Volatility in Prices of Cotton and Other Commodities

1. Introduction

Commodities prices have been closely scrutinized during the last commodity boom that ended in 2008. However, most analyses were then focused on the direction and the magnitude of the change in commodities prices. How high could prices go? When will they decline? How low will prices go after the burst of the bubble? Those were the type of questions asked while the boom developed. However, it was not until the advent of a second upward spiral of commodities prices started in late 2009 that volatility became a widespread concern.

Cotton prices fluctuated within a relatively narrow band between 2001/02 and 2006/07, but during the commodity boom that band almost doubled. However, in 2010/11 the band of fluctuation doubles the one observed during the last commodity boom. In the face of this phenomenon, the ICAC Secretariat received the mandate to study the volatility of commodity prices from the 69th Plenary Meeting.

The present study intends to provide a thorough analysis of the volatility of commodity prices with a special focus on the volatility of the Cotlook A Index, a widely accepted measure of international cotton prices.

The study is structured as follows. Section 2 discusses alternative measures of price volatility. Section 3 analyzes the annual volatility of monthly prices for 53 commodities over the period 1980-2010. Section 4 analyzes the seasonal volatility of daily quotations of the Cotlook A Index since 1973 and nearby futures cotton prices since 1999. Section 5 analyzes the volatility of monthly cotton prices since 1980. Section 6 analyzes the inter-daily volatility of cotton prices since 1973. Section 7 summarizes the findings.

2. Measures of Price Volatility

Price volatility is a measure of dispersion of prices, higher when prices are more disperse and lower when prices are more concentrated. Volatility does not measure the direction of price changes (increases or declines), but the magnitude of the fluctuation itself.

Although several measures of volatility can be used to analyze the magnitude of price fluctuations (such as the difference between the highest and the lowest price, or the average change in prices), only those invariant to the units of measurement of prices that filter off the effects of long-term trends in prices are used in the present study. Three measures of price volatility are calculated: the relative spread, the coefficient of variation, and the standard logarithmic deviation of prices.

The relative spread (RS), calculated as the ratio of the difference between the maximum price and the minimum price to the average price, gauges the dispersion of extreme values or the range of the bandwidth in which prices moved through a period of time.

The coefficient of variation (CV), calculated as the ratio of the standard deviation to the average price, gauges the dispersion from the mean of the distribution of prices, i.e. the dispersion of all prices in the series.

The RS and the CV are reported as percentages, and the higher their value, the greater the price volatility, and vice versa. The lowest possible value for the RS and the CV is zero (for a constant price), but they have no upper bound.

The third measure of price volatility used in this study is the standard deviation of the change in logarithmic prices (SLD). Since the change in logarithmic prices approximates the proportional change in prices in levels for small changes in prices, for low volatility levels the SLD takes values similar to those obtained with the CV. A major difference between the SLD and the other two measures of volatility is that the SLD depends on the sequence of observed prices, while the CV and the RS do not.

To put these volatility measures into perspective, the following example compares three simulated series of prices for 4 periods: S1={90, 110, 100, 100}, S2={90, 110, 105, 95}, and S3={90, 110, 95, 105}. All series have a mean of 100, a maximum value of 110, and a minimum value of 95. Therefore, RS=20% for all series indicating that the dispersion of extreme values with respect to the mean is the same across series. However, the standard deviation of S1 amounts to 8.2 while the standard deviation for S2 and S3 equals 9.1. Therefore, the CVs differ across series (CV=8.2% for S1, CV=9.1% for S2 and S3), indicating that S2 and S3 are more disperse than S1 or that price fluctuations in S2 and S3 were more prevalent than in S1. Finally, note that the SLD of S2 (7.0%) is different (lower) than the SLD of S3 (7.8%) despite the series having the same elements.

3. Annual Volatility of Monthly Prices for 53 Commodities

a. Objective

The objective of this section is to analyze the evolution of average annual volatility measures for 53 commodities prices.

b. Data

The study is conducted on monthly average nominal prices of 53 commodities, covering the period from January 1980 to September 2010 (IMF 2010).[1] Commodities are grouped in 5 categories: food, beverages, metals, energy and raw agricultural products. Cotton belongs to the latter group. For comparison purposes, the category raw agricultural products will be further disaggregated into cotton and other raw agricultural products. See appendix 1 for the description of the series of prices.

c. Methodology

Volatility is measured using the CV and the RS. Two types of analyses are conducted on the data. First, in order to analyze whether cotton price volatility differs from the price volatility of other commodities, Welch's t-tests of mean equality are conducted between prices for cotton and for groups of other commodities. The test accounts for different variances across sub-periods, and p-values are reported

[1] IMF 2010. Primary Commodities Prices. Available online at http://www.imf.org/external/np/res/ commod/index.asp

properly adjusted for degrees of freedom. A complementary analysis of the correlation of each commodity with cotton is also conducted.

Second, in order to analyze the evolution of volatility through time, Welch's t-tests of mean equality are conducted for each commodity price across sub-periods: decades, 5-year periods, and 2010 vs. 1980-2009.

d. Results

In this section, only results referring to groups of commodities are reported. For a detailed analysis of each of the 53 commodities, see appendixes 2 and 3.

The comparison of average annual volatilities by groups of commodities over 1980-2009 (pooled through commodities within groups and through time) indicates that the price volatility measures observed for food, other agricultural raw products and metals were not significantly different from the volatility measures observed for cotton prices. The price volatility measures for beverages and energy were higher than for cotton, both in terms of more disperse extreme values and in terms of more disperse distribution of prices.

Table 1. Comparison of Annual Average Volatilities by Commodity Group, 1980-2009.

	Coefficient of Variation			Relative Price Spread		
Commodities	Average Volatility 1980-2009 (%)	Test of Equality	p-value (%)	Average Volatility 1980-2009 (%)	Test of Equality	p-value (%)
Cotton	9.01			27.08		
Food	9.83	1.13	13.2	29.67	1.13	13.4
Beverages	10.55	1.73	4.4	32.70	2.12	1.9
Other Raw Agricultural Products	8.13	-1.16	12.7	24.61	-1.15	12.9
Metals	9.01	0.01	49.8	27.57	0.14	44.3
Energy	10.88	2.12	1.8	33.79	2.41	0.9

The annual volatility of extreme values of cotton prices is significantly correlated with the annual volatility of extreme values of only 6 other commodities prices over the period 1980-2010: bananas (correlation=-0.31, p-value=0.09), beef (correlation=0.35, p-value=0.05), hides (correlation=0.31, p-value=0.09), palm oil (correlation=0.37, p-value=0.04), rapeseed oil (correlation=0.31, p-value=0.09), and uranium (correlation=-0.33, p-value=0.07). The annual volatility of the entire series of cotton prices is significantly correlated with only 7 other commodities prices over the period 1980-2010: tin (correlation=0.33, p-value=0.07), soybean oil (correlation=0.32, p-value=0.08), shrimp (correlation=0.36, p-value=0.04), rapeseed oil (correlation=0.38, p-value=0.04), palm oil (correlation=0.39, p-value=0.03), beef (correlation=0.37, p-value=0.04), and bananas (correlation=-0.32, p-value=0.08). It must be noted that the volatility of cotton prices is related to the price volatility in a few food items mainly, but no significant correlation exists between cotton and wool or between cotton and crude oil.

To analyze the evolution of volatility through time, t-tests are conducted for each commodity first across decades, then across 5-year periods, and finally between 2010 and the period 1980-2009 (Appendixes 2 and 3). Figure 1 summarizes the results of the tests by group of commodities for the 1990s against the 1980s. Thirty-one commodities (63% of the sample) did not experience a significant change in price volatility, measured by the CV or the RS. Ten commodities experienced a significant decline in at least one measure of volatility: barley, soybeans, soybean oil, palm oil, sunflower oil, and free market sugar

experienced a significant decline in both the volatility of extreme values (RS) and the volatility of the entire series (CV); cotton, soybean meal, and rapeseed oil experienced a significant decline in the volatility of the entire series (CV) but the volatility of the extreme values (RS) was similar across decades; hardwood sawnwood experienced a significant decline in the volatility of the extreme values (RS), but the volatility of the entire series was similar across decades. Finally, eight commodities experienced a significant rise in at least one measure of volatility: wheat, olive oil, bananas, coarse and fine wool, West Texas Intermediate oil, and Russian natural gas experienced a significant rise in both the volatility of extreme values and the volatility of the entire series across decades; fish experienced a significant increase in the volatility of extreme values but no significant change in the volatility of the entire series.

Figure 1. Comparison of Average Annual Volatilities in the 1980s and the 1990s, by Commodity Group

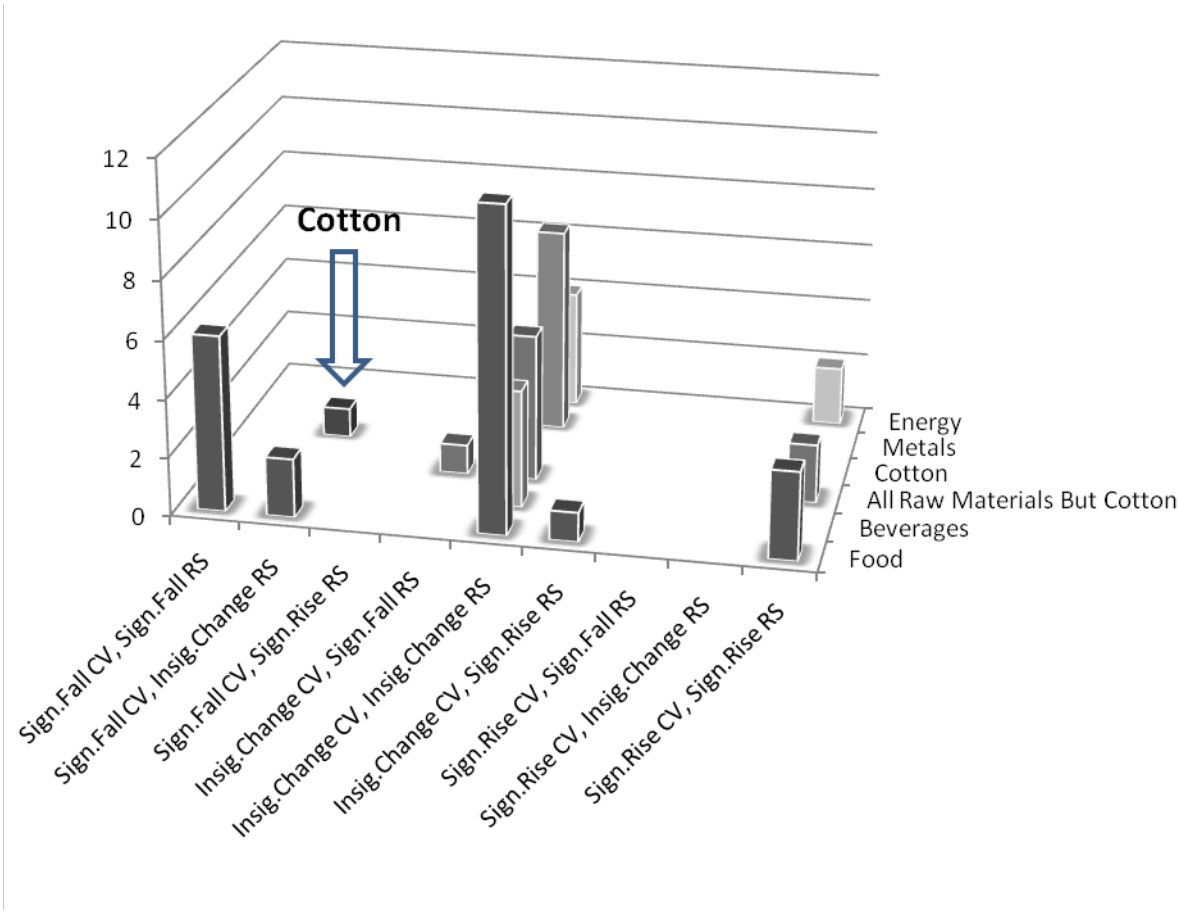


Figure 2 summarizes the results of the tests by group of commodities for the 2000s against the 1990s. Thirty-six commodities (68% of the sample) did not experience a significant change in price volatility, measured by the CV or the RS. Four commodities experienced a significant decline in at least one measure of volatility: bananas and hardwood logs experienced a significant decline in both the volatility of extreme values (RS) and the volatility of the entire series (CV); other mild coffees experienced a significant decline in the volatility of the extreme values (RS), but the volatility of the entire series was similar across decades; swine meat experienced a significant decline in the volatility of the entire series (CV) but the volatility of the extreme values (RS) was similar across decades. Finally, 13 commodities experienced a significant rise in at least one measure of volatility: softwood sawnwood, tin, nickel, zinc,

lead, uranium, coal, soybeans, soybean meal, and soybean oil experienced a significant rise in both the volatility of extreme values and the volatility of the entire series across decades; cotton and U.S. sugar experienced a significant increase in the volatility of extreme values but no significant change in the volatility of the entire series; sugar (free market) experienced a significant increase in the volatility of the entire series but no significant change in the volatility of extreme values.

Twenty commodities experienced no significant changes in their price volatility between the 1980s and 1990s, and between the 1990s and the 2000s: maize, rice, fish meal, groundnuts, beef, lamb, poultry, shrimp, oranges, robusta coffee, cocoa beans, tea, softwood logs, rubber, hides, copper, aluminum, spot crude oil, U.K. Brent oil, and Dubai oil. **No commodity experienced a consistently increasing or decreasing pattern of price volatility across the decades.**

Figure 2. Comparison of Average Annual Volatilities in the 1990s and the 2000s, by Commodity Group

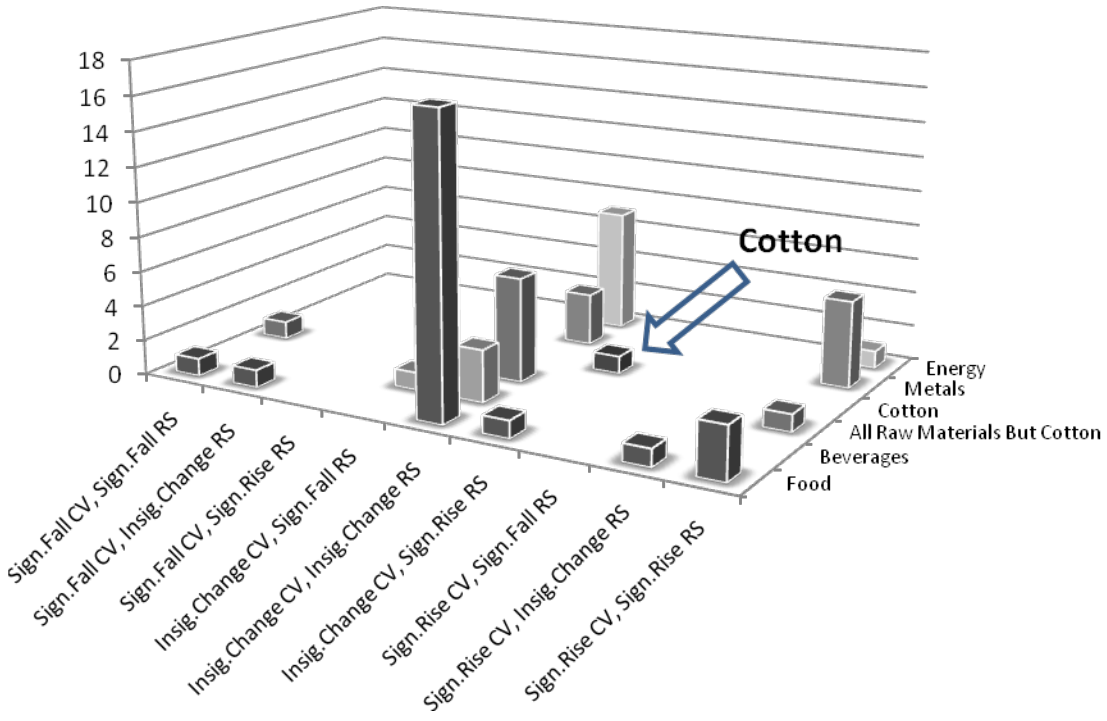
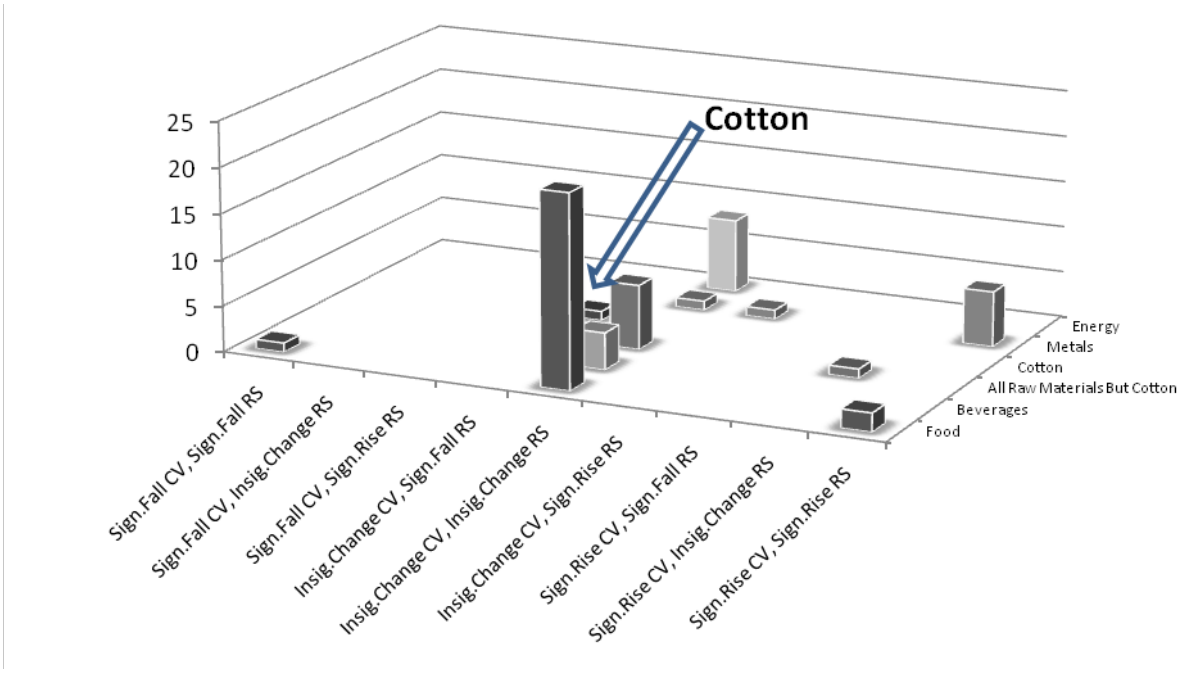


Figure 3 summarizes the results of the tests by group of commodities for the second half of the 2000s against the first half of the 2000s. Forty-one commodities (77% of the sample) did not experience a significant change in price volatility, measured by the CV or the RS. Two commodities experienced a significant decline in at least one measure of volatility: beef experienced a significant decline in both the volatility of extreme values (RS) and the volatility of the entire series (CV); cotton experienced a significant decline in the volatility of extreme values (RS), but the volatility of the entire series was similar across periods. Ten commodities experienced a significant increase in at least one measure of volatility: copper, aluminum, nickel, zinc, lead, uranium, and fish meal experienced a significant increase in the volatility of extreme values and the volatility of the entire series across periods; rubber and groundnuts experienced an increase in the volatility of the entire series, but the volatility of extreme values was

similar across periods; tin experienced an increase in the volatility of the extreme values, but the volatility of the entire series was similar across periods.

Figure 4 summarizes the results of the tests by group of commodities for 2010 against the period 1980-2009. Only seven commodities (13% of the sample) did not experience a significant change in price volatility, measured by the CV or the RS. Thirty-six commodities (68% of the sample) experienced a significant decline in at least one measure of volatility in 2010 with respect to their long term average volatility measures: barley, soybeans, soybean meal, soybean oil, palm oil, fish meal, sunflower oil, groundnuts, rapeseed oil, lamb, swine meat, poultry, shrimp, bananas, oranges, robusta coffee, cocoa beans, sawn hard wood, sawn soft wood, coarse and fine wool, hides, copper, aluminum, uranium, oil (spot crude, U.K. Brent, Dubai, and West Texas Intermediate), Indonesian and U.S. natural gas, coal experienced a significant decline in both the volatility of extreme values (RS) and the volatility of the entire series (CV); nickel experienced a significant decline in the volatility of the entire series, but no significant change in the volatility of the extreme values; sugar (free market), tea and Russian natural gas experienced a significant decline in the volatility of extreme values, but no significant change in the volatility of the entire series. Ten commodities experienced a significant increase in at least one measure of volatility: maize, softwood logs, and cotton experienced a significant increase in the volatility of extreme values, but no significant change in the volatility of the entire series; other mild coffees experienced a significant rise in the volatility of the entire series, but no significant change in the volatility of the extreme values; U.S. sugar, iron ore, tin, wheat, olive oil, and beef experienced a simultaneous increase in the volatility of the extreme values and the volatility of the entire series in 2010 with respect to the historical average.

Figure 3. Comparison of Average Annual Volatilities in 2000-04 and 2005-09, by Commodity Group

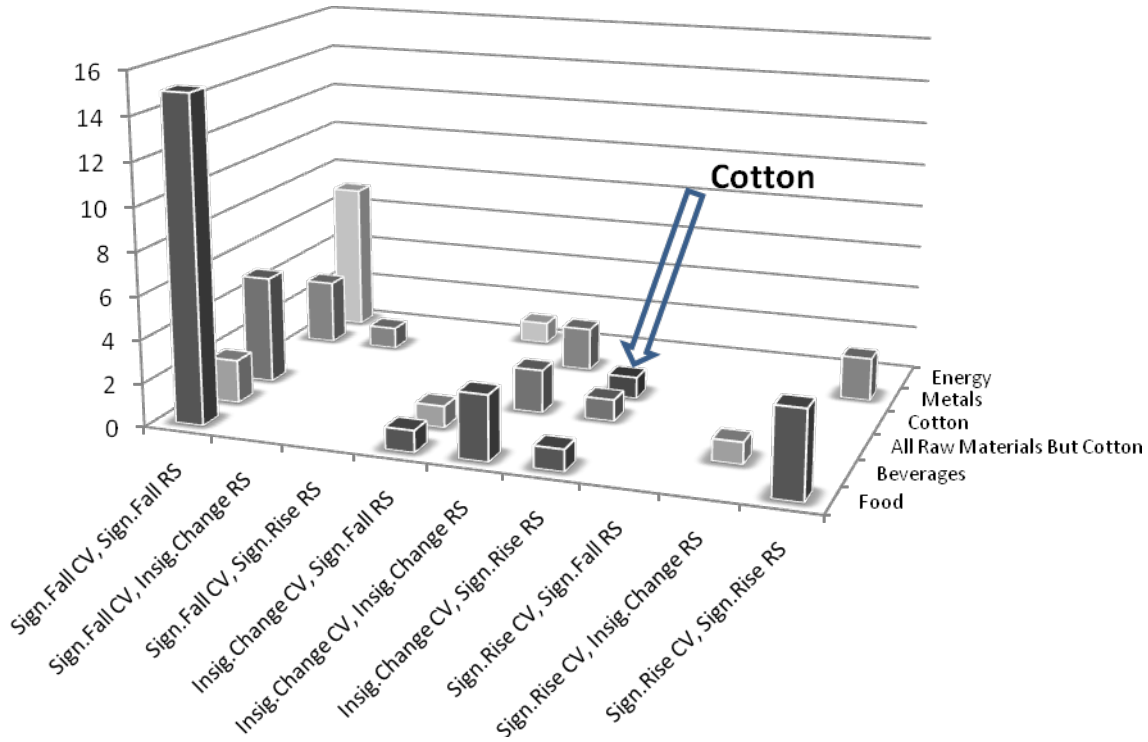


e. Conclusions

The present analysis indicates that:

i. the long term volatility of cotton prices is not significantly different from the price volatility of other raw agricultural products, food, and metals, but it is lower than the price volatility of energy and beverages;
ii. there is no consistent pattern of changes in volatility across decades. No commodity experienced a consistently increasing or decreasing pattern of price volatility across the decades. Twenty commodities experienced no significant changes in their price volatility measures between the 1980s and 1990s, and between the 1990s and the 2000s;
iii. the price volatility of 5 out of 6 commodities remained unchanged between the first half and the second half of the 2000s. Most of the commodities that experienced higher volatility in the second half of the 2000s were metals;
iv. during the first 9 months of 2010, 4 out of 6 commodities experienced a decline in price volatility with respect to their long-term averages (1980-2009). Only 1 out of 6 commodities (mainly food commodities) experienced some increase in its price volatility with respect to its long term-average;
v. the volatility of the entire series of cotton prices declined in the 1990s with respect to its levels in the 1980s, although the volatility of the extreme values remained unchanged. In the 2000s, the volatility of the entire series of cotton prices was unchanged from its levels in the 1990s, but the volatility of the extreme values increased, driven mainly by the increase experienced in the first half of the decade. During the first 9 months of 2010, the volatility of the extreme values of cotton prices was higher than the long-term average, but not the volatility of the entire series of prices.

Figure 4. Comparison of Average Annual Volatilities in 1980-2009 and 2010, by Commodity Group



4. Seasonal Volatility of Daily Cotton Prices

a. Objective

To analyze the volatility of the A Index and the price volatility of the nearby futures contract by seasons using daily quotations.

b. Data

Daily quotations of the Cotlook A Index from 2 January 1973 to 28 October 2010 and daily quotation of the nearby futures cotton contract #2 (Intercontinental Exchange) from 1 June 1999 to 25 October 2010 are used in the analysis. Since the volume of the first-front nearby contract usually declines substantially near the first notice day and its price does not properly reflect the evolution of futures prices, the series of futures prices was modified as follows: 10 working days before the first notice day and until the expiration of the first-front nearby contract, futures prices refer to the second-front nearby contract.

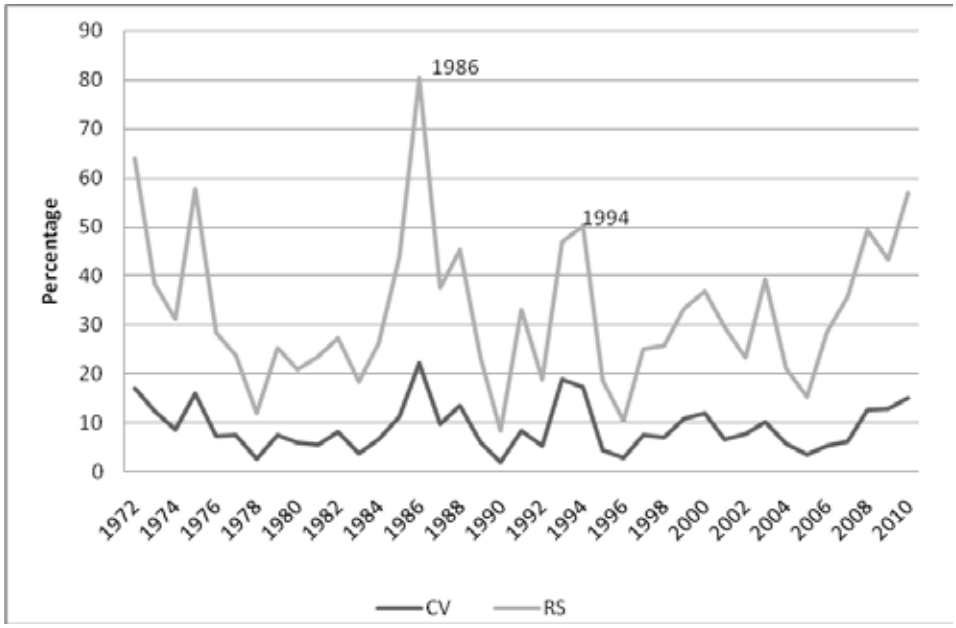
c. Methodology

The RS is calculated as the ratio of the difference between the maximum daily price and the minimum daily price to the season average price. The CV is calculated as the ratio of the standard deviation of daily prices to the season-average price.

Season-average volatility measures are compared through decades, 5-year periods, and before and after the closing of open outcry in the Intercontinental Exchange on 8 March 2008. Welch's t-tests, which allow for differences in variances, are applied to test for equality on the volatility measures across periods.

In order to compare the volatility of the A Index versus the price volatility of the nearby futures contract by season, the CV and the RS are calculated on a monthly basis, and their distributions within each season are compared using the Welch's t-test for equality.

Figure 5. Volatility of the A Index by Season.



d. Results

The volatility of the daily quotations of the A Index during a season peaked in 1986/87 and reached record low levels in 1990/91, both in terms of the volatility of the entire series (CV) and the volatility of the extreme values (RS) (Figure 5). During the first 3 months of 2010/11, the volatility of the extreme values of the daily quotations of the A Index surpassed the volatility observed in all seasons but 1972/73, 1975/76 and 1986/87. The volatility of the entire series of daily quotations of the A Index during the first 3 months of 2010/11 exceeded the volatility observed in all seasons but 1972/73, 1975/76, 1986/87, 1993/94 and 1995/96.

Table 2. Comparison of season-average volatility measures on daily quotations of the A Index.

	Coefficient of Variation (CV)			Relative Price Spread (RS)		
Seasons	Mean (%)	Equality Test*	p-value (%)	Mean (%)	Equality Test*	p-value (%)
1970s	9.90			35.09		
1980s	9.26	-0.26	79.52	34.68	-0.05	96.25
1990s	8.45	-0.33	74.79	27.09	-1.03	32.01
2000s	8.29	-0.07	94.37	32.26	0.93	36.66
1990-1994	10.37			31.52		
1995-1999	6.52	-1.07	33.32	22.67	-1.00	36.44
2000-2004	8.41	1.05	32.70	30.05	1.41	20.22
2005-2009	8.17	-0.11	91.81	34.46	0.64	54.83
1980-2009	8.88			32.17		
2010	15.16	7.21	0.00	56.93	9.11	0.00
1980-2007	8.37			30.27		
2008-2010	13.59	4.32	0.19	49.90	4.10	1.48

Table 3. Comparison of volatility measures on daily quotations of the A Index during the first 3 months of each season.

	Coefficient of Variation (CV)			Relative Price Spread (RS)		
Seasons	Mean (%)	Equality Test*	p-value (%)	Mean (%)	Equality Test*	p-value (%)
1970s	3.05			10.44		
1980s	4.54	0.96	35.39	14.95	1.07	30.37
1990s	2.78	-1.35	20.25	9.63	-1.56	14.31
2000s	4.68	1.55	14.79	15.92	1.64	12.71
1990-1994	2.51			9.58		
1995-1999	3.06	0.51	62.89	9.68	0.03	97.72
2000-2004	4.89	0.92	39.99	16.61	1.12	31.46
2005-2009	4.48	-0.17	86.91	15.22	-0.19	85.54
1980-2009	4.00			13.50		
2010	15.16	19.42	0.00	56.93	26.33	0.00
1980-2007	3.81			12.89		
2008-2010	9.49	1.60	24.98	33.69	1.57	25.78

Table 4. Comparison of season-average volatility measures on daily quotations of the nearby futures contract.

	Coefficient of Variation (CV)			Relative Price Spread (RS)		
Seasons	Mean (%)	Equality Test*	p-value (%)	Mean (%)	Equality Test*	p-value (%)
1998-1999	6.55			22.33		
2000-2004	11.96	2.91	4.35	47.81	3.95	2.89
2005-2009	9.80	-0.91	39.31	42.08	-0.73	49.02
1998-2009	10.07			41.15		
2010	10.86	0.73	48.18	42.38	0.30	77.00
1998-2007	9.48			39.42		
2008-2010	12.30	1.49	19.53	47.36	1.26	24.92

Table 5. Comparison of volatility measures on daily quotations of the nearby futures contract during the first 3 months of each season.

	Coefficient of Variation (CV)			Relative Price Spread (RS)		
Seasons	Mean (%)	Equality Test*	p-value (%)	Mean (%)	Equality Test*	p-value (%)
1998-1999	2.70			11.34		
2000-2004	7.22	2.18	9.52	26.00	2.29	8.42
2005-2009	7.52	0.12	91.09	26.46	0.06	95.61
1998-2009	6.64			23.43		
2010	10.86	3.71	0.34	42.38	5.38	0.02
1998-2007	5.96			21.56		
2008-2010	10.08	1.64	19.97	35.35	1.59	25.26

Table 6. Comparison of season-average volatility measures on daily quotations between the A Index and the nearby futures contract (NBF).

	Coefficient of Variation (CV)			Relative Price Spread (RS)		
Seasons	NBF – A Index	Equality Test*	p-value (%)	NBF – A Index	Equality Test*	p-value (%)
1999	1.05	2.03	5.66	3.94	2.83	1.04
2000	1.43	2.62	1.67	4.93	3.07	0.63
2001	1.96	2.80	1.07	7.45	3.23	0.40
2002	1.68	3.10	0.73	5.92	4.13	0.09
2003	1.55	1.94	6.61	5.32	2.64	1.52
2004	1.85	4.22	0.04	6.47	4.64	0.02
2005	1.08	3.19	0.49	3.76	3.62	0.21
2006	1.25	2.59	1.81	4.08	2.81	1.15
2007	1.69	2.57	1.78	5.10	2.47	2.23
2008	1.43	2.55	1.86	5.39	2.81	1.13
2009	0.51	0.90	38.21	2.57	1.56	13.82
2010	-1.03	-0.48	66.16	-3.53	-0.46	67.72

The season-average volatility of the daily quotations of the A Index did not experience significant changes across decades over the period 1970/71-2009/10, or across 5-year periods over the period 1990/91-2009/10, measured both in terms of the CV and the RS (Table 2). However, the season-average volatility of the A Index after the closing of open outcry in the Intercontinental Exchange (over the period 2008/09-

2010/11) has been higher than the volatility observed previously (over the period 1980/81-2007/08), both in terms of the CV and the RS. During the first 3 months of the 2010/11 season, the volatility of the A Index exceeded its long-term average (1980/81-2009/10).

Conducting a similar analysis for only on the first 3 months of each season, it is observed that the volatility of the A Index did not change significantly across decades, across 5-year periods, or after the closing of open outcry in the Intercontinental Exchange (Table 3). However, volatility of the A Index over the first 3 months of 2010/11 reached an all-time record high and it was significantly higher than the long-term average (Table 4).

The season-average price volatility of the nearby futures contract (measured as the CV and the RS) experienced a significant increase between 1998/99-1999/00 and the first half of the 2000s, and it experienced an insignificant decline between the first half and the second half of the 2000s (Table 4). However, no significant change in the volatility of nearby futures prices was detected after the end of open outcry in the Intercontinental Exchange, nor in 2010 with respect to its long-term average (measured as the CV and the RS). The results of conducting a similar analysis for only the first 3 months of each season are similar to the results obtained for the entire season (Table 5).

Finally, a comparison of monthly-average volatility measures of the A Index and the nearby futures contract by seasons indicates that futures prices have been more volatile than the A Index between 1999 and 2008, but no significant difference in volatility was observed in 2009 and 2010 (Table 6). Using the latter result along with the results from tables 2 and 4, it can be concluded that after the end of the open outcry in the ICE the volatility of the A Index increased to reach levels similar to those of the nearby futures prices in 2009/10 and 2010/11.

e. Conclusions

The findings of this section can be summarized as follows:

i. Nor the seasonal volatility of the A Index, nor the seasonal price volatility of the nearby futures contract has changed significantly across decades since the 1970s, or across 5-year periods since 1990/91.
ii. Historically, futures prices were more volatile than the A Index within each season. However, after the closing of open outcry in the ICE, the seasonal volatility of the A Index increased to levels similar to those of the nearby futures prices. The seasonal volatility of futures prices has not changed significantly after the closing of open outcry in the ICE.
iii. During the first three months of 2010/11, the A Index and the price of the nearby futures contract have been more volatile than in any other similar period on record.

5. Volatility of Monthly Cotton Prices

a. Objective

To analyze the volatility of the A Index as measured by the standard deviation of the change in logarithmic prices (SLD) between 1980 and 2010 using monthly average quotations and econometric techniques.

b. Data

Monthly average quotations of the Cotlook A Index, from January 1980 to September 2010.

c. Methodology

Volatility is measured as the standard deviation of the percentage change in the A Index from one month to the following month, which is approximated as the difference in logarithmic values of the A Index.

A generalized autoregressive conditional heteroskedastic in mean (GARCH-M) model is applied to test for changes in the volatility of the A Index through decades and after the end of the open outcry in the Intercontinental Exchange. The mean value of the daily changes in the A Index is modeled as follows:

(1) $$dlog(A_t) = a_0 + \sum_{i=2}^{12} a_i dmonth_{it} + b_0 dICE_t + \sum_{i=80s,..,00s} b_i\ ddecade_{it} + \sum_{i=1}^{j} d_i dlog(A_{t-i}) + gh_t + \varepsilon_{1t}$$

where *dlog(A)* is the logarithmic difference between monthly quotations of the A Index; *dICE* is a dummy variable indicating the electronic-only trading period in the Intercontinental Exchange (*dICE*=1 after 8 March 2008); $decade_i$ is a dummy variable for each decade *i=80s,* 90s, 00s; *h* is the conditional variance of $\{\varepsilon_1\}$ and it measures the volatility of the monthly changes in the A Index; and the error term is assumed to take the form of $\varepsilon_{1t} = \sum_i \rho_i \varepsilon_{1t-i} + v_t\sqrt{h_t}$, where the first term describes an autoregressive process and $\{v_t\}$ is a white noise process. Monthly dummy variables are included as $dmonth_i$.

The conditional variance of $\{\varepsilon_1\}$, h_t, is modeled as:

(2) $$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{1t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i} + \delta_0\ dICE_t + \sum_{i=80s,...,00s} \delta_i\ ddecade_{it} + \varepsilon_{2t}$$

where $\{\varepsilon_{2t}\}$ is a white noise process. The estimated values of h_t are one-step-ahead forecast error variances.

To analyze whether the volatility of the A Index changed after the end of the open outcry in the Intercontinental Exchange, the following z-test is conducted: H0: δ_0=0, H1: $\delta_0 \neq 0$

To analyze whether the volatility of the daily quotations of the A Index changed across decades, the following Wald Tests are conducted: H0: $\delta_i = \delta_j$, H1: $\delta_i \neq \delta_j$, for i≠j and i=80s, 90s, 00s.

To analyze whether the volatility of the A Index in the calendar year 2010 has been higher than the historical average, the following Wald Test is conducted: H0: all δ_i's equal zero for i= 80s, 90s, 00s.

To analyze whether the A Index tends to increase when volatility increases, the following z-test is conducted: H0: *g*=0, H1: *g*>0

d. Results

Equation (1) was first fit alone using ordinary least squares (OLS) and with 13 lags of the dependent variable, *j*=13.[2] Lags 3, 4, 6 through 11, and 13 were jointly not significant and therefore they were eliminated from the model. A series of ARCH tests that regress the squared residuals on lagged squared residuals and a constant, indicate that 3 ARCH lags must be included in the model of the conditional

[2] Of course, in this first attempt h_t was not included in the estimation.

variance. Furthermore, the Breusch-Godfrey serial correlation test fails to reject the hypothesis of autocorrelation in the residuals of equation (1).

The final model, estimated in EViews 7.1, is reported on Table 6. The Ljung-Box Q-statistics for the standardized residuals from equation (1) fail to reject the hypothesis of no serial correlation up to lag 36, and the Ljung-Box Q-statistic for the standardized residuals squared fail to reject the hypothesis that the sample values of the Q-statistics are equal to zero up to lag 36, indicating that no GARCH effects remain in the model. Further reassurance of the lack of serial correlation or unaccounted conditional volatility is found in the standardized residuals having a mean of 0.0004 and a variance of 0.99999.

Table 7. GARCH-M Model of Monthly Changes on the A Index

Dependent Variable: DLOG(PCOTTIND_USD)
Method: ML - ARCH (Marquardt) - Normal distribution
Sample (adjusted): 1981M03 2010M09
Included observations: 355 after adjustments
Convergence achieved after 30 iterations

Variable	Coefficient	Std. Error	z-Statistic	Prob.
g	1.319016	3.879554	0.339992	0.7339
a_0	0.053331	0.033453	1.594226	0.1109
d_1	0.306510	0.148795	2.059951	0.0394
d_2	-0.000478	0.000239	-1.996755	0.0459
d_5	-0.097192	0.056888	-1.708472	0.0875
d_{12}	-0.061626	0.054317	-1.134573	0.2566
b_{80s}	-0.019895	0.028145	-0.706893	0.4796
b_{90s}	-0.021062	0.028122	-0.748957	0.4539
b_{00s}	-0.017874	0.026649	-0.670704	0.5024
a_7	-0.013699	0.008785	-1.559381	0.1189
a_8	-0.036245	0.007154	-5.066506	0.0000
a_{10}	-0.014804	0.007458	-1.984895	0.0472
b_0	0.008027	0.015135	0.530398	0.5958
ρ_1	0.202405	0.165709	1.221443	0.2219
Variance Equation				
α_0	0.000566	0.000950	0.596143	0.5511
α_1	0.283587	0.106914	2.652490	0.0080
α_2	-0.220539	0.101527	-2.172221	0.0298
α_3	0.080960	0.064125	1.262526	0.2068
β_1	0.711259	0.221153	3.216140	0.0013
δ_{80s}	-0.000342	0.000880	-0.389151	0.6972
δ_{90s}	-0.000368	0.000885	-0.415404	0.6778
δ_{00s}	-0.000221	0.000847	-0.261303	0.7939
δ_0	0.000186	0.000522	0.356417	0.7215

The explanatory power of the percentage change in monthly quotations of the A Index is acceptable for this type of models (R^2=0.32). However, the goal of the present analysis is not to forecast that magnitude of the A Index, but to test a few hypotheses regarding the volatility of the A Index, and this model is fit for that purpose. Given that the model was estimated using 355 observations, the cut-off significance level used in this study is 5%.

The dummy variables for the decades are not significant in equation (1), indicating that the average monthly percentage change in the A Index has not changed significantly over the period 1980-2010.[3] The end of the open outcry in the Intercontinental Exchange has not resulted in significant changes on the average monthly percentage change in the A Index (b_0 is not significant). Furthermore, the average monthly percentage change of the A Index has not been significantly affected by its volatility, as indicated by the non-significant effect of h_t in equation (1). Cotton prices tend to decline in August and October as indicated by the significance of a_8 and a_{10}.

The volatility of the A Index has not changed through the decades, as indicated by the non-significant effects of the corresponding dummy variables in the conditional variance equation. The fact that a joint test of significance of α_0 and the dummy variables for the decades fails to reject the hypothesis that they all equal zero, F-test(4, 332)=0.317, indicates that the volatility of the A Index in calendar year 2010 was not different than the historical average. The volatility of the A Index experienced no significant change after the end of the open outcry in the Intercontinental Exchange, as indicated by the non-significance of δ_0. A further analysis of the volatility of the monthly quotations of the A Index confirms the finding that volatility did not change significantly across decades (Table 7).

Table 8. Tests of Equality of Variance Across Decades

Null Hypothesis	Value	Wald t-Test	Degrees of freedom	p-value
δ_{80s}- δ_{90s}=0	2.5E-05	0.363	332	0.717
δ_{80s}- δ_{00s}=0	-1.2E-04	-0.797	332	0.426
δ_{90s}- δ_{00s}=0	-1.5E-04	-0.893	332	0.373

Notes: H0: $\delta_i = \delta_j$, for i≠j and i=70s, 80s, 90s, 00s.

e. Conclusions

The findings of this section can be summarized as follows:

i. volatility in monthly prices did not change significantly across decades;
ii. the volatility in monthly prices during calendar year 2010 was not significantly different than the historical average;
iii. the end of the open outcry in the Intercontinental Exchange has had no significant impact on volatility in monthly prices;
iv. the average monthly percentage change of the A Index has not been significantly affected by its volatility.

6. Inter-daily Volatility of Cotton Prices

a. Objective

To analyze whether the inter-daily[4] volatility of the A Index changed across decades, changed after the end of the open outcry in the Intercontinental Exchange, is higher in 2010 than the historical average, and it increases the level of the A Index (i.e. whether the A Index tends to increase when volatility increases).

[3] A joint test of significance cannot reject the hypothesis H0: bi=0, i= 80s, 90s, 00s. F-test(3,332)=0.195.
[4] Inter-daily refers to the change between two consecutive days.

b. Data

Daily quotations of the Cotlook A Index from 2 January 1973 to 25 October 2010.

c. Methodology

Volatility is measured as the standard deviation of the percentage change in the A Index from one day to the following day, which is approximated as the difference in logarithmic values of the A Index. Due to the high frequency of the data, inflation does not affect the results of the analysis.

A generalized autoregressive conditional heteroskedastic in mean (GARCH-M) model is applied to test for changes in the volatility of the A Index through decades and after the end of the open outcry in the Intercontinental Exchange. The mean value of the daily changes in the A Index is modeled as follows:

$$dlog(A_t) = a_0 + \sum_{i=1}^{3} a_1 ddaym_{it} + b_0 dICE_t + \sum_{i=70s,\ldots,00s} b_i\, ddecade_{it} + \sum_{i=1}^{j} d_i dlog(A_{t-i}) + g h_t + \varepsilon_{1t} \quad (3)$$

where *dlog(A)* is the logarithmic difference between daily quotations of the A Index; *dICE* is a dummy variable indicating the electronic-only trading period in the Intercontinental Exchange (*dICE*=1 after 8 March 2008); $decade_i$ is a dummy variable for each decade *i*=70s,80s, 90s, 00s; *h* is the conditional variance of $\{\varepsilon_1\}$ and it measures the volatility of the daily changes in the A Index; and the error term is assumed to take the form of $\varepsilon_{1t} = v_t\sqrt{h_t}$, where $\{v_t\}$ is a white noise process. In order to obtain a continue sample of quotations, empty data points were deleted, and three dummy variables were created to indicate the number of data points missing between two contiguous observations: $ddaym_1$=1 when 1 data point was missing; $ddaym_2$=1 when 2 data points were missing; $ddaym_3$=1 when more than 2 data points were missing.

The conditional variance of $\{\varepsilon_1\}$, h_t, is modeled as:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{1t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i} + \delta_0\, dICE_t + \sum_{i=70s,\ldots,00s} \delta_i\, ddecade_{it} + \varepsilon_{2t} \quad (4)$$

and $\{\varepsilon_{2t}\}$ is a white noise process. The estimated values of h_t are one-step-ahead forecast error variances.

To analyze whether the volatility of the A Index changed after the end of the open outcry in the Intercontinental Exchange, the following z-test is conducted: H0: δ_0=0, H1: $\delta_0 \neq 0$

To analyze whether the volatility of the daily quotations of the A Index changed across decades, the following Wald Tests are conducted: H0: $\delta_i = \delta_j$, H1: $\delta_i \neq \delta_j$, for i≠j and i=70s, 80s, 90s, 00s,

To analyze whether the volatility of the A Index in 2010/11 has been higher than the historical average, the following Wald Test is conducted: H0: all δ_i's equal zero for i=70s, 80s, 90s, 00s

To analyze whether the A Index tends to increase when volatility increases, the following z-test is conducted: H0: *g*=0, H1: *g*>0

d. Results

Equation (3) was first fit alone using ordinary least squares (OLS) and with 25 lags of the dependent variable, j=25.[5] Lags 11 through 17 and 19 through 25 were jointly not significant and therefore they were eliminated from the model. A series of ARCH tests that regress the squared residuals on lagged squared residuals and a constant, indicate that 5 ARCH lags must be included in the model of the conditional variance. Furthermore, the Breusch-Godfrey serial correlation test fails to reject the hypothesis of autocorrelation in the residuals of equation (3).

The final model, estimated in EViews 7.1, is reported on Table 9. The Ljung-Box Q-statistics for the standardized residuals from equation (3) fail to reject the hypothesis of no serial correlation up to lag 18, and the Ljung-Box Q-statistic for the standardized residuals squared fail to reject the hypothesis that the sample values of the Q-statistics are equal to zero up to lag 36, indicating that no GARCH effects remain in the model. Further reassurance of the lack of serial correlation or unaccounted conditional volatility is found in the standardized residuals having a mean of 0.0009 and a variance of 1.

The explanatory power of the percentage change in daily quotations of the A Index is low (R^2=0.023). However, the goal of the present analysis is not to forecast that magnitude, but to test a few hypotheses regarding the volatility of the A Index, and this model is fit for that purpose. Given that the model was estimated using 9378 observations, the cut-off significance level used in this study is 5%.

The dummy variables indicating a change in the A Index over a period longer than two days are statistically significant, as expected, since the model captures daily price dynamics (Table 9). The dummy variables for the decades are not significant, indicating that the average percentage daily change in the A Index has not changed significantly over the period 1972-2010.[6] The end of the open outcry in the Intercontinental Exchange has not resulted in significant changes on the average daily percentage change in the A Index (b_0 is not significant). Furthermore, the average daily percentage change of the A Index has not been significantly affected by its volatility, as indicated by the non-significant effect of h_t in equation (3).

The volatility of the A Index has changed through the decades, as indicated by the significance of the corresponding dummy variables in the conditional variance equation. The fact that α_0 is positive and significant, and that the dummy variables for the decades are negative and jointly significant[7] indicates that the volatility of the A Index in 2010/11 exceeded the historical average. The volatility of the A Index experienced no significant change after the end of the open outcry in the Intercontinental Exchange (δ_0 is not significant).

A further analysis of the volatility of the daily quotations of the A Index indicates that volatility increased every decade from the 1970s to the 1990s, and that it stabilized afterwards (Table 10). Furthermore, although statistically insignificant, the difference between the volatility in the 1990s and the volatility in the 2000s is positive indicating that volatility in the 2000s was lower than in the 1990s.

[5] Of course, in this first attempt h_t was not included in the estimation.
[6] A joint test of significance cannot reject the hypothesis H0: bi=0, i=70s, 80s, 90s, 00s. F-test(4,9345)=2.07.
[7] A joint test of significance cannot reject the hypothesis H0: all δ_i's equal zero for i=70s, 80s, 90s, 00s. F-test(4,9345)=77.61.

Table 9. GARCH-M Model of Daily Changes on the A Index

Dependent Variable: DLOG(A)
Method: ML - ARCH (Marquardt) - Normal distribution
Sample (adjusted): 20 9397
Included observations: 9378 after adjustments
Convergence achieved after 158 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(22) + C(23)*RESID(-1)^2 + C(24)*RESID(-2)^2 + C(25)
*RESID(-3)^2 + C(26)*RESID(-4)^2 + C(27)*RESID(-5)^2 + C(28)
*GARCH(-1) + C(29)*DFICE + C(30)*D1970S + C(31)*D1980S +
C(32)*D1990S + C(33)*D2000S

Variable	Coefficient	Std. Error	z-Statistic	Prob.
g	-0.099265	1.641093	-0.060487	0.9518
a_0	0.000658	0.001439	0.457101	0.6476
a_1	0.000517	0.000283	1.825712	0.0679
a_2	0.003870	0.000314	12.31635	0.0000
a_3	-0.019571	0.000795	-24.61412	0.0000
b_0	4.12E-05	0.000705	0.058416	0.9534
b_{70s}	-0.000486	0.001441	-0.337145	0.7360
b_{80s}	-0.000767	0.001439	-0.533153	0.5939
b_{90s}	-0.000976	0.001440	-0.678036	0.4977
b_{00s}	-0.000687	0.001419	-0.483935	0.6284
d_1	0.104590	0.012003	8.713892	0.0000
d_2	0.034803	0.009093	3.827422	0.0001
d_3	0.084429	0.013524	6.242798	0.0000
d_4	0.090354	0.011591	7.795331	0.0000
d_5	0.071703	0.012048	5.951318	0.0000
d_6	-0.007085	0.011393	-0.621848	0.5340
d_7	0.032844	0.011413	2.877780	0.0040
d_8	0.067176	0.011574	5.804263	0.0000
d_9	0.062531	0.011788	5.304787	0.0000
d_{10}	0.048687	0.010916	4.460110	0.0000
d_{18}	0.024639	0.010750	2.292133	0.0219
Variance Equation				
α_0	1.10E-05	2.32E-06	4.745452	0.0000
α_1	0.092093	0.008199	11.23212	0.0000
α_2	-0.079050	0.008560	-9.234617	0.0000
α_3	0.168941	0.010679	15.82064	0.0000
α_4	-0.057978	0.010006	-5.794390	0.0000
α_5	0.044185	0.006864	6.436878	0.0000
β_1	0.846131	0.005044	167.7458	0.0000
δ_0	1.29E-06	1.51E-06	0.854285	0.3929
δ_{70s}	-1.05E-05	2.32E-06	-4.510208	0.0000
δ_{80s}	-9.95E-06	2.32E-06	-4.293962	0.0000
δ_{90s}	-8.80E-06	2.31E-06	-3.803523	0.0001
δ_{00s}	-8.83E-06	2.31E-06	-3.827284	0.0001

e. Conclusions

The results of this section can be summarized as follows:

i. the inter-daily volatility of the A Index increased every decade from the 1970s to the 1990s, but volatility in the 2000s was similar to the volatility in the 1990s;

ii. the inter-daily volatility in 2010/11 exceeded its historical average;
iii. the end of the open outcry in the Intercontinental Exchange has had no significant impact on the inter-daily volatility of the A Index;
iv. the average daily percentage change of the A Index has not been significantly affected by its inter-daily volatility.

Table 10. Tests of Equality of Variance of Daily Cotton Prices Across Decades

Null Hypothesis	Value	Wald t-Test	Degrees of freedom	p-value
δ_{70s}- δ_{80s}=0	-5.10E-07	-8.33	9345	0.000
δ_{70s}- δ_{90s}=0	-1.66E-06	-17.28	9345	0.000
δ_{70s}- δ_{00s}=0	-1.64E-06	-8.94	9345	0.000
δ_{80s}- δ_{90s}=0	-1.15E-06	-12.97	9345	0.000
δ_{80s}- δ_{00s}=0	-1.13E-06	-6.37	9345	0.000
δ_{90s}- δ_{00s}=0	2.75E-08	0.17	9345	0.869

Notes: H0: $\delta_i = \delta_j$, for i≠j and i=70s, 80s, 90s, 00s.

7. Summary

The major findings of this study are summarized in table 11. It must be noted that conclusions depend on the frequency of the data used, the statistic used to measure volatility, and the period over which volatility is measured.

Sections 3 and 4, and sections 5 and 6, respectively, use the same statistics to measure volatility but different data and periods over which volatility is measured. Conclusions regarding the evolution of volatility across decades are different.

Sections 3 and 5, and sections 4 and 6, respectively, use the same data but different statistics to measure volatility and periods over which volatility is measured. Conclusions regarding the evolution of volatility across decades are different.

The choice of model to measure volatility in commodity prices must be consistent with the objectives of the study. Given that the mandate of the ICAC Secretariat is to monitor cotton prices on a daily basis but to forecast season-averages, the models used in sections 4 and 6 are more relevant than the other ones.

Table 11. Summary of the Major Findings of the Study

Section	Volatility measure	Data	Period over which volatility is calculated	Findings					
				Volatility across commodities	Volatility across decades	Volatility in 2010 or 2010/11	Volatility within-seasons, across spot & futures prices	Volatility before & after the end of the open outcry in the ICE	Impact of volatility on cotton prices
3. Annual Volatility of Monthly Prices for 53 Commodities	CV and RS	Monthly nominal prices of 53 commodities (including cotton), January 1980 to September 2010	Calendar Year (January to December)	The long term volatility of cotton prices is not significantly different from the price volatility of other raw agricultural products, food, and metals, but it is lower than the price volatility of energy and beverages.	No consistent pattern of changes in the volatility of commodity prices across decades. For cotton: the average annual volatility measured by the CV was lower in the 1990s than in the 1980s, but remained stable in the 2000s; the average annual volatility of the extreme values (RS) remained unchanged in the 1990s with respect to its levels in the 1980s, but it increased in the 2000s.	During the first 9 months of 2010, the volatility of the extreme values of cotton prices was higher than the long-term average, but not the volatility of the entire series of prices.			
4.Seasonal Volatility of Daily Cotton Prices	CV and RS	Daily quotations of the A Index (Jan 1973-Oct 2010) and Nearby Futures Contract (Jun 1999 to Oct 2010)	Cotton season (August-July)		Nor the seasonal volatility of the A Index, nor the seasonal price volatility of the nearby futures contract has changed significantly across decades since the 1970s, or across 5-year periods since 1990/91.	During the first three months of 2010/11, the A Index and the price of the nearby futures contract have been more volatile than in any other similar period on record.	Between 1999/00 and 2008/09, futures prices were more volatile than the A Index. Since 2009/10, the volatility of the A Index is similar to that of futures prices.	The seasonal volatility of the A Index increased significantly after the closing of open outcry in the ICE. The seasonal volatility of futures prices did not.	

Section	Volatility measure	Data	Period over which volatility is calculated	Findings					
				Volatility across commodities	Volatility across decades	Volatility in 2010 or 2010/11	Volatility within-seasons across spot & futures prices	Volatility before & after the end of the open outcry in the ICE	Impact of volatility on cotton prices
5.Volatility of Monthly Cotton Prices	SLD	Monthly averages of the Cotlook A Index, January 1980 to September 2010	2 consecutive months		Volatility in monthly prices did not change significantly across decades.	The volatility in monthly prices during calendar year 2010 was not significantly different than the historical average.		The end of the open outcry in the ICE has had no significant impact on volatility in monthly prices.	The average monthly percentage change of the A Index has not been significantly affected by its volatility.
6.Inter-daily Volatility of Cotton Prices	SLD	Daily quotations of the Cotlook A Index (January 1973-October 2010)	2 consecutive days		The inter-daily volatility of the A Index increased across decades from the 1970s to the 1990s, but remained stable in the 2000s.	The inter-daily volatility in 2010/11 exceeded its historical average.		The end of the open outcry in the ICE has had no significant impact on the inter-daily volatility of the A Index.	The average daily percentage change of the A Index has not been significantly affected by its inter-daily volatility.

Appendix 1. Description of the Price Series

Name	Description
Food	
Cereals	
Wheat	Wheat, No.1 Hard Red Winter, ordinary protein, FOB Gulf of Mexico, US$ per metric ton
Maize	Maize (corn), U.S. No.2 Yellow, FOB Gulf of Mexico, U.S. price, US$ per metric ton
Rice	Rice, 5 percent broken milled white rice, Thailand nominal price quote, US$ per metric ton
Barley	Barley, Canadian no.1 Western Barley, spot price, US$ per metric ton
Vegetable oils and protein meals	
Soybeans	Soybeans, U.S. soybeans, Chicago Soybean futures contract (first contract forward) No. 2 yellow and par, US$ per metric ton
Soybean meal	Soybean Meal, Chicago Soybean Meal Futures (first contract forward) Minimum 48 percent protein, US$ per metric ton
Soybean oil	Soybean Oil, Chicago Soybean Oil Futures (first contract forward) exchange approved grades, US$ per metric ton
Palm oil	Palm oil, Malaysia Palm Oil Futures (first contract forward) 4-5 percent FFA, US$ per metric ton
Fish meal	Fishmeal, Peru Fish meal/pellets 65% protein, CIF, US$ per metric ton
Sunflower Oil	Sunflower oil, Sunflower Oil, US export price from Gulf of Mexico, US$ per metric ton
Olive oil	Olive Oil, extra virgin less than 1% free fatty acid, ex-tanker price U.K., US$ per metric ton
Groundnuts	Groundnuts (peanuts), 40/50 (40 to 50 count per ounce), cif Argentina, US$ per metric ton
Rapeseed oil	Rapeseed oil, crude, fob Rotterdam, US$ per metric ton
Meat	
Beef	Beef, Australian and New Zealand 85% lean fores, CIF U.S. import price, US cents per pound
Lamb	Lamb, frozen carcass Smithfield London, US cents per pound
Swine Meat	Swine (pork), 51-52% lean Hogs, U.S. price, US cents per pound.
Poultry	Poultry (chicken), Whole bird spot price, Ready-to-cook, whole, iced, Georgia docks, US cents per pound
Seafood	
Fish	Fish (salmon), Farm Bred Norwegian Salmon, export price, US$ per kilogram
Shrimp	Shrimp, No.1 shell-on headless, 26-30 count per pound, Mexican origina, New York port, US cents per pound
Sugar	
Free market	Sugar, Free Market, Coffee Sugar and Cocoa Exchange (CSCE) contract no.11 nearest future position, US cents per pound
United States	Sugar, U.S. import price, contract no.14 nearest futures position, US cents per pound (Footnote: No. 14 revised to No. 16)
EU	Sugar, European import price, CIF Europe, US cents per pound

Fruits	
Bananas	Bananas, Central American and Ecuador, FOB U.S. Ports, US$ per metric ton
Oranges	Oranges, miscellaneous oranges CIF French import price, US$ per metric ton
Beverages	
Coffee	
Other milds	Coffee, Other Mild Arabicas, International Coffee Organization New York cash price, ex-dock New York, US cents per pound
Robusta	Coffee, Robusta, International Coffee Organization New York cash price, ex-dock New York, US cents per pound
Cocoa Beans	Cocoa beans, International Cocoa Organization cash price, CIF US and European ports, US$ per metric ton
Tea	Tea, Mombasa, Kenya, Auction Price, US cents per kilogram, From July 1998,Kenya auctions, Best Pekoe Fannings. Prior, London auctions, c.i.f. U.K. warehouses
Agricultural raw materials	
Hardwood	
Logs	Hard Logs, Best quality Malaysian meranti, import price Japan, US$ per cubic meter
Sawnwood	Hard Sawnwood, Dark Red Meranti, select and better quality, C&F U.K port, US$ per cubic meter
Softwood	
Logs	Soft Logs, Average Export price from the U.S. for Douglas Fir, US$ per cubic meter
Sawnwood	Soft Sawnwood, average export price of Douglas Fir, U.S. Price, US$ per cubic meter
Cotton	Cotton, Cotton Outlook 'A Index', Middling 1-3/32 inch staple, CIF Liverpool, US cents per pound
Wool	
Fine	Wool, fine, 19 micron, Australian Wool Exchange spot quote, US cents per kilogram
Coarse	Wool, coarse, 23 micron, Australian Wool Exchange spot quote, US cents per kilogram
Rubber	Rubber, No.1 Smoked Sheet, Singapore Commodity Exchange, 1st contract, US cents per pound
Hides	Hides, Heavy native steers, over 53 pounds, wholesale dealer's price, US, Chicago, fob Shipping Point, US cents per pound
Metals	
Copper	Copper, grade A cathode, LME spot price, CIF European ports, US$ per metric ton
Aluminum	Aluminum, 99.5% minimum purity, LME spot price, CIF UK ports, US$ per metric ton
Iron Ore	Iron Ore, 67.55% iron content, fine, contract price to Europe, FOB Ponta da Madeira, US cents per dry metric ton unit
Tin	Tin, standard grade, LME spot price, US$ per metric ton
Nickel	Nickel, melting grade, LME spot price, CIF European ports, US$ per metric ton

Zinc	Zinc, high grade 98% pure, US$ per metric ton
Lead	Lead, 99.97% pure, LME spot price, CIF European Ports, US$ per metric ton
Uranium	Uranium, NUEXCO, Restricted Price, Nuexco exchange spot, US$ per pound

Energy

Oil

Spot Crude	Oil; Average of U.K. Brent, Dubai, and West Texas Intermediate
U.K. Brent	Crude Oil (petroleum), Dated Brent, light blend 38 API, fob U.K., US$ per barrel
Dubai	Oil; Dubai, medium, Fateh 32 API, fob DubaiCrude Oil (petroleum), Dubai Fateh Fateh 32 API, US$ per barrel
West Texas Intermediate	Crude Oil (petroleum), West Texas Intermediate 40 API, Midland Texas, US$ per barrel

Natural Gas

Russian in Germany	Natural Gas, Russian Natural Gas border price in Germany, US$ per thousands of cubic meters of gas
Indonesian in Japan (LNG)	Natural Gas, Indonesian Liquified Natural Gas in Japan, US$ per cubic meter of liquid
US, domestic market	Natural Gas, Natural Gas spot price at the Henry Hub terminal in Louisiana, US$ per thousands of cubic meters of gas

Coal

Australian, export markets	Coal, Australian thermal coal, 1200- btu/pound, less than 1% sulfur, 14% ash, FOB Newcastle/Port Kembla, US$ per metric ton

Appendix 2. Price Volatility by Commodity Measured by the Relative Price Spread

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Food												
Cereals												
Wheat	Avg. Vol.**	17.34	30.76	32.21	14.12	20.55	31.51	30.00	23.30	41.12	26.77	55.95
	Equality Test+		3.86	0.20		1.41	2.03	-0.29	-0.94	1.42		10.77
	p-value (%)		0.11 significant rise	84.12 insignificant rise		20.06 insignificant rise	7.66 significant rise	78.26 insignificant fall	38.51 insignificant fall	20.60 insignificant rise		0.00 significant rise
Maize	Avg. Vol.**	29.27	25.10	27.08	30.01	28.54	20.55	29.65	22.58	31.58	27.15	31.97
	Equality Test+		-0.82	0.30		-0.23	-1.08	1.14	-0.89	0.87		2.06
	p-value (%)		42.16 insignificant fall	76.47 insignificant rise		82.83 insignificant fall	31.61 insignificant fall	29.06 insignificant rise	40.47 insignificant fall	41.76 insignificant rise		4.83 significant rise
Rice	Avg. Vol.**	24.78	29.73	23.06	22.62	26.95	31.85	27.60	17.88	28.23	25.85	27.10
	Equality Test+		0.78	-0.71		0.57	0.40	-0.39	-1.38	0.63		0.38
	p-value (%)		44.67 insignificant rise	48.99 insignificant fall		58.96 insignificant rise	69.76 insignificant rise	71.19 insignificant fall	20.87 insignificant fall	55.43 insignificant rise		70.88 insignificant rise
Barley	Avg. Vol.**	38.74	25.59	31.24	42.47	35.01	26.72	24.46	23.52	38.96	31.86	19.41
	Equality Test+		-3.29	1.00		-1.41	-1.69	-0.38	-0.17	1.78		-5.52
	p-value (%)		0.41 significant fall	33.10 insignificant rise		19.61 insignificant fall	13.55 insignificant fall	72.01 insignificant fall	87.32 insignificant fall	15.02 insignificant rise		0.00 significant fall
Vegetable oils and protein meals												
Soybeans	Avg. Vol.**	29.21	18.85	33.59	33.56	24.85	15.20	22.50	30.96	36.22	27.22	12.63
	Equality Test+		-2.29	2.67		-1.12	-1.44	1.86	1.01	0.50		-5.92
	p-value (%)		3.82 significant fall	2.03 significant rise		29.59 insignificant fall	20.08 insignificant fall	10.52 insignificant rise	35.99 insignificant rise	63.21 insignificant rise		0.00 significant fall

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Soybean meal	Avg. Vol.**	30.37	22.47	34.39	31.24	29.50	16.25	28.70	32.79	36.00	29.08	14.65
	Equality Test+		-1.37	1.90		-0.19	-1.77	1.85	0.37	0.30		-5.51
	p-value (%)		18.63 insignificant fall	7.48 significant rise		85.44 insignificant fall	12.68 insignificant fall	10.68 insignificant rise	71.92 insignificant rise	77.13 insignificant rise		0.00 significant fall
Soybean oil	Avg. Vol.**	35.43	20.48	34.85	36.80	34.07	20.61	20.35	32.76	36.93	30.25	12.66
	Equality Test+		-2.53	2.55		-0.25	-2.39	-0.04	1.64	0.42		-6.38
	p-value (%)		2.30 significant fall	2.22 significant rise		80.79 insignificant fall	4.84 significant fall	96.91 insignificant fall	14.04 insignificant rise	68.93 insignificant rise		0.00 significant fall
Palm oil	Avg. Vol.**	43.88	28.11	41.56	42.69	45.06	28.09	28.12	40.38	42.75	37.85	17.43
	Equality Test+		-1.93	1.48		0.26	-1.61	0.00	0.99	0.19		-5.85
	p-value (%)		7.31 significant fall	15.63 insignificant rise		80.31 insignificant rise	15.23 insignificant fall	99.84 insignificant rise	36.58 insignificant rise	85.68 insignificant rise		0.00 significant fall
Fish meal	Avg. Vol.**	21.28	27.81	22.43	28.15	14.40	25.42	30.21	13.45	31.41	23.84	19.72
	Equality Test+		1.60	-1.06		-2.75	2.39	0.98	-3.64	2.58		-2.05
	p-value (%)		12.84 insignificant rise	30.58 insignificant fall		3.32 significant fall	5.43 significant rise	35.82 insignificant rise	0.83 significant fall	3.66 significant rise		4.99 significant fall
Sunflower Oil	Avg. Vol.**	33.57	22.29	39.03	33.07	34.07	22.95	21.63	38.51	39.56	31.63	9.35
	Equality Test+		-1.75	1.71		0.09	-0.99	-0.16	2.23	0.06		-5.89
	p-value (%)		9.84 significant fall	11.32 insignificant rise		92.86 insignificant rise	34.99 insignificant fall	88.07 insignificant fall	7.66 significant rise	95.82 insignificant rise		0.00 significant fall
Olive oil	Avg. Vol.**	13.79	24.06	19.61	13.48	14.11	20.10	28.03	18.88	20.34	19.15	24.86
	Equality Test+		1.82	-0.71		0.15	1.20	0.73	-0.80	0.20		2.52
	p-value (%)		9.56 significant rise	49.13 insignificant fall		88.19 insignificant rise	27.03 insignificant rise	49.89 insignificant rise	45.64 insignificant fall	84.62 insignificant rise		1.74 significant rise

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Groundnuts	Avg. Vol.**	50.85	38.56	23.58	66.58	35.12	58.75	18.37	13.00	34.16	37.66	7.61
	Equality Test+		-0.79	-1.28		-1.46	1.13	-2.30	-1.05	2.99		-5.31
	p-value (%)		44.18 insignificant fall	22.34 insignificant fall		18.76 insignificant fall	29.54 insignificant rise	8.27 significant fall	32.32 insignificant fall	2.01 significant rise		0.00 significant fall
Rapeseed oil	Avg. Vol.**	37.92	23.50	31.73	30.37	45.47	21.12	25.88	28.16	35.30	31.05	16.88
	Equality Test+		-1.69	1.20		1.00	-1.89	0.57	0.27	0.62		-4.09
	p-value (%)		11.36 insignificant fall	24.84 insignificant rise		34.65 insignificant rise	11.80 significant fall	58.51 insignificant rise	79.75 insignificant rise	56.07 insignificant rise		0.03 significant fall
Meat												
Beef	Avg. Vol.**	13.68	14.77	18.20	14.24	13.12	14.04	15.50	24.33	12.07	15.55	20.65
	Equality Test+		0.47	0.84		-0.44	0.25	0.35	1.69	-1.99		3.62
	p-value (%)		64.47 insignificant rise	41.24 insignificant rise		66.99 insignificant fall	80.81 insignificant rise	73.51 insignificant rise	14.13 insignificant rise	8.17 significant fall		0.11 significant rise
Lamb	Avg. Vol.**	22.54	19.76	17.08	28.85	16.22	16.48	23.05	15.61	18.55	19.79	9.87
	Equality Test+		-0.58	-0.81		-1.88	0.06	1.17	-1.42	0.87		-5.93
	p-value (%)		56.75 insignificant fall	43.08 insignificant fall		10.18 insignificant fall	95.59 insignificant rise	28.61 insignificant rise	21.49 insignificant fall	41.30 insignificant rise		0.00 significant fall
Swine Meat	Avg. Vol.**	50.74	48.59	35.15	45.80	55.67	42.15	55.03	37.30	33.00	44.82	24.92
	Equality Test+		-0.24	-1.77		0.85	-1.05	0.91	-1.77	-0.70		-6.00
	p-value (%)		81.52 insignificant fall	10.15 insignificant fall		42.20 insignificant rise	32.66 insignificant fall	38.71 insignificant rise	15.21 insignificant fall	52.04 insignificant fall		0.00 significant fall
Poultry	Avg. Vol.**	14.67	12.56	8.88	13.66	15.68	8.65	16.46	9.01	8.75	12.04	8.65
	Equality Test+		-0.66	-1.51		0.39	-1.44	2.23	-2.33	-0.10		-2.83
	p-value (%)		52.07 insignificant fall	15.24 insignificant fall		70.74 insignificant rise	19.91 insignificant fall	5.62 significant rise	5.28 significant fall	92.05 insignificant fall		0.83 significant fall

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Seafood												
Fish	Avg. Vol.**	18.37	27.10	27.44	15.79	20.95	33.76	20.44	24.25	30.62	24.30	22.08
	Equality Test+		2.05	0.06		1.28	1.95	-2.11	0.81	0.79		-1.10
	p-value (%)		5.98 significant rise	95.10 insignificant rise		25.71 insignificant rise	9.16 significant rise	7.31 significant fall	44.39 insignificant rise	45.75 insignificant rise		28.08 insignificant fall
Shrimp	Avg. Vol.**	33.45	30.09	28.94	28.16	38.74	30.97	29.21	25.07	32.82	30.83	10.35
	Equality Test+		-0.81	-0.21		2.66	-1.15	-0.26	-0.54	0.88		-10.42
	p-value (%)		43.03 insignificant fall	83.53 insignificant fall		3.73 significant rise	30.14 insignificant fall	80.86 insignificant fall	61.35 insignificant fall	40.67 insignificant rise		0.00 significant fall
Sugar												
Free market	Avg. Vol.**	64.71	32.50	43.16	76.99	52.43	35.47	29.54	44.16	42.16	46.79	40.24
	Equality Test+		-4.62	1.64		-2.74	-2.69	-0.78	1.59	-0.18		-1.74
	p-value (%)		0.03 significant fall	12.07 insignificant rise		2.90 significant fall	3.10 significant fall	46.71 insignificant fall	15.15 insignificant rise	86.41 insignificant fall		9.18 significant fall
United States	Avg. Vol.**	21.50	6.90	15.24	36.42	6.59	4.84	8.96	10.60	19.89	14.55	34.00
	Equality Test+		-1.62	1.79		-1.95	-0.89	1.00	0.29	1.13		5.75
	p-value (%)		13.59 insignificant fall	9.65 significant rise		12.33 insignificant fall	41.55 insignificant fall	37.35 insignificant rise	77.62 insignificant rise	30.20 insignificant rise		0.00 significant rise
EU	Avg. Vol.**	n.a.	9.50	11.97	n.a.	n.a.	14.27	5.68	9.81	14.14	10.97	10.01
	Equality Test+		n.a.	0.82		n.a.	n.a.	-2.15	2.26	1.07		-0.53
	p-value (%)		n.a.	42.48 insignificant rise		n.a.	n.a.	12.07 insignificant fall	5.80 significant rise	33.28 insignificant rise		60.37 insignificant fall
Fruits												
Bananas	Avg. Vol.**	50.11	68.38	47.45	43.85	56.36	72.35	64.40	50.94	43.96	55.31	23.43
	Equality Test+		2.61	-2.20		2.09	1.53	-0.63	-1.14	-0.45		-8.63
	p-value (%)		2.07 significant rise	4.21 significant fall		7.05 significant rise	17.58 insignificant rise	54.45 insignificant fall	28.73 insignificant fall	66.38 insignificant fall		0.00 significant fall

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Oranges	Avg. Vol.**	52.87	48.11	52.40	58.68	47.05	51.96	44.27	52.57	52.23	51.13	37.65
	Equality Test+		-0.65	0.53		-1.10	0.46	-0.74	0.59	-0.03		-4.28
	p-value (%)		52.70 insignificant fall	60.29 insignificant rise		30.93 insignificant fall	66.15 insignificant rise	48.28 insignificant fall	57.99 insignificant rise	98.10 insignificant fall		0.02 significant fall
Beverages												
Coffee												
Other milds	Avg. Vol.**	32.95	44.30	27.69	23.62	42.27	42.38	46.22	30.13	25.26	34.98	36.89
	Equality Test+		1.09	-1.92		1.44	0.01	0.23	-1.39	-0.64		0.51
	p-value (%)		29.01 insignificant rise	7.72 significant fall		19.42 insignificant rise	99.53 insignificant rise	82.33 insignificant rise	20.06 insignificant fall	55.11 insignificant fall		61.65 insignificant rise
Robusta	Avg. Vol.**	30.78	36.69	33.56	25.04	36.52	39.24	34.15	38.86	28.26	33.68	21.72
	Equality Test+		0.62	-0.34		1.14	0.15	-0.30	0.55	-1.21		-3.51
	p-value (%)		54.34 insignificant rise	73.80 insignificant fall		29.34 insignificant rise	88.61 insignificant rise	77.53 insignificant fall	59.94 insignificant rise	26.40 insignificant fall		0.15 significant fall
Cocoa Beans	Avg. Vol.**	30.34	26.76	28.41	34.23	26.45	31.31	22.21	31.06	25.75	28.50	21.10
	Equality Test+		-0.66	0.31		-0.96	0.63	-1.28	0.95	-0.65		-3.39
	p-value (%)		51.91 insignificant fall	76.33 insignificant rise		37.21 insignificant fall	55.61 insignificant rise	25.71 insignificant fall	36.94 insignificant rise	53.55 insignificant fall		0.20 significant fall
Tea	Avg. Vol.**	39.41	34.59	26.92	34.37	44.45	36.10	33.09	22.43	31.41	33.64	25.76
	Equality Test+		-0.58	-1.60		0.67	-0.75	-0.38	-1.27	1.67		-2.65
	p-value (%)		56.87 insignificant fall	12.76 insignificant fall		52.31 insignificant rise	48.75 insignificant fall	71.58 insignificant fall	24.54 insignificant fall	15.57 insignificant rise		1.28 significant fall
Agricultural raw materials												
Hardwood												
Logs	Avg. Vol.**	36.49	30.19	15.64	36.42	36.56	35.57	24.82	14.97	16.31	27.44	24.20
	Equality Test+		-0.82	-2.43		0.01	-0.07	-0.99	-1.37	0.25		-1.06

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Logs	p-value (%)		42.37 insignificant fall	3.04 significant fall		99.06 insignificant rise	94.74 insignificant fall	36.14 insignificant fall	20.87 insignificant fall	80.91 insignificant rise		29.85 insignificant fall
Sawnwood	Avg. Vol.**	34.47	19.43	14.21	27.14	41.81	18.43	20.42	13.11	15.32	22.70	13.32
	Equality Test+		-2.18	-1.31		1.29	-2.33	0.26	-1.01	0.66		-3.37
	p-value (%)		4.60 significant fall	21.20 insignificant fall		23.82 insignificant rise	6.71 significant fall	80.26 insignificant rise	35.20 insignificant fall	54.12 insignificant rise		0.22 significant fall
Softwood												
Logs	Avg. Vol.**	21.37	24.16	19.06	24.78	17.96	19.92	28.40	15.26	22.86	21.53	25.43
	Equality Test+		0.53	-1.07		-0.97	0.23	1.07	-2.27	1.54		2.01
	p-value (%)		60.52 insignificant rise	30.22 insignificant fall		36.83 insignificant fall	82.30 insignificant rise	31.44 insignificant rise	6.39 significant fall	17.57 insignificant rise		5.42 significant rise
Sawnwood	Avg. Vol.**	18.04	16.25	22.52	18.49	17.58	18.52	13.98	23.28	21.77	18.94	13.56
	Equality Test+		-0.42	1.87		-0.11	0.13	-1.32	2.07	-0.25		-3.13
	p-value (%)		68.15 insignificant fall	8.05 significant rise		91.47 insignificant fall	90.25 insignificant rise	24.50 insignificant fall	10.68 insignificant rise	80.77 insignificant fall		0.39 significant fall
Cotton	Avg. Vol.**	28.08	21.51	31.66	22.49	33.67	21.26	21.75	39.40	23.93	27.08	31.05
	Equality Test+		-1.56	1.97		1.88	-2.39	0.09	2.68	-1.99		1.86
	p-value (%)		13.73 insignificant fall	6.88 significant rise		9.64 significant rise	4.84 significant fall	92.98 insignificant rise	2.80 significant rise	8.22 significant fall		7.27 significant rise
Wool												
Fine	Avg. Vol.**	20.04	32.55	30.22	11.00	29.08	31.66	33.43	26.66	33.79	27.60	9.24
	Equality Test+		2.14	-0.38		2.45	0.27	0.23	-0.85	0.71		-6.94
	p-value (%)		4.71 significant rise	70.62 insignificant fall		5.80 significant rise	79.52 insignificant rise	82.38 insignificant rise	42.96 insignificant fall	49.70 insignificant rise		0.00 significant fall
Coarse	Avg. Vol.**	16.25	23.10	28.98	15.32	17.19	24.82	21.38	24.28	33.69	22.78	10.81

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Coarse	Equality Test+		1.78	0.98		0.45	1.18	-0.50	0.44	0.92		-5.30
	p-value (%)		9.56 significant rise	34.37 insignificant rise		66.69 insignificant rise	27.77 insignificant rise	63.06 insignificant fall	67.45 insignificant rise	39.09 insignificant rise		0.00 significant fall
Rubber	Avg. Vol.**	25.86	25.75	38.49	28.82	22.91	19.88	31.63	26.46	50.51	30.03	25.26
	Equality Test+		-0.02	1.42		-0.86	-0.28	1.08	-0.69	1.93		-1.46
	p-value (%)		98.66 insignificant fall	17.37 insignificant rise		41.44 insignificant fall	78.67 insignificant fall	32.03 insignificant rise	50.71 insignificant fall	10.15 insignificant rise		15.63 insignificant fall
Hides	Avg. Vol.**	29.55	21.71	26.33	32.38	26.73	17.23	26.20	20.74	31.92	25.86	11.82
	Equality Test+		-1.50	0.60		-0.58	-1.61	2.31	-0.98	0.74		-4.75
	p-value (%)		15.81 insignificant fall	56.09 insignificant rise		57.89 insignificant fall	15.79 insignificant fall	4.97 significant rise	36.60 insignificant fall	49.02 insignificant rise		0.01 significant fall
Metals												
Copper	Avg. Vol.**	31.54	26.08	38.47	24.70	38.39	27.47	24.70	22.39	54.55	32.03	17.12
	Equality Test+		-0.65	1.51		0.91	-0.70	-0.33	-0.37	3.14		-4.03
	p-value (%)		52.88 insignificant fall	15.45 insignificant rise		40.60 insignificant rise	50.74 insignificant fall	75.07 insignificant fall	72.19 insignificant fall	2.00 significant rise		0.04 significant fall
Aluminum	Avg. Vol.**	34.35	24.18	24.95	33.73	34.97	28.97	19.39	15.11	34.79	27.83	18.18
	Equality Test+		-1.57	0.12		0.11	-0.49	-1.30	-1.18	2.16		-3.39
	p-value (%)		13.63 insignificant fall	90.88 insignificant rise		91.54 insignificant rise	64.20 insignificant fall	25.08 insignificant fall	27.11 insignificant fall	8.37 significant rise		0.20 significant fall
Iron Ore	Avg. Vol.**	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	65.96
	Equality Test+		n.a.	1.00		n.a.	n.a.	n.a.	1.00	-1.00		19805.72
	p-value (%)		n.a.	34.34 insignificant rise		n.a.	n.a.	n.a.	37.39 insignificant rise	37.39 insignificant fall		0.00 significant rise

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Tin	Avg. Vol.**	23.16	16.41	34.59	20.05	26.26	18.59	14.22	25.60	43.58	24.72	34.25
	Equality Test+		-1.33	3.31		0.68	-0.91	-0.86	2.02	2.19		3.58
	p-value (%)		20.35 insignificant fall	0.57 significant rise		51.61 insignificant rise	39.60 insignificant fall	41.61 insignificant fall	9.03 significant rise	6.50 significant rise		0.12 significant rise
Nickel	Avg. Vol.**	39.34	35.86	53.33	23.25	55.44	36.36	35.36	36.71	69.95	42.85	35.92
	Equality Test+		-0.35	1.85		2.12	-1.33	-0.11	0.13	2.44		-1.57
	p-value (%)		72.99 insignificant fall	8.71 significant rise		7.88 significant rise	24.19 insignificant fall	91.23 insignificant fall	90.25 insignificant rise	4.48 significant rise		12.76 insignificant fall
Zinc	Avg. Vol.**	30.54	23.25	41.11	23.68	37.41	25.40	21.10	20.15	62.06	31.63	31.68
	Equality Test+		-1.46	2.09		2.09	-1.75	-0.65	-0.13	5.23		0.02
	p-value (%)		16.23 insignificant fall	5.89 significant rise		10.45 insignificant rise	14.12 insignificant fall	54.24 insignificant fall	89.99 insignificant fall	0.20 significant rise		98.79 insignificant rise
Lead	Avg. Vol.**	28.26	26.95	46.10	29.20	27.33	34.32	19.58	24.73	67.46	33.77	31.18
	Equality Test+		-0.24	1.81		-0.26	0.85	-2.00	0.74	3.07		-0.66
	p-value (%)		81.20 insignificant fall	9.56 significant rise		79.81 insignificant fall	42.21 insignificant rise	10.26 insignificant fall	49.50 insignificant rise	2.21 significant rise		51.33 insignificant fall
Uranium	Avg. Vol.**	21.02	23.75	38.38	23.71	18.33	22.54	24.95	24.24	52.52	27.71	13.70
	Equality Test+		0.49	1.98		-0.59	0.50	0.33	-0.10	2.94		-4.50
	p-value (%)		63.32 insignificant rise	6.83 significant rise		57.27 insignificant fall	63.10 insignificant rise	75.11 insignificant rise	92.34 insignificant fall	2.17 significant rise		0.01 significant fall
Energy												
Oil												
Spot Crude	Avg. Vol.**	24.07	38.05	43.51	16.30	31.84	37.97	38.13	34.38	52.64	35.21	12.61
	Equality Test+		1.31	0.54		1.06	0.32	0.01	-0.34	1.48		-5.23
	p-value (%)		20.78	59.71		35.03	75.40	99.23	75.34	21.38		0.00

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Spot Crude			insignificant rise	insignificant rise		insignificant rise	insignificant rise	insignificant rise	insignificant rise	insignificant rise		significant fall
U.K. Brent	Avg. Vol.**	24.00	39.63	44.98	15.74	32.27	38.02	41.24	37.58	52.37	36.20	13.83
	Equality Test+		1.41	0.51		1.15	0.30	0.18	-0.29	1.18		-5.06
	p-value (%)		17.44 insignificant rise	61.59 insignificant rise		31.44 insignificant rise	77.11 insignificant rise	85.91 insignificant rise	78.21 insignificant fall	29.05 insignificant rise		0.00 significant fall
Dubai	Avg. Vol.**	24.88	38.22	41.96	14.54	35.22	40.29	36.14	31.61	52.30	35.02	13.76
	Equality Test+		1.09	0.35		1.15	0.23	-0.24	-0.41	1.63		-4.50
	p-value (%)		29.01 insignificant rise	73.03 insignificant rise		31.34 insignificant rise	82.47 insignificant rise	81.55 insignificant fall	70.51 insignificant fall	17.89 insignificant rise		0.01 significant fall
West Texas Intermediate	Avg. Vol.**	20.64	37.14	44.55	9.91	31.38	36.78	37.50	35.37	53.72	34.11	13.84
	Equality Test+		1.76	0.77		1.94	0.35	0.05	-0.20	1.44		-4.89
	p-value (%)		9.50 significant rise	45.22 insignificant rise		12.49 insignificant rise	73.69 insignificant rise	96.18 insignificant rise	84.75 insignificant fall	20.99 insignificant rise		0.00 significant fall
Natural Gas												
Russian in Germany	Avg. Vol.**	4.96	16.37	31.02	n.a.	4.96	15.73	17.00	20.34	41.70	19.95	12.15
	Equality Test+		2.52	1.45		n.a.	1.57	0.18	0.70	1.14		-1.75
	p-value (%)		2.67 significant rise	17.49 insignificant rise		n.a.	16.77 insignificant rise	86.18 insignificant rise	50.54 insignificant rise	31.92 insignificant rise		9.22 significant fall
Indonesian in Japan (LNG)	Avg. Vol.**	n.a.	24.62	34.33	n.a.	n.a.	15.75	29.94	30.49	38.16	28.59	11.11
	Equality Test+		n.a.	1.50		n.a.	n.a.	2.00	0.06	0.91		-5.70
	p-value (%)		n.a.	15.45 insignificant rise		n.a.	n.a.	11.57 insignificant rise	95.18 insignificant rise	39.01 insignificant rise		0.00 significant fall
US, domestic market	Avg. Vol.**	n.a.	55.12	76.44	n.a.	n.a.	53.20	56.66	91.74	61.13	65.68	42.32

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
US, domestic market	Equality Test+		n.a.	1.42		n.a.	n.a.	0.28	1.31	-1.12		-3.01
	p-value (%)		n.a.	18.09 insignificant rise		n.a.	n.a.	78.85 insignificant rise	24.59 insignificant rise	31.49 insignificant fall		0.76 significant fall
Coal												
Australian, export markets	Avg. Vol.**	15.71	11.96	37.15	19.98	11.45	10.74	13.19	29.87	44.42	21.61	10.79
	Equality Test+		-0.94	3.77		-1.35	-0.12	0.52	2.60	1.18		-3.42
	p-value (%)		36.26 insignificant fall	0.31 significant rise		21.52 insignificant fall	90.46 insignificant fall	61.64 insignificant rise	3.53 significant rise	28.23 insignificant rise		0.19 significant fall

Notes:
* January-September
** Average Annual Volatility
^ 1980-2009 or longest available period
# 1980-2010 or longest available period
+ Welch's Equality Test of average annual volatilities between the selected period and the period in the column to the left.
p-value: 2 sided, df for Welch's T-Test

Appendix 3. Price Volatility by Commodity Measured by the Coefficient of Variation

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Food												
Cereals												
Wheat	Avg. Vol.**(%)	6.01	10.47	11.17	4.52	7.50	10.78	10.16	8.38	13.97	9.22	16.88
	Equality Test+		3.03	0.26		1.55	1.41	-0.28	-0.59	1.16		7.56
	p-value (%)		0.71 significant rise	79.70 insignificant rise		17.22 insignificant rise	19.71 insignificant rise	78.92 insignificant fall	57.49 insignificant fall	28.35 insignificant rise		0.00 significant rise
Maize	Avg. Vol.**(%)	10.73	8.73	9.13	10.43	11.04	7.17	10.29	8.02	10.25	9.53	9.46
	Equality Test+		-0.97	0.18		0.20	-1.22	1.05	-0.70	0.61		-0.08
	p-value (%)		34.34 insignificant fall	86.27 insignificant rise		84.71 insignificant rise	26.83 insignificant fall	33.59 insignificant rise	50.52 insignificant fall	55.90 insignificant rise		93.63 insignificant fall
Rice	Avg. Vol.**(%)	7.96	9.57	7.23	6.82	9.10	10.24	8.90	5.70	8.76	8.25	9.79
	Equality Test+		0.79	-0.79		0.92	0.29	-0.39	-1.44	0.60		1.46
	p-value (%)		44.09 insignificant rise	44.14 insignificant fall		39.31 insignificant rise	77.77 insignificant rise	71.35 insignificant fall	19.43 insignificant fall	57.68 insignificant rise		15.37 insignificant rise
Barley	Avg. Vol.**(%)	13.58	9.15	11.09	15.02	12.14	9.45	8.85	8.74	13.45	11.28	6.13
	Equality Test+		-3.03	0.98		-1.53	-1.49	-0.27	-0.05	1.49		-6.50
	p-value (%)		0.72 significant fall	34.31 insignificant rise		16.45 insignificant fall	17.37 insignificant fall	79.54 insignificant fall	96.10 insignificant fall	19.53 insignificant rise		0.00 significant fall
Vegetable oils and protein meals												
Soybeans	Avg. Vol.**(%)	10.35	6.29	11.69	11.84	8.86	5.19	7.39	11.72	11.66	9.44	4.40
	Equality Test+		-2.45	2.50		-1.05	-1.49	1.36	1.20	-0.01		-5.39
	p-value (%)		2.71 significant fall	2.79 significant rise		32.28 insignificant fall	18.00 insignificant fall	22.21 insignificant rise	29.54 insignificant rise	98.93 insignificant fall		0.00 significant fall

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Soybean meal	Avg. Vol.**(%)	10.80	7.14	11.46	11.85	9.75	5.25	9.02	11.54	11.38	9.80	5.19
	Equality Test+		-1.90	1.82		-0.66	-1.68	1.81	0.58	-0.04		-4.71
	p-value (%)		7.52 significant fall	9.08 significant rise		52.88 insignificant fall	14.31 insignificant fall	11.37 insignificant rise	58.90 insignificant rise	97.21 insignificant fall		0.01 significant fall
Soybean oil	Avg. Vol.**(%)	11.88	6.48	11.71	12.43	11.34	6.74	6.22	11.28	12.14	10.02	4.10
	Equality Test+		-2.59	2.63		-0.27	-2.20	-0.29	1.91	0.23		-5.91
	p-value (%)		2.36 significant fall	2.09 significant rise		79.55 insignificant fall	7.02 significant fall	77.73 insignificant fall	9.80 significant rise	82.70 insignificant rise		0.00 significant fall
Palm oil	Avg. Vol.**(%)	15.54	8.85	14.48	16.39	14.68	9.27	8.43	13.92	15.04	12.96	6.04
	Equality Test+		-2.22	1.68		-0.42	-1.28	-0.17	1.42	0.22		-5.08
	p-value (%)		4.03 significant fall	11.07 insignificant rise		68.59 insignificant fall	23.58 insignificant fall	86.85 insignificant fall	21.38 insignificant rise	83.58 insignificant rise		0.00 significant fall
Fish meal	Avg. Vol.**(%)	6.99	8.40	7.79	9.42	4.56	7.42	9.37	4.15	11.42	7.73	6.34
	Equality Test+		0.99	-0.33		-2.63	2.12	1.29	-3.80	2.85		-1.91
	p-value (%)		33.81 insignificant rise	74.97 insignificant fall		4.64 significant fall	8.71 significant rise	23.82 insignificant rise	0.53 significant fall	2.93 significant rise		6.58 significant fall
Sunflower Oil	Avg. Vol.**(%)	10.81	6.61	12.26	11.64	9.98	6.78	6.44	11.95	12.56	9.89	3.33
	Equality Test+		-1.97	1.70		-0.45	-0.98	-0.13	2.45	0.09		-5.09
	p-value (%)		6.68 significant fall	11.52 insignificant rise		66.81 insignificant fall	35.52 insignificant fall	89.93 insignificant fall	5.76 significant rise	93.01 insignificant rise		0.00 significant fall
Olive oil	Avg. Vol.**(%)	4.01	8.08	6.90	4.00	4.01	7.61	8.55	6.84	6.97	6.33	8.60
	Equality Test+		2.31	-0.54		0.02	1.61	0.26	-0.47	0.05		2.90
	p-value (%)		4.36 significant rise	59.55 insignificant fall		98.54 insignificant rise	16.75 insignificant rise	80.33 insignificant rise	65.51 insignificant fall	96.51 insignificant rise		0.70 significant rise

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Groundnuts	Avg. Vol.**(%)	17.02	13.90	8.37	22.91	11.14	21.61	6.19	4.42	12.31	13.10	2.21
	Equality Test+		-0.53	-1.24		-1.49	1.32	-2.25	-1.00	3.56		-5.24
	p-value (%)		60.24 insignificant fall	23.75 insignificant fall		17.98 insignificant fall	22.94 insignificant rise	8.73 significant fall	34.78 insignificant fall	0.74 significant rise		0.00 significant fall
Rapeseed oil	Avg. Vol.**(%)	12.29	7.23	10.10	10.70	13.88	6.45	8.02	9.01	11.20	9.88	5.82
	Equality Test+		-1.89	1.37		0.64	-2.06	0.67	0.38	0.60		-3.70
	p-value (%)		8.07 significant fall	19.08 insignificant rise		54.14 insignificant rise	9.43 significant fall	52.44 insignificant rise	71.39 insignificant rise	56.99 insignificant rise		0.09 significant fall
Meat												
Beef	Avg. Vol.**(%)	4.47	4.91	5.94	4.53	4.40	4.70	5.11	7.97	3.92	5.11	6.11
	Equality Test+		0.55	0.78		-0.14	0.24	0.30	1.68	-2.03		2.17
	p-value (%)		58.72 insignificant rise	44.73 insignificant rise		89.50 insignificant fall	81.63 insignificant rise	76.82 insignificant rise	13.78 insignificant rise	7.68 significant fall		3.87 significant rise
Lamb	Avg. Vol.**(%)	6.82	6.68	5.70	8.77	4.88	5.75	7.61	5.12	6.28	6.40	3.19
	Equality Test+		-0.10	-0.88		-2.03	0.62	0.98	-1.40	1.01		-6.26
	p-value (%)		92.13 insignificant fall	39.05 insignificant fall		8.23 significant fall	55.54 insignificant rise	36.30 insignificant rise	22.10 insignificant fall	34.55 insignificant rise		0.00 significant fall
Swine Meat	Avg. Vol.**(%)	16.14	16.35	11.62	14.64	17.64	14.09	18.62	12.60	10.65	14.71	9.03
	Equality Test+		0.07	-1.82		0.75	-0.85	0.97	-1.93	-0.84		-5.06
	p-value (%)		94.47 insignificant rise	9.16 significant fall		47.82 insignificant rise	42.74 insignificant fall	36.24 insignificant rise	11.13 insignificant fall	43.87 insignificant rise		0.00 significant fall
Poultry	Avg. Vol.**(%)	5.00	4.44	2.98	4.53	5.47	2.88	6.00	3.12	2.83	4.14	2.97
	Equality Test+		-0.43	-1.54		0.46	-1.36	2.15	-2.11	-0.34		-2.49
	p-value (%)		67.36 insignificant fall	14.87 insignificant fall		66.06 insignificant rise	23.06 insignificant fall	6.89 significant rise	7.97 significant fall	74.39 insignificant fall		1.86 significant fall

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Seafood												
Fish	Avg. Vol.**(%)	6.43	8.51	9.23	5.76	7.11	10.72	6.30	8.55	9.92	8.06	7.35
	Equality Test+		1.50	0.38		0.93	1.74	-2.26	1.21	0.45		-1.04
	p-value (%)		15.41 insignificant rise	70.55 insignificant rise		39.39 insignificant rise	12.09 insignificant rise	5.85 significant fall	25.95 insignificant rise	67.06 insignificant rise		30.63 insignificant fall
Shrimp	Avg. Vol.**(%)	10.84	9.28	9.31	8.49	13.19	9.79	8.77	8.25	10.37	9.81	3.46
	Equality Test+		-0.98	0.01		2.77	-1.24	-0.42	-0.21	0.73		-9.09
	p-value (%)		34.18 insignificant fall	98.84 insignificant rise		3.22 significant rise	25.55 insignificant fall	68.90 insignificant fall	83.93 insignificant fall	48.73 insignificant rise		0.00 significant fall
Sugar												
Free market	Avg. Vol.**(%)	21.32	10.14	15.16	26.18	16.45	11.09	9.19	15.64	14.69	15.54	14.55
	Equality Test+		-4.41	1.98		-3.12	-1.86	-0.72	1.91	-0.21		-0.72
	p-value (%)		0.05 significant fall	6.59 significant rise		1.42 significant fall	9.96 significant rise	48.91 insignificant fall	9.83 significant rise	84.23 insignificant fall		47.70 insignificant fall
United States	Avg. Vol.**(%)	6.89	2.27	5.14	11.64	2.14	1.45	3.08	3.42	6.87	4.77	10.10
	Equality Test+		-1.60	1.76		-1.96	-0.97	1.01	0.17	1.25		4.87
	p-value (%)		13.84 insignificant fall	10.04 insignificant rise		12.12 insignificant fall	38.71 insignificant fall	36.99 insignificant rise	87.27 insignificant rise	25.70 insignificant rise		0.00 significant rise
EU	Avg. Vol.**(%)	n.a.	3.02	4.08	n.a.	n.a.	4.57	1.78	3.11	5.05	3.63	3.09
	Equality Test+		n.a.	0.99		n.a.	n.a.	-2.16	1.86	1.28		-0.91
	p-value (%)		n.a.	33.53 insignificant rise		n.a.	n.a.	9.74 significant fall	10.52 insignificant rise	25.81 insignificant rise		37.51 insignificant fall
Fruits												
Bananas	Avg. Vol.**(%)	15.75	22.14	14.74	13.83	17.68	22.89	21.38	15.63	13.85	17.54	8.10
	Equality Test+		2.74	-2.43		1.90	1.55	-0.35	-1.48	-0.37		-7.79
	p-value (%)		1.59 significant rise	2.59 significant fall		9.37 significant rise	17.14 insignificant rise	73.29 insignificant fall	17.76 insignificant fall	72.16 insignificant fall		0.00 significant fall

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Oranges	Avg. Vol.**(%)	17.62	14.91	16.96	20.16	15.08	16.50	13.33	17.22	16.69	16.50	11.42
	Equality Test+		-1.05	0.78		-1.29	0.40	-1.01	0.91	-0.12		-4.66
	p-value (%)		30.77 insignificant fall	44.74 insignificant rise		23.71 insignificant fall	70.05 insignificant rise	35.31 insignificant fall	40.44 insignificant rise	91.05 insignificant fall		0.01 significant fall
Beverages												
Coffee												
Other milds	Avg. Vol.**(%)	11.25	14.35	8.69	7.77	14.73	14.80	13.90	9.35	8.03	11.43	13.93
	Equality Test+		0.75	-1.78		1.28	0.01	-0.14	-1.35	-0.59		1.75
	p-value (%)		46.09 insignificant rise	10.31 insignificant fall		24.91 insignificant rise	99.27 insignificant rise	89.19 insignificant fall	21.46 insignificant fall	58.09 insignificant fall		9.15 significant rise
Robusta	Avg. Vol.**(%)	10.43	12.41	10.46	8.48	12.37	14.78	10.03	11.92	9.00	11.10	8.67
	Equality Test+		0.52	-0.57		0.92	0.33	-0.74	0.73	-1.12		-1.87
	p-value (%)		60.86 insignificant rise	57.96 insignificant fall		39.03 insignificant rise	75.13 insignificant rise	50.27 insignificant fall	48.64 insignificant rise	29.81 insignificant fall		7.18 significant fall
Cocoa Beans	Avg. Vol.**(%)	9.39	8.62	9.15	10.79	8.00	10.19	7.05	10.21	8.09	9.05	5.68
	Equality Test+		-0.42	0.28		-1.07	0.90	-1.25	0.98	-0.74		-4.50
	p-value (%)		68.09 insignificant fall	78.47 insignificant rise		32.18 insignificant fall	40.25 insignificant rise	25.89 insignificant fall	35.68 insignificant rise	48.30 insignificant fall		0.01 significant fall
Tea	Avg. Vol.**(%)	12.89	10.47	8.45	10.95	14.84	10.34	10.60	6.70	10.20	10.60	10.26
	Equality Test+		-0.86	-1.27		0.74	-1.21	0.11	-1.48	1.80		-0.34
	p-value (%)		40.32 insignificant fall	21.86 insignificant fall		47.83 insignificant rise	27.92 insignificant fall	91.79 insignificant rise	18.29 insignificant fall	11.54 insignificant rise		73.61 insignificant fall
Agricultural raw materials												
Hardwood												
Logs	Avg. Vol.**(%)	12.41	10.00	5.13	12.39	12.43	11.64	8.35	5.16	5.10	9.18	8.35
	Equality Test+		-0.80	-2.42		0.01	-0.13	-0.93	-1.17	-0.03		-0.70
	p-value (%)		43.82 insignificant fall	2.99 significant fall		99.43 insignificant rise	89.65 insignificant fall	38.46 insignificant fall	27.49 insignificant fall	97.60 insignificant fall		48.68 insignificant fall

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Sawnwood	Avg. Vol.**(%)	12.01	7.18	4.64	9.18	14.84	7.16	7.21	4.87	4.41	7.95	4.70
	Equality Test+		-1.64	-1.56		1.12	-1.57	0.01	-0.82	-0.31		-2.88
	p-value (%)		12.39 insignificant fall	14.20 insignificant fall		30.43 insignificant rise	17.66 insignificant fall	98.96 insignificant rise	44.29 insignificant fall	76.81 insignificant fall		0.75 significant fall
Softwood												
Logs	Avg. Vol.**(%)	6.57	7.50	5.47	12.39	12.43	11.64	8.35	5.16	5.10	9.18	8.35
	Equality Test+		0.54	-1.37		-0.77	0.34	0.67	-2.26	1.66		0.77
	p-value (%)		59.52 insignificant rise	19.10 insignificant fall		47.52 insignificant fall	73.99 insignificant rise	52.32 insignificant rise	7.32 significant fall	15.74 insignificant rise		44.80 insignificant rise
Sawnwood	Avg. Vol.**(%)	5.73	4.76	6.87	9.18	14.84	7.16	7.21	4.87	4.41	7.95	4.70
	Equality Test+		-0.66	2.24		0.08	-0.28	-0.72	2.04	-0.39		-2.78
	p-value (%)		52.50 insignificant fall	4.20 significant rise		93.65 insignificant rise	78.96 insignificant fall	50.22 insignificant fall	11.14 insignificant rise	70.74 insignificant fall		0.95 significant fall
Cotton	Avg. Vol.**(%)	9.61	7.20	10.23	7.72	11.49	7.17	7.23	12.71	7.75	9.01	8.97
	Equality Test+		-1.74	1.73		2.14	-2.47	0.03	2.31	-1.86		-0.06
	p-value (%)		9.85 significant fall	10.46 insignificant rise		6.49 significant rise	3.89 significant fall	97.66 insignificant rise	5.00 significant rise	10.02 insignificant fall		95.39 insignificant fall
Wool												
Fine	Avg. Vol.**(%)	6.39	11.17	10.41	3.86	8.91	10.72	11.61	8.97	11.84	9.32	3.80
	Equality Test+		2.55	-0.34		2.02	0.59	0.36	-0.86	0.74		-5.86
	p-value (%)		2.09 significant rise	73.90 insignificant fall		9.99 significant rise	57.11 insignificant rise	73.21 insignificant rise	42.48 insignificant fall	48.01 insignificant rise		0.00 significant fall
Coarse	Avg. Vol.**(%)	5.21	7.82	9.74	4.82	5.59	7.98	7.65	7.44	12.04	7.59	4.28
	Equality Test+		1.91	0.85		0.55	1.11	-0.13	-0.09	1.22		-3.95
	p-value (%)		7.64 significant rise	41.08 insignificant rise		59.63 insignificant rise	30.40 insignificant rise	90.12 insignificant fall	93.18 insignificant fall	26.94 insignificant rise		0.05 significant fall

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Rubber	Avg. Vol.**(%)	8.43	8.78	12.57	9.01	7.85	6.61	10.95	8.50	16.64	9.93	8.11
	Equality Test+		0.15	1.26		-0.48	-0.33	1.14	-0.92	2.04		-1.66
	p-value (%)		87.96 insignificant rise	22.57 insignificant rise		64.51 insignificant fall	75.01 insignificant fall	29.62 insignificant rise	38.55 insignificant fall	8.72 significant rise		10.69 insignificant rise
Hides	Avg. Vol.**(%)	9.82	7.45	9.08	10.42	9.23	5.98	8.92	7.26	10.91	8.79	4.03
	Equality Test+		-1.42	0.59		-0.38	-1.66	2.43	-0.83	0.66		-4.63
	p-value (%)		17.90 insignificant fall	56.80 insignificant rise		71.55 insignificant fall	14.13 insignificant fall	4.57 significant rise	44.33 insignificant fall	53.56 insignificant rise		0.01 significant fall
Metals												
Copper	Avg. Vol.**(%)	9.87	8.69	12.92	7.35	12.38	9.06	8.33	6.92	18.92	10.49	6.22
	Equality Test+		-0.44	1.43		1.12	-0.70	-0.26	-0.62	3.31		-3.43
	p-value (%)		66.38 insignificant fall	17.72 insignificant rise		31.41 insignificant rise	51.06 insignificant fall	80.52 insignificant fall	55.21 insignificant fall	2.13 significant rise		0.18 significant fall
Aluminum	Avg. Vol.**(%)	10.70	7.84	8.09	10.90	10.50	9.64	6.04	4.79	11.38	8.87	5.89
	Equality Test+		-1.45	0.11		-0.13	-0.24	-1.46	-0.93	2.22		-3.37
	p-value (%)		16.55 insignificant fall	91.29 insignificant rise		90.23 insignificant fall	81.62 insignificant fall	19.55 insignificant fall	37.80 insignificant fall	7.68 significant rise		0.22 significant fall
Iron Ore	Avg. Vol.**(%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	28.91
	Equality Test+		n.a.	1.00		n.a.	n.a.	n.a.	1.00	-1.00		30066.74
	p-value (%)		n.a.	34.34 insignificant rise		n.a.	n.a.	n.a.	37.39 insignificant rise	37.39 insignificant fall		0.00 significant rise
Tin	Avg. Vol.**(%)	7.80	5.19	11.07	6.31	9.29	5.97	4.40	8.56	13.58	8.02	10.68
	Equality Test+		-1.42	3.35		0.90	-1.05	-0.93	2.10	1.82		2.98
	p-value (%)		17.99 insignificant fall	0.48 significant rise		39.84 insignificant rise	33.62 insignificant fall	38.75 insignificant fall	9.00 significant rise	10.67 insignificant rise		0.58 significant rise

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Nickel	Avg. Vol.**(%)	12.65	11.86	18.24	7.60	17.69	11.65	12.08	11.81	24.67	14.25	11.31
	Equality Test+		-0.25	1.85		2.13	-1.46	0.14	-0.07	2.63		-1.94
	p-value (%)		80.60 insignificant fall	8.88 significant rise		7.10 significant rise	20.46 insignificant fall	89.14 insignificant rise	94.36 insignificant fall	3.88 significant rise		6.26 significant fall
Zinc	Avg. Vol.**(%)	10.39	7.76	13.42	7.91	12.88	8.78	6.73	6.59	20.25	10.52	10.81
	Equality Test+		-1.43	1.91		2.08	-1.59	-0.84	-0.05	4.35		0.26
	p-value (%)		16.97 insignificant fall	8.04 significant rise		10.65 insignificant rise	16.33 insignificant fall	43.05 insignificant fall	96.12 insignificant fall	0.48 significant rise		80.05 insignificant rise
Lead	Avg. Vol.**(%)	9.21	8.18	15.02	9.73	8.69	10.39	5.97	7.87	22.17	10.80	10.36
	Equality Test+		-0.58	1.92		-0.39	0.64	-2.12	0.85	2.86		-0.33
	p-value (%)		56.59 insignificant fall	8.14 significant rise		70.54 insignificant fall	53.77 insignificant rise	7.88 significant fall	43.47 insignificant rise	2.86 significant rise		74.29 insignificant fall
Uranium	Avg. Vol.**(%)	7.09	7.82	12.53	7.75	6.43	8.03	7.60	8.20	16.86	9.15	5.22
	Equality Test+		0.38	1.93		-0.45	0.51	-0.16	0.25	2.70		-3.87
	p-value (%)		70.76 insignificant rise	7.31 significant rise		66.70 insignificant fall	62.69 insignificant rise	87.62 insignificant fall	80.63 insignificant rise	3.07 significant rise		0.06 significant fall
Energy												
Oil												
Spot Crude	Avg. Vol.**(%)	6.95	12.41	14.22	5.02	8.87	12.89	11.94	10.96	17.49	11.19	4.05
	Equality Test+		1.60	0.50		1.08	0.69	-0.15	-0.24	1.66		-5.03
	p-value (%)		13.12 insignificant rise	62.39 insignificant rise		32.94 insignificant rise	51.48 insignificant rise	88.07 insignificant fall	82.04 insignificant fall	15.76 insignificant rise		0.00 significant fall
U.K. Brent	Avg. Vol.**(%)	6.81	13.02	14.56	4.67	8.95	12.88	13.17	11.69	17.43	11.46	4.28
	Equality Test+		1.73	0.41		1.27	0.64	0.04	-0.33	1.45		-4.88
	p-value (%)		10.52 insignificant rise	68.95 insignificant rise		27.30 insignificant rise	54.00 insignificant rise	96.60 insignificant rise	75.22 insignificant fall	20.64 insignificant rise		0.00 significant fall

Commodity		1980-89	1990-99	2000-09	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	1980-2009^	2010*
Dubai	Avg. Vol.**(%)	7.30	12.93	13.87	4.53	10.07	14.15	11.71	10.30	17.44	11.37	4.12
	Equality Test+		1.40	0.24		1.17	0.58	-0.36	-0.33	1.78		-4.60
	p-value (%)		17.89 insignificant rise	81.40 insignificant rise		30.76 insignificant rise	57.85 insignificant rise	72.73 insignificant fall	75.49 insignificant fall	14.91 insignificant rise		0.01 significant fall
West Texas Intermediate	Avg. Vol.**(%)	6.11	11.77	14.55	3.62	8.60	12.03	11.51	11.27	17.83	10.81	4.33
	Equality Test+		1.96	0.84		1.89	0.73	-0.10	-0.06	1.64		-4.86
	p-value (%)		6.86 significant rise	40.98 insignificant rise		13.15 insignificant rise	49.07 insignificant rise	92.41 insignificant fall	95.10 insignificant fall	16.28 insignificant rise		0.00 significant fall
Natural Gas												
Russian in Germany	Avg. Vol.**(%)	1.99	6.28	11.97	n.a.	1.99	6.14	6.42	8.46	15.47	7.70	5.19
	Equality Test+		2.43	1.65		n.a.	1.59	0.10	1.11	1.11		-1.60
	p-value (%)		3.34 significant rise	12.47 insignificant rise		n.a.	16.35 insignificant rise	92.10 insignificant rise	30.12 insignificant rise	33.07 insignificant rise		12.23 insignificant fall
Indonesian in Japan (LNG)	Avg. Vol.**(%)	n.a.	8.21	10.91	n.a.	n.a.	5.32	9.95	9.61	12.20	9.27	3.36
	Equality Test+		n.a.	1.22		n.a.	n.a.	1.71	-0.11	1.04		-5.86
	p-value (%)		n.a.	24.50 insignificant rise		n.a.	n.a.	16.22 insignificant rise	91.63 insignificant fall	33.31 insignificant rise		0.00 significant fall
US, domestic market	Avg. Vol.**(%)	n.a.	17.08	23.01	n.a.	n.a.	16.76	17.33	26.47	19.56	20.03	13.96
	Equality Test+		n.a.	1.33		n.a.	n.a.	0.14	1.20	-0.84		-2.65
	p-value (%)		n.a.	20.60 insignificant rise		n.a.	n.a.	89.49 insignificant rise	28.48 insignificant rise	43.29 insignificant rise		1.62 significant fall
Coal												
Australian, export markets	Avg. Vol.**(%)	5.34	4.07	11.71	6.89	3.79	3.65	4.49	9.11	14.32	7.04	3.41
	Equality Test+		-0.89	3.75		-1.30	-0.08	0.58	2.39	1.44		-3.68
	p-value (%)		38.64 insignificant fall	0.32 significant rise		23.08 insignificant fall	94.07 insignificant fall	58.08 insignificant rise	4.39 significant rise	19.99 insignificant rise		0.09 significant fall

Notes:
* January-September
** Average Annual Volatility
^ 1980-2009 or longest available period
# 1980-2010 or longest available period
+ Welch's Equality Test of average annual volatilities between the selected period and the period in the column to the left.
p-value: 2 sided, df for Welch's T-Test.

Price Volatility of Cotton and Other Commodities

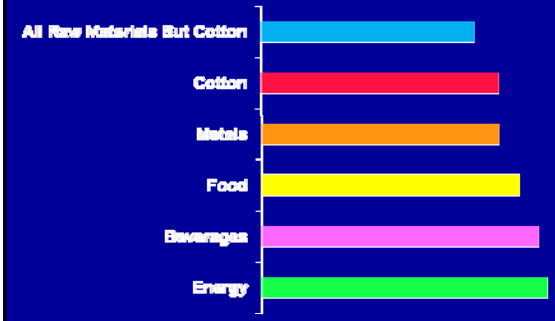
International Cotton Advisory Committee
Standing Committee Meeting 507
Attachment III

23 November 2010

Overview

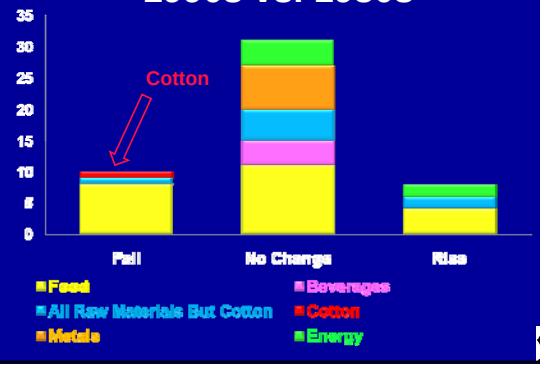
- Monthly Prices for 53 Commodities, 1980-2010
  - Cotton
  - All raw materials but cotton
  - Metals
  - Beverages
  - Food
  - Energy
- Daily Cotton Prices, 1972-2010

Annual Average Volatility: 1980-2009

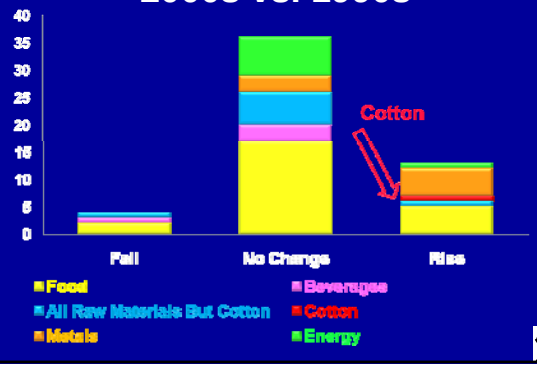


Annual Average Volatility: 1980-2009

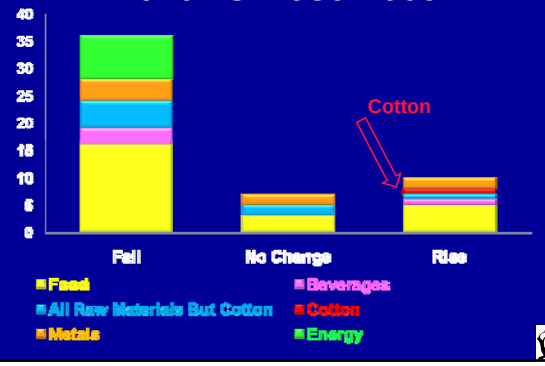
Change in Volatility: 1990s vs. 1980s



Change in Volatility: 2000s vs. 1990s

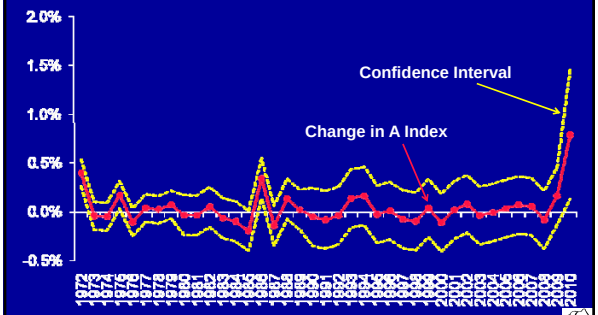


Change in Volatility: 2010 vs. 1980-2009



Volatility of Daily Futures Prices and the A Index

Volatility: Season-Average Inter-Daily Change in A Index



Volatility 53 Commodities Monthly Prices

Conclusions:

- No consistently rising or falling pattern of price volatility for any commodity.
- In 2010, volatility fell for 4 out of 6 commodities, and rose for 1 out of 6 commodities (with respect to long term average volatility).

Volatility 53 Commodities Monthly Prices

Conclusions (cont'd):

- Volatility of cotton prices:
  - Similar to volatility of other raw agricultural products, food, and metals; but lower than volatility of energy and beverages.
  - Fell in the 1990s, rose in the 2000s.
  - In 2010, higher than long term average volatility.

Volatility: Daily Cotton Prices

Conclusions:

- Volatility of the A Index increased across decades from the 1970s to the 1990s, but remained stable in the 2000s, and peaked in 2010/11 to a record.
- 1999/00-2008/09: futures prices more volatile than A Index
- 2009/10-2010/11: similar volatility


International Cotton Advisory
Committee