Price instability in black pepper: A comparative analysis of pre-liberalisation and post-liberalisation periods

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Abstract

Black pepper as an internationally traded commodity has always been associated with price fluctuations which are influenced by numerous factors including production and consumption in India and the world, international prices, export-import policies, exchange rates and trade agreements. The present study is focused on price instability of black pepper in Indian and international markets in the pre-liberalisation and post-liberalisation periods. Annual instability indices of nominal and real prices of black pepper in the domestic and international markets were computed and used to compare price instability before and after agricultural trade liberalisation in India. The study revealed that the magnitude of price instability of black pepper has increased significantly in Indian markets during the post-liberalisation period, whereas it has declined in the international markets. The destabilising effect of trade liberalisation on prices of black pepper was comparatively more in Indian markets as compared to the international markets. This could be attributed to the transmission of volatility from international markets to domestic markets after liberalisation, resulting in reduction in instability of international prices and a concomitant increase in instability in the domestic markets. Hence, suitable price stabilisation policies need to be implemented to safeguard the producers of black pepper in India from price fluctuations resulting from liberalisation of international trade in agricultural commodities.

Keywords: Domestic price, Instability, International price, Nominal price, Post-liberalisation, Pre-liberalisation, Real price.

Introduction

Price instability refers to the tendency of the price of a commodity to fluctuate sharply and unpredictably. Historically, commodity prices in the international as well as domestic markets have been susceptible to instability. The agricultural trade liberalisation policies have been operating mainly through prices and it has been argued that free trade creates high volatility in the world prices of agricultural commodities (Sekhar, 2004). This volatility would be directly transmitted to Indian prices due to the increased integration with the world markets, eventually leading to rise in volatility of the domestic prices (Srinivasan and Jha, 2001). The surges in agricultural commodity prices in recent years has raised the question of whether or not volatility is increasing and leading to frequent as well as extreme price swings. The vulnerability of the developing countries to volatility in international prices has increased as liberalisation of markets has shifted price risk from governments to households (Hallam and Sarris, 2006). Various factors like variability in demand and supply, arbitraging and speculation and government or third party interventions have been listed by theoretical literature as the major determinants of agricultural commodity price instability (Anoopkumar, 2012; Newberry and Joseph, 1981). Thus, price instability is often a major source of risk to farmers, especially

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for those who are dependent upon a specific crop as the major source of their income and livelihood. Black pepper as an internationally traded commodity is always associated with price fluctuations, which are influenced by several factors like domestic and international production as well as consumption, international prices, exchange rates, trade agreements and export-import policies. The prices of black pepper move cyclically through time and internationally traded pepper shows price changes of more than five per cent from one month to another (Chopra and Bessler, 2005). Hence, the study was aimed to understand the dynamics of instability in annual prices of black pepper in domestic and international markets during the pre-liberalisation and post-liberalisation periods.

Materials and Methods

The present study is based on time series data on annual prices of black pepper in Indian and international markets for the period from 1980 to 2014. The Indian prices of black pepper considered for the study were Cochin Malabar garbled, Cochin Malabar ungarbled and Calicut Nadan whereas the international price was that of Malabar Garbled 1 (MG1) in New York. Nominal prices were adjusted to remove the effects of changes in general price level over time using the respective wholesale price indices and analyses were carried out for both nominal and real prices. In the case of domestic prices, annual Wholesale Price Index (WPI) for black pepper published by the Department of Industrial Policy and Promotion, Government of India, with 2004-2005 as 100 was used for converting the nominal prices to real prices. The international prices were deflated using the WPI for food (with 2005 as 100) published by the World Bank.

To study the influence of trade liberalization on price instability, the data was divided into two sub-periods *viz.,* pre-liberalisation (1980 to 1994) and post-liberalisation (1995 to 2014) periods. Three different measures of instability *viz.,* Cuddy Della Vale

Instability Index, Instability index using exponential trend and Coppock's Instability Index were computed so as to confirm the dynamics of price instability and establish the robustness of the results obtained from the analyses.

Even though Coefficient of Variation (CV) is the simplest measure of instability, it over-estimates the level of instability in time-series data which are characterised by long-term trends. The Cuddy Della Valle Index de-trends the annual price and shows the exact direction of the instability (Cuddy and Della Valle, 1978). Hence, it is a better measure to capture instability in agricultural production and prices. A low value of this index indicates low instability in prices and vice-versa. The Cuddy-Della Valle index corrects the CV as:

Cuddy-Della Valle Instability Index (%)
$$= \text{CV} \times \sqrt{(1-\bar{R}^2)}$$

Where, *CV is* the Coefficient of Variation in per cent, and $\bar{R}^2$ is the coefficient of determination from a time trend regression adjusted for its degrees of freedom.

Another measure of instability in annual prices is measured as the absolute percentage deviation of prices from their long-run exponential trend levels for the period (UNDP, 2011). The uniqueness of this method is that it assumes an exponential trend for the data and ignores the sign of the deviation of prices from the exponential trend.
The instability index is estimated as:

$$\text{Instability Index} = \frac{1}{n}\sum_{t=1}^{n}[(|P_t - p_t|)/p_t] \times 100$$

Where, $P_{(t)}$ is the observed magnitude of the price variable
$p_{(t)}$ is the magnitude of the estimate obtained by fitting an exponential trend to the observed price variable
n is the number of observations
The vertical bar indicates the absolute value (i.e., disregarding signs).
The extent of annual instability in prices of black pepper was also measured using Coppock's

Instability Index (CII), which is calculated as the antilog of the square root of the logarithmic variance using the following formula (Coppock, 1962):

$$CII = (Antilog)\sqrt{[V \log - 1]} \times 100$$

where, $V \log = \frac{1}{(N-1)} \Sigma (\log P_{t+1} - \log P_t - M)^2$

$M = \frac{1}{(N-1)} \Sigma (\log P_{t+1} - \log P_t)$

N = Number of years
P= Price of black pepper
M = Arithmetic mean of the differences between logs P_t and P_{t+1}, P_{t+2} etc.
V log = Logarithmic variance of the price series
CII is a close approximation of the average year-to-year percentage variation adjusted for trend and the advantage of CII is that it measures the instability in relation to the trend in prices. A higher numerical value for the index represents greater instability.

Results and Discussion

Behaviour of Black Pepper Prices
Black pepper is a premium commodity which is high in demand in the overseas markets and the prices are also found to vary considerably from year to year. The nominal prices of black pepper in Indian rupee in the Indian and international markets (Fig. 1) moved closely especially in the pre-liberalisation period. After 1995, there was a slight divergence between the Indian and world prices and the

international price was always higher than the domestic prices. The prices of black pepper in nominal US dollar in the domestic and international markets (Fig. 2) showed fluctuations as well as increased divergence even before liberalization and the international price was always higher than the domestic prices in both the pre-liberalisation and post-liberalisation periods. When the real prices in Indian rupee were plotted (Fig. 3), a greater divergence than that of nominal prices were found between the Indian and international prices. In the case of prices in real US dollars (Fig. 4), the plots exhibited a similar pattern as that of the nominal dollar prices.

Price cycles represent deviations in price levels from the average trend due to business sequences of booms and recession in an economy. Black pepper price tends to move in a cyclical way and the prices were found to fluctuate with varying magnitudes in different years. The cyclical pattern of pepper prices could be observed in Figure 1 and Figure 2 and was clearly demonstrated when the prices were plotted in US dollar per kilogram. The first 11 year cycle was from 1983 to 1993 and the second cycle from 1993, showed some fluctuation near the peak values and reached the lowest value in 2004. The third cycle started from 2005 when the prices started increasing, crossed the eight dollar mark in 2013 and reached the peak value in 2014. The third cycle has shown an expansion in duration in the boom
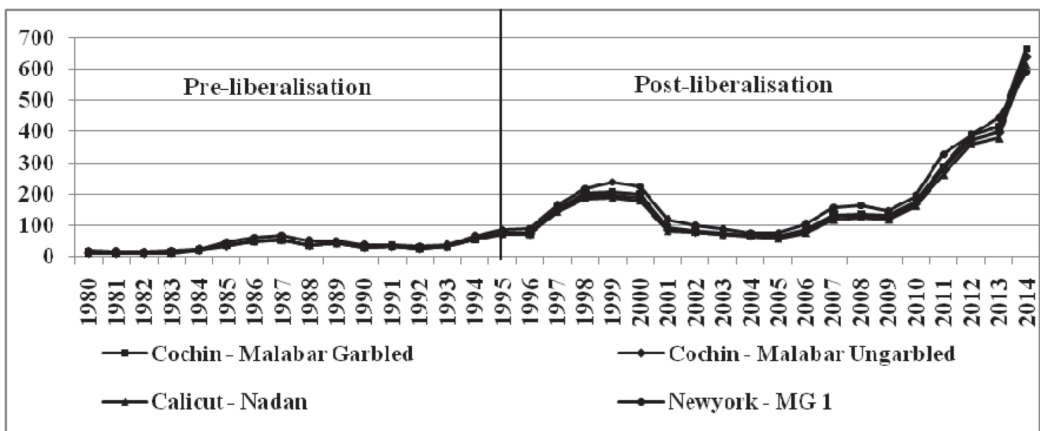

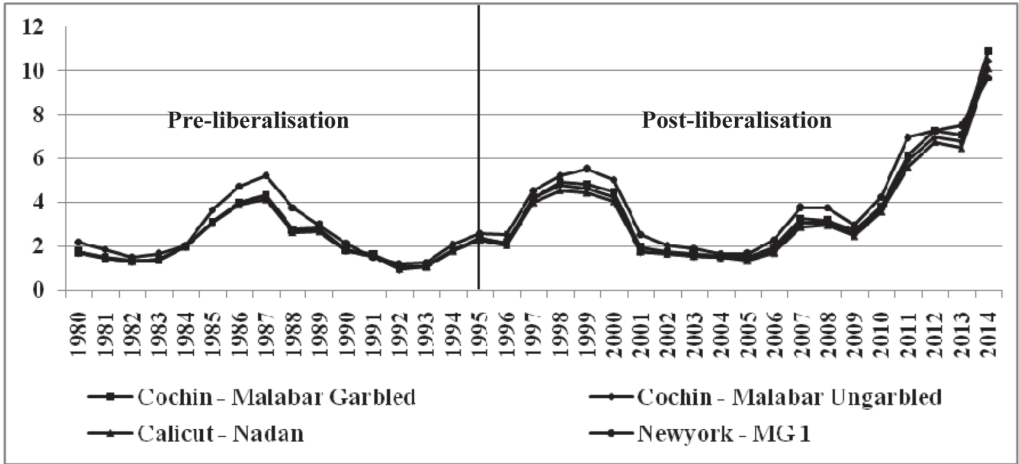*Figure 1.* Behaviour of annual nominal prices of black pepper (in rupee per kilogram)

Figure 2. Behaviour of annual nominal prices of black pepper (in dollar per kilogram)
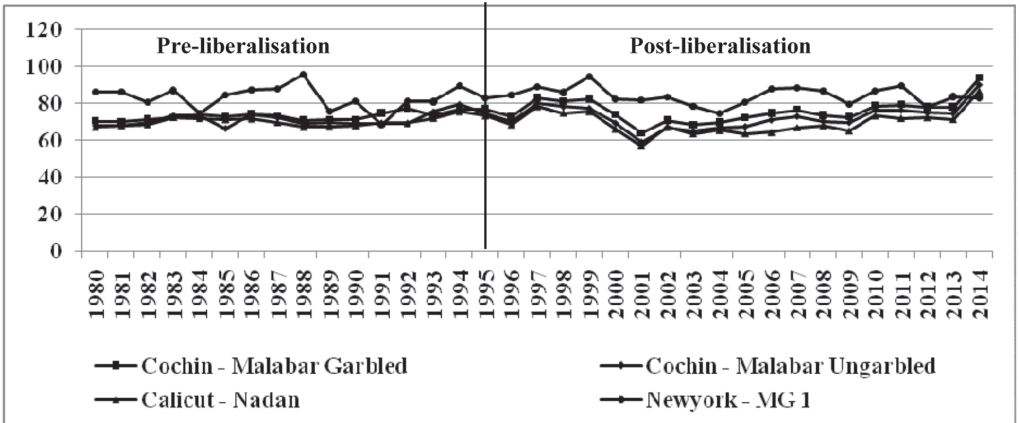

Figure 3. Behaviour of annual real prices of black pepper (in rupee per kilogram)
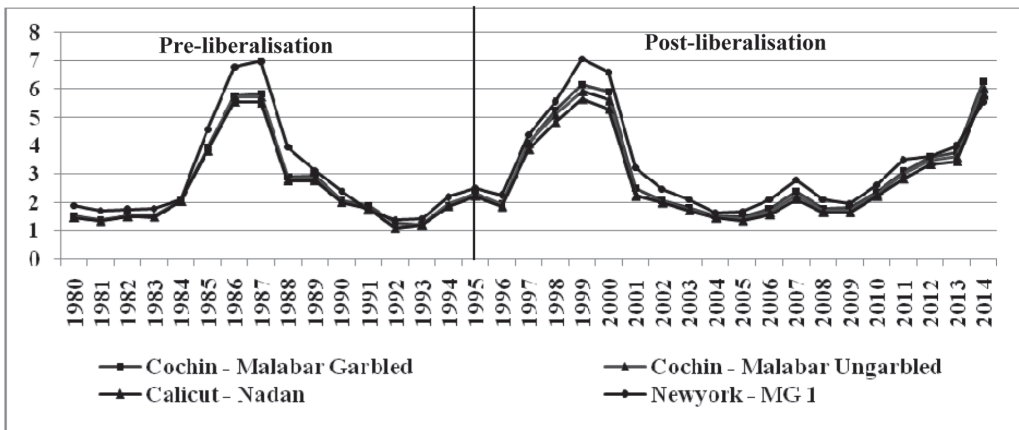

Figure 4. Behaviour of annual real prices of black pepper (in dollar per kilogram)

Table 1. Instability Indices for Nominal and Real Prices of Black Pepper in Indian and International markets (in per cent)

Market/Price	Cuddy-Della Valle Instability Index				Index as deviation from exponential trend				Coppock's Instability Index			
	Nominal price		Real price		Nominal price		Real price		Nominal price		Real price	
	Pre-libera-lisation	Post-libera-lisation	Pre-libera-lisation	Post-libera lisation	Pre-libera-lisation	Post-libera lisation	Pre-libera-lisation	Post-libera-lisation	Pre-libera-lisation	Post-libera lisation	Pre-libera-lisation	Post-libera-lisation
Prices in Indian Rupee												
Cochin - Malabar Garbled	35.8	65.3	2.4	8.4	32.2	50.9	1.9	5.9	31.8	36.2	2.8	7.7
Cochin – UnGarbled	37.1	65.5	4.6	9.0	32.9	50.9	3.7	6.6	32.1	36.3	5.2	8.4
Calicut – Nadan	36.4	66.2	3.4	9.5	32.6	51.3	2.8	7.2	31.8	36.5	2.5	9.2
Newyork - Malabar Garbled1	40.5	55.6	8.3	5.7	36.3	46.0	5.8	4.4	31.3	31.9	12.4	7.3
Prices in US Dollar												
Cochin - Malabar Garbled	48.7	54.6	63.0	53.6	38.6	47.5	48.6	46.0	34.9	37.6	41.1	38.4
Cochin –UnGarbled	49.6	55.4	64.1	54.3	39.6	48.8	49.3	47.1	36.9	39.1	42.8	39.6
Calicut –Nadan	48.7	55.3	63.2	53.7	38.7	48.2	48.5	46.3	36.0	38.0	41.9	38.3
Newyork - Malabar Garbled1	51.7	47.4	65.9	49.6	42.3	42.2	52.1	41.6	34.6	33.7	40.3	34.1
Exchange rate (^{1}/US$)	17.4	19.1	-	-	7.46	7.51	-	-	6.19	6.33	-	-

phase to almost nine years.

Instability Indices for black pepper prices
The results of the instability analyses in which three instability indices were estimated for nominal and real Indian and international prices of black pepper are presented in Table 1.

(i) Cuddy-Della Valle Instability Index
With the exception of real prices in US dollar, the estimated Cuddy-Della Valle instability indices for nominal as well as real domestic prices were found to be higher in the post-liberalisation period. For nominal and real domestic prices in rupee, the instability in the post-liberalisation period was almost two times or more than the instability during the pre-liberalisation period. The international prices exhibited a fall in instability with liberalisation and the only exception to this pattern was the instability for the nominal prices in rupee.

(ii) Instability Index as percentage deviation from exponential trend
The volatility indices for nominal as well as real rupee prices of black pepper in domestic market estimated as the percentage deviation of the price from its exponential trend levels were found to be higher in the post-liberalisation period. For nominal domestic prices in US dollars, the instability in the

pre-liberalisation period itself was higher than that for the prices in rupee and hence the rise in instability in the post-liberalisation period was not as high as for prices in rupee. For the real US dollar prices in the domestic market, the indices showed slight decline in instability in the post-liberalisation period. The annual price instabilities of the international prices in nominal as well as real terms were higher than domestic price instabilities in the pre-liberalisation period while the pattern reversed in the post-liberalisation period, with a higher instability in domestic prices. For the international real prices of black pepper in both rupee and dollar, the instability was comparatively higher in pre-liberalisation period and it decreased slightly in the post-liberalisation period. In the case of international nominal prices, the instability indices showed higher values in the post-liberalisation period.

(iii) Coppock's Instability Index
The instability of both domestic prices in real and nominal terms as estimated by the Coppock's Instability Index increased in the post-liberalisation period except for real prices in dollars. The instability in domestic prices was higher than that for the international prices in pre-liberalisation and post-liberalisation periods with the exception of real prices in rupee, for which the instability in
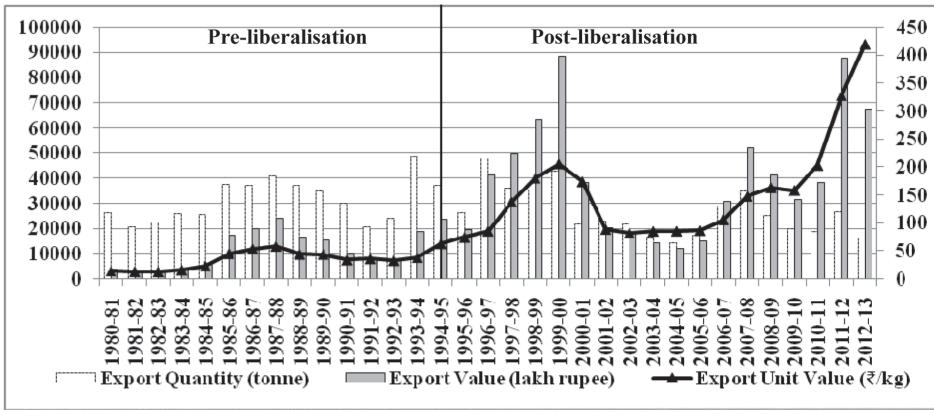
Figure 5. Export of black pepper from India.
Source: Spice Statistics 1991, 1998, 2004 and www.indianspices.com
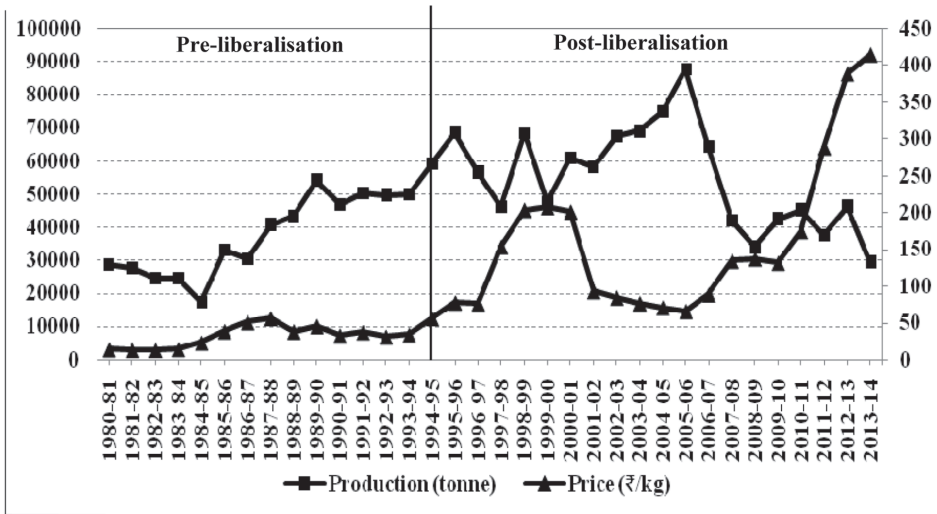

Figure 6. Production and price of black pepper in India
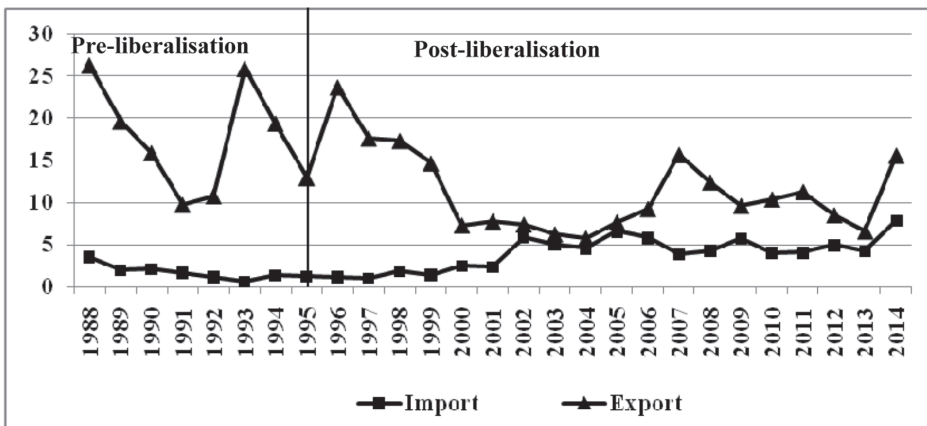Note: Price of Malabar garbled black pepper in Kochi

Figure 7. India's share in world exports and imports of black pepper

international market was higher in the pre-liberalisation era. The instability in the international market prices decreased in the post-liberalisation period and it was only for the international price in nominal rupee that there was negligible increase in the value of the index.

It could be observed from the results in Table 1 that the instability in nominal rupee prices were higher than the instability in real rupee prices while in the case of dollar prices, the real prices turned out to be more unstable than the nominal prices. The general pattern in instability that was found from all the indices was that the nominal prices have become more unstable in the domestic markets in rupee as well as dollar terms in the post-liberalisation period, whereas the international price instability has declined in the post-liberalisation era. For real prices, the instability was found to increase in the domestic market for prices in rupee while it decreased in dollar terms. In the case of real international prices, instability was always found to decrease.

Factors affecting price instability
The extent of price instability for black pepper depends on many factors including changes in international trade (export and import); variations in production and consumption in India and other countries; behaviour of the prices; rupee-dollar exchange rate etc.

(i) Changes in international trade in black pepper
It could be observed from Table 2 and Fig.5 that the share of export of black pepper in production has declined in India. The country exported more than 80 per cent of the production in TE 1982-83 while it declined to one-third of the production in TE 2002-03, which further increased to 42 per cent in TE 2012-13. This could be attributed to the increasing domestic consumption of black pepper in India and increasing competition from other producers, especially, Vietnam. As per IPC estimates, about 50 to 60 per cent of Indian production is consumed in the country itself and the Indian consumption is growing at the rate of four to five per cent per year.

The share of India in world exports declined from more than 20 per cent in 1989 to about 10 per cent in 1991 which further increased to about 25 per cent in 1993 (Fig.7). From 1996 onwards the share has shown a continuously declining trend from about 24 per cent to as low as six per cent in 2004. It again increased to 15.8 per cent in quantity terms in 2007 and again declined and started increasing from 2010 and in 2011 India accounted for about 19 per cent of world exports in quantity terms and the value of exports was 15 per cent of the world export value. The unit value of black pepper exports were very low in the 1970s and it remained low upto mid 1980s and because of that the value of exports were very low when compared to the quantity of exports from India. After 1985, the unit value of pepper exports strated increasing and because of that the value of exports also increased and this trend continued upto 1998-99. This increase could be atrributed to the devaluation of rupee and liberalisation policies implemented in India. From 2000 onwards the exports declined in

Table 2. Dynamics in production and export of black pepper from India

Trienniums	Production (tonne)	Export quantity (tonne)	Export Value (lakh rupee)	ExportUnit Value(Rs. /kg)	Percentage share of export in production
TE 1982-83	28443	23188	3211	14	82
TE 1992-93	50240	24780	8522	34	49
TE 2002-03	65043	22105	25446	115	34
TE 2012-13	48667	20517	64463	318	42

Source: Estimation based on data from Spice Statistics 1991, 1998, 2004 and www.indianspices.com
Note: TE denotes Triennium Ending

both value and quantity terms upto 2005 and the export unit value was less than Rs. 100/kg in some of the years. From 2006-07, the unit value started increasing whereas the quantity of exports exhibited a declining pattern and consequntly the value of exports increased. The export unit value of black pepper crossed the Rs. 700/kg mark in 2014-15.

With the increase in consumption and decrease in production of black pepper in India, the country has become an importer of black pepper especially to meet the demand for value addition and processing industry. India happened to import less than 2 per cent of the world imports till 1997 and then it increased to more than 5 per cent in 2002. The share of the country in world imports has always remained above or close to 5 per cent in the subsequent years and it increased to about 8 per cent in 2014. The country imported about 20,000 tonnes of black pepper in TE 2014-15.

It could be inferred from the above discussion that with the increased openness to international trade in India as a result of tariff reduction and removal of non-tariff barriers emanating from liberalisation policies including the economic reforms of 1991, the subsequent WTO agreement and the proliferating Regional Trading Agreements, the high volatility in international markets were getting transmitted to domestic markets resulting in reduction in instability in international prices and a consequent increase in instability in the Indian markets.

(ii) Variation in production
Pepper production is influenced by price movements and the pattern of the relationship between the prices and production is complicated by the fact that black pepper is a perennial crop. The movement of production and price of black pepper in India is depicted in Figure 6. An inverse relationship between production and price could clearly be detected from the figure. Since pepper is a perennial crop the production response by increase in area to rise or fall in price in a particular year

will be at a lag of three to four years. When world pepper prices are high, new vines are planted and fertilizer usage goes up. The pepper exporters also try to reduce their stocks during the periods of high price. Then, as the newly planted vines start to yield, production increases and the prices fall. When world pepper prices are low, pepper vines are neglected and replanting will not be carried out on the required scale. Because producers neglect management, pepper production stagnates or even declines, tightening the supply situation until pepper prices increase again. This cycle of pepper production and prices continues.

(iii) Rupee - US dollar exchange rate
The instability in black pepper prices is also influenced by the rupee-US dollar exchange rate as it is an internationally traded commodity. The instability in export unit value gets transmitted to the domestic prices through the exchange rates. It could be observed from Table 1 that all the instability indices for rupee - US dollar exchange rates have exhibited a slightly increased value in the post-liberalisation period and hence it could be concluded that the exchange rate instability has increased in the post-liberalisation period, which has led to increased instability in domestic prices. The study revealed that the price instability of black pepper in domestic and international markets was quite high and the instability in prices has generally increased in the open trade regime. Even though prices of black pepper were unstable in both domestic and international markets even before liberalisation, the magnitude of price instability has increased significantly in the post-liberalisation period in domestic markets, whereas it declined in the international markets. The main factors responsible for increase in instability in prices of black pepper in the Indian market were increasing domestic demand, fluctuating share in world exports, rising share in world imports, the lagged response of production to prices and the instability in rupee-US dollar exchange rates. The study has shown that the destabilising effect of liberalisation on prices of black pepper was comparatively more

in domestic markets. This could be attributed to the fact that with increased openness of India to international trade as a result of tariff reduction and removal of non-tariff barriers emanating from liberalisation policies, the high volatility in international markets were getting transmitted to domestic markets resulting in reduction in instability in international prices and a consequent increase in instability in the domestic markets. Hence, suitable price stabilisation policies need to be implemented to safeguard the black pepper producers in the country from price instability.

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