



International Coffee Organization  
Organización Internacional del Café  
Organização Internacional do Café  
Organisation Internationale du Café

ICC 94-5

13 September 2005  
Original: French

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Study

International Coffee Council  
Ninety-fourth Session  
27 – 29 September 2005  
Salvador, Brazil

**Coffee price volatility**

## **Introduction**

1. Market prices are determined by a number of factors which can be placed in hierarchical order of importance. Basically, they are merely a reflection of the equilibrium of physical transactions. The fundamental factors determining coffee prices are production, consumption and stocks. At the same time, however, less fundamental factors come into play in trading activities and these superimpose themselves on the underlying fundamentals to influence coffee price behaviour and volatility. Price volatility is one of the major concerns of players in the world commodity market, particularly in the case of coffee. For exporters it is a source of uncertainty in regard to export earnings and creates difficulties in carrying out effective sales policies. For importers, particularly roasters, price volatility sometimes makes it difficult to control production costs. For traders and stock holders volatility may affect profit margins, making their activities more speculative and often less attractive.

2. This document provides an update of previous studies and reviews the dynamics of coffee prices, particularly in relation to their volatility. In other words, it provides a comparative study that makes it possible to determine whether coffee prices have been more volatile in recent years. The following points will be covered:

- I. Historical and recent behaviour of coffee prices
- II. Definitions and measurements of price volatility
- III. Analysis of coffee price volatility test results

## **I. Historical and recent behaviour of coffee prices**

3. Graph 1 in Annex 1 shows changes in the ICO composite indicator price between 1965 and 2005. Graphs 2 to 7 in Annex 1 show indicator prices for the four groups of coffee and average prices on the New York and London futures markets. These graphs indicate a cyclical pattern in the behaviour of coffee prices. Four main periods can be distinguished. From 1965 to 1974 prices were relatively weak. From 1975 to 1987 prices were high before falling steadily until 1992. From 1993 to 1997 price levels were again high but the period from 1998 to 2005 was characterized by the most serious low coffee price crisis on record.

## **II. Definitions and measurements of price volatility**

4. Volatility is a statistical measure of price fluctuations over a given period. It measures the size of the increase or decrease in prices in a short period. It does not measure price levels but their degree of variation from one period to the next. Marked volatility indicates a rapid swing from low to high or high to low prices. In the case of coffee prices, volatility is strongly influenced by supply and demand conditions. For coffee producers, volatility becomes a matter of concern when there is a fall in prices or a price correction. When there is a significant upturn in prices it merits little attention. A highly volatile market has a higher standard deviation, i.e. a high historical volatility. A market without pronounced price fluctuations would be characterized by a low standard deviation and low historical volatility.

5. The causes of volatility vary according to the commodity concerned. For agricultural commodities, the main cause can be found in supply variations whereas in case of industrial commodities volatility is more dependent on demand. There are three types of volatility. So-called non-conditional volatility or historical volatility provides an ex-post determination of past price fluctuations. Conditional volatility of the GARCH type<sup>1</sup> makes it possible to derive the anticipated ex-ante share of the historical volatility on the basis of different possible specifications postulated from the behaviour of the conditional variance. Implied volatility, which relates mainly to options, is an estimate of anticipated volatility and is by nature oriented to the future. There have been numerous studies analysing price determination and volatility but the most important relating to commodities is the study by Christopher Gilbert and Celso Brunetti<sup>2</sup> which defines volatility as the daily, weekly or monthly variation in price determined by deriving the long-term trend. These authors establish two different ways of measuring volatility. Historical volatility, which is the most commonly used measure, is the sample standard deviation of previous daily, weekly or monthly percentage changes in price and implied volatility, which is derived from options, and aims to predict actual volatility.

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<sup>1</sup> *GARCH Model: Generalized Autoregressive Conditional Heteroscedasticity.*

<sup>2</sup> *Christopher Gilbert and Celso Brunetti, "Commodity price volatility in the nineties", Occasional Paper, Queen Mary and Westfield College, London, 1995.*

6. On the basis of an analysis of price data since 1970, Akifumi Kuchiki<sup>3</sup> established causal links between price volatility for a number of primary commodities, including coffee, and financial instruments, particularly stock-exchange securities, Treasury bonds and certain currencies. He concluded that fluctuations had become more pronounced since the 1970s in comparison with the 1950s and 1960s. Futures contracts had played a more important role in investment portfolios and prices had become far more unstable during the period from 1970 to 1986. The main determining factors for this volatility were changes in interest rates, prices of petroleum products, stock-exchange securities and portfolio investments in primary commodities in the form of paper contracts in commodity exchange markets. Investment funds seeking to increase their profit margins invested in short-term paper contracts in commodity markets. In other words, investment funds carry out arbitrage operations, making simultaneous purchases and sales in order to profit from price variations and price differences. Arbitrage leads to very rapid market adjustment since the relevant information is very rapidly assimilated in market prices. Investment fund activities play a significant role in short-term price volatility.

### III. Analysis of coffee price volatility test results

7. We have used standard deviation to measure coffee price volatility. Daily price variations were recorded on a monthly basis from January 1980 to August 2005. These daily variations are represented by the Napierian logarithm (ln) in which the variation in price from one day to the next is defined as:

$$\text{Var} (P_d, P_{d-1}) = \ln (P_d/P_{d-1})$$

$P_d$  is the price of coffee on day  $d$ ;  $P_{d-1}$  is the price of coffee on the previous day.

8. The standard deviation of the monthly variations has been calculated in order to isolate high-volatility months and analyse explanatory factors. The annual standard deviation is the average of the standard deviation for the 12 months concerned. The period from January 1980 to August 2005 covers both the situation during the existence of the economic clauses of the International Coffee Agreement and the free market situation after the elimination of direct market intervention through the export quota system. A separate analysis is made of ICO indicator prices for each of the four groups of coffee as well as of the average of the 2<sup>nd</sup> and 3<sup>rd</sup> position prices on the London and New York futures markets.

9. The results obtained give standard deviations for daily variations in ICO monthly indicator prices from January 1980 to August 2005. In the case of the ICO composite indicator price, the strongest standard deviation for daily variations in price since 1980 was 9.21% recorded in May 1997. On average, for the period as a whole, standard deviations have been significant since 1992. Coefficients have been equally high in recent years.

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<sup>3</sup> Akifumi Kuchiki, "The pricing mechanism of primary commodities since the 1970s", in *The Developing Economies*, vol. XXVIII-1, March 1990.

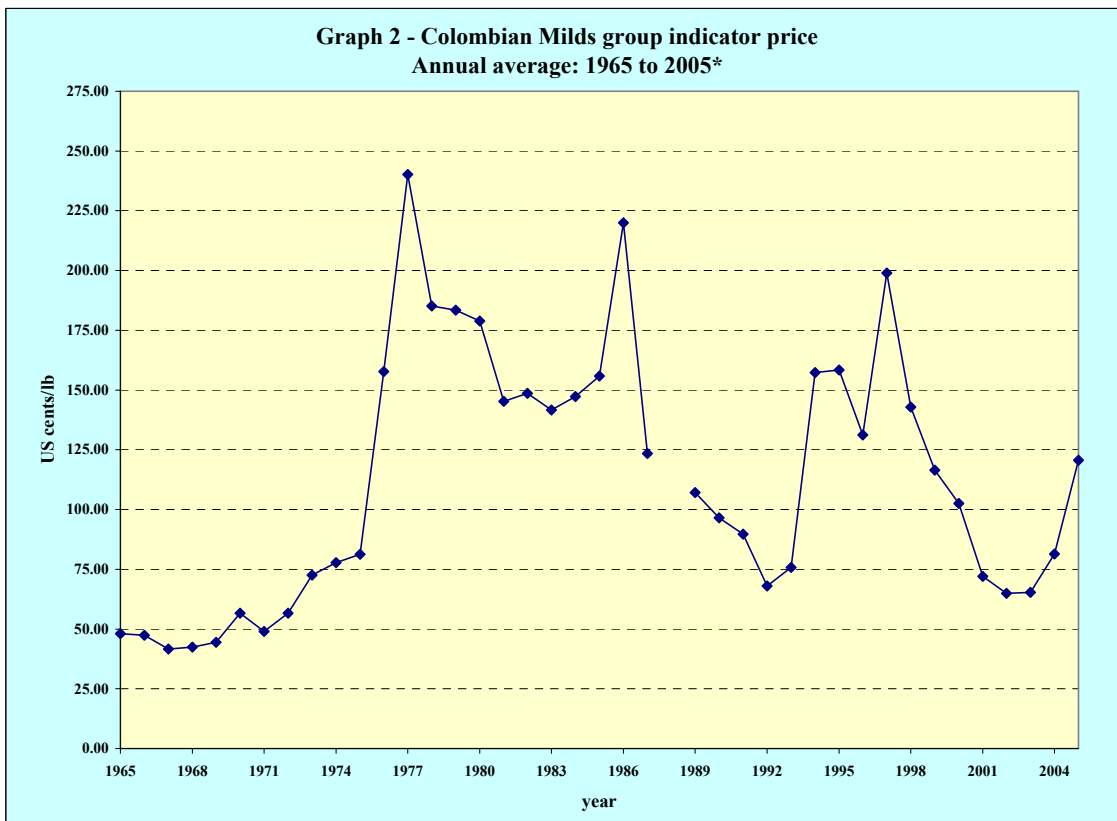
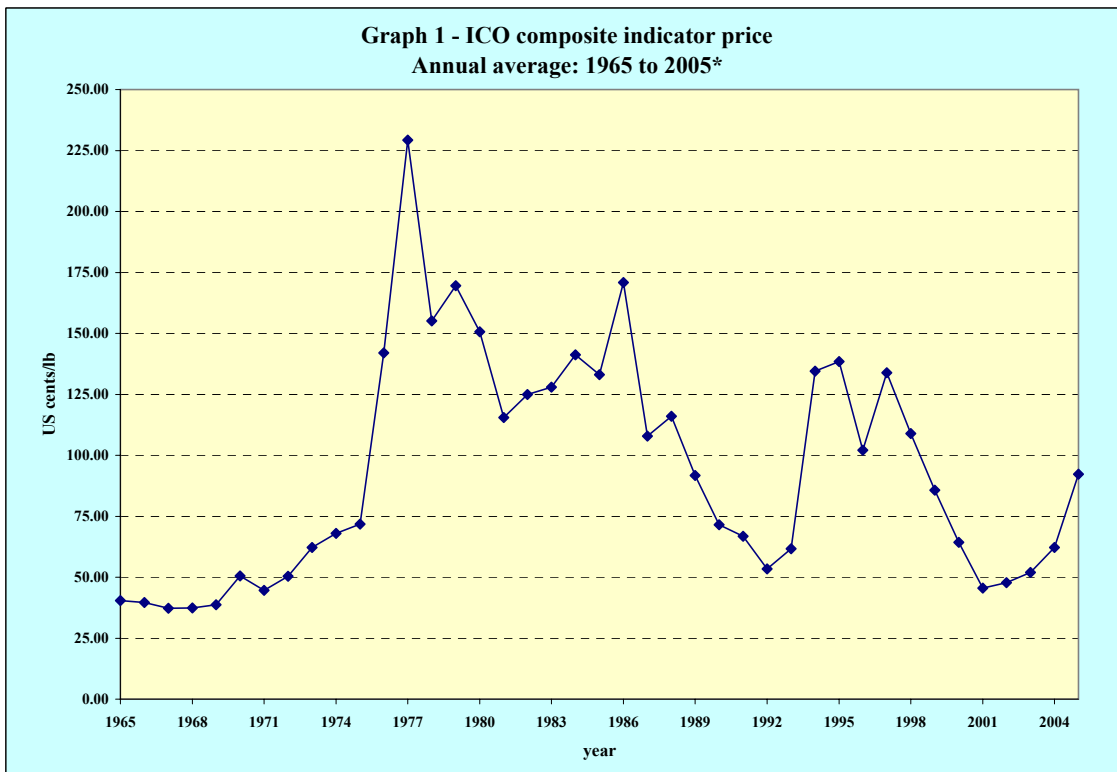
The highest volatility was recorded in 1997. If we take 2% as the threshold for indicating high volatility in the course of the same month, it can be said that coffee prices have become more volatile since 1989. Graphs 1 to 7 in Annex 2 show price volatility during the period under consideration. These graphs indicate that there is an upward trend reflecting the increased volatility of coffee prices.

10. During the period from 1980 to 1989 volatility was weak except in 1986 when the volatility coefficient was above the 2% threshold, particularly in the case of indicator prices for Other Mild Arabicas and Robustas as well as on the London futures market. There were three adverse climatic events in Brazil during this period: in July 1981 (frost), August 1984 (frost) and August-November 1985 (drought). The quotas introduced in October 1980 were suspended in February 1986 following a sharp rise in prices as a consequence of the drought, which lasted from August to November 1985. Coffee prices remained relatively stable in the immediate aftermath of the suspension of export quotas but marked volatility has reappeared since 1993. Apart from 1996, the coffee market has become very volatile. During the more recent period, particularly since 2000, volatility has somewhat lessened, although there continues to be a basic upward trend.

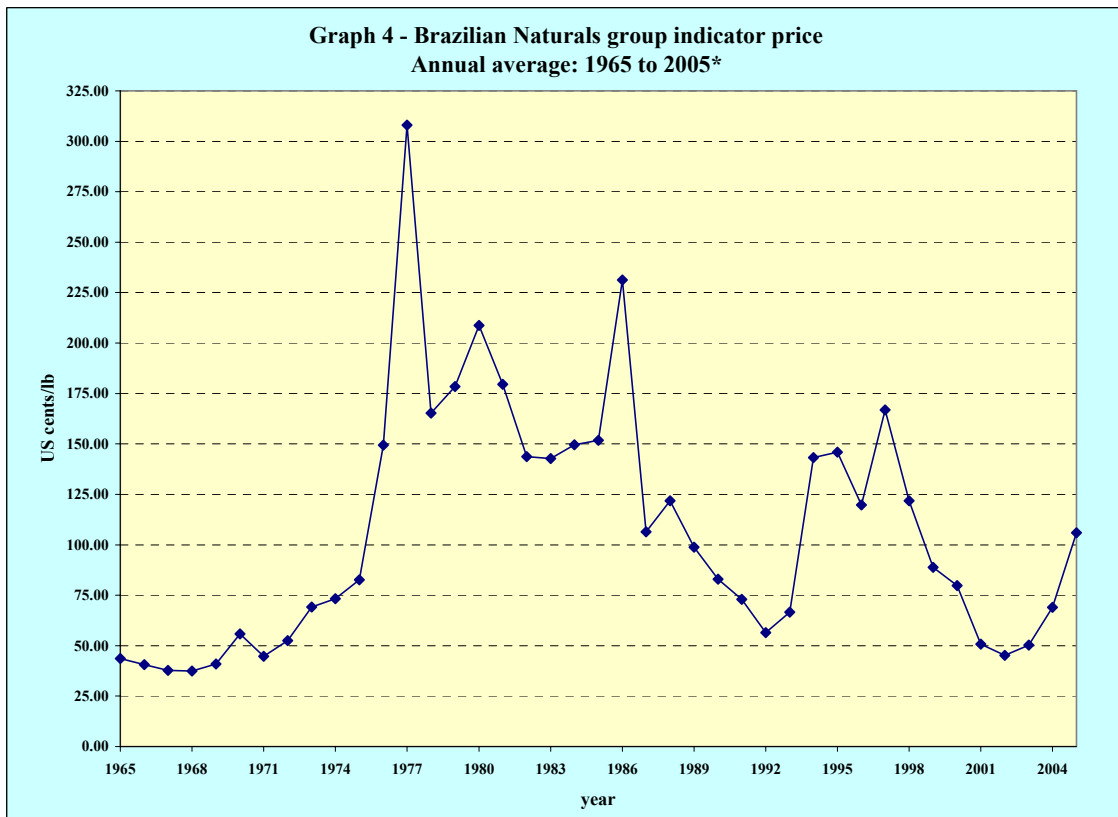
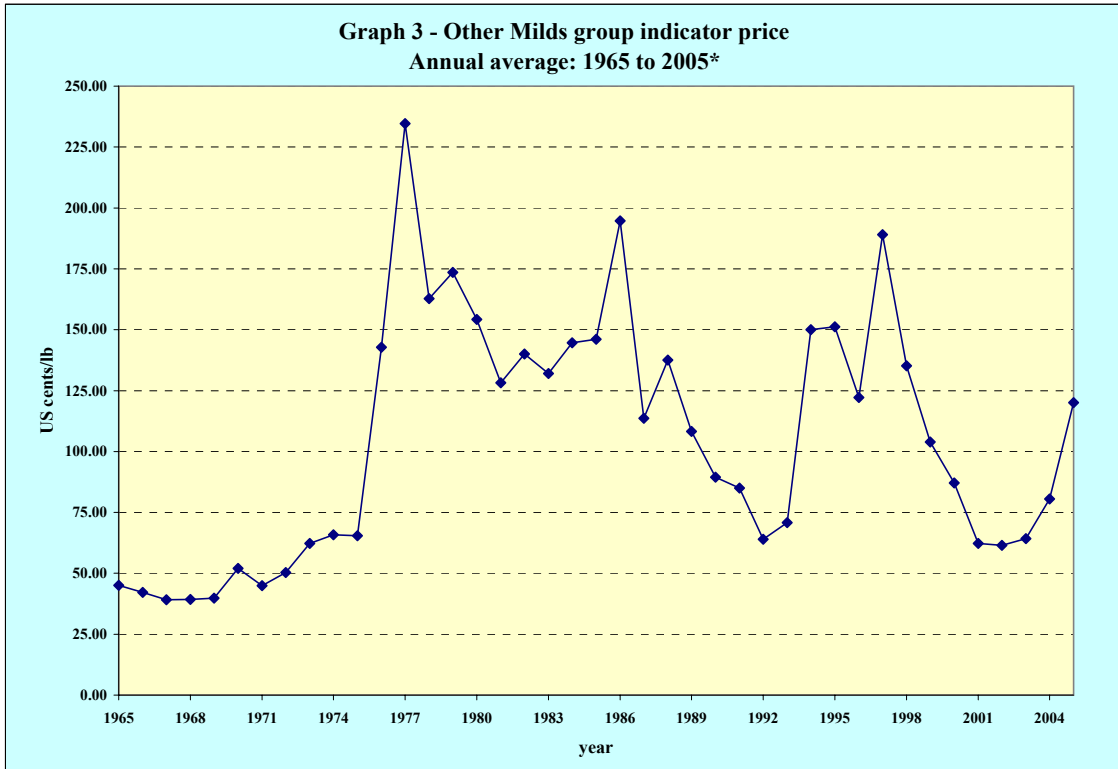
11. Finally, test results indicate that volatility, measured on the basis of daily price variations, is relatively weak (below 2%) over the period studied. However, there are periods of high volatility but of a sporadic nature. It should be noted that high volatility coefficients were found throughout the period studied (1980 to 2005).

## **Conclusion**

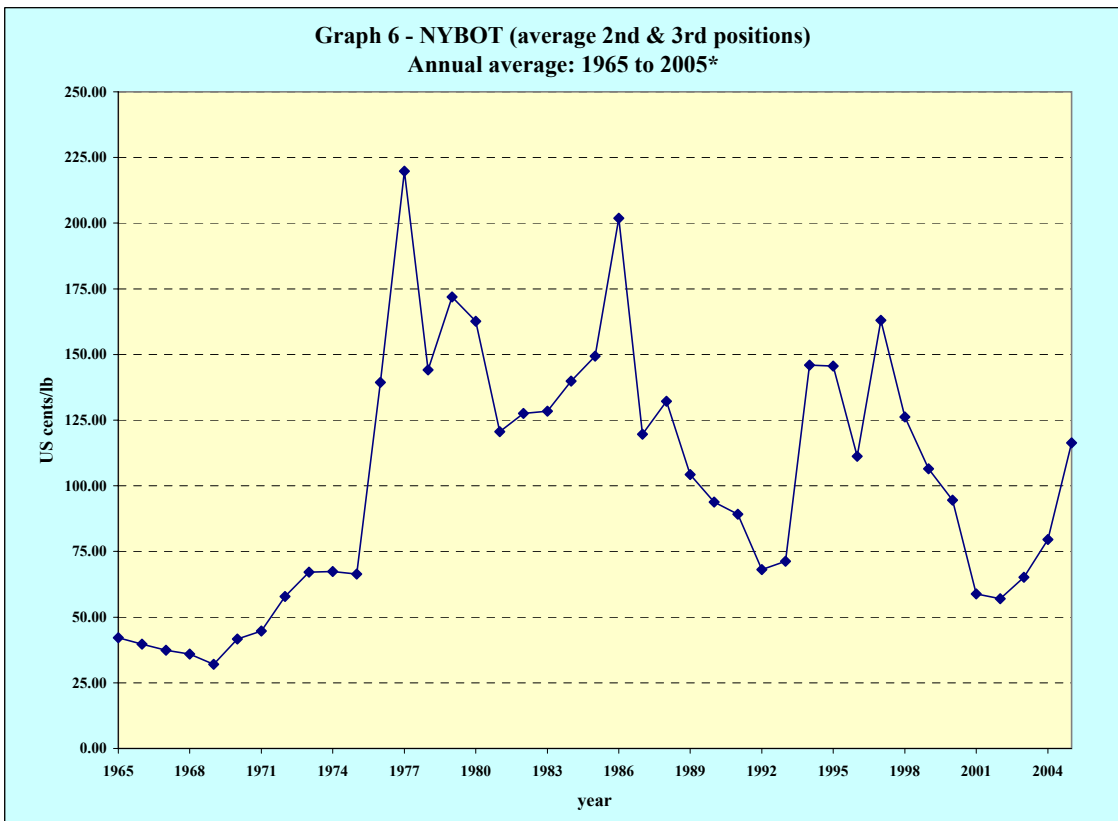
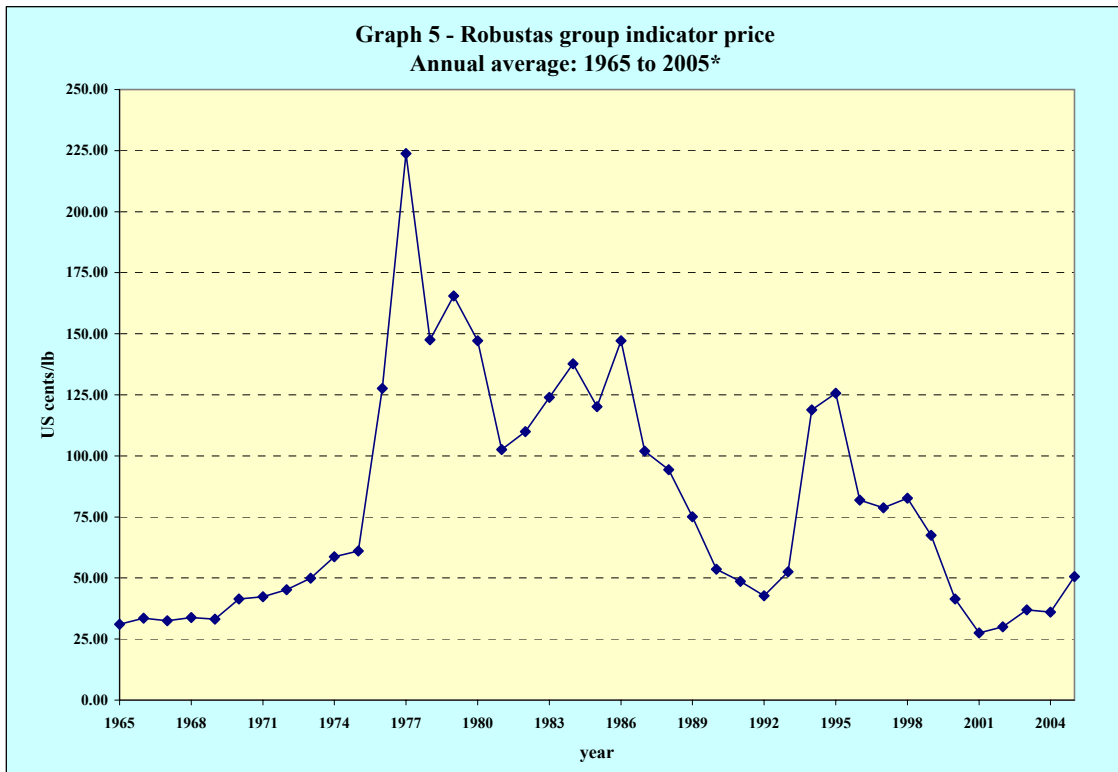
12. In conclusion it should be noted that the volatility recorded since 2000 is not more marked than in previous years even though there is still an upward trend. In fact, while volatility is basically determined by specific events that affect the coffee industry, it is increasingly influenced by investment fund activities. Exogenous factors unrelated to market fundamentals, particularly climatic problems in leading producing countries, are responsible for contributing to increased volatility. Since 2000, the coffee market has not experienced any major exogenous impact that could increase price volatility but investment fund activities have been increasing.



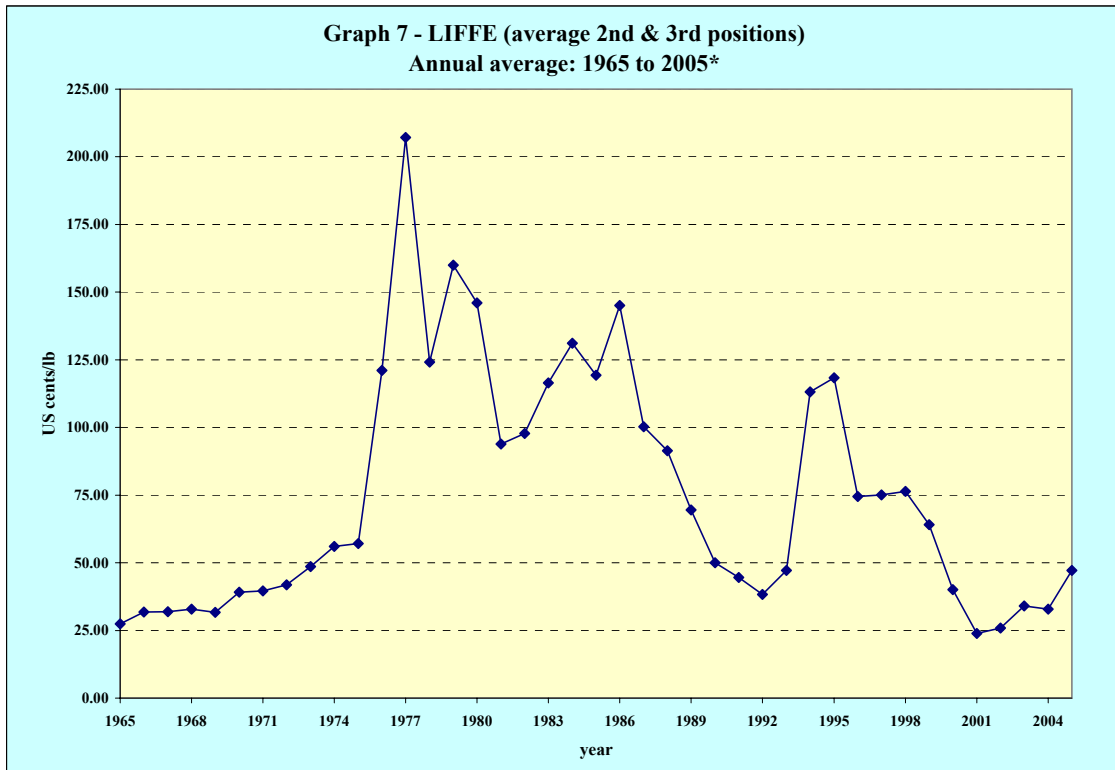
Note: 2005 average: January to August only



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