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Commodity Derivatives and Price Risk Management: An Empirical Anecdote from India

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Commodity derivatives trading in India notwithstanding its long and tumultuous history, with globalisation and recent measures of liberalisation, has witnessed a massive resurgence turning it one of the most rapidly growing areas in the financial sector today. This paper endeavours to test the efficacy and performance of commodity derivatives in steering the price risk management. The critical analytics of performance divulges that these markets although are yet to achieve minimum critical liquidity, almost all the commodities throw an evidence of co-integration in both spot and future prices, presaging that these markets are marching in the right direction of achieving improved operational efficiency, *albeit*, at a slower pace. In the case of some commodities, however, the volatility in the future price has been substantially lower than the spot price indicating an inefficient utilisation of information. Several commodities also appear to attract wide speculative trading. Hedging proves to be an effective proposition in respect of some commodities, while others entail moderate or considerably higher risk. As the markets develop, it remains to be seen whether the information content of future prices could be factored in the course of future monetary policy setting.

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Introduction

In the wake of globalisation and surge in the global uncertainties, financial organisations around the world are devising methods and instruments to contain the price risk that these uncertainties bring. Commodity derivatives are such instruments that have been devised to achieve price risk management by basing the value of a security

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on the value of an underlying commodity. Commodity derivatives trading although has witnessed a long and chequered history, with the recent measures of liberalisation, the sector has witnessed a massive boom in the country.

Planned and sustained growth of any sector coupled with a prudent demand and supply management calls for a system, which can not only yield adequate returns to its producers but also ensure timely supply at desired prices to the consumers. Commodity derivatives or futures markets hold a key in insulating the producers and the trade functionaries from the seasonal and cyclical oscillations in the prices of commodities, which are aggravated by the high income and low price elasticities of demand and the shifts in such elasticties overtime. Derivatives markets hold an immense potential for the economy as they stabilise the amplitude of price variations, facilitate lengthy, complex production decisions, bring a balance between demand and supply, act as a price barometer to the farmers and the traders besides encouraging competition. These markets while enabling price discovery and better price risk management engender inter-temporal price equilibrium and horizontal and vertical price integration. While ensuring price risk mitigation and remunerative returns, these markets also contribute in scaling down the downside risks associated with agricultural lending and thereby facilitate the flow of credit to agriculture. Besides, these markets through the use of warehouse receipts obviate the need for collaterals, the lack of which has currently impeded the flow of agricultural credit. They also hold a key role not only in reinvigorating the spot markets but also triggering the diversified growth of Indian agriculture in line with the consumption pattern. A strong, healthy, vibrant and well developed commodity exchanges can play a pivotal role in the globalisation of international trade by imparting a competitive pricing efficiency to exports. The promotion of derivatives trading has become imperative particularly, in the aftermath of WTO regime to face the challenges in terms of exposure to the vicissitudes of world commodity prices and heightened competition.

In the Indian context, there are very few studies on the performance of the derivatives trading in select agricultural commodities. However, there is no firm study on the overall performance of derivatives trading covering wide range of commodities as trading in most of them has commenced/picked up only in the recent time. In an endeavour to fill this gap, the present study seeks to address the questions as to currently (i) how vibrant the market has been in terms depth/breadth and liquidity ?, (ii) how effective the market has been in terms of price risk management and price discovery functions ?, (iii) is the market stable or volatile ?, and (iv) what are the constraints and required policy response in the future ?

The depth/extent of liquidity in Indian commodity derivatives markets is sought to be examined by analysing the trends in the proportion of value of commodities traded in relation to Gross Domestic Product (GDP) and volumes traded in relation to the production. The efficacy of these markets in India has been evaluated by testing their forward pricing ability through tests of co-integration between spot and future prices. An attempt has also been made to assess the performance of these markets by analysing the risk involved in the spot, derivatives and basis of commodities. In this endeavour, Section I traces briefly the evolution of these markets in India and outlines the contours of international experience. Section II captures some of the empirical underpinnings from the extant literature. The performance, efficacy and effectiveness of these markets are tested and elucidated in Section III. Section IV and V identify some of the constraints and required policy response in the future. Section VI draws some of the implications of commodity futures prices for the future monetary policy. The study concludes with the last Section VII.

Section I
Evolution and Contours of International Experience

Evolution

The origin of commodity derivatives markets dates as far as back to the 17th century, when they were informally established in Amsterdam and centered on the trade in Tulips. The modern form,

however, came into existence in the 19th century, *inter alia,* in London, Chicago and New York. Notwithstanding the fact that India is considered a pioneer in some forms of derivatives in commodities, commodity derivatives market in India has had a turbulent history. The first ever organised derivatives market evolved with the setting up of Bombay Cotton Trade Association Ltd., in 1875. With the enactment of Defence of India Act- 1935, however, the market was subjected to restriction/ prohibition from time to time, owing to the apprehensions of speculation in times of scarcity. After independence, the market received a fillip with the enactment of Forward Contracts Regulation Act (FCRA) in December 1952. The derivatives markets, which were once vibrant and attracted huge trading volumes in commodities, particularly, cotton, oilseeds, bullion and jute were either suspended or prohibited during 1960s and 1970s. Concomitantly, the revival of this industry in India had a slow and shaky start. It began with the setting up of the Dantwala Committee (1966) and subsequently, the Khusro Committee (June 1980). In the post-reforms era, accepting partially the recommendations of Kabra Committee (1993), the Government of India permitted derivatives trading in large number of commodities. A number of initiatives were also undertaken subsequently to decontrol and develop the forward markets in commodities. There are presently 21 regional exchanges in the country.

Contours of International Experience

Price volatility is perhaps the most pressing issue facing the producers of primary commodities. While these producers are not exclusively in less developing countries (LDCs) (Sapsford and Morgan, 1994), the impact of volatility on producers is much greater in LDCs than it is for those in developed market economies. Given the demand for many of the primary commodities is price inelastic and also given the large potential for shocks in supply, there is clearly a significant price and quantity risk for producer nations. Trying to deal with this volatility has been at the centre stage of commodity policy since the 1930s where the main emphasis was on supply control and thus, reducing price instability. Policies designed to counter the effects of the inherent instability of commodity markets have taken

various forms since the 1930s but in general, they all shared the common feature of being based on intervention.

Agricultural producers are prone to several risks such as price, crop and weather/climatic variations and a plethora of other natural disasters, which could be devastating to their anticipated income and could have negative effects on the standard of living, ability to build capital and ability to access credit and repay debts[1]. To deal with the risks, several countries have attempted to guarantee commodity prices and provide crop insurance. There are yet no examples of successful crop insurance programmes without heavy reliance on Government subsidies (Skees, Hazel and Marinda, 1999) or the problems of moral hazard, adverse selection and high administrative costs[2].

However, at present, policies based on market solutions to the problem solely of price instability are being sought as the general macroeconomic stance shifts away from intervention and more specifically that of supply control (Morgan, 2000). "…..Market based risk management instruments, despite several limitations, offer a promising alternative to traditional stabilisation schemes" (World Bank, 1994). Moreover, in view of the fiscal pressure and obligation under WTO to reduce direct support to agriculture, there has been a policy shift towards market oriented approach. Hence, the case for the development of commodity derivatives market world over was advanced more forcefully since the demise of aggregate intervention policies such as International Commodity Agreements (Gilbert, 1996) and the failure of large-scale international financing schemes such as the IMF's Compensatory Finance Fund, *etc.*, (Herrmann *et al*, 1993). There is now considerable consensus that the derivatives markets play a significant role in shaping the investment decisions of the market intermediaries and in smoothening price volatility.

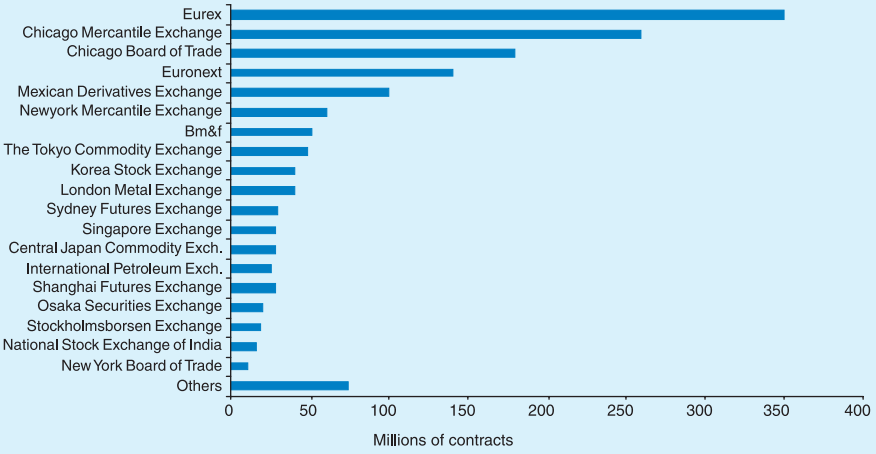
In the international domain, in US and other Western countries, derivatives trading is allowed in a range of commodities including live cattle, feeder cattle, hogs, pork bellies, fluid milk, rubber, tea, wool and industrial metals and even in a number of non-commodities such as weather index and pollution permits. In advanced countries, there are several innovations in packaging natural-disaster/weather

risk into various forms of tradable financial assets-catastrophic bonds; insurance contracts; weather derivative contracts; exotic options, *etc*., providing the holder with large amounts of capital contingent upon the occurrence of some risky event.

The application of weather-based index insurance in the case of energy sector and cat bonds in the case of earthquake is quite advanced, nevertheless, applications in the agriculture sector are still limited. Weather-related financial instruments are now spreading to potential clients in low income groups in developing countries (Fernando.N.A, 2004).

Furthermore, in some of the major derivative exchanges in the world such as Chicago Board of Trade (CBOT), London International Futures and Options Exchange (LIFEE), *etc*, there is convergence between the commodities and securities derivatives markets. With the globalisation of financial markets, significant developments are taking place in the international arena in terms of electronic trading, internet based commodity exchanges and electronic communication networks (ECNs) using multiple products and combination of networks as competitors to exchanges. There are increasing alliances, often international, to compete effectively with exchanges and ECNs. An overview of futures trading and the volumes traded around the world divulges massive divergence across the different exchanges (Chart 1).

Chart 1: Futures Trading Volume Around the World



Source: Chakrabarti R (2005): "Commodity Futures in India"

Section II
Extant Literature: Some Empirical Underpinnings

In the literature, several studies attempted to compare the impact of derivatives markets in comparison to buffer stock schemes that had been favoured since 1930s and highlighted that derivatives markets offered a more effective and welfare raising method of dealing with price volatility (Gilbert, 1985). By taking a position in the derivatives market, the producer can potentially offset losses in the spot market. However, with regard to the stabilisation effect of futures trading on the spot prices, the evidence is mixed. Newbery (1990) observes that since forward markets reduce risk, they encourage fringe firms to supply more output and thus, reduce the spot price. Furthermore, forward markets concentrate trading in one location and reduce information and other transaction costs, which can also lower prices. Similarly, Netz (1995) and Morgan (1999) concluded that the level of inventories held in the spot market will be determined by the *basis*[3] and will ensure a more efficient process of private storage, which in turn, ensures a smoother pattern of prices in the spot market. According to Turnovsky and Campbell (1985), since forward markets reduce the price risk of holding inventories, larger inventories are held and prices tend to stabilise as a consequence. Conversely, Kawai (1983) shows that when the storage is subject to shocks, increased storage can destabilise prices. It is also revealed that risk reduction encourages producers to undertake more risky investment projects, and risky investment destabilise spot prices (Newbery, 1987).

Similarly, Cox (1976) finds that in many markets, forward trading is stabilising whereas Figlewski (1981) and Simpson and Ireland (1985) conclude that opposite is true. Varangis and Larson (1996) cited several examples in the case of cotton and oil in Mexico and Algeria, where group of producers is represented by an agent who trades on their behalf. In doing so, minimum prices for output could be guaranteed and thus, risk is reduced for an individual trader for the cost of a small premium. Other such examples are provided by Claessens and Duncan (1993) and World Bank (1999).

With regard to the causal relationship between future and spot prices, *viz.*, whether future price leads the spot prices or *vice-versa*, the evidence is mixed and inconclusive (Box).

Box: Spot and Future Prices Causation

While numerous studies have examined the relationship between spot and future prices for various types of commodities as also for financial assets, empirical evidence in this regard is mixed. In the literature, there are two strands on the price formation process of commodity future prices. One in which, the inter-temporal relationship between cash and future prices are explained by the cost of carry of the commodity, *i.e.*, future prices should never be less than the spot price *plus* storage and interest cost (Brennan, 1958 and Telser, 1958). In the case of second, future prices are split into an expected risk premium and a forecast of a future spot price (Breeden, 1980 and Hazuka, 1984). In this case, basis is expressed as a sum of an expected premium and an expected change in the spot price.

For the future price to be an unbiased predictor of subsequent spot price, *i.e.*, E_t ($P(t,T)$ equals zero, the future price should lead the spot price (Garbade and Silber, 1983). There are also arguments in favour of opposite hypothesis, that spot price leads future prices (Silvapulle and moosa, 1999, Quan, 1992, Moosa, 1996). The spot prices can be price leading if the convenience yield is high enough. According to Pindyck (2001), the spread between the future prices and spot price gives a direct measure of the marginal value of the storage for a commodity termed alternatively, as marginal convenience yield (MCY). Future price could be greater or less than the spot price depending on the magnitude of the net (of storage costs) MCY.

For the future price to be an unbiased predictor of the spot price, the future and spot prices must be proportional that is the basis should be constant and the market is said to be efficient. For instance, Asche and Guttormsen, (2002) found that the future and spot prices in the case of gas oil formed a stable long-run relationship and the prices were proportional (basis being constant) indicating that future price leads the spot price. If $a_1=0$, a change in the basis will be atleast partly corrected by a change in the spot price, in that case spot price will lead the future prices[4] . If $a_2=0$, a change in the basis will be atleast partly corrected by a change in the future price, in which case, future price will lead the spot prices.

In other words, the argument of risk reduction through hedging rests on the premise that the spot and future markets move together so that losses in one market can be made good through gains in other market. Risk reduction or price discovery function is conditioned by the fact that futures markets must be able to predict the subsequent cash price at maturity. At maturity, the future prices become equivalent to cash prices except for some transaction costs and quality premium. If the future prices are a reflection of future demand and supply conditions of the market, then they are considered to exert influence on the inventory holding. If future prices are falling, it indicates that either future demand would fall or future supply would ease. This would induce traders to reduce inventory stock, which eventually results in fall in spot prices (Singh, 2004).

A key aspect of derivatives market performance is the degree of liquidity in the market (Cuny, 1993). A derivatives market is considered liquid, if traders and participants can buy and sell derivatives contracts quickly with little price effect resulting from their transactions. However, in thin markets, the transactions of individual hedgers may have significant price effects and result in substantial 'transaction costs' (Thompson, *et al*, 1996). This phenomenon of lack of market depth is particularly important for relatively small commodity derivatives markets and might be especially true for new derivatives markets (Pennings and Leuthold, 1999). The problems associated with credit constraints, issues relating to basis risk such as quality differentials and transport costs make the process of trading more risky for LDC producers (Morgan 1999). Lack of understanding of the market and lack of close link to those doing the day-to-day trading have also hindered the growth of these markets.

According to Pennings and Leuthold (1994) hedging effectiveness is related to trading volume and this relationship is more prominent when the hedging effectiveness takes market depth risk into account. Having evaluated the hedging effectiveness by taking into account basis risk and market depth risk and analysing the overall risk reduction capacity of the derivatives contract, they concluded that hedging effectiveness is an important determinant in explaining the derivatives contract volume. Hedging effectiveness is related to the service design-the core business of derivatives exchange. According to them, the factors, which influence the use of derivatives are perceived performance, risk attitude, perceived risk exposure, market orientation, *etc*. In the finance literature, several factors such as firm's risk exposure, its growth opportunity, the level of wealth, managerial risk aversion, financial distress costs and the accessibility to financing influence the adoption of commodity derivatives (Visvanathan, 1998 and Koski and Pontiff, 1999). Several authors identify experience, education, enterprise size, expected income change from hedging as factors influencing the use of derivatives contracts (Patrick, *et al*, 1998).

In India, derivatives trading was strangulated owing to ban/ prohibition from time to time. The trading has picked up only in recent

time, particularly after 2002. For some primary commodities fortnightly prices data are available since 1996-97, whereas for some commodities such as cotton, sugar, rubber, metals, *etc*, they are available for latest years (2003 and 2004) on a daily basis. With the limited data in hand, this study attempts to assess the performance of commodity derivatives markets in India.

Section III
Performance of Commodity Derivatives Market in India

1. Few Stylised Facts

A decadal overview of growth pattern reveals that the commodities such as turmeric, pepper and castorseed witnessed a significant turnaround in their volumes as measured by their compound growth rates since the late 1990s compared to the first half of the decade, while the commodities such as gur and cotton displayed downtrend during the same period. In terms of the value of trading, while commodities such as castorseed, and pepper witnessed a sharp rebound, others such as cotton, gur and turmeric revealed a negative growth (Table 1).

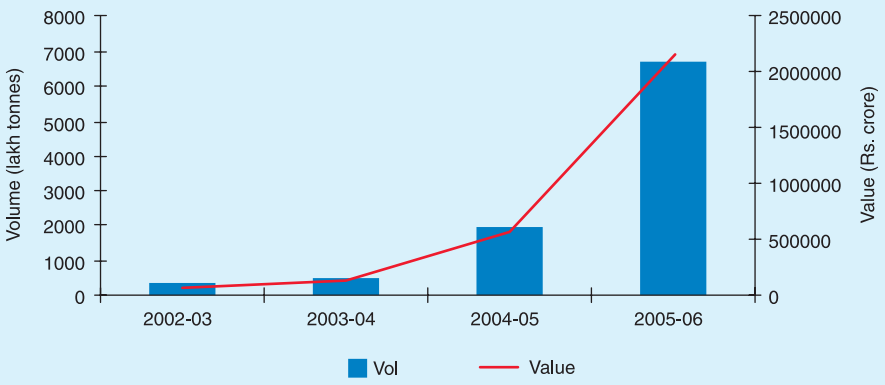
There has, however, been a massive spurt in the business of commodity derivatives trading in the recent past. The size of volumes and value of commodities traded tripled during 2004-05. During

Table 1: Compound Growth Rates

Volume of Trade					
Period	**Gur**	**Castorseed**	**Turmeric**	**Pepper**	**Cotton**
1	2	3	4	5	6
1990-1997	6.8	12.1	-5.7	-1.9	1.7
1998-2005	-7.6	5.3	15.0	19.4	-1.5
Value of Trade					
1990-1997	16.8	20.3	2.3	21.4	3.6
1998-2005	-2.2	7.8	-1.0	3.1	-28.4

Note : The data since 1990s is available only for select primary commodities.
Source : Computed on the basis of data from Annual Report, various issues, Forward Markets Commission, GOI.

Chart 2: Resurgence in the Commodity Derivatives Market

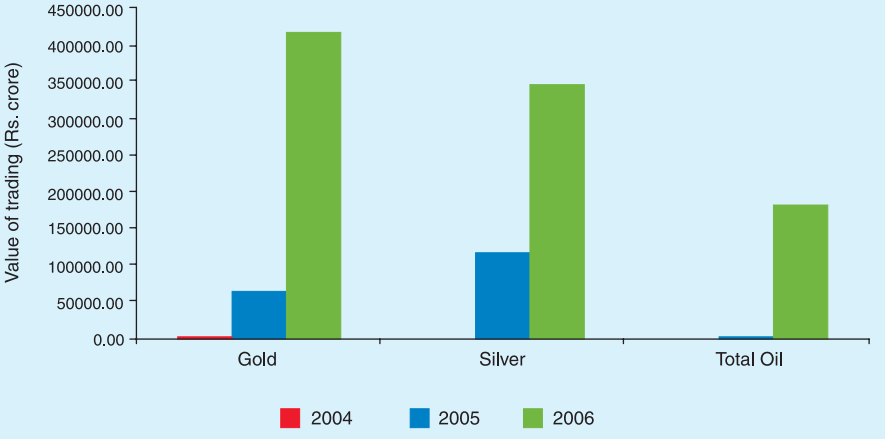


Source: Ministry of Consumer Affairs, Food and Public Distribution, GOI.

2005-06, the volume of trading recorded at 6,685 lakh tonnes valued at over Rs. 21 crore was more than 2 times the level of preceding year (Chart 2).

In India, the primary commodities account for bulk of the value of trading on the existing commodities derivatives market. In the last three years, they accounted for 74 per cent of total value of derivatives trading. Although trading in other commodities such as gold silver, metals and oil recorded only in the recent period, there has been a boom, particularly in the bullion market (Chart 3).

Chart 3: Boom in the Bullion Derivatives Market

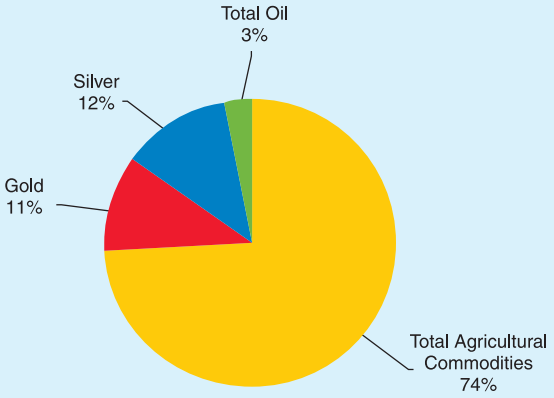


In terms of the average share in the value of derivatives trading among non-primary commodities, silver accounted for the largest amount (12 per cent) followed by gold (11 per cent) and oil (3 per cent) during the last three years ending 2005-06 (Chart 4). However, the share of other commodities like metals, particularly bullion in the basket of commodities traded in India has a potential to grow rapidly in the near future.

2. Liquidity in the Commodity Derivatives Market

Liquidity forms a key aspect of performance of commodity derivatives market. In order to capture the extent of penetration or depth of the market, the values of trading in the commodity derivatives market have been juxtaposed with the Gross Domestic Product (GDP) and volumes of trading with production of those commodities. Accordingly, the total value of commodity derivatives traded at present accounts for about 2/3rd of overall GDP, ramifying the extent of penetration that this market has gained in the Indian economy. The total value of commodities traded as a proportion of GDP shows a sharp turnaround in 2005-06 to around 67 per cent from over 20 per cent a year ago. Similarly, the value of trading of agricultural commodities as a proportion GDP emanating from agriculture witnessed a three-fold increase in 2004-05, recording a ratio over 70 per cent. However, the value of trading of agricultural commodities

Chart 4: Share of Commodities in the Total Value of Futures Trading (2003-04 to 2005-06)



as a proportion overall GDP stood at around 37 per cent, followed by bullion (around 24 per cent), oils (6 per cent) and other metals (0.6 per cent) during 2005-06 (Table 2).

The liquidity in the commodity derivatives markets could be examined by analysing the proportion of total volume of trading of a commodity to its total production in the country. Accordingly, among the primary commodities, liquidity is found to be high only in respect of two such as castorseed and soyabean oil (Table 3). The volume of transaction in the castorseed derivatives was as high as twenty times the production in 2002-03 and was above 4.6 times of its production in any given year after 1999-00. The derivatives trading in the case of soyabean oil reached to a peak (3.7 times of its production) in 2002-03, though it declined in the next year, but remained considerably higher than its production in the subsequent years. However, trading in the case of groundnut was found to be very thin. Conversely, trading in respect of sesamum reached to almost half of its production in 2003-04 but recorded a substantial decline thereafter. Incidentally, liquidity in respect of sunflower soared almost to six times of its production. Similarly, the volume of transaction of cotton recouped gradually and exceeded its production in 2004-05 by almost

Table 2: Value of Trading as a Proportion of GDP

Year	Agricultural Commodities		Bullion (Gold/Silver)	Other metals	Oils	Total Commodities
	As a % of Agri. GDP	As a % of Overall GDP				
1	2	3	4	5	6	7
1999-00	4.34	1.10	–	–	–	1.29
2000-01	5.31	1.26	–	–	–	1.42
2001-02	6.87	1.60	–	–	–	1.64
2002-03	20.86	4.33	–	–	–	4.51
2003-04	23.18	4.87	0.13	0.08	–	5.09
2004-05	70.16	13.72	6.30	0.02	0.07	20.10
2005-06	–	36.51	23.70	0.58	5.67	66.51

Source : Computed on the basis of data from *Futures Trading and Forward Markets Commission*, August 2003 and December 2005, Ministry of Consumer Affairs, Food and Public Distribution, GOI and the National Accounts Statistics, CSO.

1.3 times. On the contrary, the volume of trading in the case of gur witnessed stagnation, while in the case of sacking, the liquidity was relatively higher but has declined since 2003-04. The commodities such as sugar and pepper were thinly traded.

Thus, barring castorseed, soyabean oil and to some extent cotton, volume of trading in the case of select commodities is found to be considerably low compared to their production levels and hence, derivatives market in respect of these commodities is yet to achieve minimum critical liquidity so as to ensure minimum transaction costs and attract larger participation. One of the reasons for low volumes could be attributed to some of the measures that FMC undertook in the recent period such as daily mark to market margining, time stamping of trades, novation of contracts, demutualisation for the new exchanges, *etc.*, with a view to promote market integrity and transparency. The exchanges have attributed subsequent fall in the volume of trade to introduction of these measures. The exchanges like Bombay Commodity Exchange and Kanpur Commodity Exchange, which implemented most of these reforms, were literally deserted by all the traditional players (Kolamkar, 2003).

Table 3: Volume of Trading as a Proportion of Production

Commodity	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
1	2	3	4	5	6	7	8
Groundnut	–	–	2.38	2.31	0.84	0.01	0.03
Castorseed	611.95	497.39	775.04	2064.02	869.37	1036.70	460.50
Sesamum	–	–	–	18.14	45.65	5.64	3.62
Rapeseed & Mustard	–	0.31	0.18	36.16	65.08	36.07	2.92
Safflower	–	–	–	–	24.02	600.74	–
Sunflower	–	–	0.05	598.86	106.99	–	–
Soyabean oil	1.53	61.02	83.62	370.55	154.32	362.92	239.83
Cotton seed/ kapas	0.30	0.22	0.05	0.34	73.92	125.44	50.02
Sugar	–	–	–	0.00	0.01	1.73	1.65
Gur	3.52	3.14	3.60	3.92	3.13	2.87	2.69
Sacking	5.88	8.37	9.46	8.42	4.11	0.49	0.15
Pepper	–	–	–	–	–	0.02	0.01

Source : Computed on the basis of data from *Futures Trading and Forward Markets Commission* August 2003 and December 2005 and the Ministry of Agriculture, GOI.

3. Efficacy of Markets: Tests of Co-integration

By taking a position in the derivatives market, a producer can potentially offset losses in the spot market. However, as revealed by Telser (1981), complete price insurance is possible only if spot and future prices move exactly together, if not then perfect insurance is not feasible. In other words, if the markets are efficient, there has to be a co-movement between both the spot and future prices. In the literature, a pre-condition for market efficiency is the convergence of both future and spot prices across the market spectrum. The argument of risk reduction through hedging rests on the premise that the spot and future markets move together so that losses in one market can be made good through gains in other market. For the future price to be an unbiased predictor of the spot price, the future and spot prices must be proportional that is the basis should be constant and the market is said to be efficient. The studies exploring the price discovery role and the lead lag relationship between futures and spot prices have followed a procedure that is based on price series being nonstationary (Asche and Guttormsen, 2002), *i.e.,* to test the existence of a long-run relationship between the spot and future prices by investigating whether the data series are co-integrated.

In the Indian commodity derivatives markets, most of the price series are found to be non-stationary with no tendency to revert back to an underlying trend value as they typically exhibit 'random walk' properties, *i.e.,* today's prices cannot be used to predict future prices (Table 8 to 11). However, differencing the data runs the disadvantage of losing information about underlying long run relationships between prices. Thus, the relationship and co-movement between the prices is examined in a co-integration framework in which linear combinations of non-stationary variables could be identified. Conducting the estimation of both future and spot prices under the Johansen-Juselius (JJ) procedure yields the following results.

In respect of pepper barring September, the contracts of all the months yield at least one co-integrating relationship, while the contracts of particularly, April, July, August and November display two such co-integrating relationships, reflecting thereby enhanced operational efficiency and improved transmission of information in both spot and derivatives markets (Table 4).

Table 4: Johansen Trace Statistics

Commodity/ Contract Month	Eigen Value	Trace Statistic	0.05 % critical value	Hypothesised No.of CE(s)
1	2	3	4	5
Pepper				
January	0.296117	24.37	15.49	None *
	0.041093	2.60	3.84	At most 1
February	0.292425	25.20	15.49	None *
	0.046725	3.06	3.84	At most 1
March	0.294872	27.75	15.49	None *
	0.051450	3.64	3.84	At most 1
April	0.264682	24.74	15.49	None *
	0.076101	5.07	3.84	At most 1 *
May	0.288498	27.99	15.49	None *
	0.037257	2.81	3.84	At most 1
June	0.278234	22.70	15.49	None *
	0.033672	2.16	3.84	At most 1
July	0.251319	23.40	15.49	None *
	0.073303	4.87	3.84	At most 1 *
August	0.237713	23.43	15.49	None *
	0.065878	4.70	3.84	At most 1 *
September	0.186826	12.73	15.49	None
	0.028516	1.56	3.84	At most 1
October	0.346511	30.15	15.49	None *
	0.037695	2.50	3.84	At most 1
November	0.310646	23.59	15.49	None *
	0.103567	5.36	3.84	At most 1 *
December	0.289843	24.51	15.49	None *
	0.023320	1.58	3.84	At most 1
Sacking				
February	0.129518	5.55	15.49	None
	0.039444	1.25	3.84	At most 1
May	0.385548	19.67	15.49	None *
	0.103209	3.59	3.84	At most 1
August	0.392138	21.84	15.49	None *
	0.088200	3.42	3.84	At most 1
November	0.153656	7.94	15.49	None
	0.031245	1.27	3.84	At most 1

* : Denotes rejection of the hypothesis at the 0.05 level.

** : MacKinnon-Haug-Michelis (1999) p-values.

Conversely, the contracts of May and August of sacking indicate one co-integrating relationship, while the contracts of February and November do not reveal any evidence of co-integration. In the case of potato, the October contract reveals a strong evidence of co-integration, while the same is not true for the months of March and July. In the case of castorseed, only two (June and February) out of

six months indicate co-movement. There exists a strong evidence of co-integration in the case of Mustard (January and May) and gur (May, July and December) (Table 5).

In the case of other commodities, long period data is not available, as their trading has commenced/picked up only in the recent period. However, the evidence for the recent years using daily data, indicates that there exist two co-integrating relationships in the case

Table 5: Johansen Trace Statistics

Commodity/ Contract Month	Eigen Value	Trace Statistic	0.05 % critical value	Hypothesised No.of CE(s)
1	2	3	4	5
Potato				
March	0.146020	8.03	15.49	None
	0.063048	2.34	3.84	At most 1
July	0.178343	13.40	15.49	None
	0.096410	4.56	3.84	At most 1 *
October	0.388858	28.72	15.49	None *
	0.123639	6.07	3.84	At most 1 *
Castorseed				
February	0.665754	20.23	15.49	None *
	0.089985	1.60	3.84	At most 1
March	0.487649	7.92	15.49	None
	0.050301	0.57	3.84	At most 1
April	0.232007	5.17	15.49	None
	0.057213	0.94	3.84	At most 1
June	0.268917	16.40	15.49	None *
	0.092321	3.87	3.84	At most 1 *
September	0.277908	14.95	15.49	None
	0.085875	3.23	3.84	At most 1
December	0.251352	14.77	15.49	None
	0.135006	4.93	3.84	At most 1 *
Mustard				
January	0.407921	22.66	15.49	None *
	0.132714	4.84	3.84	At most 1 *
May	0.500030	23.14	15.49	None *
	0.151118	4.42	3.84	At most 1 *
Gur				
May	0.259154	15.98	15.49	None *
	0.180768	6.38	3.84	At most 1 *
July	0.333212	20.97	15.49	None *
	0.162452	6.38	3.84	At most 1 *
December	0.225255	24.34	15.49	None *
	0.075259	5.71	3.84	At most 1 *

* : Denotes rejection of the hypothesis at the 0.05 level.

** : MacKinnon-Haug-Michelis (1999) p-values.

of rice, wheat, sugar (grade-S), cotton, sesame seed among the primary commodities; gold, copper, lead and tin among the metals; and bent crude oil among the oils. The estimation in the case of rubber, sesame oil, aluminium, zinc, silver, and furnace oil yields one such relationship. Only sugar (grade-M) and nickel do not show any co-movement (Table 6 and 7). This however, is an indicative evidence of the state of efficiency of markets.

4. Price Volatility:

In the markets which are efficient, the extent of fluctuations in both spot and derivatives markets are supposed to be same for storable commodities. If the spot market is efficient, the relative magnitude of variation in prices helps us to see whether future market is able to

Table 6: Johansen Trace Statistics

Commodity	Eigen Value	Trace Statistic	0.05 % critical value	Hypothesised No.of CE(s)
1	2	3	4	5
Rice^	0.777055	45.44	15.49	None *
	0.431321	12.42	3.84	At most 1 *
Wheat^	0.441468	21.79	15.499	None *
	0.305728	8.399	3.849	At most 1 *
Sugar (M)	0.020589	12.48	15.49	None
	0.001314	0.74	3.84	At most 1
Sugar (S)	0.132327	64.10	15.49	None *
	0.010255	4.34	3.84	At most 1 *
Rubber	0.078561	37.63	15.49	None *
	0.001801	0.81	3.84	At most 1
Sesame oil^	0.534638	22.62	15.49	None *
	0.015050	0.44	3.84	At most 1
Sesame seed^	0.304802	44.54	15.49	None *
	0.143044	13.28	3.84	At most 1 *
Cotton (J-34)^	0.481645	20.46	15.49	None *
	0.306504	7.32	3.84	At most 1 *
Cotton (S-06)^	0.537798	23.78	15.49	None *
	0.341109	8.34	3.84	At most 1 *
Bent Crude Oil	0.141113	45.88	15.49	None *
	0.015804	4.35	3.84	At most 1 *
Furnace Oil	0.160861	36.57	15.49	None *
	0.008371	1.67	3.84	At most 1

* : Denotes rejection of the hypothesis at the 0.05 level.

** : MacKinnon-Haug-Michelis (1999) p-values.

^ : Pertain to data at fortnightly intervals.

Table 7: Johansen Trace Statistics

Commodity	Eigen Value	Trace Statistic	0.05 % critical value	Hypothesised No.of CE(s)
1	2	3	4	5
Aluminium	0.072304	16.51	15.49	None *
	0.003953	0.83	3.84	At most 1
Nickel^	0.343624	14.49	15.49	None
	0.045200	1.43	3.84	At most 1
Lead	0.221481	20.74	15.49	None *
	0.061865	4.21	3.84	At most 1 *
Zinc	0.169979	20.59	15.49	None *
	0.013490	1.40	3.84	At most 1
Copper	0.059051	31.40	15.49	None *
	0.008566	3.89	3.84	At most 1 *
Gold^	0.425488	27.77	15.49	None *
	0.212822	8.38	3.84	At most 1 *
Tin	0.083852	32.28	15.49	None *
	0.016073	5.04	3.84	At most 1 *
Silver	0.107610	42.13	15.49	None *
	0.002857	1.03	3.84	At most 1

* : Denotes rejection of the hypothesis at the 0.05 level.
** : MacKinnon-Haug-Michelis (1999) p-values.
^ : Pertain to data at fortnightly intervals.

incorporate the information efficiently. In the efficient markets, daily variations in spot and derivatives emanate purely from the new information that is arriving in the market.

The ratio of standard deviations of month-wise future and spot prices throws light on the extent of volatility in the derivatives markets. Assuming that the carrying costs in the month are negligible, a ratio of standard deviation of future and spot prices that is closer to one indicates that derivatives market is efficient, *viz.*, markets are incorporating the information efficiently. A ratio greater than one close to the maturity period indicates speculative activities. Conversely, a ratio less than one shows that markets are not being able to incorporate the information fully and efficiently.

For the sake of analysis, a cut-off has been assumed at 0.8 and 1.2 as the lower and upper levels to provide an indication of extent of variability in the spot and derivatives markets. This assumption is

Table 8: Stationarity (ADF) Test Statistics

Commodity	Contract Month	Price	Level	1st Difference
1	2	3	4	5
Pepper	January	*Future*	-1.54	-10.02*
		Spot	-6.34*	-9.34*
	February	*Future*	-1.61	-7.61*
		Spot	-6.83*	-9.42*
	March	*Future*	-1.68	-7.89*
		Spot	-6.95*	-9.79*
	April	*Future*	-2.12	-10.78*
		Spot	-6.77*	-9.53*
	May	*Future*	-1.73	-8.92*
		Spot	-7.30*	-10.29*
	June	*Future*	-0.91	-6.94*
		Spot	-6.79*	-9.68*
	July	*Future*	-1.18	-8.18*
		Spot	-1.04	-7.71*
	August	*Future*	-1.2	-8.81*
		Spot	-0.96	-7.03*
	September	*Future*	-1.28	-6.26*
		Spot	-1.25	7.07
	October	*Future*	-0.56	-8.02*
		Spot	-0.61	-8.26*
	November	*Future*	-2.70$	-6.25*
		Spot	-2.24	-8.02*
	December	*Future*	-1.13	-7.27*
		Spot	-6.48	-9.77*
Sacking	February	*Future*	-0.94	-4.31
		Spot	-1.97	-5.68*
	May	*Future*	-1.81	-6.37*
		Spot	-6.05*	-9.53*
	August	*Future*	-1.93	-4.04*
		Spot	-1.33	-10.19*
	November	*Future*	-0.89	-4.33*
		Spot	-2.06	-7.21*

Note : * : Significant at 1 % level. @ : Significant at 5 % level.
$: Significant at 10 % level. ^ : Data at fortnightly intervals.

on the same lines as adopted in the previous study (Naik and Jain, 2002) (Annex Table I).

- In the case of pepper, in most of the cases ratio has hovered around one, indicating that there is an efficient utilisation of information and to that extent, market is efficient in respect of pepper. Among

all the months, however, contracts between June to October as also December appear to attract some speculative trading.

- In the case of gur and potato, in almost all the cases, the ratio has been less than 0.8 suggesting that volatility in the future price is substantially lower than the spot price. This pattern is an indication of inefficient utilisation of information in the market.
- Similarly, in respect of castorseed in more than 50 per cent cases, the ratio turns out be less than 0.8, reflecting that future price has been unable to incorporate the information fully. Furthermore, the contracts pertaining to February, April, June and December show some speculative trading.
- In the case of sacking, while in some cases the ratio turns out closer to one, while in several cases, it stands at less than 0.8. The contract of November has relatively more speculative trading.
- Sugar shows no discernible pattern as in one year the ratio is around one but in the subsequent year, it is less than 0.8 in most cases, while the contract of November revealed some speculative activities.
- In respect of cotton in most cases, the ratio hovers around one, while in 40 per cent of the cases, ratio exceeds the upper ceiling (1.2), indicating to that extent higher volatility in the future price than in the spot price. Besides, the contracts of most of the months have also witnessed speculative trading.
- In the case of mustard, future price variability is higher for August contract than for May and November, indicating thereby an excessive speculative activity in respect of August contract.
- Future price volatility as compared to the spot price is found to be high in respect of wheat and low in the case of rice.
- The variability in future price turns out to be high in respect of contracts of rubber maturing in January, February, March and December, reflecting excessive speculation in them.
- In respect of metals, barring aluminium and to some extent nickel, others such as lead, copper and tin, future price shows considerable variability compared to that of spot price.

Table 9: Stationarity (ADF) Test Statistics

Commodity	Contract Month	Price	Level	1st Difference
1	2	3	4	5
Potato	July	*Future*	-1.52	-6.01 *
		Spot	-2.26	-7.19 *
	March	*Future*	-1.40	-5.95 *
		Spot	-2.25	-7.73 *
	October	*Future*	-1.82	-6.14 *
		Spot	-2.07	6.79
Castorseed	June	*Future*	-1.59	-5.44 *
		Spot	-1.72	-5.98 *
	September	*Future*	-1.64	5.06
		Spot	-1.72	5.35
	December	*Future*	-1.32	-4.18 *
		Spot	-2.93	-3.03 @
Mustard	January	*Future*	-1.95	-17.7 *
		Spot	-4.64 *	4.98
	May	*Future*	-1.93	4.90
		Spot	-2.65 $	-5.42 *
Gur	May	*Future*	-2.48	-4.60 *
		Spot	-2.90 $	-6.08 *
	July	*Future*	-2.27	-5.69 *
		Spot	-2.75 $	-5.91 *
	December	*Future*	-2.21	-8.67 *
		Spot	-3.42 @	7.59

Note : Same as Table 8.

Similaraly, the gold contract of August and silver contract of April and May display higher volatility in future price compared to the spot price. Thus, by and large, metals appear to attract wide speculative trading.

5. Marginal Convenience Yield- Basis Risk

If the spot price is less than the future price of the underlying asset, the market is said to be in contango. Conversely, if the spot price is more than the future price, the market is said to be in backwardation. When the future contracts expire, the spot and future price converge with each other. According to Pindyck (2001), the spread between the future price and spot price gives a direct measure of the marginal value of the storage for a commodity termed alternatively, as marginal convenience yield (MCY). Future price

could be greater or less than the spot price depending on the magnitude of the net (of storage costs) MCY. If MCY is large, the spot price will exceed the future prices. As observed in the earlier Section, derivatives markets besides providing flexibility in pricing, facilitate inventory management. The level of inventories held in the spot market will be determined by the *basis* and will ensure a more efficient process of private storage, which in turn, ensures a smoother pattern of prices in the spot market and hence, potentially reduce price volatility (Netz, 1995 and Morgan, 1999). Hence, producers taking position in the commodity derivatives markets are beset with basis risk. Lower the basis risk, more effective is the derivatives market in terms of its function of price risk management. In the efficient markets, future price converges to the spot price and thus, the basis risk becomes zero in the maturity month. In such markets, producer who hedges his price risk can contain his business risk by holding on to the contract until the maturity of the contract. Thus, if the basis is low, hedging becomes an effective instrument of price risk management. The effectiveness of commodity derivatives markets in terms of the price risk management could be examined by analysing the ratio of standard deviation of basis to the spot price in the maturity month of the contract. A ratio of standard deviation of basis to the spot price of any contract that is less than 0.5 (a benchmark) could be considered to be effective in price risk management and hence, would attract more participants to the derivatives market (Naik and Jain, 2002).

- During 1997-2004, in the case of pepper trading, the ratio was less than one in 70 per cent of the cases, while it was less than 0.5 in about 50 per cent of the cases except for one or two years. Furthermore, the contracts maturing in July and August witnessed the ratio being less than the benchmark in 50 per cent of the cases. However, the contracts of January, May, June and September display considerable volatility in their basis compared to the spot prices, as their ratio below the benchmark could be observed only in 30 per cent of the cases (Annex Table II).
- Prior to 2001, the basis in respect of gur revealed considerable variability compared to the spot prices, although it was moderated in the recent years. However, in none of the years, ratio was

Table 10: Stationarity (ADF) Test Statistics

Commodity	Price	Level	1st Difference
1	2	3	4
Rice^	*Future*	-4.00 *	5.47
	Spot	-6.29 *	-5.56 *
Wheat^	*Future*	3.39	-5.89 *
	Spot	-3.23 @	-6.03
Sugar (M)	*Future*	-1.36	-22.51 *
	Spot	-0.68	-18.79 *
Sugar (S)	*Future*	-3.05 @	-15.74 *
	Spot	-2.14	-21.90 *
Rubber	*Future*	-0.88	-20.98 *
	Spot	-0.87	-11.42 *
S.Seed^	*Future*	-4.30 *	12.27
	Spot	-4.03 *	-7.80 *
Cotton (J-34)^	*Future*	-3.47 @	-4.92 *
	Spot	-3.12 @	-5.70 *
Cotton (06)^	*Future*	-4.41 *	-7.20 *
	Spot	-4.23 *	-1.71
Bent Crude Oil	*Future*	-2.51	-18.54 *
	Spot	-2.37	-18.57 *
Furnace Oil	*Future*	-1.34	-13.19 *
	Spot	-2.06	-13.04 *

^ : Data at fortnightly intervals.
Note : Same as Table 8.

around the benchmark. Even in terms of the maturity months of March, July and December, the ratio was less than one only in 50 per cent of the cases.

- In respect of castorseed, the ratio turned out to be less than the benchmark in 50 to 70 per cent of the cases, implying thereby less risk involved in its trading. While the contracts of April, June and September proved effective in scaling down the price risk as they show lower basis risk in almost 70 per cent of the cases.
- The basis risk of potato trading displayed relatively moderate variation as the ratio was less than one in almost 70 per cent of the cases, barring one year. However, the ratio was never below the benchmark in four out of five years under the review. Among the contracts months of March, July and October, none of them showed basis being closer to the spot price except in 20 per cent of the cases in respect of October.

- The ratio in respect of sacking ruled below one in around 70 per cent and above cases, however, the ratio was below the benchmark in around 30 per cent of the cases only in two out of five years and thus, indicating that basis risk in this case was neither too low nor high but at best moderate. Among the four months, only in the case of August contract, the ratio was below the benchmark in 40 per cent of the cases.
- Basis risk varies even between different varieties of the same commodity as they are traded in different markets. In respect of sugar (grade-M), the ratio was below the benchmark in 60 per cent of the cases in 2003 and 33 per cent of the cases in 2004, while it was never below the benchmark in the case of sugar (grade-S). The contracts of March and April witnessed ratio being less than the benchmark in around 70 per cent of the cases.
- In the case of rubber, the ratio was below the benchmark in 70 per cent of the cases in 2003 while in the case of contracts of January, February, March, April and May, the basis displayed considerable variability compared to the spot price and the ratio exceeded one in respect of all.
- Among the metals, the basis risk turned out to be substantially high in the case of lead, copper and tin, while the ratio was below the benchmark in around 30 per cent of the cases in respect of aluminium and zinc.
- The basis risk of gold was moderate as the ratio was less than one in 70 per cent of the cases. Silver revealed the same position, however, its ratio was below the benchmark in 40 per cent of the cases, implying thereby that trading in silver was relatively less riskier than in the gold.
- Overall among the metals, the contracts of February and March revealed relatively lower basis risk, as the ratio hovered below the benchmark in one-half of the cases.
- The basis risk in respect safflower oil trading was substantially high, while it was moderate in the case of sesame oil and sesame

seed. It is only the June contract, which showed low basis risk as the ratio fell below the benchmark in 70 per cent of the cases.

- In respect of cotton, one grade, J-34 showed relatively moderate basis risk, while the other grade-S-06, revealed high basis risk and among the months, March contract was relatively better.
- The trading in mustard indicates considerable volatility in its basis compared to the spot price, with only the contract of May being less riskier. However, overall the trading in mustard showed high basis risk.
- In respect of grain contracts, rice showed a moderate basis risk, while it was quite high in respect of wheat and among the four contract months none of them showed ratio being less than the benchmark in any of the cases.

Table 11: Stationarity (ADF) Test Statistics

Commodity	Price	Level	1st Difference
1	2	3	4
Aluminium	*Future*	-1.45	-15.77 *
	Spot	-0.86	-14.78 *
Copper	*Future*	-1.90	-23.14 *
	Spot	-1.91	-25.11 *
Gold^	*Future*	3.86	-2.85 $
	Spot	-4.46*	-2.96 $
Lead	*Future*	-1.27	-8.91 *
	Spot	-1.08	-8.34 *
Nickel^	*Future*	0.06	-6.51 *
	Spot	0.21	-7.12 *
Silver	*Future*	-1.23	-1.19 *
	Spot	-1.17	-22.19 *
Tin	*Future*	-2.80$	-20.88 *
	Spot	-2.39	-18.83
Zinc	*Future*	-1.38	-9.78 *
	Spot	-0.90	-10.23 *

Note : Same as Table 8.

Section IV
Constraints and Challenges

The misconceived apprehensions that the derivatives trade leads to speculative and inflationary tendencies were largely responsible for strangulation of this industry in the past. Some of the constraints in the development of commodity derivatives market in India could be identified below.

- The long period of prohibition has resulted in driving a part of the trade underground, with a large number of participants shifting to other professions, including securities market. These markets in India remained isolated from rapid advances in the systems of brokerages, market designs, trading, clearing, settlement, and governance of exchanges since 1970s, when derivatives were introduced in Western markets.
- The hawala markets, which are operating since decades, are often localised, operating with low transaction costs and hence attract many speculators and small hedgers. Indian commodity derivatives markets are still in a developing stage as they are dispersed and fragmented, with small turnovers among separate trading communities in different regions.
- In India, trading in these markets is yet to achieve the minimum critical liquidity. In thin markets, the transactions of individual hedgers have significant price effects and result in substantial 'transaction costs' (Kyle, 1985 and Thompson, Garcia and Dallafior,1996).
- The major stumbling block for the development of derivatives market is the fragmented physical/spot markets. The national level derivative exchanges cannot be founded on fragmented localised cash markets.
- In India, fragmented land holdings, dependence on monsoon, low level of input usage, poor agronomic practices, lack of rural infrastructure (warehousing, grading/sorting facilities, access roads to markets), poor flow of price and market information all combine to translate to unsteady output, sub-standard quality and fluctuating farmgate prices.

- The agenda of liberalisation and reforms in legal, policy and regulatory levels for the development of these markets is still unfinished. The proposal to allow options in commodities and provide registration to brokers by amending Forward Contracts Act is still pending.
- The issue of differential tax structure both stamp duty and octroi is yet to be resolved. It is felt in several corners that in case non-delivery transactions, high stamp duties imposed by the State Governments have made the market unattractive leading to illegal hawala markets.
- The freedom to diversify does not exist in the regional exchanges as they have to seek fresh recognition every time they intend to add another commodity to their portfolio.
- Several restrictions such as stock limits, levy system, *etc.*, have hindered the process of integration of markets throughout the country. The system of administered price mechanism has not only distorted the cropping pattern but has also restricted the scope for adequate development of commodity derivatives markets.
- The progress in terms of infrastructure development in terms of efficient clearing settlement and guarantee systems, system of well organised and capitalised brokerage houses, real time price and trade information dissemination, *etc.*, has been slow.
- Apart from physical/infrastructural limitations such as limited online trading, online surveillance and monitoring, the non-availability of full proof legal system of contracts, particularly relating to the warehouse receipt system, *etc.*, are seriously constraining the derivatives market.
- Further, limited and closed nature of membership, particularly in the regional exchanges absence of many hedgers has scuttled the spread of derivatives trading. Due to the small size of commodity exchanges in terms of their turnover, large corporate houses are looking forward to offshore commodity exchanges.
- Lack of awareness about the role and technique of derivatives trading among the potential beneficiaries is hindering the growth

of the market. Small size of the farmers and inadequate access to credit has also dampened the development of this market in India.

- Forward Markets Commission exercises delegated powers and has no autonomy to garner resources- human, financial, infrastructural to discharge the responsibility in a changed environment.
- The other common issues include lack of efficient mechanism for collection of spot prices, existence of different regulators for spot and futures markets, lack of de-mutualisation in regional exchanges, taxation issues such as setting up off speculative transactions for calculation of IT, capital gains on transactions in the forward market, service tax, *etc*.

Section V
Required Policy Response

In view of the promising prospects that these markets hold, following issues need to be addressed.

- Concerted efforts have to be made to bring the traditional players to the formal market in order to achieve minimum critical liquidity, sufficient breadth and depth, and provide relatively less expensive exit route.
- There is a need to strengthen the input delivery system, expansion of irrigation facilities, ensure timely and adequate credit delivery, educate farmers about agronomy and enable them to follow pre and post harvest scientific practices. Besides, putting in place adequate rural infrastructure for warehousing and dissemination of price and market information to farmers warrants renewed thrust.
- One way to shorten the existing long supply chain and ensure disintermediation (intermediaries that add to the cost but not to the value) is for corporates to get into contract farming.
- There is need to strengthen the spot or physical market by pumping adequate investment and changing the archaic laws relating to produce marketing. Development of modern markets needs to be encouraged by amending the respective Agricultural Produce Marketing Committee (APMC) Acts and notifying the rules thereunder by all the States.

- Derivatives market cannot exist without an underlying spot market. First, there is a need to have sound and vibrant physical market so as to ensure a vibrant and transparent derivatives market.

- The Government should continue its efforts to strengthen the commodity exchanges and instill confidence and awareness among the market players for increasing participation in derivatives markets.

- The reform initiatives suggested by the Government and FMC to commodity exchanges such as daily mark to market margining to improve financial integrity of the markets, simultaneous reporting, trading ring discipline, representation of diverse interests (growers/ processors/exporters/importers), full professionalisation of Boards of exchanges, *etc.*, need to be pursued vigorously to make the derivatives market deliver effectively.

- Furthermore, efficient clearing, settlement and guarantee systems, system of well organised and capitalised brokerage houses, real time price and trade information dissemination, ensuring transparency, *etc*, should be made conditional on the exchanges. To instill the confidence in investors, increasing volumes and thereby reaping the full potential of derivatives trading, exchanges have to mature by adopting to the best international practices.

- The success of commodities derivatives trading assumes a multi variant dimension with several stakeholders involved. The effective co-ordination and interface between the exchanges, banks and the warehousing agencies is crucial in evolving a necessary framework in developing a mature warehousing system.

- As recommended by the Working Group on Warehouse Receipts and Commodity Futures (2005) set up by the Reserve Bank, a system needs to be evolved by which warehouse receipts become freely transferable between holders as it would reduce transaction costs and increase the usage.

- The system of warehouse receipts needs to be universalised in derivatives trading to enable enhanced volumes and in

minimising transaction costs. Warehouse receipts should act as good evidence of the receipt for goods and the terms of the contract and storage, proof for their quality and conditions.

- For evolving a mature warehouse receipt system, legal framework needs to be strengthened. In addition to these steps, warehouses need to be upgraded and properly regulated, which should enable them to certify the quality of the products and the standard parameters for the same can also be set.

- There is a need to introduce options trading and pending amendment to this effect should be expedited. In case of non-delivery transactions, there is a need to minimise the stamp duties imposed by the State Governments to attract the customers from illegal hawala markets.

- Another issue that merits attention is the integration of markets throughout the country, which is not possible unless all the existing restrictions such as stock limits, levy system, *etc.*, are done away with.

- It has also been suggested that there is a need to grant industry status to commodity derivatives sector so that the players, like their counterparts in securities industry, can have access to the institutional funds for their working capital.

- It has been deliberated in several quarters that participation in commodity derivatives market needs to be enlarged by including mutual funds, financial institutions and foreign institutional investors, which would enable them to reallocate assets, maximise returns and diversify risks. A view needs to be taken on the issue of allowing these entities for participating in the commodity derivatives market.

- With the deepening and widening of derivatives markets, the regulatory system should also achieve dynamism, being autonomous with adequate powers and professionalism to monitor and ensure surveillance in a liberalised market system. In this context, establishment of an independent regulator as in the case of securities market needs to be considered.

Section VI
Commodity Future Prices and their Implications for Monetary Policy

Future prices usually contain useful information about the emerging demand and supply conditions, particularly as markets develop, mature and achieve higher efficiency. Recent studies have revealed that despite the relative noise in the commodity futures markets, they remain an important source of information about the likely conditions of future developments in inflation and monetary conditions. An earlier study provides indirect observations on the short-end of the term structure by using a measure of the real interest rate extracted from commodity futures prices (Cornell and French, 1986). They found that it was expected inflation in commodity prices and not the real returns that increased when there was an unexpected increase in the money supply. Others have found that the long-term expected inflation rate falls when there is a surprise increase in the federal funds rate (Gurkaynak, *et al,* 2003). Conversely, the short-term response is different (Armesto and Gavin, 2005), *i.e.,* expected inflation, at least as observed in the commodity markets, moves in the same direction over the ensuing 3 to 9 months as a surprise in the federal funds rate target.

In this regard, studies derive measures of the interest rate and expected inflation from commodity futures prices and use these measures to examine how interest rates and expected inflation respond to monetary policy shocks (Armesto and Gavin, 2005). Although the commodity futures data contain a substantial amount of idiosyncratic noise, they remain an important source of information about how markets respond to the evolving stance of monetary policy. These results show that the commodity expected inflation rate does respond significantly to surprises in the federal funds rate. The expected inflation rate in commodities is calculated from the relative basis in commodity markets and the basis is defined as the difference between the spot and the future price of a commodity.

However, whether these findings have important implications for monetary policy depends on how closely the measures derived

from commodity markets are connected to the inflation rates and real interest rates that matter for long-term consumption and investment decisions. Nevertheless, as the commodity futures market develop in India, it remains a subject of study to explore how these markets respond to monetary policy shocks and whether commodity future prices can be factored in for arriving at expected future inflation and interest rates by the market participants. On the other hand, the evolving pattern of commodity futures prices would reveal significant information to the monetary authorities on real economic factors, which have a bearing on policy formuation. The development of a vibrant commodity futures market would facilitate the signaling mechanism of monetary policy both for the central bank to the market participants and *vice-versa.*

Section VII
Concluding Observations

Commodity derivatives trading in India after a phase of long and turbulent historical sojourn, witnessed a massive spurt in the recent period. The total value of commodity derivatives trading accounts for about 2/3rd of overall GDP, reflecting the extent of depth that this market has gained in the economy. In India, however, it is largely the agricultural commodities, which are traded on the existing exchanges. The value of agricultural commodities traded as a proportion of overall GDP amounts to around 37 per cent (70 per cent of the agricultural GDP) in the country while the share of bullion, oil and other metals is relatively low. An analytical overview of these markets, however, reveals that liquidity in respect of primary commodities was found to be high only in few commodities such as castorseed, soyabean oil, and to some extent cotton, while in the case of others, it was quite thin. These markets in India are thus, yet to achieve minimum critical liquidity that can generate greater economies of scale, minimum transaction costs and wider participation.

While standing the tests of efficacy, contracts of most of the months in respect of pepper, mustard and gur throw a strong evidence of co-integration between the spot and future prices, while in the

case of several others such as sacking, potato and castorseed, only contracts of few months revealed such co-movement. Even evidence in respect of other commodities, where the trading has been a recent phenomenon, such as rice, wheat, sugar (S), cotton, sesame seed, gold, copper, lead, tin and bent crude oil, rubber, sesame oil, aluminium, zinc, silver and furnace oil does not elude the above trend. Only sugar (M) and nickel did not throw any evidence of co-integration. Thus, by and large, trading in the commodity derivatives is moving in the desired direction of achieving improved operational efficiency, *albeit*, at a slower pace.

In terms of volatility, barring pepper and to some extent cotton, in the case of others such as gur, castorseed, potato, rice, sacking and sugar, variability in future price was substantially lower than the spot price, reflecting thereby an inefficient utilisation of information in the market. While the contracts of few months in respect of pepper, castorseed, sugar and sacking revealed moderate speculation, others such as cotton, rubber, wheat and most of the metals; lead, copper, tin, gold and silver to some extent displayed wide speculative trading.

An analytics of effectiveness of these markets in terms of their function of price risk management divulges that basis (MCY) risk in respect of pepper, castorseed, rubber and to some extent silver was low and hence, hedging in their case proved to be an effective proposition. However, in the case of several others such as potato, sacking, sugar (M), sesame oil, sesame seed, rice, cotton (J-34), aluminium, zinc and gold, the risk was moderate. Conversely, the basis risk was considerably high in respect of gur, mustard, wheat, sugar (S), cotton (S-06), safflower oil, lead, copper and tin, indicating that hedging in their case was less effective. The contracts of some months particularly in respect of pepper, gur, potato and rubber did reveal some basis risk, while the contracts of some months in the case of castorseed (April, June September), sugar (March and April), cotton (March), metlas (February and March) proved effective in containing the price risk.

This, however, is an indicative evidence of the developing state of the market. Notwithstanding several policy initiatives undertaken

recently, some of the older exchanges have not been able to generate resources and therefore not demonstrated the seriousness and flexibility to introduce the reforms. Several measures in the institutional, infrastructural and legal spheres are warranted for the rapid development of these markets in the country. Furthermore, as the markets develop, it needs to be explored whether future prices, which contain useful information about the future demand and supply conditions, could be used as an input for arriving at expected inflation and interest rates by the market participants and whether the information content of futures prices could be factored in the future monetary policy formulation.

Notes

[1] In order to mitigate price and yield risks at the farm level, low-risk and low-yield crop and production patterns are adopted to ensure a minimum income, which are at the expense of high risk, high yield production that could create income growth and the build up of capital (Bryla E., Dana J., Hess, U Varangis U.P., 2003).

[2] Weather risks are covariant and typically shock entire regions at once, which makes it difficult to set up local insurance schemes that have sufficient diversity in their portfolio to deal with the covariant risks (Skees *et. al.,* 2002). With regards to price risk, attempts to stabilise prices using stabilisation funds and bufferstocks have defied market forces and resulted in unsustainable programmes and substantial losses to treasuries (World Bank, 2001).

[3] The difference between future prices and spot prices is commonly known as the *basis* and could be measured at any point during the lifetime of the derivatives contract. In essence, the basis is a measure of storage and interest costs that have to be borne by a spot market trader in holding stocks for sale at some point of time in the future. Higher the basis higher is an incentive to store more.

[4] 'a' Measures the impact of changes in basis on the spot and future prices, respectively.

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Annex Table I: Ratio of Standard Deviation of Future Price to that of Spot Price

I.1: Pepper*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Per cent of Times the Ratio was	
													< 0.8	*>1.2*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1997	–	1.2	1.6	–	0.8	–	1.0	0.8	–	0.6	–	0.9	14.0	14.0
1998	1.2	0.9	0.9	1.1	1.1	1.3	1.8	1.9	1.7	2.2	–	1.2	0.0	36.0
1999	0.5	0.2	0.7	0.8	0.6	1.5	1.2	1.1	1	0.8	1.1	1.4	33.0	17.0
2000	1.2	1.0	0.9	0.8	1.0	1.1	1.3	1.4	1.2	1.4	1	0.8	0.0	25.0
2001	0.8	0.6	0.5	0.4	0.4	0.4	0.5	0.4	0.5	0.6	0.5	1	83.0	0.0
2002	0.9	0.4	0.5	1.2	1.2	1.2	1.1	1.1	0.9	0.9	1	0.1	17.0	0.0
2003	0.1	0.1	0.1	0.1	0.05	0.4	2.1	2.0	1.9	1.9	2	2.1	17.0	33.0
2004	1.8	0.3	1.1	0.9	1.0	1.0	0.7	1.1	–	–	–	–	25.0	13.0
< 0.8 (%)	29.0	63.0	50.0	29.0	38.0	29.0	25.0	13.0	17.0	29.0	20.0	14.0		
>1.2 (%)	14.0	0.0	13.0	0.0	0.0	29.0	38.0	25.0	33.0	43.0	20.0	29.0		

* : Traded at Kochi Market.

I.2: Gur*

Year	Mar	May	Jul	Dec	Per cent of Times the Ratio was	
					< 0.8	*>1.2*
1	2	3	4	5	6	7
1997	0.4	0.3	1.0	0.7	75.0	0.0
1998	–	0.8	0.3	0.1	67.0	0.0
1999	0.3	0.4	0.6	0.1	100.0	0.0
2000	–	0.5	0.6	0.2	100.0	0.0
2001	0.6	0.5	0.2	0.1	100.0	0.0
2002	1.1	0.3	–	–	50.0	0.0
2003	–	–	0.3	0.3	100.0	0.0
2004	0.2	0.3	–	–	100.0	0.0
< 0.8 (%)	80.0	86.0	83.0	100.0		
>1.2 (%)	0.0	0.0	0.0	0.0		

* : Traded at Mujaffarnagar Market.

I.3: Castorseed*

Year	Mar	Jun	Sept	Dec	Feb	Apr	Per cent of Times the Ratio was	
							< 0.8	*>1.2*
1	2	3	4	5	6	7	8	9
1997	1	5.3	0.3	0.6	–	–	50.0	25.0
1998	0.9	0.4	0.3	0.4	–	–	75.0	0.0
1999	0.3	0.6	0.7	1	–	–	75.0	0.0
2000	1	0.5	0.7	0.4	–	–	75.0	0.0
2001	–	1.1	0.7	1.4	1.1	1.4	20.0	20.0
2002	–	0.9	0.8	0.5	1.5	–	25.0	25.0
2003	–	1.3	–	1.3	1	0.7	25.0	50.0
2004	–	0.3	–		1.4	0.2	67.0	33.0
< 0.8 (%)	25.0	50.0	83.0	57.0	0.0	67.0		
>1.2 (%)	0.0	25.0	0.0	29.0	50.0	33.0		

* : Traded at Mumbai Market.

I.4: Potato*

Year	Mar	Jul	Oct	Per cent of Times the Ratio was	
				< 0.8	*>1.2*
1	2	3	4	5	6
1997	0.5	0.7	0.6	100.0	0.0
1998	0.2	0.4	0.4	100.0	0.0
1999	0.7	0.8	1.2	33.0	0.0
2000	0.3	0.8	0.7	67.0	0.0
2001	0.4	0.3	0.8	67.0	0.0
2002	0.2	–	–	–	–
2003	–	–	–	–	–
2004	–	–	–	–	–
< 0.8 (%)	100.0	60.0	60.0		
>1.2 (%)	0.0	0.0	0.0		

* : Traded at Hapur Market.

I.5: Sacking*

Year	Feb	May	Aug	Nov	Per cent of Times the Ratio was	
					< 0.8	***>1.2***
1	2	3	4	5	6	7
1997	–	–	–	1	0.0	0.0
1998	0.4	3	0.7	–	100.0	0.0
1999	–	–	–	–	0.0	0.0
2000	–	0.6	0.4	0.5	100.0	0.0
2001	0.7	1.1	1.1	1.3	25.0	25.0
2002	1.3	0.3	0.6	1.4	75.0	25.0
2003	0.5	–	0.03	0.5	100.0	0.0
2004	0.5	–	–	–	0.0	0.0
< 0.8 (%)	80.0	50.0	80.0	40.0		
>1.2 (%)	20.0	25.0	0.0	40.0		

* : Traded at Kolakata Market.

I.6: Sugar

Year	Jan	Feb	Mar	Apr	May	Jun	Nov	Dec	Per cent of Times the Ratio was	
									< 0.8	***>1.2***
1	2	3	4	5	6	7	8	9	10	11
2003										
*M' grade**	–	–	0.8	0.8	1.2		1.6	0.4	20.0	20.0
*S' grade***	–	–	–	–	–	–	1.1	1.2	0.0	0.0
2004										
M' grade	0.2	0.5	0.8	0.7	0.6	0.1	–	–	67.0	0.0
S' grade	0.6	0.3	0.8	0.9	0.6	0.3	–	–	67.0	0.0
< 0.8 (%)	100.0	100.0	0.0	33.0	67.0	100.0	0.0	50.0		
>1.2 (%)	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0		

* : Traded at *E-sugarindia Ltd.* Market Mumbai.
** : Traded at NMCEIL, Ahmedabad.

I.7: Cotton*

Year	Jan	Feb	Mar	Apr	May	Per cent of Times the Ratio was	
						< 0.8	*>1.2*
1	2	3	4	5	6	7	8
2004							
Grade: J-34	0.5	1.3	0.8	1.4	2.0	20.0	40.0
Grade: S-06	0.6	1.2	1.3	1.4	1.0	20.0	40.0
< 0.8 (%)	100.0	0.0	0.0	0.0	0.0		
>1.2 (%)	0.0	50.0	50.0	100.0	50.0		

* : Traded at *NCDEX* Market Mumbai.

I.8: Mustard*

Year	May	Aug	Nov	Per cent of Times the Ratio was	
				< 0.8	*>1.2*
1	2	3	4	5	6
2003	0.9	2.1	0.3	33.0	33.0
2004	0.9	2.1	1.6	0.0	67.0
< 0.8 (%)	0.0	0.0	50.0		
>1.2 (%)	0.0	100.0	50.0		

* : Traded at Hapur Market.

I.9: Rubber*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Per cent of Timesthe Ratio was	
													< 0.8	*>1.2*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2003	–	–	–	0.5	1.3	1.4	1.4	1.2	0.8	1.0	1.3	1.6	11.0	56.0
2004	2	3.2	1.7	1.4	0.8	–	–	–	–	–	–	–	0.0	80.0
< 0.8 (%)	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
>1.2 (%)	100.0	100.0	100.0	50.0	50.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0		

* : Traded at NMCEIL, Ahmedabad.

I.10: Rice and Wheat

Year	Mar	Apr	May	Jun	Per cent of Times the Ratio was	
					< 0.8	*>1.2*
1	2	3	4	5	6	7
2004						
Rice	0.8	0.9	1.0	1.2	0.0	0.0
Wheat	1.4	1.6	2.0	1.4	0.0	100.0
< 0.8 (%)	0.0	0.0	0.0	0.0		
>1.2 (%)	50.0	50.0	50.0	50.0		

I.11: Metals

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Nov	Per cent of Times the Ratio was	
											< 0.8	*>1.2*
1	2	3	4	5	6	7	8	9	10	11	12	13
2003												
*Aluminium**	–	–	1.0	1.0	1.0	0.9	1.1	–	0.7	0.8	14.0	0.0
*Nickel**	–	–	–	2.6	–	0.9	0.9	–	1.0	1.0	0.0	20.0
Lead	–	–	–	–	–	2.7	2.2	–	2.6	0.2	25.0	75.0
Zinc	–	–	–	–	1.1	1.1		–	5.2	0.2	25.0	25.0
Copper	–	–	–	–	–	2.9	2	–	8.9	0.9	0.0	75.0
Tin	–	–	–	–	–	2.2	2.5	–	6.6	0.5	25.0	75.0
2004												
Gold	–	1.3	–	1.3	–	1.2	–	1.5	–	–	0.0	75.0
Silver@	0.9	0.9	0.9	1.7	1.9	–	–	–	–	–	0.0	40.0
< 0.8 (%)	0.0	0.0	0.0	0.0	0.0	43.0	0.0	0.0	17.0	50.0		
>1.2 (%)	0.0	50.0	0.0	75.0	33.0	0.0	60.0	100.0	57.0	0.0		

* : Traded at NMCEIL, Ahmedabad. @ : Traded at NCDEX Mumbai.

Annex Table II: Ratio of Standard Deviation of Basis to that of Spot Price

II.1: Pepper

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Per cent of Times the Ratio was		
													>1.0	*0.5-1.0*	*< 0.5*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1997	–	0.4	1.1	–	0.5	–	0.3	0.4	–	0.5	–	1.6	29.0	29.0	43.0
1998	0.6	0.2	0.2	0.3	0.3	0.3	1.1	1.8	0.8	2.1	–	1.1	36.0	18.0	45.0
1999	0.5	1.1	1.3	1.5	1.3	1.1	0.3	0.2	0.4	0.3	0.5	0.4	42.0	17.0	42.0
2000	0.3	0.1	0.1	0.2	0.6	0.5	0.6	0.8	0.6	0.5	0.2	0.3	0.0	50.0	50.0
2001	0.3	0.5	0.5	0.7	0.7	0.7	0.7	0.6	1.2	0.4	0.5	0.9	8.0	75.0	17.0
2002	0.9	1.0	1.1	1.1	0.7	0.5	0.2	0.3	0.3	0.3	0.2	0.3	17.0	33.0	50.0
2003	1.0	1.0	0.7	0.7	1.0	1.5	1.3	1.1	1.0	1.1	1.1	1.2	50.0	50.0	0.0
2004	1.0	0.7	0.4	0.2	0.2	0.2	0.4	0.1	–	–	–	–	0.0	25.0	75.0
>1.0	0.0	13.0	38.0	29.0	13.0	29.0	25.0	25.0	17.0	29.0	20.0	43.0			
0.5-1.0	71.0	50.0	25.0	29.0	63.0	43.0	25.0	25.0	50.0	29.0	40.0	14.0			
< 0.5	29.0	38.0	38.0	43.0	25.0	29.0	50.0	50.0	33.0	43.0	40.0	43.0			

II.2: Gur

Year	Mar	May	Jul	Dec	Per cent of Times the Ratio was		
					>1.0	*0.5-1.0*	*< 0.5*
1	2	3	4	5	6	7	8
1997	0.5	0.7	1.7	1.3	50.0	50.0	0.0
1998	–	1.7	1.2	1.0	67.0	33.0	0.0
1999	6.7	0.7	1.5	1.0	50.0	50.0	0.0
2000	–	1.5	1.5	1.1	100.0	0.0	0.0
2001	0.6	0.6	0.8	1.1	25.0	75.0	0.0
2002	1.5	0.7	–	–	33.0	67.0	0.0
2003	–	2.4	0.8	1.0	50.0	50.0	0.0
2004	0.8	1.3	–	–			
>1.0	40.0	50.0	67.0	50.0			
0.5-1.0	60.0	50.0	33.0	50.0			
< 0.5	0.0	0.0	0.0	0.0			

II.3: Castorseed

Year	Mar	Jun	Sept	Dec	Feb	Apr	Per cent of Times the Ratio was		
							>1.0 (%)	*0.5-1.0 (%)*	*< 0.5 (%)*
1	2	3	4	5	6	7	8	9	10
1997	1.1	5.6	0.8	0.6	–	–	50.0	50.0	0.0
1998	1.8	0.3	0.3	0.5	–	–	25.0	25.0	50.0
1999	0.9	0.2	0.4	0.2	–	–	0.0	25.0	75.0
2000	0.3	0.3	0.2	0.7	–	–	0.0	25.0	75.0
2001	–	0.1	0.6	0.4	0.4	0.6	0.0	40.0	60.0
2002	–	0.9	0.4	0.6	1.2	0.4	20.0	40.0	40.0
2003	–	0.4	–	0.4	0.1	1.0	0.0	25.0	75.0
2004	–	1.0	–	–	0.6	–			
>1.0 (%)	50.0	13.0	0.0	0.0	25.0	0.0			
0.5-1.0 (%)	25.0	25.0	33.0	57.0	25.0	33.0			
< 0.5 (%)	25.0	63.0	67.0	43.0	50.0	67.0			

II.4: Potato

Year	Mar	Jul	Oct	Per cent of Times the Ratio was		
				>1.0	*0.5-1.0*	*< 0.5*
1	2	3	4	5	6	7
1997	0.8	0.9	1.3	33.0	67.0	0.0
1998	0.9	0.7	1.1	33.0	67.0	0.0
1999	1.0	2.8	2.1	67.0	33.0	0.0
2000	1.0	1.5	0.3	33.0	33.0	33
2001	0.6	0.7	1.3	33.0	67.0	0.0
2002	1.0	–	–			
2003	–	–	–			
2004	–	–	–			
>1.0	0.0	40.0	80.0			
0.5-1.0	100	60.0	0.0			
< 0.5	0.0	0.0	20.0			

II.5: Sacking

Year	Feb	May	Aug	Nov	Per cent of Times the Ratio was		
					>1.0	***0.5-1.0***	***< 0.5***
1	2	3	4	5	6	7	8
1997	–	–	–	–			
1998	–	0.7	0.4	0.6	0.0	67.0	33.0
1999	0.7	–	–	–			
2000	–	0.4	0.8	0.6	0.0	67.0	33.0
2001	0.5	1.0	1.4	0.5	25.0	75.0	0.0
2002	0.5	0.7	0.8	0.8	0.0	100	0.0
2003	0.7	–	0.1	0.7	0.0	100	0.0
2004	1.1	–	–	–			
>1.0	20.0	0.0	20.0	0.0			
0.5-1.0	80.0	100	40.0	100			
< 0.5	0.0	0.0	40.0	0.0			

II.6: Sugar

Year	Jan	Feb	Mar	Apr	May	Jun	Nov	Dec	Per cent of Times the Ratio was		
									>1.0	***0.5-1.0***	***< 0.5***
1	2	3	4	5	6	7	8	9	10	11	12
2003											
M' grade	–	–	0.2	0.2	0.4	–	2.1	1	20.0	20.0	60
S' grade	–	–	–	–	–	–	0.8	0.7	0.0	100	0.0
2004											
M' grade	0.9	0.7	0.3	0.4	0.5	0.7	–	–	0.0	67.0	33.0
S' grade	0.7	0.7	1	0.7	0.6	0.5	–	–	0.0	100	0.0
>1.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0			
0.5-1.0	100	100	33.0	33.0	67.0	100	50.0	100			
< 0.5	0.0	0.0	67.0	67.0	33.0	0.0	0.0	0.0			

II.7: Rubber

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Per cent of Times the Ratio was		
													>1.0	*0.5-1.0*	*< 0.5*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2003	–	–	–	0.5	14.6	1	0.5	0.4	0.4	0.2	0.5	0.8	22.0	44.0	33.0
2004	1.4	2.2	1.5	1.6	1.1	–	–	–	–	–	–	–	100	0.0	0.0
>1.0	100	100	100	100	100										
0.5-1.0	0.0	0.0	0.0	0.0	0.0										
< 0.5	0.0	0.0	0.0	0.0	0.0										

II.8: Metals

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Nov	Per cent of Times the Ratio was		
											>1.0	*0.5-1.0*	*< 0.5*
1	2	3	4	5	6	7	8	9	10	11	12	13	14
2003													
Aluminium	–	–	0.1	0.2	0.6	1	0.8	–	1.5	1.1	29.0	43.0	29.0
Nickel	–	–	–	–	3.2	0.1	0.7	–	1.3	0.4	4.0	60.0	0.0
Lead	–	–	–	–	–	3.6	2.9	–	3.4	1	75.0	25.0	0.0
Zinc	–	–	–	–	–	0.2	0.8	–	4.7	0.5	25.0	50.0	25.0
Copper	–	–	–	–	–	3.8	2.7	–	8.9	1.1	100	0.0	0.0
Tin	–	–	–	–	–	1.4	1.6	–	5.9	0.6	75.0	25.0	0.0
2004													
Gold	–	0.7	–	0.8	–	1	–	1.2	–	–	25.0	75.0	0.0
Silver	0.1	0.1	0.6	0.8	0.9	–	–	–	–	–	0.0	60.0	40
>1.0	0.0	0.0	0.0	0.0	33.0	43.0	50.0	100	100	33.0			
0.5-1.0	0.0	50.0	50.0	67.0	67.0	29.0	50.0	0.0	0.0	50.0			
< 0.5	100	50.0	50.0	33.0	0.0	29.0	0.0	0.0	0.0	17.0			

II.9: Sesame

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Per cent of Times the Ratio was		
													>1.0	*0.5-1.0*	*< 0.5*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2003															
Sesame Oil	–	–	1	–	2	0.9	–	0.9	–	1	–	0.5	17.0	83.0	0.0
Sesame Seed	–	0.2	1.8	0.2	0.7	0.4	0.5	–	0.5	0.8	0.9	4.1	20.0	50.0	30.0
Safflower Oil	–	–	8.3	–	–	0.2	–	2.4	–	2	–	0.4	60.0	40.0	0.0
>1.0			67.0		50.0	0.0		50.0		67.0		33.0			
0.5-1.0			33.0		50.0	33.0		50.0		33.0		33.0			
< 0.5			0.0		0.0	67.0		0.0		0.0		33.0			

II.10: Cotton

Year	Jan	Feb	Mar	Apr	May	Per cent of Times the Ratio was		
						>1.0	*0.5-1.0*	*< 0.5*
1	2	3	4	5	6	7	8	9
2004								
Grade: J-34	0.8	1.0	0.3	1.0	2.2	20.0	60.0	20.0
Grade: S-06	0.6	2.0	1.4	1.0	2.2	60.0	40.0	0.0
>1.0	0.0	50.0	50.0	0.0	100			
0.5-1.0	100	50.0	0.0	100	0.0			
< 0.5	0.0	0.0	50.0	0.0	0.0			

II.11: Mustard

Year	May	Aug	Nov	Per cent of Times the Ratio was		
				>1.0	*0.5-1.0*	*< 0.5*
1	2	3	4	5	6	7
2003	0.3	1.2	1.1	67.0	0.0	33
2004	1.3	1.2	0.7	67.0	33.0	0
>1.0	50.0	100	50.0			
0.5-1.0	0.0	0.0	50.0			
< 0.5	50.0	0.0	0.0			

II.12: Rice and Wheat

Year	Mar	Apr	May	Jun	Per cent of Times the Ratio was		
					>1.0	***0.5-1.0***	***< 0.5***
1	2	3	4	5	6	7	8
2004							
Rice	0.6	0.9	0.9	0.8	0.0	100	0
Wheat	2.1	0.7	1.1	0.9	50.0	50.0	0
>1.0	50.0	0.0	50.0	0.0			
0.5-1.0	50.0	100	50.0	100			
< 0.5	0.0	0.0	0.0	0.0			