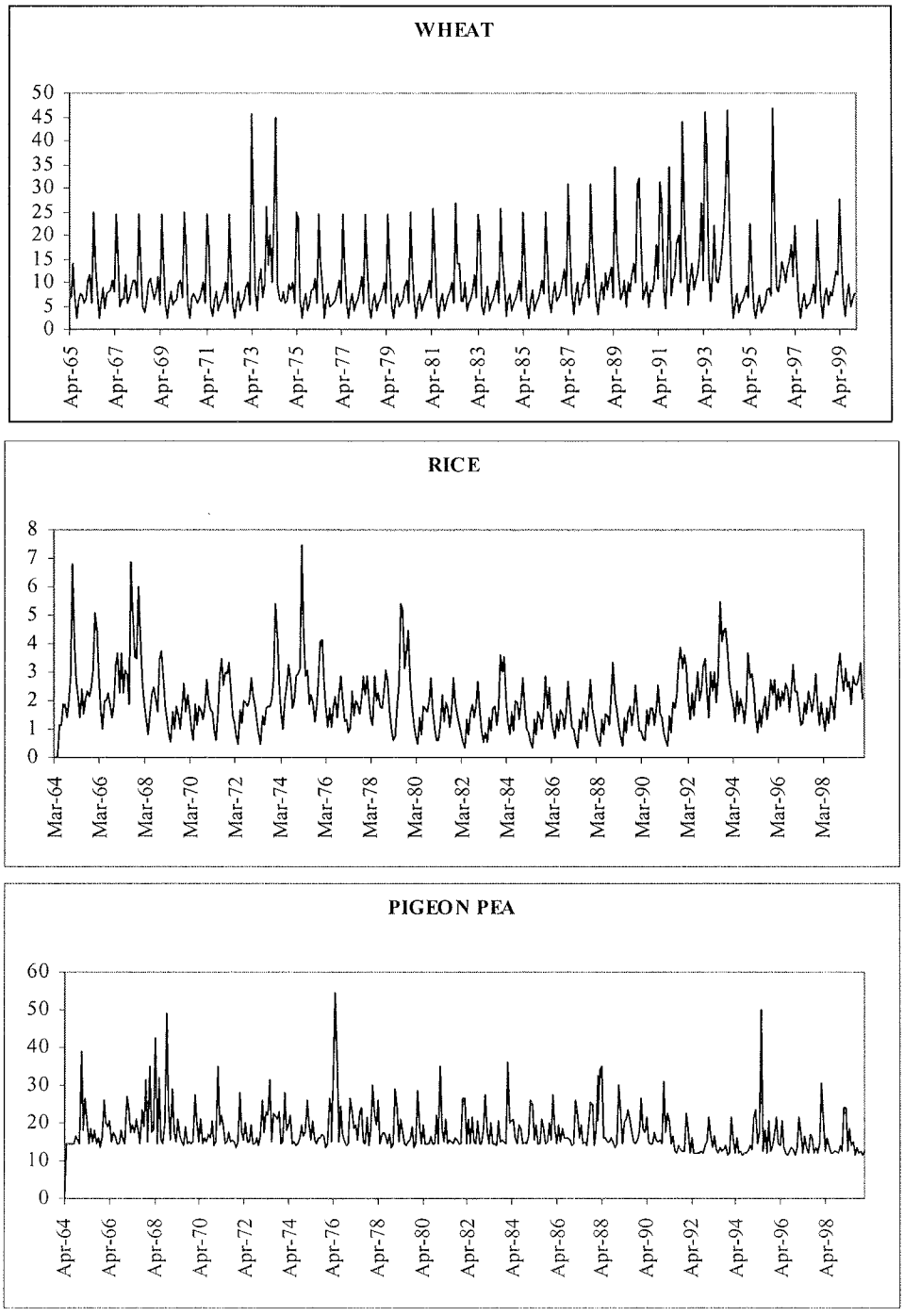


Figure 5.13: Estimated Conditional Variance for Cotton, Groundnut Oil and Sugar for Model 2

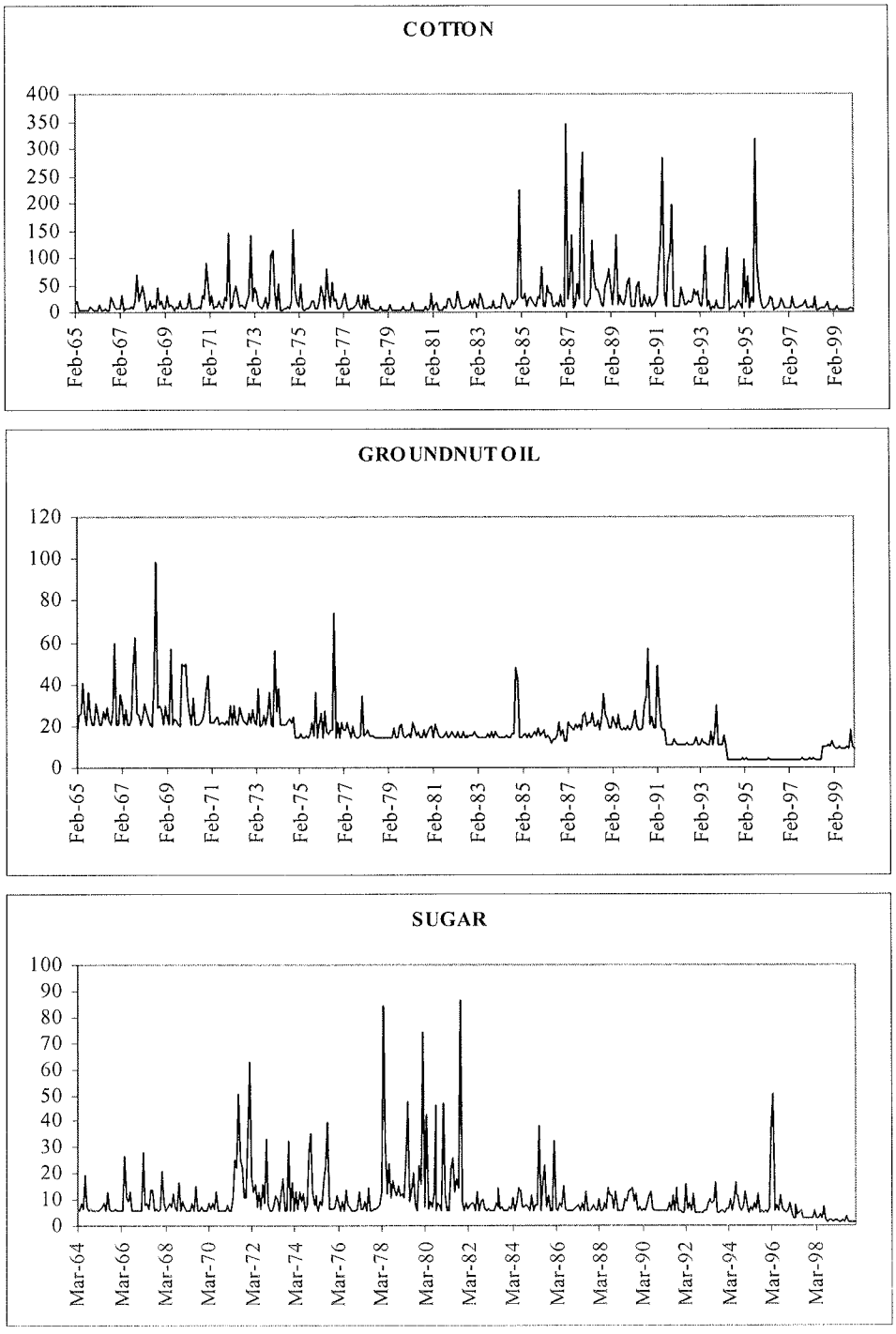
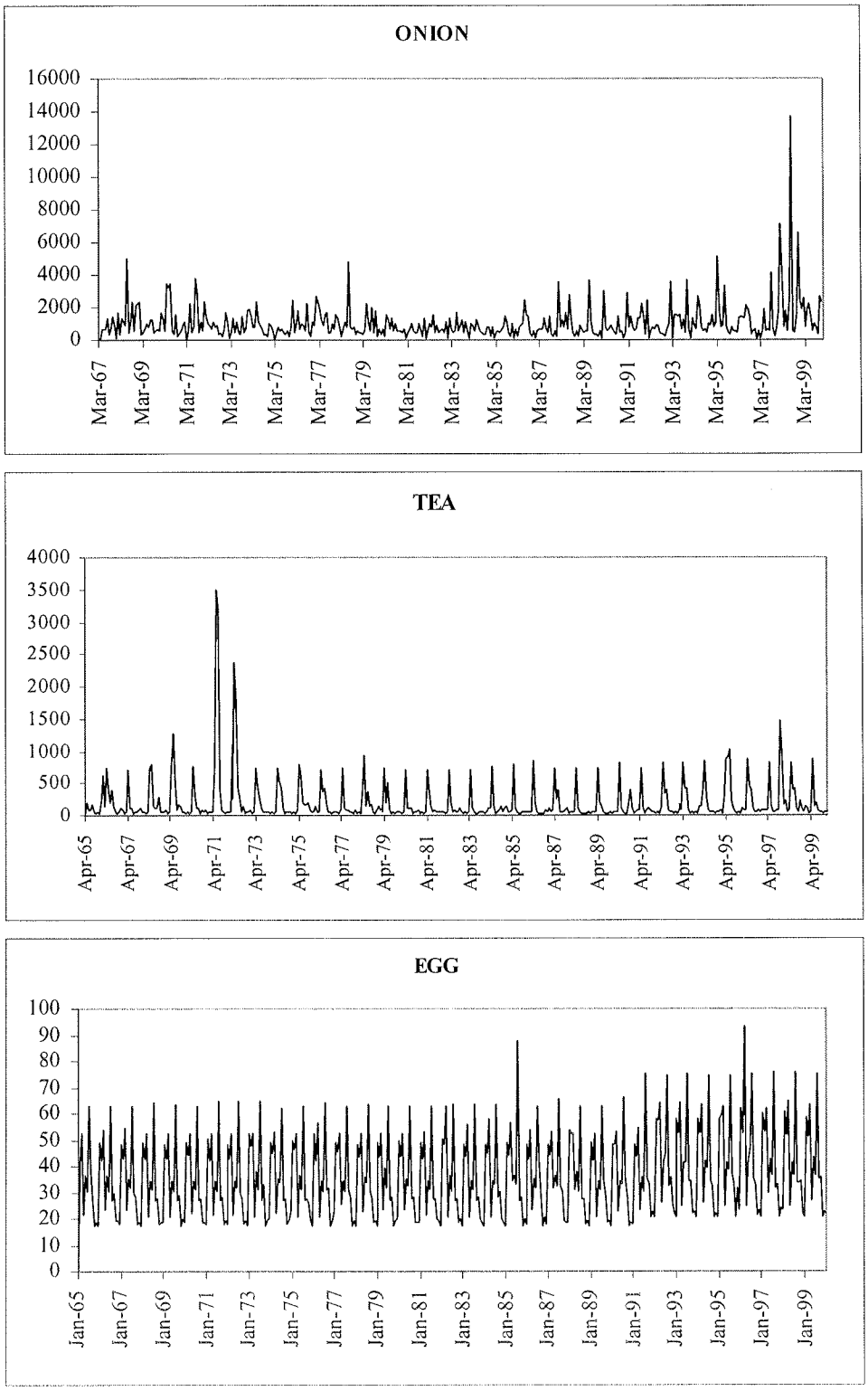


Figure 5.14: Estimated Conditional Variance for Egg, Onion and Tea for Model 2



5.5 Summary of Results

Estimated results for the nine commodities show that ARCH (1) is the appropriate model for explaining the conditional variance for most of the commodities. GARCH (1,1) fits well for the rice and tea prices. The ARCH1 coefficient is not significant for eggs and sugar but the conditional variance is still time-varying because of seasonality and policy variables. Tests indicate departure from normality for all commodities except for pigeon pea and onion and a *t* distribution is used for specifying the likelihood function. The estimated reciprocal of degrees of freedom parameter is significant in almost all the models indicating that *t* distribution is the appropriate specification for the error terms.

The variable DEVAL is significant in the mean equation in case of sugar and groundnut oil. However, this variable has opposite signs for two commodities despite the fact that both commodities are imported. In case of sugar, the mean price has increased due to devaluation, as is expected. In case of groundnut the negative sign could have occurred due to some other unexplained factors. DEVAL is not significant in the conditional variance equation in any of the commodities.

The trade liberalization measure for onion (LIBZ_2ON) is significant and affected the mean price negatively. The textile policy of 1978 (TEXP_78) and delicensing of textile industry (DLICENDC) are significant variables in the mean equation for cotton and reduce the mean price. The liberalization measure for cotton (LIBZ_1C) is also significant in the mean equation for cotton but affects the mean price negatively.

The textile policy announced by the Indian government in 1978 (TEXP_78), the policy of liberalizing wheat exports (LIBZ_3W) and the policy of partial control of sugar

price (PCONT_SU) contributed to reducing the price variance of these commodities. The trade liberalization measures adopted by the Indian government for groundnut (LIBZ_2GN) increased the price variance of groundnut oil. Other policy variables were not found to be significant in the conditional variance equation in any of the commodities.

CHAPTER 6
CONCLUSIONS AND SUMMARY

Price volatility has adverse effect on both consumers and producers. Hence, volatility of agricultural commodity prices is a topic of concern for all countries -both developing and developed. Policy makers in different countries use different instruments to attain the objective of price stabilization. India is no exception in this regard. Government of India intervenes heavily in agriculture sector and resorts to various policies to attain the objective of price stability. On the one hand the government intervenes through its price support/ procurement policies and on the other hand it extends various kinds of subsidies to the farmers. Various government policies insulate the domestic market from external influences by imposing various quantity and/or price controls over exports and imports of commodities and by "canalizing" the import and export operations through public corporations.

The limited literature on price stabilization policies focuses mostly on comparison of changes in price volatility pre-reform and post-reform or the cost of stabilization programs to the government. Very few studies have analyzed the impact of specific policies on price volatility. This study tries to fill this gap by analyzing how successful government has been in attaining its objective of price stability and what are the major policies that affected price volatility over time.

The primary purpose of this thesis is to analyze commodity price volatility overtime in India. An objective of this study is studying the impact of liberalization and other government policies on the price volatility in India and analyzing the effects of

futures market on volatility of commodity prices. This analysis is conducted for nine agricultural commodities in India using monthly wholesale price (index) data from India from 1963 to 1999. These commodities were chosen according to their importance in agricultural sector in India. GARCH models with *t* distribution for the error term were estimated for the analysis. Tests indicated departure from normality for all commodities except for pigeon pea and onion hence *t* distribution was used for specifying the likelihood function. For each commodity two models were estimated with two different specifications for the conditional variance equation.

6.1 Conclusions

Previous experience in other countires has shown that agricultural commodity prices are very volatile. Similar pattern is observed in case of India. However, prices of some commodities show more volatility than the prices of other commodities.

Previous studies conducted in Ghana and Madagascar had shown that liberalization measures affected price variance and mean price. In case of India, results indicate that devaluation affected mean price of sugar and groundnut oil but had no impact on the price variance.

It was believed by Indian government that futures market led to pure speculation and price manipulation and hence enhanced price volatility. Thus futures trading was banned in most of the commodities in 1960s. After the introduction of economic reforms in 1991, the government's stand softened and it allowed futures trading in a number of commodities. Results from this study show that futures market does not affect the price

variance of spot prices. Thus though futures market did not enhance price volatility as is the popularly held belief in India, they also did not contribute to reducing the price volatility. This could have happened due the fact that futures markets are not as developed in India as the ones in developed countries. This reason being that futures markets have been subject to prohibition from time to time and the participants have not been able to shrug off the scare of being banned anytime in future

Analysis shows that only selected government policies affected price variance and mean price. Most of the government policies were ineffective in reducing price variance and did not attain their stated objectives. The textile policy announced by the Indian government in 1978, the policy of liberalizing wheat exports and the policy of partial control of sugar price contributed to reducing the price variance of these commodities. The trade liberalization measures adopted by the Indian government for groundnut increased the price variance of groundnut oil. Other policy variables were not found to be significant in the conditional variance equation in any of the commodities.

The trade liberalization measure for onion is significant and affected the mean price negatively. The textile policy of 1978 and delicensing of textile industry are significant variables in the mean equation for cotton and reduce the mean price. The liberalization measure for cotton is also significant in the mean equation for cotton but affects the mean price negatively.

It can be observed from the results that very few policies contributed to reducing the price volatility. Indian government has a very complicated policy structure and for each commodity various policies are in place. These results indicate that government

needs to rethink its various policies by taking into consideration the fact that they do not meet their stated objectives and the large costs of implementing them.

The study period does not take into account the more recent liberalization measures. The extension of study period and the inclusion of more recent policy developments can shed more light on the influence of removal of trade restrictions on the price volatility.

6.2 Limitations of the Study and Future Research

This study could not take into account the inter-state and inter-zonal movement restrictions for wheat and rice due to data unavailability. In case of wheat and rice these movement restrictions are a very important policy. This policy has undergone many changes overtime and probably affects price volatility considerably. It would be interesting to study the impact of this policy on price volatility overtime.

In this thesis univariate GARCH models were estimated for each commodity, as it is very difficult to estimate a nine equation GARCH system. A reasonable compromise may be dividing commodities in sub-groups of three or four and estimating the sub-groups as a system.

Appendix A

Table A.1: Results from Dickey Fuller Test for Stationarity

Variable: Log Price of Wheat Periods of Differencing :1,12							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-413.25	0.0001	-14.3	<.0001		
Single Mean	1	-413.25	0.0001	-14.3	<.0001	102.6	0.001
Trend	1	-413.89	0.0001	-14.3	<.0001	102.5	0.001
Zero Mean	10	383.544	0.9999	-7.74	<.0001		
Single Mean	10	383.489	0.9999	-7.73	<.0001	29.88	0.001
Trend	10	379.678	0.9999	-7.74	<.0001	29.93	0.001
Variable: Log Price of Rice Period of Differencing : 1							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-305.34	0.0001	-12.3	<.0001		
Single Mean	1	-305.38	0.0001	-12.3	<.0001	75.61	0.001
Trend	1	-305.63	0.0001	-12.3	<.0001	75.52	0.001
Zero Mean	10	-7631	0.0001	-6.83	<.0001		
Single Mean	10	-7627	0.0001	-6.82	<.0001	23.25	0.001
Trend	10	-8420.1	0.0001	-6.81	<.0001	23.22	0.001
Variable: Log Price of Pigeon Pea Period of Differencing : 1							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-372.36	0.0001	-13.6	<.0001		
Single Mean	1	-373.02	0.0001	-13.6	<.0001	92.09	0.001
Trend	1	-373.44	0.0001	-13.6	<.0001	92.06	0.001
Zero Mean	10	-173.44	0.0001	-5.47	<.0001		
Single Mean	10	-175.48	0.0001	-5.46	<.0001	14.95	0.001
Trend	10	-176.67	0.0001	-5.47	<.0001	14.95	0.001

Table A.1: Results from Dickey Fuller Test for Stationarity (cont.)

Variable: Log Price of Cotton Period of Differencing : 1							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-385.44	0.0001	-13.9	<.0001		
Single Mean	1	-385.56	0.0001	-13.9	<.0001	95.89	0.001
Trend	1	-385.79	0.0001	-13.8	<.0001	95.72	0.001
Zero Mean	10	-163.45	0.0001	-5.42	<.0001		
Single Mean	10	-163.71	0.0001	-5.41	<.0001	14.64	0.001
Trend	10	-164.47	0.0001	-5.41	<.0001	14.67	0.001
Variable: Log Price of Groundnut Oil Period of Differencing : 1							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-384.95	0.0001	-13.8	<.0001		
Single Mean	1	-385.15	0.0001	-13.8	<.0001	95.62	0.001
Trend	1	-387.32	0.0001	-13.9	<.0001	95.96	0.001
Zero Mean	10	-247.81	0.0001	-5.81	<.0001		
Single Mean	10	-249.94	0.0001	-5.81	<.0001	16.87	0.001
Trend	10	-271.68	0.0001	-5.88	<.0001	17.31	0.001
Variable: Log Price of Sugar Period of Differencing : 1							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-389.34	0.0001	-14	<.0001		
Single Mean	1	-391.17	0.0001	-14	<.0001	97.63	0.001
Trend	1	-391.27	0.0001	-14	<.0001	97.42	0.001
Zero Mean	10	-106.54	0.0001	-4.96	<.0001		
Single Mean	10	-110.13	0.0001	-5	<.0001	12.5	0.001
Trend	10	-110.28	0.0001	-4.99	0.0003	12.47	0.001

Table A.1: Results from Dickey Fuller Test for Stationarity (Cont.)

Variable: Log Price of Onion Period of Differencing : 1							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-375.07	0.0001	-13.7	<.0001		
Single Mean	1	-375.07	0.0001	-13.6	<.0001	92.89	0.001
Trend	1	-375.06	0.0001	-13.6	<.0001	92.68	0.001
Zero Mean	10	174.135	0.9999	-10.2	<.0001		
Single Mean	10	174.113	0.9999	-10.2	<.0001	52.17	0.001
Trend	10	174.113	0.9999	-10.2	<.0001	52.05	0.001
Variable: Log Price of Tea Period of Differencing : 1,12							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-796.6	0.0001	-19.9	<.0001		
Single Mean	1	-796.69	0.0001	-19.9	<.0001	197.9	0.001
Trend	1	-796.69	0.0001	-19.9	<.0001	197.4	0.001
Zero Mean	10	-131.96	0.0001	-5.07	<.0001		
Single Mean	10	-131.93	0.0001	-5.07	<.0001	12.84	0.001
Trend	10	-131.35	0.0001	-5.05	0.0002	12.83	0.001
Variable: Log Price of Egg Period of Differencing : 1,12							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-753.93	0.0001	-19.4	<.0001		
Single Mean	1	-753.93	0.0001	-19.4	<.0001	187.2	0.001
Trend	1	-753.94	0.0001	-19.3	<.0001	186.7	0.001
Zero Mean	10	-2349.9	0.0001	-6.58	<.0001		
Single Mean	10	-2361.7	0.0001	-6.57	<.0001	21.58	0.001
Trend	10	-2355	0.0001	-6.56	<.0001	21.53	0.001

Table A.2: Results from Phillips-Perron Test for Stationarity

Variable: Log Price of Wheat Periods of Differencing :1,12					
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau
Zero Mean	10	-255.35	0.0001	-14.51	<.0001
Single Mean	10	-255.35	0.0001	-14.49	<.0001
Trend	10	-255.04	0.0001	-14.48	<.0001
Zero Mean	1	-304.85	0.0001	-15.08	<.0001
Single Mean	1	-304.85	0.0001	-15.06	<.0001
Trend	1	-305.06	0.0001	-15.06	<.0001
Variable: Log Price of Rice Period of Differencing : 1					
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau
Zero Mean	1	-278.64	0.0001	-14.15	<.0001
Single Mean	1	-278.66	0.0001	-14.14	<.0001
Trend	1	-278.81	0.0001	-14.13	<.0001
Zero Mean	10	-174.74	0.0001	-13.04	<.0001
Single Mean	10	-174.76	0.0001	-13.01	<.0001
Trend	10	-174.91	0.0001	-13	<.0001
Variable: Log Price of Pigeon Pea Period of Differencing : 1					
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau
Zero Mean	1	-309.4	0.0001	-15.2	<.0001
Single Mean	1	-309.62	0.0001	-15.19	<.0001
Trend	1	-309.78	0.0001	-15.18	<.0001
Zero Mean	10	-274.63	0.0001	-14.8	<.0001
Single Mean	10	-274.32	0.0001	-14.78	<.0001
Trend	10	-274.15	0.0001	-14.77	<.0001

Table A.2: Results from Phillips-Perron Test for Stationarity (Cont.)

Variable: Log Price of Cotton Period of Differencing : 1					
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau
Zero Mean	1	-297.12	0.0001	-14.71	<.0001
Single Mean	1	-297.16	0.0001	-14.7	<.0001
Trend	1	-297.29	0.0001	-14.68	<.0001
Zero Mean	10	-270.05	0.0001	-14.36	<.0001
Single Mean	10	-270	0.0001	-14.34	<.0001
Trend	10	-269.99	0.0001	-14.33	<.0001
Variable: Log Price of Groundnut Oil Period of Differencing : 1					
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau
Zero Mean	1	-449.37	0.0001	-21.33	<.0001
Single Mean	1	-449.44	0.0001	-21.31	<.0001
Trend	1	-450.33	0.0001	-21.33	<.0001
Zero Mean	10	-448.14	0.0001	-21.33	<.0001
Single Mean	10	-447.92	0.0001	-21.31	<.0001
Trend	10	-445.72	0.0001	-21.33	<.0001
Variable: Log Price of Sugar Period of Differencing: 1					
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau
Zero Mean	1	-410.56	0.0001	-19.65	<.0001
Single Mean	1	-411.21	0.0001	-19.66	<.0001
Trend	1	-411.28	0.0001	-19.64	<.0001
Zero Mean	10	-437.53	0.0001	-19.76	<.0001
Single Mean	10	-435.67	0.0001	-19.75	<.0001
Trend	10	-435.63	0.0001	-19.73	<.0001

Table A.2: Results from Phillips-Perron Test for Stationarity (Cont.)

Variable: Log Price of Onion Period of Differencing: 1					
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau
Zero Mean	1	-357.25	0.0001	-17.24	<.0001
Single Mean	1	-357.26	0.0001	-17.22	<.0001
Trend	1	-357.27	0.0001	-17.2	<.0001
Zero Mean	10	-197.5	0.0001	-18.89	<.0001
Single Mean	10	-197.53	0.0001	-18.85	<.0001
Trend	10	-197.54	0.0001	-18.81	<.0001
Variable: Log Price of Tea Period of Differencing: 1,12					
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau
Zero Mean	1	-542.19	0.0001	-27.98	<.0001
Single Mean	1	-542.2	0.0001	-27.95	<.0001
Trend	1	-542.2	0.0001	-27.91	<.0001
Zero Mean	10	-498.89	0.0001	-29.36	<.0001
Single Mean	10	-498.86	0.0001	-29.32	<.0001
Trend	10	-498.87	0.0001	-29.29	<.0001
Variable: Log Price of Egg Period of Differencing: 1,12					
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau
Zero Mean	1	-554.81	0.0001	-28.77	<.0001
Single Mean	1	-554.81	0.0001	-28.74	<.0001
Trend	1	-554.81	0.0001	-28.7	<.0001
Zero Mean	10	-453.56	0.0001	-34.9	<.0001
Single Mean	10	-453.56	0.0001	-34.85	<.0001
Trend	10	-453.55	0.0001	-34.8	<.0001

Table A.3: Results from Godfrey's Lagrange Multiplier Test Before Fitting the Model

WHEAT		
	LM	Pr > LM
AR(1)	74.0841	<.0001
AR(2)	95.616	<.0001
AR(3)	101.1889	<.0001
AR(4)	103.7834	<.0001
RICE		
	LM	Pr > LM
AR(1)	63.3088	<.0001
AR(2)	64.404	<.0001
AR(3)	69.4277	<.0001
AR(4)	74.7654	<.0001
PIGEON PEA		
	LM	Pr > LM
AR(1)	43.7047	<.0001
AR(2)	48.0757	<.0001
AR(3)	49.0586	<.0001
AR(4)	50.0332	<.0001
COTTON		
	LM	Pr > LM
AR(1)	54.209	<.0001
AR(2)	62.5761	<.0001
AR(3)	63.9858	<.0001
AR(4)	65.4772	<.0001
GROUNDNUT OIL		
	LM	Pr > LM
AR(1)	0.1141	0.7355
AR(2)	2.6237	0.2693
AR(3)	2.6564	0.4477
AR(4)	3.0503	0.5494

Table A.3: Results from Godfrey's Lagrange Multiplier Test Before Fitting the Model (Cont.)

SUGAR		
	LM	Pr > LM
AR(1)	2.0565	0.1516
AR(2)	2.3387	0.3106
AR(3)	3.781	0.2861
AR(4)	3.8456	0.4273
ONION		
	LM	Pr > LM
AR(1)	16.6905	<.0001
AR(2)	17.0004	0.0002
AR(3)	24.0345	<.0001
AR(4)	30.78	<.0001
TEA		
	LM	Pr > LM
AR(1)	29.3219	<.0001
AR(2)	37.6538	<.0001
AR(3)	39.291	<.0001
AR(4)	49.4912	<.0001
EGG		
	LM	Pr > LM
AR(1)	0.1472	0.7012
AR(2)	0.5659	0.7536
AR(3)	14.9512	0.0019
AR(4)	21.5314	0.0002

Table A.4: Results from Godfrey's Lagrange Multiplier Test After Fitting the Model

	MODEL 1		MODEL 2	
	WHEAT			
	LM	Pr > LM	LM	Pr > LM
AR(1)	0.2690	0.604	0.0868	0.7682
AR(2)	0.8493	0.654	0.509	0.7753
AR(3)	0.9325	0.8176	0.5168	0.9152
AR(4)	1.9957	0.7366	1.5175	0.8235
AR(5)	2.1015	0.8349	1.6559	0.8944
AR(6)	2.1577	0.9046	1.6964	0.9454
AR(7)	3.8465	0.7973	3.7111	0.8124
AR(8)	4.2101	0.8377	4.0951	0.8484
AR(9)	6.2948	0.7101	6.5856	0.6802
AR(10)	7.3473	0.6923	7.8258	0.6458
AR(11)	7.3532	0.7698	7.8266	0.7287
AR(12)	21.167	0.048	20.1717	0.0639
AR(13)	24.3696	0.0279	22.674	0.0458
AR(14)	25.7527	0.0278	23.5695	0.0516
AR(15)	29.5056	0.0138	27.5191	0.0248
	RICE			
	LM	Pr > LM	LM	Pr > LM
AR(1)			0.5283	0.4673
AR(2)			0.5284	0.7678
AR(3)			0.8203	0.8446
AR(4)			2.4139	0.6601
AR(5)			2.4544	0.7833
AR(6)			4.0091	0.6754
AR(7)			4.0358	0.7756
AR(8)			8.1589	0.4181
AR(9)			8.2485	0.5093
AR(10)			8.2979	0.5998
AR(11)			8.3201	0.6844
AR(12)			8.6879	0.7293
AR(13)			8.8004	0.7878

Table A.4: Results from Godfrey's Lagrange Multiplier Test After Fitting the Model (Cont.)

	PIGEON PEA			
	LM	Pr > LM	LM	Pr > LM
AR(1)	0.6491	0.4204	0.2867	0.5923
AR(2)	5.0447	0.0803	4.9841	0.0827
AR(3)	5.1329	0.1623	4.9841	0.173
AR(4)	5.1417	0.2731	4.9891	0.2884
AR(5)	6.4829	0.262	6.1959	0.2876
AR(6)	6.5018	0.3694	6.3488	0.3853
AR(7)	6.5545	0.4767	6.4272	0.4908
AR(8)	9.2548	0.3213	9.1547	0.3294
AR(9)	9.2825	0.4116	9.1807	0.4208
AR(10)	9.9244	0.4471	9.5933	0.4769
AR(11)	10.9335	0.4488	10.4462	0.4908
AR(12)	11.0367	0.5258	10.5118	0.5712
AR(13)	11.3571	0.5809	10.9062	0.6187
AR(14)	11.787	0.6234	11.245	0.6667
AR(15)	11.8366	0.6914	11.3881	0.7246

	COTTON	
	LM	Pr > LM
AR(1)	0.2402	0.6241
AR(2)	0.2875	0.8661
AR(3)	1.7549	0.6248
AR(4)	2.577	0.6309
AR(5)	3.3511	0.646
AR(6)	6.163	0.4052
AR(7)	6.5816	0.4737
AR(8)	6.6073	0.5795
AR(9)	6.7863	0.6594
AR(10)	8.4835	0.5817
AR(11)	9.1578	0.6073
AR(12)	12.1335	0.435
AR(13)	13.517	0.4087
AR(14)	13.7484	0.4686

Table A.4: Results from Godfrey's Lagrange Multiplier Test After Fitting the Model (Cont.)

AR(15)			16.9645	0.321
AR(16)			20.8739	0.1834
AR(17)			23.7657	0.1259
AR(18)			24.3048	0.1453
AR(19)			27.9158	0.0851
AR(20)			28.2996	0.1025
AR(21)			28.3148	0.1314
AR(22)			28.5239	0.159
AR(23)			29.1815	0.1744
AR(24)			29.1818	0.2134
AR(25)			29.4171	0.2469
GROUNDNUT OIL				
	LM	Pr > LM	LM	Pr > LM
AR(1)	0.0215	0.8834	0.0327	0.8565
AR(2)	2.9241	0.2318	2.6405	0.2671
AR(3)	5.2548	0.1541	5.132	0.1624
AR(4)	5.4272	0.2462	5.2845	0.2593
AR(5)	5.4333	0.3653	5.2972	0.3807
AR(6)	7.7693	0.2555	7.4407	0.282
AR(7)	10.386	0.1677	9.8982	0.1944
AR(8)	11.327	0.1839	10.9503	0.2045
AR(9)	11.7742	0.2263	11.4268	0.2476
AR(10)	11.7813	0.3	11.4397	0.3243
AR(11)	12.3261	0.3396	12.0228	0.3619
AR(12)	12.3944	0.4145	12.1191	0.4362
AR(13)	13	0.4478	12.8325	0.4608
AR(14)	13.967	0.4522	13.6983	0.4724
AR(15)	15.9716	0.3839	15.5555	0.4122
AR(16)	15.9738	0.4548	15.5653	0.4837
AR(17)	16.0329	0.5215	15.6012	0.5523
AR(18)	17.3543	0.4989	16.804	0.5366
AR(19)	17.4093	0.5622	16.8709	0.5986
AR(20)	21.1019	0.3912	20.6733	0.4166
AR(21)	22.6321	0.3639	22.2084	0.3876

Table A.4: Results from Godfrey's Lagrange Multiplier Test After Fitting the Model (Cont.)

AR(22)	24.8223	0.3056	24.1389	0.34
AR(23)	25.2309	0.3385	24.5715	0.3727
AR(24)	25.5564	0.376	24.8845	0.4121
AR(25)	26.3943	0.3868	25.6817	0.4247
AR(26)	29.0117	0.3106	28.3537	0.3413
SUGAR				
	LM	Pr > LM	LM	Pr > LM
AR(1)	0.0588	0.8084	0.0288	0.8652
AR(2)	0.1328	0.9358	0.0654	0.9678
AR(3)	0.7987	0.8498	0.8811	0.83
AR(4)	2.0088	0.7341	1.9763	0.7401
AR(5)	2.0646	0.8401	2.0355	0.8442
AR(6)	2.1469	0.9057	2.1658	0.9038
AR(7)	2.2807	0.9427	2.1952	0.9483
AR(8)	3.5145	0.8981	3.4793	0.9008
AR(9)	3.5187	0.9401	3.5776	0.937
AR(10)	3.5189	0.9665	3.5862	0.9641
AR(11)	4.4752	0.9539	5.0818	0.9271
AR(12)	5.2553	0.9489	6.1811	0.9067
AR(13)	5.3056	0.9678	6.4598	0.9278
AR(14)	7.6879	0.9049	8.6781	0.8511
AR(15)	8.9685	0.8792	10.2679	0.8026
ONION				
	LM	Pr > LM	LM	Pr > LM
AR(1)	1.5287	0.2163	0.8545	0.3553
AR(2)	1.8296	0.4006	0.8779	0.6447
AR(3)	1.8807	0.5975	1.0897	0.7796
AR(4)	6.6428	0.156	3.2667	0.5142
AR(5)	9.0521	0.107	8.4946	0.131
AR(6)	9.7573	0.1353	10.3404	0.111
AR(7)	10.8216	0.1466	10.3602	0.1691
AR(8)	14.4383	0.071	12.0325	0.1498
AR(9)	14.4835	0.1061	12.3094	0.1964
AR(10)	14.7959	0.1397	13.7594	0.1843

Table A.4: Results from Godfrey's Lagrange Multiplier Test After Fitting the Model (Cont.)

AR(11)	20.0117	0.0452	18.4467	0.0718
AR(12)	25.7008	0.0118	20.9549	0.051
AR(13)	25.8239	0.018	21.2	0.0691
AR(14)	26.5443	0.0221	21.3566	0.0928
AR(15)	30.799	0.0093	21.6702	0.1167
AR(16)	30.8718	0.014	21.9981	0.1433
AR(17)	32.3623	0.0136	22.6867	0.1597
AR(18)	34.4344	0.0111	26.066	0.0983
AR(19)	35.6905	0.0115	26.1228	0.1268
AR(20)	35.704	0.0167	27.2652	0.128
AR(21)	36.1849	0.0208	27.2654	0.1622
AR(22)	36.2106	0.0288	27.299	0.2001
AR(23)	36.3029	0.0384	27.307	0.2431
AR(24)	36.5907	0.048	27.3353	0.2891
AR(25)	37.6446	0.0501	27.543	0.3293
AR(26)	39.4492	0.0441	29.2202	0.3012
AR(27)	40.6903	0.0441	31.5121	0.2506
AR(28)	42.9679	0.0351	31.7192	0.2861
AR(29)	42.9988	0.0455	31.7205	0.3323
AR(30)	43.3351	0.0547	32.8479	0.3292
AR(31)	43.4539	0.068	32.9606	0.3713
AR(32)	45.9383	0.0526	33.1331	0.4117
AR(33)	46.1264	0.0642	33.673	0.4347
AR(34)	47.1241	0.0666	33.7126	0.4816
AR(35)	48.316	0.0664	34.1008	0.5113
AR(36)	50.3075	0.0571	36.9093	0.4267
AR(37)	51.0019	0.0625	39.1366	0.3741
AR(38)	51.5663	0.0699	40.043	0.3796
AR(39)	53.0043	0.0666	40.852	0.3891
AR(40)	53.045	0.0811	42.1919	0.3764
AR(41)	53.6747	0.0887	44.2994	0.3342
AR(42)	54.2484	0.0975	44.3055	0.3746
AR(43)	54.2635	0.1165	45.4654	0.3697
AR(44)	54.4813	0.1337	45.8139	0.3968
AR(45)	55.5574	0.1345	46.8422	0.3968

Table A.4: Results from Godfrey's Lagrange Multiplier Test After Fitting the Model (Cont.)

AR(46)	55.6574	0.1557	46.8697	0.4366
AR(47)	58.1121	0.1284	47.3469	0.4584
AR(48)	59.646	0.1208	55.3442	0.2172
AR(49)	60.1688	0.1317	55.9506	0.2302
AR(50)	60.3087	0.1508	55.9546	0.2613
TEA				
	LM	Pr > LM	LM	Pr > LM
AR(1)	0.0037	0.9517	0	0.9993
AR(2)	0.0191	0.9905	0	1
AR(3)	0.0633	0.9958	0	1
AR(4)	0.0638	0.9995	0	1
AR(5)	0.0647	0.9999	0	1
AR(6)	0.0788	1	0	1
AR(7)	0.0861	1	0	1
AR(8)	0.2168	1	0	1
AR(9)	0.2859	1	0	1
AR(10)	0.2863	1	0	1
AR(11)	0.2876	1	0	1
AR(12)	0.2973	1	0	1
AR(13)	0.3049	1	0	1
AR(14)	0.3653	1	0	1
AR(15)	0.3668	1	0.0001	1
EGG				
	LM	Pr > LM	LM	Pr > LM
AR(1)	0.0009	0.9763	0.5479	0.4592
AR(2)	0.0329	0.9837	3.5183	0.1722
AR(3)	0.189	0.9793	3.5266	0.3173
AR(4)	0.1894	0.9958	4.1062	0.3918
AR(5)	0.1923	0.9992	6.1862	0.2885
AR(6)	0.42	0.9987	6.2472	0.3961
AR(7)	0.4406	0.9996	8.7445	0.2715
AR(8)	0.4425	0.9999	8.7462	0.3642
AR(9)	0.4581	1	8.7486	0.4608
AR(10)	0.4582	1	9.8045	0.4578

Table A.4: Results from Godfrey's Lagrange Multiplier Test After Fitting the Model (Cont.)

	LM	Pr > LM	LM	Pr > LM
AR(11)	0.4717	1	12.747	0.3102
AR(12)	0.5345	1	13.8296	0.3117

Table A.5: Results from Q^2 and Engel's Lagrange Multiplier Tests Before Fitting the Model

WHEAT				
Order	Q	Pr > Q	LM	Pr > LM
1	32.0754	<.0001	31.9698	<.0001
2	33.1059	<.0001	38.9003	<.0001
3	34.9651	<.0001	45.4394	<.0001
4	37.4441	<.0001	45.5103	<.0001
5	37.4811	<.0001	45.5103	<.0001
RICE				
Order	Q	Pr > Q	LM	Pr > LM
1	43.8231	<.0001	43.6654	<.0001
2	43.969	<.0001	50.2271	<.0001
3	44.4331	<.0001	50.2897	<.0001
4	44.9628	<.0001	50.9276	<.0001
5	45.7834	<.0001	50.9823	<.0001
PIGEON PEA				
Order	Q	Pr > Q	LM	Pr > LM
1	26.7326	<.0001	26.6685	<.0001
2	34.6293	<.0001	29.1955	<.0001
3	37.5665	<.0001	29.6931	<.0001
4	42.3526	<.0001	31.9087	<.0001
5	44.8369	<.0001	32.2531	<.0001
GROUNDNUT OIL				
Order	Q	Pr > Q	LM	Pr > LM
1	47.4572	<.0001	47.1594	<.0001
2	55.5001	<.0001	47.5429	<.0001
3	55.5446	<.0001	49.472	<.0001
4	55.5973	<.0001	49.5048	<.0001
5	55.6988	<.0001	49.8421	<.0001
COTTON				
Order	Q	Pr > Q	LM	Pr > LM
1	22.8071	<.0001	22.6982	<.0001
2	23.1542	<.0001	22.9457	<.0001
3	23.1748	<.0001	22.965	<.0001

Table A.5: Results from Q^2 and Engel's Lagrange Multiplier Tests Before Fitting the Model (Cont.)

Order	Q	Pr > Q	LM	Pr > LM
4	23.4101	0.0001	23.1808	0.0001
5	23.4748	0.0003	23.1844	0.0003
SUGAR				
Order	Q	Pr > Q	LM	Pr > LM
1	39.3839	<.0001	38.9073	<.0001
2	43.228	<.0001	38.9165	<.0001
3	43.4656	<.0001	40.2236	<.0001
4	43.4738	<.0001	40.3721	<.0001
5	47.5065	<.0001	44.9275	<.0001
ONION				
Order	Q	Pr > Q	LM	Pr > LM
1	0.1205	0.7285	0.1061	0.7446
2	0.8297	0.6604	0.8264	0.6615
3	7.0219	0.0712	6.9685	0.0729
4	11.5267	0.0212	11.5861	0.0207
5	12.4005	0.0297	12.2705	0.0313
TEA				
Order	Q	Pr > Q	LM	Pr > LM
1	38.5909	<.0001	38.3713	<.0001
2	38.591	<.0001	42.1114	<.0001
3	39.1271	<.0001	44.0435	<.0001
4	39.1399	<.0001	44.4071	<.0001
5	39.6993	<.0001	44.6891	<.0001
EGG				
Order	Q	Pr > Q	LM	Pr > LM
1	1.2066	0.272	1.1821	0.2769
2	1.5594	0.4585	1.5789	0.4541
3	14.3972	0.0024	14.0658	0.0028
4	14.9124	0.0049	15.2912	0.0041
5	17.0628	0.0044	16.664	0.0052

Table A.6: Results from Q^2 and Engel's Lagrange Multiplier Tests After Fitting the Model

	MODEL 1				MODEL 2			
WHEAT								
Order	Q	Pr > Q	LM	Pr > LM	Q	Pr > Q	LM	Pr > LM
1	0.1133	0.7365	0.1046	0.7464	0.005	0.9434	0.0068	0.9341
2	4.581	0.1012	4.5037	0.1052	5.3239	0.0698	5.2535	0.0723
RICE								
Order					Q	Pr > Q	LM	Pr > LM
1					0.0033	0.9542	0.005	0.9438
2					1.5067	0.4708	1.4185	0.492
PIGEON PEA								
Order	Q	Pr > Q	LM	Pr > LM	Q	Pr > Q	LM	Pr > LM
1	0.0122	0.9122	0.0085	0.9266	0.081	0.7759	0.0907	0.7633
2	8.9657	0.0113	9.0791	0.0107	11.3226	0.0035	11.4222	0.0033
COTTON								
Order	Q	Pr > Q	LM	Pr > LM	Q	Pr > Q	LM	Pr > LM
					1.0076	0.3155	1.0053	0.316
					1.5234	0.4669	1.4566	0.4827
GROUNDNUT OIL								
Order	Q	Pr > Q	LM	Pr > LM	Q	Pr > Q	LM	Pr > LM
1	0.0037	0.9515	0.0058	0.9391	0.0011	0.9741	0.0003	0.9866
2	0.4764	0.7881	0.5173	0.7721	0.5017	0.7781	0.5403	0.7633
SUGAR								
Order	Q	Pr > Q	LM	Pr > LM	Q	Pr > Q	LM	Pr > LM
1	1.393	0.2379	1.3612	0.2433	0.5968	0.4398	0.5779	0.4471
2	4.6037	0.1001	4.3879	0.1115	5.0321	0.0808	4.9419	0.0845
ONION								
Order	Q	Pr > Q	LM	Pr > LM	Q	Pr > Q	LM	Pr > LM
1	5.7655	0.0163	5.6437	0.0175	6.6281	0.01	6.5053	0.0108
2	8.6196	0.0134	9.4355	0.0089	8.7934	0.0123	9.6672	0.008
TEA								
Order	Q	Pr > Q	LM	Pr > LM	Q	Pr > Q	LM	Pr > LM
1	0	0.9997	0.0025	0.9599	0	0.9999	0.0024	0.9608
2	0	1	0.0051	0.9975	0	1	0.0049	0.9976

Table A.6: Results from Q^2 and Engel's Lagrange Multiplier Tests After Fitting the Model (Cont.)

	MODEL 1				MODEL 2			
	EGG							
Order	Q	Pr > Q	LM	Pr > LM	Q	Pr > Q	LM	Pr > LM
1	0	0.9971	0.0031	0.9554	0.0282	0.8667	0.022	0.882
2	0	1	0.006	0.997	0.3321	0.847	0.3636	0.8338

Table A.7: Results from Normality Test

	Normality Test Statistic	Pr > ChiSq
Wheat	533.6216	<.0001
Rice	17.7171	<.0001
Pigeon Pea	5.5156	0.0634
Cotton	452.2976	<.0001
Groundnut Oil	2837.9717	<.0001
Sugar	845.8728	<.0001
Onion	2.0083	0.3664
Tea	567.2357	<.0001
Egg	14.2169	0.0008

APPENDIX B

Table B.1: Wholesale Prices and Consumer Price Index Data used in the Study

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
		WPI 1981-82=100	WPI 1981-82=100	WPI 1981-82=100	WPI 1981-82=100	WPI 1981-82=100	WPI 1981-82=100	Rs/Quintal	Rs/Kg	Rs/100
Jan-63	23.56	24.40	22.52	16.51	12.13	21.86	25.12	37.50	4.83	17.4
Feb-63	23.35	24.30	22.48	16.64	12.29	22.33	26.24	37.52	4.70	16.5
Mar-63	23.56	24.15	22.74	16.11	12.06	23.30	26.78	26.80	4.48	16.9
Apr-63	23.77	24.20	24.17	16.70	12.38	23.78	26.93	16.08	6.41	16.9
May-63	23.77	24.02	25.14	16.99	13.20	23.95	26.49	12.06	6.08	17.9
Jun-63	24.19	24.22	25.78	17.89	13.84	23.63	26.49	10.72	5.79	16.9
Jul-63	24.40	24.75	26.41	17.54	13.93	23.51	26.49	16.08	6.41	17.9
Aug-63	24.61	24.72	26.68	17.53	14.04	23.23	26.49	16.08	6.11	20.9
Sep-63	24.82	24.92	27.36	18.62	14.55	23.21	26.49	17.42	5.43	22.2
Oct-63	25.04	25.27	27.62	18.95	14.01	21.21	26.49	26.80	5.18	21.9
Nov-63	24.97	25.97	27.20	19.60	13.06	23.02	27.03	40.00	4.94	19.9
Dec-63	25.33	28.30	25.84	20.01	12.89	23.55	28.17	35.00	4.73	20.9
Jan-64	25.33	29.35	25.12	19.62	13.66	23.82	28.30	28.00	4.70	18.9
Feb-64	25.69	31.08	25.34	20.97	14.45	24.16	28.30	30.00	4.61	18.4
Mar-64	25.88	30.68	25.62	22.05	14.69	24.22	28.30	29.00	4.18	18.4
Apr-64	26.04	29.43	25.97	22.25	15.01	24.07	28.30	15.00	6.31	19.5
May-64	26.59	28.48	27.18	22.45	15.83	24.05	28.30	13.00	6.02	19.5
Jun-64	27.14	29.50	28.24	23.40	17.04	23.95	29.76	14.50	6.64	20.0
Jul-64	27.85	30.45	28.85	24.45	18.56	24.16	29.76	26.80	6.14	25.9
Aug-64	28.21	32.20	29.93	25.28	18.25	24.31	29.76	24.12	5.88	24.9
Sep-64	28.76	35.18	30.13	27.16	19.44	24.26	29.76	24.12	5.49	25.4
Oct-64	29.50	35.96	30.10	29.56	19.06	24.49	29.76	26.80	5.27	25.4
Nov-64	29.50	35.81	27.82	29.92	16.55	25.82	29.52	37.52	4.98	25.4
Dec-64	29.66	37.58	27.01	32.92	17.95	24.87	29.45	46.56	5.76	25.4
Jan-65	29.85	41.16	26.74	33.91	17.45	24.60	29.45	42.88	4.21	23.4
Feb-65	29.31	39.94	26.85	30.03	16.66	24.94	29.45	24.12	4.21	23.4
Mar-65	28.76	37.93	26.90	27.06	16.03	24.87	29.45	21.43	4.19	23.4
Apr-65	28.95	37.61	26.90	26.02	17.32	24.54	29.45	10.72	6.59	23.4
May-65	29.12	35.16	26.92	24.66	17.89	24.56	29.45	13.40	7.56	23.4
Jun-65	29.50	35.38	27.09	24.03	18.21	24.60	29.45	19.00	5.92	24.4
Jul-65	30.40	37.06	28.63	25.87	20.61	24.96	29.45	29.48	6.91	26.9
Aug-65	30.76	38.28	30.15	26.77	22.68	25.00	29.45	26.00	6.53	29.4
Sep-65	31.12	37.61	30.17	26.35	23.17	25.00	29.81	30.00	5.90	26.9
Oct-65	31.12	37.08	29.78	26.42	23.29	25.04	29.81	32.16	5.71	25.9
Nov-65	31.30	37.86	30.83	27.36	24.40	25.67	29.81	35.00	5.02	26.9
Dec-65	31.30	38.13	31.60	26.91	23.93	25.53	29.81	29.48	4.86	26.9
Jan-66	31.30	38.31	32.32	25.21	23.95	25.15	29.81	29.00	4.83	25.8
Feb-66	31.47	37.78	32.85	23.13	24.07	24.94	29.81	34.84	4.81	23.5
Mar-66	31.47	37.58	33.20	23.35	25.68	24.92	31.75	30.00	4.53	24.8
Apr-66	31.66	36.98	34.17	23.99	27.46	24.98	31.40	22.00	6.10	24.8
May-66	32.73	37.96	34.85	24.15	30.59	25.10	31.40	23.00	7.18	24.8

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
Jun-66	33.47	39.09	35.49	23.89	31.04	25.23	31.40	23.00	6.87	27.3
Jul-66	34.02	40.61	36.04	24.32	32.18	25.65	31.40	22.00	7.72	27.3
Aug-66	34.38	40.99	36.41	24.87	34.83	27.46	31.40	28.00	6.69	29.8
Sep-66	34.54	40.44	36.17	24.20	31.01	27.44	31.40	38.50	5.73	29.8
Oct-66	34.73	42.06	36.54	25.38	29.78	27.25	31.43	55.00	5.21	29.8
Nov-66	35.09	45.04	37.69	25.98	28.01	27.27	31.48	64.30	5.42	29.8
Dec-66	35.64	48.37	37.60	25.44	30.10	27.46	31.48	53.58	5.44	29.8
Jan-67	35.64	52.37	39.25	27.30	33.55	27.74	31.48	58.94	5.50	28.6
Feb-67	35.81	55.05	40.41	29.26	34.68	27.90	33.92	64.50	5.34	27.3
Mar-67	36.19	54.57	39.84	29.91	33.61	28.14	33.92	45.50	4.84	27.0
Apr-67	36.54	51.42	40.30	31.00	33.04	28.03	33.92	32.16	8.54	27.0
May-67	37.26	49.37	41.75	34.24	33.52	28.37	33.92	26.00	8.37	27.0
Jun-67	38.16	53.45	45.55	38.51	33.07	28.49	33.92	21.50	7.37	27.0
Jul-67	38.52	57.55	47.86	40.63	29.58	28.62	35.10	26.80	8.78	30.0
Aug-67	38.90	55.55	48.48	39.09	25.73	28.37	35.10	25.50	6.60	32.0
Sep-67	38.73	55.27	47.18	41.38	25.99	27.15	35.10	22.50	6.17	33.0
Oct-67	39.27	55.02	45.11	48.67	25.20	29.21	35.10	22.50	6.27	32.5
Nov-67	39.10	53.35	42.70	51.60	24.02	31.35	35.10	25.00	5.76	34.5
Dec-67	38.73	51.05	41.00	48.00	22.99	33.86	36.61	32.50	5.32	33.5
Jan-68	39.80	55.25	42.76	48.37	21.92	33.38	38.91	20.00	5.36	33.0
Feb-68	39.27	53.32	43.20	44.10	19.68	31.78	38.91	21.50	4.99	32.0
Mar-68	38.54	51.05	42.92	36.93	19.36	30.91	38.91	22.50	4.27	28.5
Apr-68	38.73	49.47	43.73	34.62	19.94	30.85	38.91	20.00	8.59	27.5
May-68	38.37	47.72	45.00	29.96	19.62	31.88	38.91	26.25	6.51	27.5
Jun-68	38.73	47.94	45.79	27.71	18.09	32.11	38.91	27.50	6.51	27.5
Jul-68	38.54	48.97	45.49	26.64	32.37	32.15	38.91	42.50	8.02	30.0
Aug-68	39.10	50.70	46.04	29.02	23.54	32.53	38.91	70.00	6.27	29.0
Sep-68	37.66	53.20	45.44	33.40	28.88	33.00	38.91	60.00	5.54	29.0
Oct-68	37.87	52.27	44.89	31.82	27.91	33.08	38.91	90.00	5.52	28.0
Nov-68	37.03	52.02	42.12	30.57	26.09	33.19	38.91	47.50	5.11	30.0
Dec-68	35.97	51.80	40.28	27.97	23.70	32.70	38.52	56.25	4.86	30.0
Jan-69	35.76	53.30	39.64	27.81	24.78	32.83	38.40	50.00	4.76	30.0
Feb-69	35.55	53.10	39.42	26.61	25.12	32.53	38.40	37.50	4.63	28.0
Mar-69	35.76	52.32	40.06	27.43	29.28	33.56	38.57	27.50	4.70	28.0
Apr-69	35.97	49.44	41.11	26.82	30.25	35.35	38.62	26.25	7.41	26.0
May-69	36.40	48.79	42.28	27.10	30.54	35.80	38.62	17.50	7.84	26.0
Jun-69	37.45	51.20	44.17	28.93	33.74	35.98	38.62	22.50	7.04	27.0
Jul-69	37.66	53.00	44.87	29.02	35.75	36.09	38.62	35.00	7.32	28.0
Aug-69	37.66	53.07	45.84	28.93	36.08	36.41	38.59	42.50	6.02	29.0
Sep-69	37.66	53.12	45.24	28.90	38.17	36.03	38.59	55.00	6.08	27.0
Oct-69	37.45	52.47	44.34	29.29	32.73	34.76	38.59	62.50	5.49	28.0
Nov-69	37.24	52.90	43.07	29.00	27.27	33.92	38.59	50.00	5.31	27.5
Dec-69	37.24	55.20	41.09	29.82	28.90	34.57	38.59	50.00	5.25	27.0
Jan-70	37.24	57.28	41.64	31.82	32.31	36.43	38.59	57.50	5.61	26.0
Feb-70	37.24	58.75	41.97	31.26	32.96	37.65	37.81	50.00	5.63	26.0
Mar-70	37.66	59.78	42.61	32.17	35.18	38.45	37.61	65.00	5.25	26.0
Apr-70	38.08	54.07	44.10	32.13	36.17	39.16	37.84	27.50	13.96	26.0

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
May-70	38.50	51.47	45.33	33.68	37.13	39.67	38.52	37.50	7.03	27.0
Jun-70	38.92	51.97	46.01	35.19	37.59	40.07	38.52	35.00	7.22	26.0
Jul-70	39.13	52.00	46.12	34.57	36.81	40.99	38.52	45.00	8.40	29.0
Aug-70	39.34	52.27	46.23	33.86	37.60	40.57	38.52	60.00	7.45	30.0
Sep-70	39.55	51.62	46.17	36.53	38.47	38.45	38.52	72.50	7.09	29.0
Oct-70	39.76	51.37	45.33	37.63	35.44	39.08	38.52	80.00	6.55	28.0
Nov-70	39.76	51.72	43.68	37.52	31.74	44.13	38.52	50.00	5.99	29.0
Dec-70	39.13	51.62	41.36	39.35	32.40	49.66	38.52	32.50	5.87	28.0
Jan-71	38.71	52.97	41.71	38.16	33.48	53.16	38.52	25.00	8.72	27.0
Feb-71	38.71	52.90	42.12	34.39	32.38	52.65	38.52	20.00	9.04	26.0
Mar-71	38.71	52.42	42.52	33.03	32.49	50.32	38.52	22.50	4.99	26.0
Apr-71	38.71	51.16	43.43	32.77	31.31	48.21	39.62	20.00	11.5	25.0
May-71	38.71	49.96	45.46	31.88	30.47	47.07	41.12	17.50	8.89	24.0
Jun-71	39.34	49.85	45.86	33.30	30.12	49.67	44.23	12.00	7.66	24.0
Jul-71	39.97	49.85	46.52	35.29	30.43	51.16	43.19	23.50	8.90	29.0
Aug-71	40.81	51.05	46.61	38.24	32.26	52.04	45.23	30.00	7.20	30.0
Sep-71	41.23	51.37	47.10	38.95	31.45	53.89	45.96	42.00	6.82	29.0
Oct-71	41.23	51.05	46.75	39.55	30.71	52.53	45.66	45.00	6.77	28.0
Nov-71	41.44	52.41	45.37	39.27	28.82	45.75	48.31	75.00	6.26	29.0
Dec-71	41.02	52.62	44.05	39.59	28.01	43.11	51.73	87.50	5.75	26.0
Jan-72	40.81	54.76	44.62	38.88	29.66	43.95	50.77	82.50	5.93	28.0
Feb-72	40.60	54.76	45.15	37.21	28.82	42.63	51.50	50.50	5.71	26.0
Mar-72	40.81	54.50	45.73	36.14	29.10	38.98	54.31	38.50	5.45	25.0
Apr-72	41.02	51.52	47.01	36.46	28.11	35.90	54.12	35.00	5.97	22.0
May-72	41.23	50.58	48.29	37.53	27.09	35.99	53.23	27.50	6.97	24.0
Jun-72	42.29	51.68	49.31	41.57	28.89	36.12	53.69	36.25	7.76	24.0
Jul-72	43.13	52.83	51.17	42.75	31.31	36.91	54.42	43.00	7.82	28.0
Aug-72	43.55	54.34	53.56	43.31	32.37	37.96	57.16	48.00	6.73	32.0
Sep-72	43.76	54.03	54.09	42.50	34.12	37.30	58.85	46.25	5.94	32.0
Oct-72	43.97	54.55	53.87	42.92	34.93	37.83	63.12	57.50	6.15	30.0
Nov-72	44.18	55.39	52.19	44.73	36.58	42.76	62.39	72.50	5.93	32.0
Dec-72	44.18	58.05	50.15	45.27	38.20	47.16	62.35	75.00	5.73	32.0
Jan-73	44.18	61.65	50.64	45.27	39.46	45.58	62.50	45.00	5.84	32.0
Feb-73	44.81	62.75	52.05	48.82	43.51	45.36	62.16	38.50	5.55	31.5
Mar-73	45.44	59.61	53.03	52.44	44.84	44.52	60.69	41.50	5.25	27.0
Apr-73	46.49	54.18	54.18	48.82	46.91	46.81	60.35	32.50	8.59	28.0
May-73	47.97	53.25	55.41	49.95	52.22	48.70	61.96	31.25	7.23	31.0
Jun-73	49.02	52.78	56.83	47.25	54.29	50.99	62.46	35.00	7.93	32.0
Jul-73	51.12	52.83	58.82	52.01	60.62	56.22	61.23	48.00	8.47	36.0
Aug-73	51.96	53.09	61.78	50.41	58.86	57.14	61.08	69.00	7.45	37.0
Sep-73	52.17	52.83	62.22	47.11	57.56	57.41	60.89	90.00	6.63	38.0
Oct-73	53.44	52.88	62.98	47.08	56.51	66.78	57.35	105.00	6.66	40.0
Nov-73	54.49	59.30	66.34	48.64	48.29	64.49	57.66	60.00	6.38	36.0
Dec-73	54.70	61.18	64.44	46.79	49.20	64.93	60.23	70.00	5.99	40.0
Jan-74	55.54	61.34	65.14	47.96	54.58	67.04	61.23	83.00	6.10	34.0
Feb-74	56.17	62.07	66.60	49.60	55.03	72.32	60.04	79.00	6.28	34.0
Mar-74	57.85	62.38	69.61	52.22	57.18	77.07	60.81	65.00	6.74	32.0

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
Apr-74	59.54	73.86	73.46	52.86	58.55	79.67	60.31	34.00	11.63	31.0
May-74	61.85	89.26	74.83	56.52	61.53	81.91	60.31	35.00	10.20	35.5
Jun-74	63.32	86.81	78.23	58.79	63.85	81.34	60.85	42.00	12.11	39.0
Jul-74	65.43	91.04	80.36	62.56	63.96	82.57	62.08	52.00	14.72	44.0
Aug-74	67.53	95.68	84.51	67.92	65.08	84.29	65.12	55.00	11.45	48.0
Sep-74	70.27	102.73	87.65	78.21	63.82	86.31	72.27	62.00	10.35	43.00
Oct-74	70.48	100.90	87.30	79.53	60.73	73.99	66.96	65.00	9.98	43.00
Nov-74	69.64	98.87	82.48	82.90	59.53	62.29	67.58	50.00	10.22	43.00
Dec-74	68.58	101.48	77.00	82.40	60.66	62.82	67.96	50.00	11.06	47.00
Jan-75	68.58	103.51	81.51	87.69	59.88	68.27	65.81	45.00	11.02	43.00
Feb-75	68.37	102.99	82.17	84.32	57.63	66.21	67.23	42.00	10.08	37.00
Mar-75	67.53	99.60	82.74	78.92	56.54	61.54	66.62	40.00	9.70	35.00
Apr-75	67.95	89.68	85.22	75.30	59.04	60.31	67.43	30.00	15.43	35.00
May-75	68.79	85.92	87.83	75.83	59.64	61.24	69.54	28.00	12.05	36.00
Jun-75	69.00	85.61	88.80	73.42	57.70	59.83	67.50	36.00	14.18	37.00
Jul-75	68.16	83.73	87.39	70.44	53.59	58.60	61.81	47.00	14.93	45.00
Aug-75	67.53	83.16	87.12	72.39	55.42	60.27	65.31	45.00	13.44	48.00
Sep-75	67.11	82.53	85.44	75.16	50.46	59.65	66.08	60.00	12.54	45.00
Oct-75	66.48	81.17	82.44	75.98	47.72	57.45	63.85	95.00	12.29	45.00
Nov-75	66.27	80.91	77.31	75.83	43.19	56.27	64.00	160.00	11.44	50.00
Dec-75	64.38	82.37	70.63	71.08	37.67	58.24	63.04	130.00	10.78	48.00
Jan-76	62.69	83.26	67.53	72.50	35.63	63.26	63.66	70.00	10.80	45.00
Feb-76	61.01	82.01	65.32	70.79	31.77	62.95	64.12	40.00	10.60	40.00
Mar-76	60.17	79.71	64.21	63.62	32.12	62.12	63.39	30.00	10.35	40.00
Apr-76	60.80	79.19	65.19	52.83	33.95	69.33	64.54	30.00	13.82	37.00
May-76	61.01	75.38	66.29	45.05	32.58	77.07	64.89	20.00	12.52	37.00
Jun-76	61.22	76.11	67.53	42.75	34.23	80.72	65.77	28.00	14.13	40.00
Jul-76	62.48	77.36	70.94	47.50	43.61	88.60	67.77	28.00	14.01	48.00
Aug-76	62.69	77.62	72.09	46.79	46.70	87.06	69.04	32.00	13.23	48.00
Sep-76	63.53	77.00	71.47	46.01	51.45	88.38	69.43	40.00	12.35	47.00
Oct-76	63.96	77.00	70.58	45.44	51.27	90.67	69.16	40.00	13.23	49.00
Nov-76	64.38	78.35	70.76	46.22	46.67	91.11	68.54	50.00	12.88	49.00
Dec-76	64.38	80.29	70.05	46.93	48.85	88.91	67.16	75.00	13.06	48.00
Jan-77	64.59	84.36	69.17	50.13	54.26	94.01	64.73	105.00	13.40	47.00
Feb-77	65.22	85.19	69.65	51.80	61.46	94.58	64.39	60.00	16.28	45.00
Mar-77	65.64	84.10	69.08	51.73	61.08	92.12	63.62	65.00	18.02	39.00
Apr-77	65.85	79.14	70.94	51.23	61.25	92.21	62.77	68.00	23.29	40.00
May-77	66.90	77.47	72.31	59.25	67.54	94.14	63.31	40.00	18.90	45.00
Jun-77	67.32	78.25	73.50	59.01	68.04	92.60	62.23	50.00	21.67	50.00
Jul-77	68.37	79.45	76.24	61.70	69.34	90.93	62.19	85.00	19.70	58.00
Aug-77	68.79	79.55	76.77	63.30	67.72	87.02	62.16	120.00	17.51	55.00
Sep-77	69.64	79.71	76.42	70.86	63.99	83.36	63.35	180.00	16.31	52.00
Oct-77	69.42	80.02	74.39	73.38	54.44	79.98	61.77	195.00	15.12	49.00
Nov-77	69.42	81.85	71.56	78.53	52.50	77.95	62.23	125.00	13.00	50.00
Dec-77	69.42	86.76	67.80	83.68	56.05	81.38	61.00	72.00	12.45	52.00
Jan-78	68.37	86.60	67.40	79.70	53.59	82.04	58.66	60.00	13.81	50.00
Feb-78	67.32	86.08	66.34	79.81	52.33	78.61	55.62	65.00	13.74	47.00

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
Mar-78	67.53	85.45	65.81	85.85	53.28	78.52	60.39	40.00	13.76	47.00
Apr-78	67.74	80.55	68.11	85.81	52.50	76.85	58.96	28.00	19.28	40.00
May-78	67.95	77.52	70.14	88.47	52.57	76.55	58.19	60.00	14.59	41.00
Jun-78	68.79	77.36	71.78	93.87	51.80	76.50	59.08	65.00	15.10	46.00
Jul-78	69.42	77.88	72.93	94.40	50.32	75.36	58.62	90.00	15.48	52.00
Aug-78	69.64	78.20	72.71	95.61	50.32	74.08	67.69	75.00	14.37	55.00
Sep-78	70.69	78.56	72.13	102.07	50.64	73.82	58.50	110.00	13.43	55.00
Oct-78	71.53	79.08	72.31	104.88	51.10	73.55	55.89	128.00	13.25	56.00
Nov-78	71.53	79.76	72.88	103.10	49.34	73.99	54.46	90.00	13.58	51.00
Dec-78	70.48	82.37	70.76	94.83	49.41	73.42	52.85	80.00	12.94	54.00
Jan-79	69.85	84.10	69.96	87.27	49.90	72.63	51.85	65.00	12.72	52.00
Feb-79	69.21	84.30	69.79	81.73	48.74	71.18	51.58	60.00	12.28	50.00
Mar-79	69.85	84.04	69.70	82.30	51.83	72.19	55.81	85.00	11.96	42.00
Apr-79	70.90	80.60	72.09	85.46	53.59	73.55	62.23	55.00	15.08	40.00
May-79	71.32	78.51	75.58	85.85	53.73	71.97	61.62	44.00	16.65	45.00
Jun-79	72.58	78.51	74.61	86.56	58.41	71.13	61.66	80.00	15.33	47.00
Jul-79	74.26	79.92	78.76	87.27	66.56	71.57	65.39	85.00	16.62	50.00
Aug-79	75.74	81.02	81.46	92.24	74.43	71.35	65.22	135.00	15.65	51.00
Sep-79	76.37	83.21	83.81	89.40	77.52	72.76	65.04	150.00	15.72	50.00
Oct-79	76.79	84.30	85.40	88.54	75.49	73.16	60.85	180.00	16.70	51.00
Nov-79	77.42	86.76	85.04	87.91	69.93	73.47	63.08	200.00	16.84	50.00
Dec-79	78.68	89.68	84.25	85.60	70.46	72.63	72.00	210.00	16.15	52.00
Jan-80	78.05	88.12	84.56	83.08	66.81	71.09	73.93	150.00	15.55	52.00
Feb-80	77.63	88.64	84.47	80.84	69.16	72.23	80.96	90.00	14.86	51.00
Mar-80	78.47	87.23	85.58	81.41	72.11	72.85	83.93	58.00	14.31	45.00
Apr-80	78.89	83.00	86.46	79.28	71.09	72.54	82.85	60.00	14.62	45.00
May-80	80.36	84.67	88.54	78.89	71.51	71.97	85.20	38.00	14.16	45.00
Jun-80	81.21	86.29	91.01	78.67	71.44	71.93	85.00	48.00	14.92	50.00
Jul-80	82.89	86.65	92.74	83.96	76.68	72.89	93.46	58.00	17.08	51.00
Aug-80	83.52	85.92	92.78	85.88	77.98	74.21	95.58	62.00	15.69	52.00
Sep-80	84.57	87.91	92.61	87.41	73.59	74.92	98.73	65.00	14.17	57.00
Oct-80	85.41	90.62	91.41	97.21	74.19	75.31	96.54	75.00	13.68	54.00
Nov-80	86.47	95.89	91.15	101.11	76.26	78.70	97.46	100.00	14.68	55.00
Dec-80	85.83	99.29	88.80	93.51	77.88	87.19	105.46	75.00	14.68	52.00
Jan-81	86.47	103.46	89.87	96.11	86.41	94.67	104.08	66.00	14.29	57.00
Feb-81	87.94	103.25	93.31	95.57	93.86	94.10	105.46	65.00	13.82	46.00
Mar-81	88.36	97.09	92.43	91.35	91.93	97.44	106.04	66.00	13.13	47.00
Apr-81	89.83	97.20	92.65	89.57	94.46	100.04	112.73	65.00	14.44	43.00
May-81	91.09	95.89	94.15	93.34	96.11	101.31	107.66	60.00	15.36	47.00
Jun-81	92.36	95.68	96.50	94.22	100.08	101.71	106.54	64.00	17.22	52.00
Jul-81	94.04	97.62	99.95	97.24	107.18	103.20	101.70	100.00	16.90	56.00
Aug-81	95.51	98.82	103.35	103.74	110.70	104.13	105.96	150.00	14.98	60.00
Sep-81	95.93	99.08	103.71	104.17	109.33	105.76	93.85	160.00	15.69	63.00
Oct-81	96.77	100.54	101.81	102.57	103.77	102.15	94.31	250.00	15.81	58.00
Nov-81	97.19	100.64	101.54	101.22	97.10	99.64	94.23	220.00	15.47	60.00
Dec-81	96.77	101.01	101.19	98.70	94.22	100.17	95.77	225.00	15.30	60.00
Jan-82	96.56	103.15	101.36	107.08	97.20	98.94	97.85	116.00	14.97	58.00

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
Feb-82	96.35	104.61	101.54	106.22	96.11	94.05	96.16	125.00	14.24	60.00
Mar-82	96.14	105.76	102.25	101.93	93.72	88.91	93.23	152.00	13.65	53.00
Apr-82	96.56	105.08	103.04	101.93	91.26	87.19	92.08	125.00	16.03	50.00
May-82	97.19	94.85	104.46	96.75	91.58	87.94	91.93	76.00	17.42	50.00
Jun-82	98.88	99.18	106.71	99.91	95.69	91.15	92.31	85.00	17.87	56.00
Jul-82	100.56	102.21	111.27	104.20	99.94	92.34	92.46	146.00	17.78	60.00
Aug-82	102.66	108.73	117.02	114.75	101.17	91.90	91.35	130.00	17.57	60.00
Sep-82	102.88	110.04	117.55	116.09	98.05	91.24	87.62	170.00	17.61	65.00
Oct-82	103.30	111.03	116.98	116.73	97.77	89.48	85.39	165.00	17.40	64.00
Nov-82	104.35	112.65	116.31	114.18	99.66	84.77	84.96	165.00	17.11	63.00
Dec-82	104.56	114.32	114.98	117.37	99.28	80.81	83.58	100.00	17.05	63.00
Jan-83	104.14	122.05	115.07	118.97	101.17	81.96	83.58	120.00	18.91	65.00
Feb-83	105.19	129.41	119.45	118.22	100.08	82.00	84.89	125.00	19.99	55.00
Mar-83	105.61	129.30	120.91	119.15	99.52	85.92	85.58	112.00	20.01	55.00
Apr-83	106.87	118.60	123.39	120.67	101.91	89.26	86.85	125.00	23.22	52.00
May-83	109.61	111.40	126.31	123.87	107.29	92.82	90.16	112.00	24.44	52.00
Jun-83	112.13	111.40	130.55	127.99	106.80	95.81	90.20	98.00	26.70	60.00
Jul-83	113.81	112.65	135.55	140.09	110.77	95.51	89.12	160.00	24.84	60.00
Aug-83	115.50	111.71	140.41	143.01	120.50	95.55	87.85	180.00	26.09	70.00
Sep-83	116.55	111.61	140.28	140.95	124.05	96.43	88.08	275.00	26.44	75.00
Oct-83	117.39	111.55	135.55	139.95	118.11	96.61	87.00	310.00	28.35	75.00
Nov-83	118.02	113.90	129.84	141.16	109.57	95.59	87.27	285.00	31.20	73.00
Dec-83	117.60	114.22	122.11	151.85	106.55	98.45	88.23	220.00	30.26	75.00
Jan-84	118.44	117.82	121.88	149.54	109.89	103.91	88.20	125.00	28.39	72.00
Feb-84	118.02	117.97	121.40	135.87	109.54	102.76	91.00	105.00	25.87	75.00
Mar-84	117.39	112.75	120.65	126.04	110.28	107.38	90.35	120.00	27.55	55.00
Apr-84	117.60	108.47	120.96	118.93	115.44	114.47	90.81	75.00	34.41	52.00
May-84	118.23	106.91	122.37	119.15	117.13	116.97	94.89	66.00	33.35	50.00
Jun-84	120.76	108.68	123.61	129.05	118.46	117.24	95.20	85.00	34.18	70.00
Jul-84	123.07	108.47	124.71	126.28	127.28	122.82	93.93	135.00	35.98	75.00
Aug-84	123.28	109.26	125.02	126.64	126.27	129.69	94.89	150.00	34.50	75.00
Sep-84	123.91	108.47	123.65	126.85	108.41	130.21	92.66	125.00	30.44	75.00
Oct-84	124.54	108.63	121.00	128.88	115.02	124.01	93.23	140.00	32.16	80.00
Nov-84	125.18	110.25	119.50	124.93	111.12	104.39	93.23	160.00	33.32	80.00
Dec-84	123.70	109.83	115.56	118.47	111.93	103.25	94.89	175.00	31.43	80.00
Jan-85	123.70	112.86	117.33	108.32	112.10	104.17	94.62	155.00	29.47	77.00
Feb-85	123.07	111.97	117.99	101.01	108.24	100.26	92.58	140.00	27.18	75.00
Mar-85	123.28	110.98	118.26	100.62	109.29	101.71	94.46	134.00	23.06	60.00
Apr-85	124.96	109.47	120.51	102.60	107.46	109.41	103.08	110.00	26.59	60.00
May-85	126.23	108.89	122.81	102.85	105.57	106.64	103.96	100.00	28.32	60.00
Jun-85	127.49	109.99	125.38	96.60	103.92	101.27	107.81	80.00	28.87	65.00
Jul-85	129.38	113.75	128.30	102.11	108.80	100.61	114.85	75.00	29.55	85.00
Aug-85	130.01	117.24	131.83	105.27	109.47	100.34	113.27	80.00	26.67	85.00
Sep-85	130.22	116.88	132.90	105.87	105.71	98.45	108.62	100.00	23.95	85.00
Oct-85	131.49	118.24	130.68	115.35	107.64	93.83	108.39	165.00	22.24	90.00
Nov-85	132.54	119.33	128.08	115.81	108.17	84.73	109.35	200.00	23.61	85.00
Dec-85	132.54	120.79	121.80	112.08	113.33	84.55	117.23	168.00	25.41	85.00

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
Jan-86	132.33	121.52	121.44	110.73	114.28	88.07	116.85	162.00	23.16	85.00
Feb-86	133.17	127.84	121.84	112.05	111.26	87.50	116.85	175.00	21.25	75.00
Mar-86	134.22	130.19	124.14	113.68	111.19	82.26	118.81	160.00	19.68	60.00
Apr-86	135.27	122.10	126.62	110.09	113.09	76.55	118.39	140.00	21.44	64.00
May-86	136.96	115.99	128.47	116.45	120.29	74.26	117.04	70.00	28.84	70.00
Jun-86	138.43	117.97	130.73	125.47	128.51	72.98	114.66	58.00	28.29	70.00
Jul-86	140.53	119.38	134.66	127.85	140.43	72.37	115.81	120.00	30.16	70.00
Aug-86	141.37	120.95	138.38	134.38	160.25	71.71	116.08	145.00	28.11	70.00
Sep-86	142.22	123.19	138.16	142.01	162.60	71.66	115.20	185.00	28.55	70.00
Oct-86	144.11	125.33	139.31	149.22	151.57	73.55	115.93	225.00	30.77	75.00
Nov-86	145.58	127.16	136.96	149.75	143.17	73.64	117.70	234.00	30.33	75.00
Dec-86	144.74	129.77	133.56	148.69	141.45	87.63	118.00	220.00	29.73	90.00
Jan-87	144.74	131.55	131.83	159.91	148.37	99.60	120.43	200.00	27.55	95.00
Feb-87	144.32	131.08	131.83	164.06	146.68	97.53	118.39	145.00	26.28	85.00
Mar-87	144.32	130.14	132.59	166.12	146.47	103.56	117.43	132.00	23.98	90.00
Apr-87	145.37	121.63	134.62	168.28	152.31	108.75	117.70	140.00	29.97	90.00
May-87	147.90	122.99	136.21	170.13	163.69	110.77	119.70	148.00	31.56	90.00
Jun-87	150.42	125.13	137.98	172.62	173.95	118.60	119.62	155.00	30.38	90.00
Jul-87	152.31	126.90	140.28	186.75	185.62	125.99	119.31	290.00	31.91	95.00
Aug-87	154.84	132.75	144.79	213.02	191.38	148.16	120.27	395.00	29.48	95.00
Sep-87	156.73	132.59	148.33	204.39	180.21	135.49	119.50	398.00	29.19	95.00
Oct-87	157.78	133.32	148.51	200.31	184.11	125.60	121.04	425.00	29.10	95.00
Nov-87	158.84	139.38	146.34	211.92	187.38	126.65	120.00	350.00	27.30	95.00
Dec-87	158.20	141.05	145.50	229.35	183.90	133.82	120.00	170.00	25.69	95.00
Jan-88	158.42	147.42	147.53	223.42	180.38	142.44	124.08	175.00	24.36	90.00
Feb-88	157.57	149.45	149.22	189.66	169.10	153.40	123.16	250.00	24.26	90.00
Mar-88	158.42	148.88	150.32	199.31	165.80	149.09	122.89	270.00	22.64	85.00
Apr-88	160.52	136.51	152.80	208.86	165.70	138.84	123.62	140.00	25.63	85.00
May-88	162.20	132.59	155.23	207.34	159.83	142.62	125.47	110.00	30.50	85.00
Jun-88	164.52	135.98	158.46	206.06	160.18	142.18	129.31	85.00	32.13	90.00
Jul-88	167.25	140.79	163.15	213.12	170.19	142.58	134.62	140.00	32.86	85.00
Aug-88	168.30	142.61	168.76	206.84	160.92	143.19	130.85	170.00	29.82	95.00
Sep-88	169.57	147.36	166.73	203.29	153.15	133.78	131.77	200.00	28.46	90.00
Oct-88	167.00	156.50	164.21	207.27	153.61	136.11	132.97	260.00	28.61	95.00
Nov-88	168.00	160.15	161.51	208.69	150.72	128.98	131.04	260.00	28.56	95.00
Dec-88	166.00	165.22	159.61	188.41	145.70	129.99	128.27	325.00	28.21	95.00
Jan-89	165.00	174.30	158.10	171.50	139.40	135.50	126.50	200.00	29.03	100.00
Feb-89	165.00	175.10	159.80	166.10	134.70	137.30	126.90	195.00	28.27	90.00
Mar-89	166.00	165.40	162.20	162.30	133.80	150.10	128.50	160.00	30.50	80.00
Apr-89	167.00	151.10	163.90	167.60	144.70	159.20	131.00	70.00	36.77	80.00
May-89	169.00	140.20	168.00	183.60	152.90	155.60	135.80	70.00	37.09	90.00
Jun-89	170.00	146.40	170.70	202.60	155.20	154.60	135.50	105.00	36.86	100.00
Jul-89	172.00	150.00	171.40	202.80	158.20	152.70	140.70	140.00	40.12	90.00
Aug-89	174.00	151.10	174.20	204.60	166.50	161.20	147.90	165.00	42.47	90.00
Sep-89	176.00	152.00	174.80	211.80	179.30	158.00	153.40	210.00	49.88	90.00
Oct-89	176.00	149.70	172.40	209.40	177.50	144.70	146.80	275.00	45.50	90.00
Nov-89	176.00	152.60	170.50	197.80	165.90	137.60	146.00	275.00	43.11	90.00

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
Dec-89	175.00	151.00	166.80	190.60	157.80	136.10	141.90	125.00	41.96	95.00
Jan-90	174.00	150.90	163.80	187.90	170.60	137.90	141.00	140.00	45.18	85.00
Feb-90	175.00	144.30	164.00	195.90	175.60	136.40	140.90	150.00	46.91	90.00
Mar-90	177.00	139.10	164.40	206.60	181.30	129.30	141.80	130.00	44.28	90.00
Apr-90	180.00	142.40	166.10	215.20	186.50	129.20	143.60	130.00	54.67	85.00
May-90	182.00	153.00	166.90	216.10	185.10	130.30	139.70	140.00	56.23	90.00
Jun-90	185.00	155.10	169.80	220.20	201.90	138.70	141.70	166.00	52.70	90.00
Jul-90	189.00	162.10	176.70	236.80	234.30	141.60	140.90	177.00	50.39	90.00
Aug-90	190.00	161.80	179.40	238.10	220.40	143.60	140.60	275.00	49.38	90.00
Sep-90	191.00	161.90	179.50	245.60	223.50	141.30	140.90	385.00	49.57	90.00
Oct-90	195.00	164.20	180.80	265.20	230.50	141.10	141.70	400.00	49.80	90.00
Nov-90	198.00	170.20	179.40	275.90	224.60	145.90	142.30	380.00	47.34	95.00
Dec-90	199.00	177.50	180.40	265.70	233.00	153.30	141.40	410.00	46.29	95.00
Jan-91	202.00	200.30	184.80	267.20	275.00	153.30	143.10	580.00	46.01	105.00
Feb-91	202.00	211.20	188.10	281.50	261.40	156.20	144.20	425.00	41.37	107.00
Mar-91	201.00	205.50	188.10	270.10	249.90	171.90	142.60	235.00	38.77	105.00
Apr-91	202.00	180.80	188.50	264.20	251.20	211.70	143.10	145.00	41.65	105.00
May-91	204.00	167.70	190.90	275.60	259.10	217.90	144.90	135.00	54.17	120.00
Jun-91	209.00	173.20	194.30	295.80	261.00	219.60	147.50	170.00	51.93	120.00
Jul-91	214.00	174.20	200.00	302.10	267.30	236.80	152.10	292.00	55.38	130.00
Aug-91	217.00	193.60	210.70	320.20	272.70	269.90	161.50	470.00	50.31	115.00
Sep-91	221.00	198.80	219.80	324.30	269.10	251.50	159.60	400.00	49.45	105.00
Oct-91	223.00	196.00	220.90	318.50	272.50	236.60	157.50	350.00	47.98	105.00
Nov-91	225.00	204.20	223.70	321.60	274.00	237.20	156.90	285.00	48.44	105.00
Dec-91	225.00	219.20	228.00	331.60	273.70	242.10	156.30	170.00	44.17	110.00
Jan-92	228.00	247.50	239.10	321.30	269.90	246.90	160.00	115.00	39.19	115.00
Feb-92	229.00	249.30	244.00	309.10	255.10	248.40	170.70	120.00	37.30	105.00
Mar-92	229.00	240.00	245.30	303.20	246.40	237.70	170.60	118.00	36.82	105.00
Apr-92	231.00	225.30	246.30	304.50	245.50	229.00	170.30	120.00	37.30	110.00
May-92	234.00	215.40	249.70	304.50	239.00	225.80	174.70	130.00	50.65	130.00
Jun-92	236.00	220.80	250.60	297.80	237.30	233.10	174.20	142.00	49.98	130.00
Jul-92	242.00	225.60	251.50	302.90	242.00	244.60	177.10	190.00	50.75	130.00
Aug-92	242.00	234.70	252.20	309.80	251.50	236.40	176.50	190.00	45.29	120.00
Sep-92	243.00	228.00	251.10	312.40	244.10	217.70	177.00	215.00	41.82	125.00
Oct-92	244.00	221.40	248.90	305.10	246.30	219.40	177.00	235.00	42.55	125.00
Nov-92	244.00	223.40	251.70	287.60	229.90	212.10	176.30	180.00	41.87	123.34
Dec-92	243.00	228.40	248.50	280.10	223.60	204.80	173.90	302.00	45.01	121.67
Jan-93	241.00	234.00	247.10	290.60	207.80	199.20	175.80	310.00	48.37	120.00
Feb-93	241.00	232.00	240.10	300.40	198.70	190.80	183.40	385.00	56.44	120.00
Mar-93	243.00	234.40	245.30	293.30	192.80	202.60	193.40	405.00	50.90	120.00
Apr-93	245.00	235.40	245.80	296.40	189.30	207.20	194.90	225.00	54.00	125.00
May-93	246.00	235.20	248.00	296.70	188.20	213.70	202.20	115.00	57.17	120.00
Jun-93	250.00	237.70	249.10	293.10	205.90	215.80	199.90	100.00	60.33	130.00
Jul-93	253.00	240.70	264.10	290.80	211.20	215.80	199.00	170.00	58.50	125.00
Aug-93	256.00	244.40	268.30	304.60	232.70	223.10	200.90	185.00	55.57	130.00
Sep-93	259.00	250.60	275.70	323.90	266.80	228.80	200.60	400.00	52.13	130.00
Oct-93	262.00	251.40	275.30	334.10	265.80	217.60	203.10	580.00	51.22	130.00

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
Nov-93	265.00	254.10	279.50	341.60	251.10	221.50	206.30	700.00	53.86	130.00
Dec-93	264.00	255.90	271.10	337.50	242.30	241.50	209.60	680.00	55.91	130.00
Jan-94	263.00	258.70	265.10	349.10	229.60	272.40	214.70	660.00	53.74	140.00
Feb-94	265.00	286.90	272.40	341.60	226.30	307.40	226.40	400.00	44.52	140.00
Mar-94	267.00	283.00	275.90	334.40	229.00	378.70	227.80	400.00	39.49	135.00
Apr-94	269.00	271.50	275.90	328.90	244.90	402.40	231.90	200.00	36.33	135.00
May-94	272.00	264.50	281.60	324.90	251.90	388.60	245.40	150.00	56.05	130.00
Jun-94	277.00	265.70	286.20	331.80	256.40	367.40	247.10	190.00	51.17	135.00
Jul-94	281.00	270.00	293.00	339.30	267.60	363.70	238.30	250.00	56.51	160.00
Aug-94	284.00	270.60	297.30	348.10	273.80	359.90	233.30	300.00	51.74	150.00
Sep-94	288.00	267.80	295.00	346.40	276.10	366.00	235.20	450.00	47.27	150.00
Oct-94	289.00	267.70	297.10	364.10	263.50	354.00	228.80	700.00	44.86	168.00
Nov-94	291.00	275.30	300.50	361.00	259.00	356.20	220.10	400.00	45.10	150.00
Dec-94	289.00	279.30	302.80	351.60	257.90	402.70	222.00	350.00	47.98	170.00
Jan-95	289.00	280.50	298.60	380.00	281.70	417.80	222.20	360.00	50.89	165.00
Feb-95	291.00	279.60	299.70	398.60	300.50	440.30	221.10	180.00	45.91	125.00
Mar-95	293.00	279.10	301.40	386.80	303.30	438.10	219.80	175.00	40.24	130.00
Apr-95	295.00	272.20	303.20	453.70	308.20	445.80	222.20	150.00	40.63	130.00
May-95	300.00	267.10	306.60	473.30	308.30	467.40	221.40	130.00	56.91	160.00
Jun-95	306.00	261.80	312.70	528.10	310.80	384.90	222.70	250.00	60.27	160.00
Jul-95	313.00	262.60	314.20	548.90	315.30	397.50	224.20	300.00	64.58	160.00
Aug-95	315.00	265.30	319.00	521.00	320.40	386.70	225.10	350.00	56.77	160.00
Sep-95	317.00	267.80	321.20	529.70	316.60	382.50	225.60	420.00	58.03	170.00
Oct-95	319.00	268.50	319.30	518.20	317.70	380.90	226.80	450.00	59.37	175.00
Nov-95	321.00	271.50	321.30	553.90	308.90	386.10	227.10	520.00	62.09	180.00
Dec-95	317.00	282.00	322.30	544.50	307.30	376.30	226.70	400.00	57.19	170.00
Jan-96	315.00	283.40	320.70	546.10	298.40	351.30	245.30	400.00	52.41	165.00
Feb-96	316.00	280.20	313.60	512.20	299.80	324.90	227.20	300.00	49.06	150.00
Mar-96	319.00	285.40	319.30	229.90	297.90	299.40	228.00	320.00	47.53	130.00
Apr-96	324.00	278.10	326.30	554.00	302.60	294.20	229.10	350.00	59.35	130.00
May-96	328.00	275.40	326.50	556.10	306.20	298.30	231.30	200.00	67.29	140.00
Jun-96	333.00	286.00	335.40	553.50	309.90	292.60	234.70	280.00	63.62	160.00
Jul-96	339.00	297.80	340.50	544.60	313.70	294.00	232.20	280.00	72.57	175.00
Aug-96	343.00	307.80	348.80	534.50	323.30	310.10	234.80	300.00	62.58	175.00
Sep-96	344.00	323.70	352.60	527.50	327.90	318.60	233.70	275.00	38.25	180.00
Oct-96	346.00	333.40	352.80	530.30	314.60	317.90	230.80	370.00	54.19	170.00
Nov-96	349.00	354.90	354.50	549.50	299.40	309.20	237.70	400.00	51.38	190.00
Dec-96	350.00	370.40	358.70	544.60	297.20	301.00	245.40	365.00	56.23	205.00
Jan-97	350.00	373.10	356.70	519.10	298.40	301.10	245.30	300.00	56.66	195.00
Feb-97	350.00	380.70	358.40	498.40	296.20	295.90	248.60	300.00	56.34	165.00
Mar-97	351.00	382.00	354.50	476.20	291.70	302.80	261.80	340.00	55.59	155.00
Apr-97	354.00	352.10	359.50	478.00	298.00	315.10	264.40	270.00	58.00	145.00
May-97	352.00	321.70	364.30	467.00	301.90	327.20	270.10	200.00	76.20	150.00
Jun-97	355.00	322.80	364.60	439.40	303.10	338.60	272.40	200.00	80.84	170.00
Jul-97	358.00	319.50	371.00	414.60	300.80	337.40	274.10	160.00	81.29	170.00
Aug-97	359.00	313.60	371.50	416.90	301.60	345.80	274.40	150.00	85.10	170.00
Sep-97	361.00	308.20	368.30	411.10	299.60	352.10	276.40	200.00	82.78	200.00

Year	CPI	Wheat	Rice	Pigeon Pea	Groundnut Oil	Cotton	Sugar	Onion	Tea	Egg
Oct-97	365.00	313.00	367.50	408.40	292.60	349.40	276.40	250.00	82.75	200.00
Nov-97	366.00	323.30	362.70	384.70	292.60	346.20	277.20	400.00	88.72	210.00
Dec-97	372.00	348.00	363.90	412.70	297.83	347.70	277.30	850.00	95.43	205.00
Jan-98	384.00	373.50	365.90	466.50	303.50	367.40	276.10	1350.00	97.26	190.00
Feb-98	382.00	364.00	360.50	477.60	306.90	367.60	275.80	850.00	93.19	190.00
Mar-98	380.00	345.10	361.40	475.80	311.70	367.90	275.30	400.00	81.16	160.00
Apr-98	383.00	334.40	366.00	493.90	320.90	370.30	275.90	250.00	98.10	150.00
May-98	389.00	336.60	369.40	501.00	330.60	366.70	277.80	280.00	92.81	160.00
Jun-98	399.00	343.30	374.10	510.00	348.60	376.40	277.80	830.00	89.78	180.00
Jul-98	411.00	357.10	383.20	549.60	357.90	387.20	278.40	1000.00	92.83	180.00
Aug-98	413.00	360.60	392.10	555.00	377.00	377.10	278.40	1260.00	86.28	180.00
Sep-98	420.00	361.50	403.30	566.90	402.20	369.10	277.70	1200.00	83.63	190.00
Oct-98	433.00	362.50	405.80	628.50	397.90	360.20	278.00	3250.00	83.25	200.00
Nov-98	438.00	374.10	415.20	670.70	357.90	366.00	277.60	1540.00	79.56	220.00
Dec-98	429.00	377.50	409.80	693.50	350.40	360.30	277.30	1250.00	73.39	215.00
Jan-99	420.00	389.30	411.60	621.70	344.70	364.20	277.70	480.00	71.79	190.00
Feb-99	415.00	417.40	425.10	567.20	342.30	358.30	280.00	350.00	67.97	150.00
Mar-99	414.00	415.70	421.10	518.70	332.50	343.70	279.60	350.00	59.85	145.00
Apr-99	415.00	390.80	423.00	520.50	325.90	334.00	280.60	415.00	74.67	140.00
May-99	419.00	386.40	423.50	547.40	318.40	334.10	282.20	490.00	108.33	180.00
Jun-99	420.00	394.70	432.90	557.80	313.60	336.10	280.90	475.00	98.16	185.00
Jul-99	424.00	410.00	434.20	545.10	312.70	338.20	279.90	775.00	101.25	200.00
Aug-99	426.00	422.30	451.00	546.30	319.00	338.10	279.40	580.00	90.10	185.00
Sep-99	429.00	428.90	459.40	568.80	342.10	342.30	280.10	610.00	94.47	200.00
Oct-99	437.00	432.10	462.00	580.00	330.00	334.40	283.40	790.00	97.78	200.00
Nov-99	438.00	436.20	455.10	554.60	314.20	322.40	285.00	540.00	91.06	215.00
Dec-99	431.00	433.10	441.60	513.00	318.00	315.30	284.20	400.00	84.52	210.00

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