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Are Commodity Prices More Volatile Now?

A Long-Run Perspective

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Abstract

Soaring commodity prices in 2007 and 2008 raised concerns that volatility was also rising, which would have implications for welfare and therefore for the design of public policy interventions. The literature focuses on trends in commodity prices rather than their volatility characteristics. This paper contributes by examining commodity price volatility with a newly compiled monthly panel dataset on 45 individual commodity prices from the end of the 18th century until today. The main conclusions are: the timing and number of breaks in volatility vary considerably across individual commodities, cautioning against generalizations based on the use of commodity price indices; the three most significant breaks common to most commodities are the two world wars and the collapse of the Bretton-Woods system; and structural breaks marking increased price volatility are followed by breaks marking declines in volatility so that there is no upward or downward trend in volatility over time.

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1. Introduction and Motivation

On July 11, 2008 the spot price of West Texas intermediate crude oil peaked at US$ 146 per barrel, exactly double the price a year earlier. Since then, oil prices bottomed at US$30 in December 2008, rebounding to around US$ 70 as of the time of writing. Such see-saw movements have not been confined to oil only. In 2008 large increases were also recorded for foodstuffs, metals, and commodities in general. The "commodity boom" was everywhere in the news and in policymakers' agenda. The concern was not only about the elevated price of commodities, but also that these prices had become more volatile.[1] Some analysts, including the OECD, argued that this higher commodity price volatility seemed to be driven by structural determinants.[2]

The issue of rising commodity price volatility is policy relevant. Poor countries with production and trade structures concentrated on commodities are vulnerable to price swings. The perceived welfare effects of variable commodity prices have inspired public policy interventions in developed countries as well.[3] Even the beneficiaries of higher commodity prices, such as farmers, have expressed concerns that higher volatility renders hedging mechanisms ineffective.[4] Their complaint was that options had become so expensive due to elevated levels of volatility and hence risk, so that using options as a hedge was no longer financially viable. In general, a large number of policies – price supports, buffer stocking, and producer and consumer subsidies – have been rationalized on the basis that smoothing commodity price volatility away carries significant welfare gains.

While there is a large literature focused on the trend in price level, stemming from the Prebisch-Singer hypothesis of a secular decline in the relative prices of primary products,

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[1] International Institute for Sustainable Development 2008 argued that "[…]in the past 30 years, there have been as many price shocks across the range of commodities as there were in the preceding 75 years" *Boom or bust: how commodity price volatility impedes poverty reduction, and what to do about it"*, IISD, January 2008.

[2] OECD-FAO (2008) Agricultural Outlook 2008-2017 discussed at length permanent factors that may increase volatility and underlined how Least Developed Countries could be negatively affected in an era of "high commodity prices and high price volatility," pg. 4.

[3] For example, the EU's Common Agricultural Policy, the Canadian Wheat Board, and US implicit agricultural price support policies.

[4] "Price Volatility Adds to Worry on US Farms," New York Times article on April 22, 2008.

volatility characteristics of commodity prices have attracted less attention. In this paper, we therefore address the following question: has commodity price volatility increased? We do this by exploiting a newly compiled unbalanced panel dataset on 45 individual commodity prices spanning the 1784-2009 period at a monthly frequency.

2. Literature Review

Ever since Prebisch (1950) and Singer (1950), a vast literature has grown around the issue of identifying a secular trend in commodity prices. This research has been mainly concerned that commodity prices tend to decline relative to the price of manufactures with obvious implications for the primary producers.[5] In contrast, the literature on the volatility of commodity prices and its public policy implications is relatively small. This research is mainly focused on understanding how commodity price volatility affects income volatility, especially in poor countries (Koren and Tenreyro (2007)), among others). Other authors have been concerned with how commodity price volatility generates instability in international markets (Blanford (1983), Heifner and Kinoshita (1994) among others).

While mainly concerned with identifying price cycles – booms and slumps – Cashin and McDermott (2002) also test to see if variability in prices is higher or lower across cycles. Using The Economist's index of industrial commodity prices over the period 1862 – 1999, they find evidence of a ratcheting up in the variability of commodity price movements around 1899 and then again in the early 1970s.[6]

The finding of higher variability in commodity prices after the end of the Bretton Woods era is in line with hypotheses of a link between nominal (and real) exchange rates and the volatility of dollar denominated commodity prices Chu and Morrison (1984), Reinhart and Wickham (1994), Cuddington and Liang (1999). Comparing three different datasets[7]

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[5] Interest about a possible negative long-term trend in commodity prices has occupied development economic literature since the late 1940s. For instance in Prebisch (1950) and Singer (1950), Grilli and Yang (1988), Cuddington and Urzua (1989), Cuddington (1992), Powell (1991), Reinhart and Wickham (1994).
[6] For annual data, Cashin and McDermott define large booms as a sequence of generally increasing prices that have had a price movement of at least 25 percent over the phase, and large slumps as a sequence of generally decreasing prices that have had a price movement of at least 25 percent over the phase.
[7] The datasets are the following: (1) the annual data set of Grilli and Yang from 1900 to 1992, (2) Boughton's dataset with annual observations from 1854 to 1990, (3) the IMF's *International Financial Statistics* (IFS) which covers the post World War II period with monthly observations.

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and using the methodology in Eichengreen (1994) to identify exchange rates regimes, Cuddington and Liang (2003) find that the relative price of primary commodities in terms of manufactured goods exhibits greater volatility since the early 1970s, a period characterized by an increasing number of flexible-exchange rate regimes. Mitchell (1987) presented the idea that increased trade, capital flows, policy shocks to macroeconomic variables and exchange rate uncertainty affect agricultural commodity prices.

Moledina, Roe, and Shane (2004) find little evidence for higher volatility post-1971, once predictable components are removed from the "classic" measure of volatility (the unconditional standard deviation or the coefficient of variation[8]). Moreover, they show no statistical evidence for either a positive or negative trend in median volatility. Only three of the twelve commodities in their sample (bananas, coffee, and wheat) show some increase in volatility over the sample period. They argue that the welfare gains from eliminating commodity price volatility are therefore tiny, at less than one percent of total consumption.

One lesson from Moledina *et al* (2004) is that the absence of a common trend across commodity prices calls for a need to study factors underlying commodity price volatility separately in each market. This was also highlighted by Leon and Soto (1995), who had analyzed the long-run dynamics of the price of the 24 most traded commodities over the 1990 – 1992 period. They tested for the presence of unit roots in the series, allowing for endogenously determined structural breaks. The results show that 15 of the 24 commodity prices in their sample exhibit a negative trend, six are trendless, and three show a positive trend[9].

Closest to this paper in spirit is Jacks, O'Rourke and Williamson (2009), who also examine commodity prices over a long time span. They define volatility as the standard deviation of price changes over a given period and use monthly observations on local market prices (to account for the impact of tariffs and embargoes) for four broadly defined commodity indices. They use the standard UNCTAD classification: all food

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[8] See Offutt and Blandford (1981) for a list of different single variable measures based on the standard deviation. Moreover, see Kroner, Kneafsey, and Claessens (1993) for a "classical" approach using the standard deviation of price changes.

[9] The Cusum Break Test for TS models shows the following breaks: Coffee 1945, Maize 1920, Palm Oil 1985, Rice 1920, Sugar 1922, Timber 1985, and Tin 1985.

(AF), agricultural raw materials (ARM), minerals, ores and metals (MOM) plus a fourth group for manufactures or final good (FG).

We provide below a review of the existing literature on commodity prices volatility.

Author	Research Question	Data	Methodology	Results
Moledina A., Roe L., Shane M. (2004)	The paper tries to determine the most appropriate measure of commodity prices volatility and investigates the presence of a linear time trend in the conditional volatility series.	Monthly prices (1957-2001) for selected agricultural commodities from IMF's *IFS*. CPI data from Bureau of Labor Statistics are used to deflate each commodity series.	GARCH (or ARIMA) model fitted to compute conditional volatility.	The paper attributes most of the volatility in commodity prices to macroeconomic and political factors. Moreover, the median volatility over time for all commodities does not show consistent increases or decreases.
Cuddington J.T., Jerrett D. (2008)	Do metal prices exhibit any long-term upward or downward trends? Is there evidence of a strong super-cycle component for each series? Is there any strong co-movement of the super-cycle components? How pronounced are the shorter cycles?	Annual data series (in some cases from 1850) on the LME-traded nonferrous metals from Heap (2005). US CPI (2006=100) used to deflate the series.	Band-pass filters developed by Baxter and King (1999) and Christiano and Fitzgerald (2003).	Considerable evidence of three past super-cycles in real metal prices. Moreover it finds evidence for high correlation of the six LME metal super-cycles.
Jacks S., O'Rourke K.H., Williamson J.G. (2009)	Has commodity price increased over time? Have commodities always shown greater price volatility than manufactures? Does market integration breed more or less commodity price volatility?	Monthly local city prices (UNCTAD classification) from different sources, including Bezanson (2005), Posthumus (1946), Friis and Glamann (1958), Gayer, Rostow, Schwartz (1953), IMF and UNCTAD.	The paper presents descriptive statistics of a selected measure of volatility. Prices volatility is defined as the standard deviation of the price ratio.	No evidence of an increase of commodity prices volatility though time. It also concludes that higher commodity price volatility compared to manufactures has been a constant since 18th century. It finds evidence that economic isolation has been associated with higher commodity price volatility.

Cashin P., McDermott C.J. (2001)	The paper addresses two research questions: what is the empirical behavior of commodity prices? Are there any changes in the variability of commodity prices and in the trend growth of prices over time?	Real annual data of the nominal industrial commodities price index (dollar based), deflated by the GDP deflator of the United States over the period 1862-1999.	Following Watson (1994) the paper applies two econometric tests on a "peak-trough" analysis to determine the length of a cycle and its statistical significance. Descriptive statistics complement the analysis.	No evidence of a break in the long-run trend decline in commodity prices. Evidence of a ratcheting up in the variability of price movements. The amplitude of price movements increased in the early 1900s, while the frequency of large price movements increased after the collapse of the Bretton Woods regime of fixed exchange rates.
Cuddington J.T., Liang H. (2003)	The study investigates differences in real primary commodity price volatility across fixed and flexible exchange rate regimes.	The paper combines three datasets: Grilli and Yang (1988), Boughton (1991) and IMF's *IFS*. The paper examines a *real* commodity price index, defined as the ratio of the chosen nominal commodity index deflated by a manufacturing unit value (MUV) index.	ANOVA tests are performed on long-run data to test equal variance across fixed and flexible exchange rate periods. Dummy variables in a (T)GARCH (1,1) framework are used to test the presence and persistence of a volatility shock.	Strong evidence supporting the conjecture that the flexible exchange periods have been associated with higher real commodity price volatility than the fixed exchange periods.
Leon J., Soto R. (1995)	The paper revises the long and short run time series structure of commodity prices in order to answer the questions of the secular decline and the long-run persistence of shocks.	Monthly prices of the twenty-four most-traded commodities in 1900-92.	The paper applies the non-parametric estimator of persistence proposed by Cochrane (1988 and 1991) and extended by Lo and McKinley (1989) and Chow and Denning (1993).	15 of the 24 commodity prices have negative trends, 6 are trendless and 3 exhibit positive trends implying that Prebisch-Singer hypothesis holds for most commodities. Evidence suggests that there may be substantial room for stabilization and price support mechanisms for most commodities.

Here, the question of whether commodity price volatility has increased over time is addressed with analytical rigor and at a disaggregated level. We use a unique, newly compiled dataset of 45 individual commodity prices and five commodity price indices at a monthly frequency. Two econometric tests are applied for identifying structural breaks in GARCH-type processes in order to provide a robustness check and these are described below.

3. Data

For this paper we use a newly compiled dataset which covers 45 individual commodities and 5 commodity price indexes. We use a monthly unbalanced panel of observations from Global Financial Data (GFD) covering the period 1784 – 2009. We take a pragmatic approach as to what constitutes a "commodity" and take all "commodities" included in the GFD dataset as our subject of study. We use data from GFD as it is the most comprehensive source, verifying that the price data is consistent with that from alternative sources (World Bank, IMF, and UNCTAD) for any overlapping commodity and time period. The details of the dataset can be found in Table 1.

Table 1. Availability of monthly price data for individual commodities and indexes

Group	Sub-group	No.	Commodity	Additional description (if any)	Units	Monthly data available since	Source
Energy		1	Coal		US$/Tm	Jan-1932	GFD
		2	Crude petroleum	West Texas Intermediate	US$/barrel	Jan-1860	GFD
Food	Beverages	3	Cocoa		US$/Tm	Jan 1817	GFD
		4	Coffee	Brazil Santos Arabica	US cents/lb	Jan-1900	GFD
		5	Tea		US cents/lb	Jan-1861	GFD
	Fats and oils	6	Copra	Philippines copra	US$/Tm	Jan-1929	GFD
		7	Corn oil	Wet mill, Chicago	US cents/pound	Jul-1924	GFD
		8	Cottonseed oil		US cents/lb	Aug-1909	GFD
		9	Lard	Average wholesale price	US cents/lb	Jan 1859	GFD
		10	Soybean oil		US cents/lb	Jan-1911	GFD
		11	Soybeans		US$/bushel	Sep-1923	GFD
		12	Tallow	Wholesale price	US cents/lb	Jan-1910	GFD
	Grains	13	Barley	No. 2	US cents/lb	Jan-1894	GFD
		14	Corn	No. 2 yellow	US$/bushel	Jan-1860	GFD
		15	Flaxseed	Average price to farmers	US$/bushel	Jan-1901	GFD
		16	Oats		US$/bushel	Jan-1826	GFD
		17	Rice	Bangkok	US$/Tm	Oct-1914	GFD
		18	Wheat	Hard Red Winter, No. 2, US	US$/bushel	Jul-1841	GFD
	Other food	19	Butter		US cents/pound	Jan 1890	GFD
		20	Cheese	Cheese 40-lb. Blocks	US cents/pound	Jan-1929	GFD
		21	Eggs		US cents/douzen	Jan 1890	GFD
		22	Live Cattle		US cents/pound	Jan 1858	GFD
		23	Live Hog		US cents/pound	Jan 1858	GFD
		24	Milk		US$/CWT	Jan-1890	GFD
		25	Oranges		US$/Tm	Jan-1914	GFD
		26	Pepper	Black pepper in New York	US cents/lb	Dec-1919	GFD
		27	Sheep	Sheep Av. Price	US$/CWT	Jan-1874	GFD
		28	Sugar	No. 11	US cents/lb	Jan-1784	GFD
Raw materials		29	Cotton		US cents/lb	Jan 1784	GFD
		30	Hides	Cattle hides	US cents/pound	Jan-1890	GFD
		31	Lumber		US$/1000 board feet	Jan-1891	GFD
		32	Rubber		US cents/lb	Jan-1890	GFD
		33	Wool	64s, staple 2 3/4 and up, US	US cents/lb	Jan-1890	GFD
Metals and minerals		34	Aluminum	High grade, LME, cash	Not specified	Jan-1910	GFD
		35	Copper	High grade	US cents/lb	Jan-1927	GFD
		36	Ferromanganese		US$/gross ton	Jan-1908	GFD
		37	Gold	Gold bullion, New York	US$/ounce	Jan-1800	GFD
		38	Lead	Lead bar	US$/Tm	Jan 1800	GFD
		39	Mercury		US cents/lb	Jan-1915	GFD
		40	Platinum		US$/ounce	Jan-1910	GFD
		41	Silver	99.9% Ag, New York	US cents/ounce	Jan 1784	GFD
		42	Steel scrap	Heavy melting steel scrap in Chicago	US$/Tm	Jan-1894	GFD
		43	Tin	Straits, pigs	US cents/lb	Jan-1861	GFD
		44	Wirebar	Copper Wirebar New York dealer	US cents/Lb	Jan 1800	GFD
		45	Zinc		US$/Tm	Jan-1875	GFD
Indexes		1	Economist		-	Nov 1850	GFD
		2	Food		-	Dec-1910	GFD
		3	Metal		-	Dec-1910	GFD
		4	Moody's		-	Jan-1928	GFD
		5	Non Food		-	Dec-1910	GFD

Before proceeding to discuss potential tests for multiple structural breaks we need to further characterize the underlying time series data. The commodity price series show a high degree of persistence and a clear heteroskedastic component. This suggests the use

of a GARCH process to characterize our data. GARCH models, which have become extremely popular since their introduction by Engle (1982), allow for time varying volatility and permit the inclusion of additional structural determinants that can tell you how volatility is changing and what drives it.

We formally tested the validity of this approach by fitting an AR(1) model and found the coefficient to be statistical significant at 1% level for all commodities (see results for selected commodities in Table 2). We then tested the presence of heteroskedaticity using a Breusch-Pagan ARCH Test on the residuals of the AR(1) regression and we found evidence of heteroskedasticity for all commodities as shown in the right hand side of Table 2. Visual inspection of the residuals from AR(1) regressions clearly exhibit volatility clusters as shown in Chart 1 for selected commodities. Overall, the choice of a (G)ARCH process to model the behavior of commodity prices appears robust.

Table 2. AR(1) coefficients and Breusch-Pagan ARCH Test for selected commodities

	AR (1)		Breusch - Pagan ARCH Test	
	Coefficient	t-Statistics	F - Statistics	Probability
Coal	0.99	221.2	179.7	0.00
Coffee	0.99	283.1	32.4	0.00
Copper	0.99	229.4	176.8	0.00
Corn	0.99	336.2	59.0	0.00
Cotton	0.99	340.9	119.3	0.00
Crude Petroleum	0.93	156.5	87.5	0.00
Gold	1.00	743.7	92.4	0.00
Lead	0.99	384.6	250.9	0.00
Rice	0.99	245.7	232.0	0.00
Silver	0.98	264.8	145.3	0.00
Sugar	0.98	286.7	453.8	0.00
Tea	1.00	243.3	144.7	0.00
Wheat	0.99	326.7	149.1	0.00
Zinc	0.99	372.9	378.0	0.00

Chart 1. Residuals from AR(1) model on selected commodity prices

Actual minus fitted values

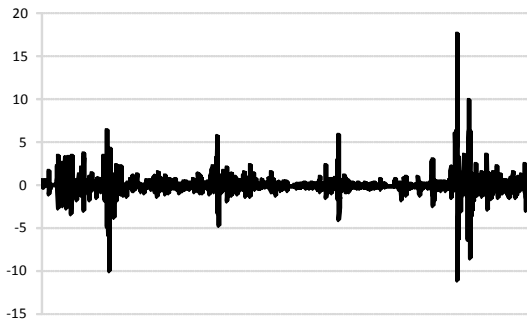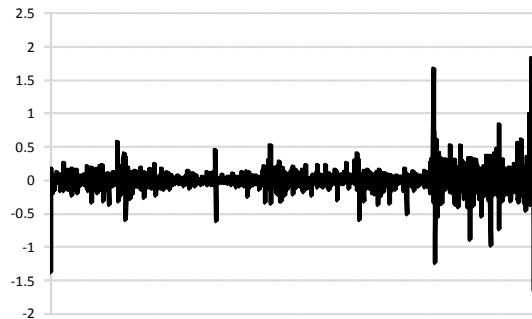### *Copper*
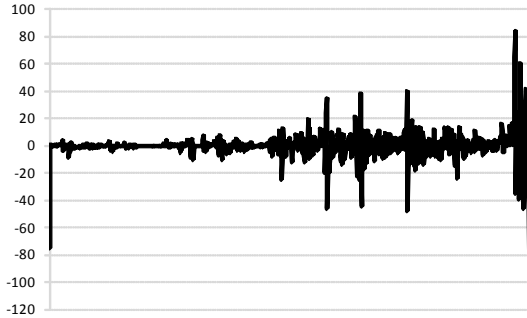
Corn
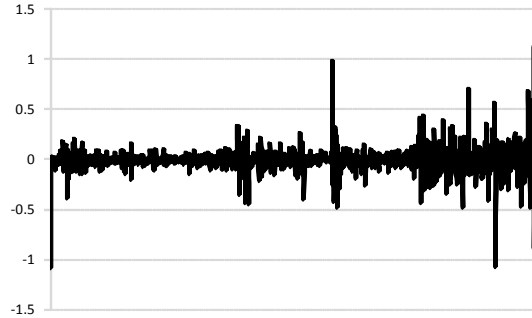
Sugar

Wheat

Source: Authors' calculations

4. Methodology

Our search for an econometric methodology to detect breaks in commodity price volatility was based largely on three criteria. First, it ought to allow for the detection of multiple breaks. Second, the dates of the breaks should not be the result of an arbitrarily imposed choice but should instead be endogenously generated by the chosen methodology. Finally, given that commodity prices can be characterized as GARCH processes, methodologies specifically designed for ARCH-type of models would be preferred. On the basis of these three criteria we selected two tests: the Kokoszka and Leipus (KL 2000) test and the Inclan and Tiao (IT 1994) test. Both tests have been

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applied in the literature to (G)ARCH-type models – see for example Hillebrand and Schnabl (2006) and Hillebrand (2005) for the use of the KL test and Granger and Hyung (1999) who applied the IT test to examine breaks in the absolute returns of the S&P 500.

To explain the KL (2000) test it is useful to start from the basic GARCH definition. ARCH models are generally defined by two equations:

$$r_k = \sigma_k \varepsilon_k, \quad \sigma_k^2 = a + \sum_{j=1}^{\infty} b(j) r_{k-j}^2 \qquad (1)$$

Where ε_k are iid errors, and a and $b(j)$ are non-negative constants. These equations are suitable for series r_k such that the observations are uncorrelated but exhibit clusters of volatility. Note that if ε_k have zero mean, unit variance and the sequence $\{r_k\}$ is weakly stationary, then:

$$Var[r_k] = a / (1 - \sum_{j=1}^{\infty} b(j)) \qquad (2)$$

The KL test assumes that the parameters a and $b(j)$ change at an *unknown* point k^* in such a way that the variance given by (2) changes. The test statistic is a CUSUM-type estimator $k^{\wedge}$ of k^* defined as follows:

$$k^{\wedge} = \min \left\{ k : |R_k| = \max_{1 \le j \le n} |R_j| \right\} \qquad (3)$$

Where

$$R_k = \frac{k(n-k)}{n^2} \left(\frac{1}{k} \sum_{j=1}^{k} r_j^2 - \frac{1}{n-k} \sum_{j=k+1}^{n} r_j^2 \right) \qquad (4)$$

The normalized test $\sup \{|R_k(k)|\} / \hat{\sigma}$ is asymptotically distributed as a Kolmogorov-Smirnov process, where $\hat{\sigma}$ is an estimate of the long-run standard deviation estimated using a VAR HAC estimator.[10] The general approach is to begin with the full set of observations to determine the first break. This break is then used to split the sample into two sub-series. The estimator then calculates breaks for the sub-series in order to

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[10] See den Haan and Levin (1997). For the choice of lags, we have followed the formula Lags = *floor*(4(T(/100)^(2/9))).

establish additional breaks. This iterative procedure is stopped once a break is found to be statistically insignificant.

The IT test is based on a centered version of the cumulative sum of squares presented by Brown, Durbin, and Evans (1975). It is an algorithm that applies in principle to independent series and is designed to find a break in the (unconditional) variance with unknown location.

Define C_k, the cumulative sum of squares of a series of uncorrelated random variables $\{a_t\}$ with mean 0 and variances σ_t^2, $t = 1,2,...,T$. as follows:

$$C_k = \sum_{t=1}^{k} a_t^2$$

(5)

Also define D_k, $k = 1,...,T$, with $D_0 = D_T = 0$, as the centered cumulative sum of squares.

$$D_k = \frac{C_k}{C_T} - \frac{k}{T}$$

(6)

Time series with no breaks in variance would exhibit a plot of D_k oscillating around 0. A sudden change in variance would cause the plot of D_k to exhibit a pattern going out of the critical boundaries with high probability. Under variance homogeneity, the normalized statistic $\sqrt{T/2}D_k$ behaves asymptotically like a Brownian bridge. The advantage of the KL test is its validity under a wide class of processes, including long memory, GARCH-type and non-linear time series models. The relative advantage of the IT test is its simplicity and its independence from estimated long-run variance (which makes the test robust to time period selection).

The Montecarlo simulations of Andreou and Ghysels (2002) suggest that the IT test has power and only minor size distortions when applied to strongly dependent data, though it is not as powerful as the KL (2000) test. It suffers from size distortions (above 10%) for all data generating processes (high and low volatility persistence) but appears to have good power in detecting even small changes in the GARCH coefficients or the error

process for large *T*. The test is not seriously affected by outliers for large samples ($T > 3000$).

The KL test has good power only for large and non-monotonic changes in the GARCH parameters for any data generating processes for the absolute returns rather than the squared. The KL (2000) test shows good power for detecting changes in the variance of the error terms in the GARCH process and appears fully robust to outliers. Finally, as the sample size (*T*) increases the performance of the test improves even for small change points.

We use both monthly and daily data on individual commodities in order to account fully for differences across commodity markets since both the mean and volatility in individual prices exhibits different break points. Additionally, the use of individual prices allows us to examine whether the relationship between prices of different commodities has changed over time. Further, a measure of how this relationship has changed permits an examination of the role of financial market integration in determining price dispersion or synchronization. Finally, we introduce robustness checks given the scale-dependence of measured volatility.

5. Results

Both tests highlight the heterogeneity across individual commodities. Even in periods where volatility breaks are more common it is far from the case that all, or even most commodities, exhibit the same regime shifts. This can be illustrated by Chart 2 below, which shows the percentage of commodities in our sample for which we detect a break in any given decade. As Chart 2 highlights, in most decades the proportion of commodities that experience a break is relatively low (below 10-15 percent using the KL test and less than 50 percent using the IT test). Even in decades of very high volatility, like the 1910s, 1940s, and 1970s there is a number of commodity prices which did not exhibit breaks in volatility.

Chart 2. Prevalence of structural breaks in volatility identified by KL and IT tests
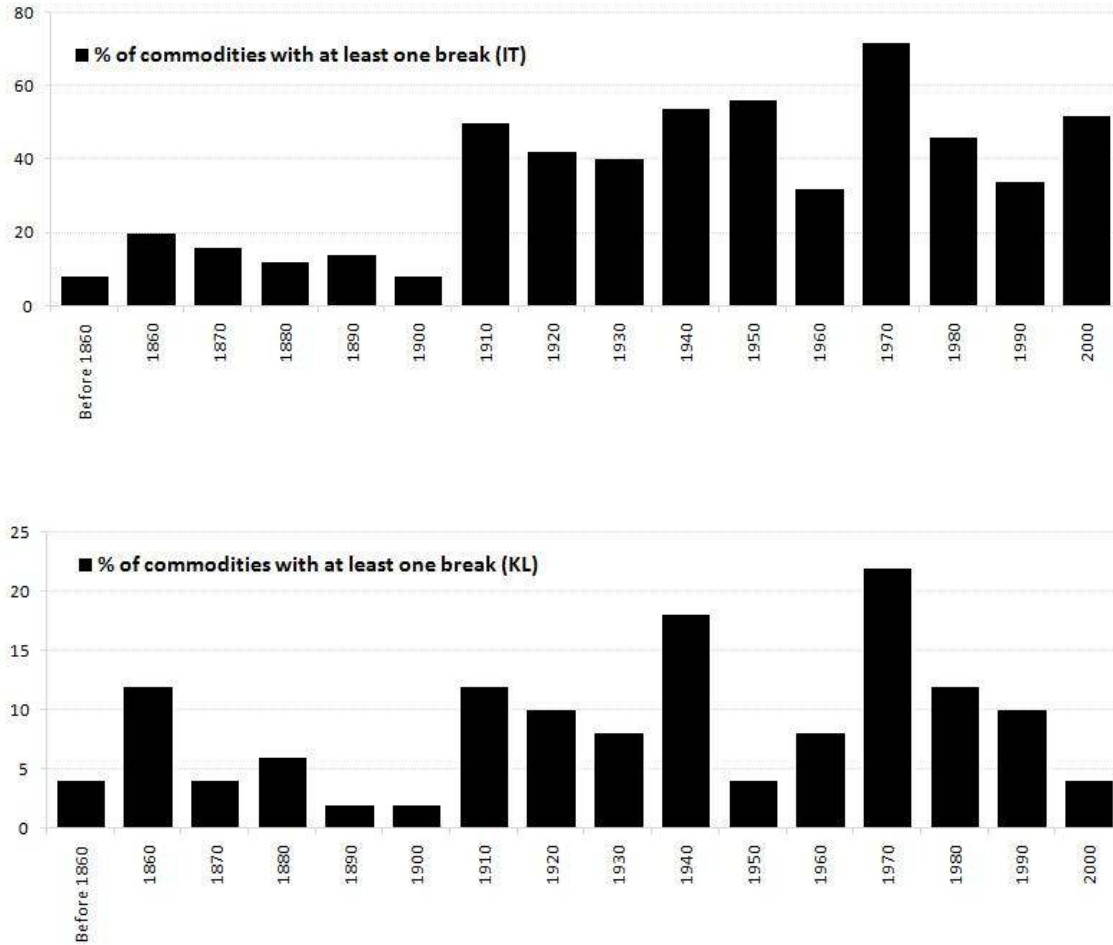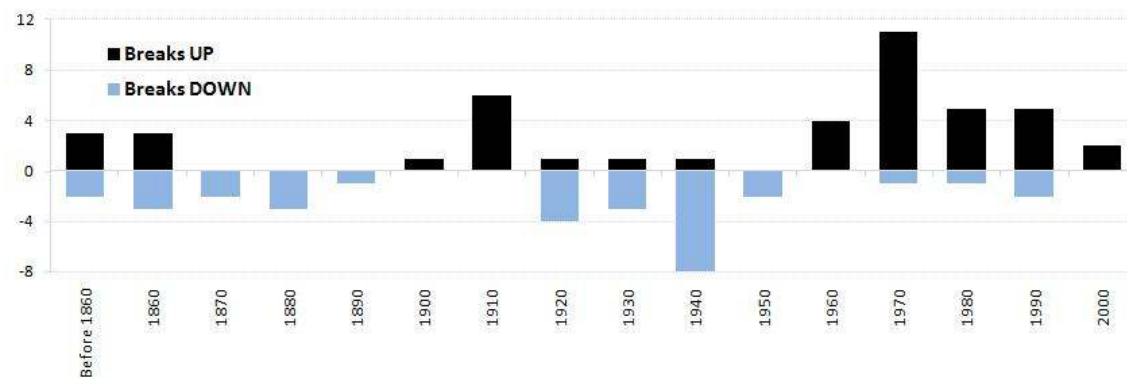

Source: Authors' calculations

Still, there are three periods where structural breaks in volatility are more common: the two world wars and the collapse of the Bretton-Woods system. This can be further illustrated by Chart 3 below, which also distinguishes between breaks marking increased price volatility and those that mark decreased volatility. Again, the results are shown for both the KL and IT test, with the expected differences in the number of breaks found (as the IT test is less stringent and thus more breaks are likely to be found). However, the overall pattern of breaks in volatility is broadly similar (with the exception of the 2000s, an issue to which we will return later).

Chart 3. Number of structural breaks in volatility

IT test
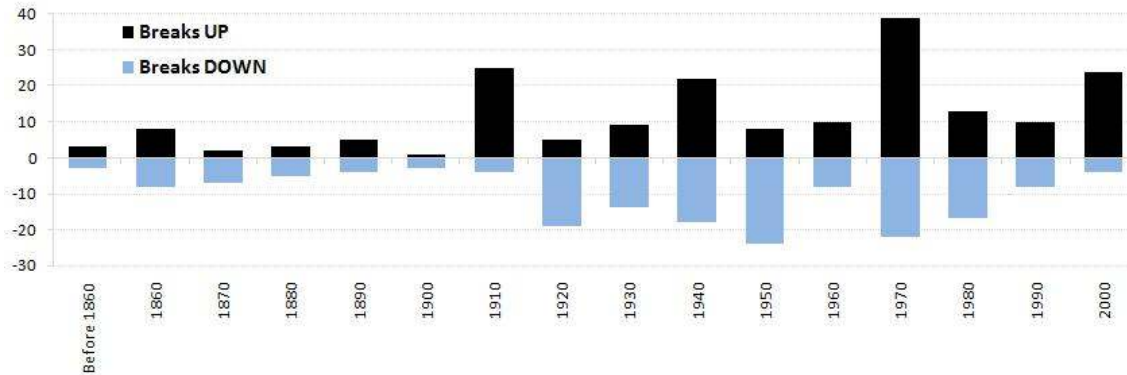
KL test

Source: Authors' calculations

The reason for why the two tests appear to give contradictory results in the 1940s has got to do with the deregulation of previously controlled prices in the aftermath of World War II. At that point there was a spike in volatility because prices had been kept constant during the war. This is picked up as a break in volatility by the IT test while it is not the case for the KL test, which is fully robust to outliers and is picking up the decrease in volatility that will characterize the Bretton Woods era.

Focusing on the period since the 1970s, it is worth noting that the KL test still detects upward breaks in volatility in the 1980s, the 1990s, and the 2000s. This suggests an overall increase in volatility as these breaks add to those observed during the 1970s (generally speaking the breaks in the 1980s and 1990s detected by the KL test affect commodities which did not see upward breaks during the 1970s). So, even using the

stringent KL test, fifty percent of all commodities are now in a higher volatility regime than during the Bretton Woods period (using the IT test 37 out of 45 individual commodities are now in a more volatile regime than they were during the Bretton Woods period). It is important to stress that when upward breaks in volatility are not followed by downward breaks, volatility increases as a whole. This can help to explain why commodity price volatility is currently higher but the evidence on the number of structural breaks in the 2000s seems ambiguous depending on whether we use the KL or IT test. The difference in results for the 2000s between the two tests can also be related to the possibility that 2008 may still prove to be an outlier (and therefore the KL test is less likely to determine a break so close to the end-point of a time series). The very different sensitivity of the two tests can be illustrated by Chart 4, which shows the number of commodities that have exhibited 0, 1, 2, 3, or 4 breaks since the 1970s. Because the KL is particularly apt for a long-term analysis, focusing on its results may not be that informative when analyzing short-term trends.

Chart 4. Number of breaks since the 1970s (by structural breaks in volatility)
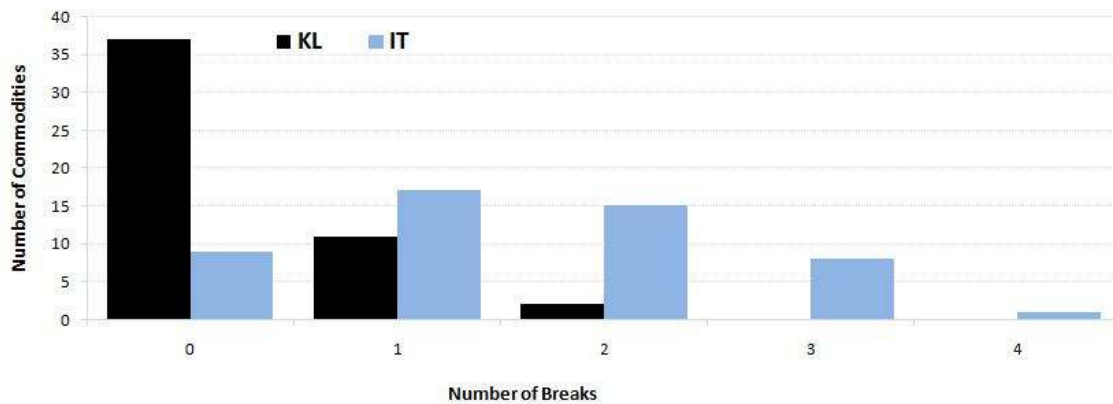
Source: Authors' calculations

Drawing on the IT test we can conclude that there have been a number of upward breaks in price volatility in recent years. This is illustrated by Chart 5 below, which shows the average number of commodities that see a break in any given year (calculated using 5-year moving averages). In fact, the number of commodities that have seen such upward breaks in volatility in the 2000s is close to that observed during the 1910s, 1940s, and 1970s. This makes the recent period the decade with the fourth-highest increase in

volatility as measured by the number of commodities experiencing upward breaks (again using the IT test). However, the evidence suggests that structural breaks marking increased price volatility are subsequently followed by downward breaks in volatility so that there is no upward or downward trend in volatility over time.

Chart 5. Breaks in volatility identified by KL and IT tests

IT breaks – 5 years moving average
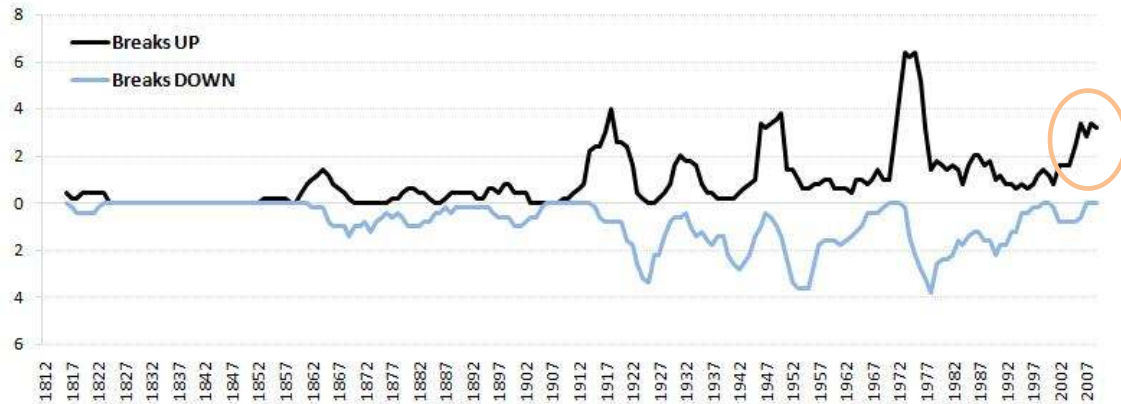
KL breaks – 5 years moving average
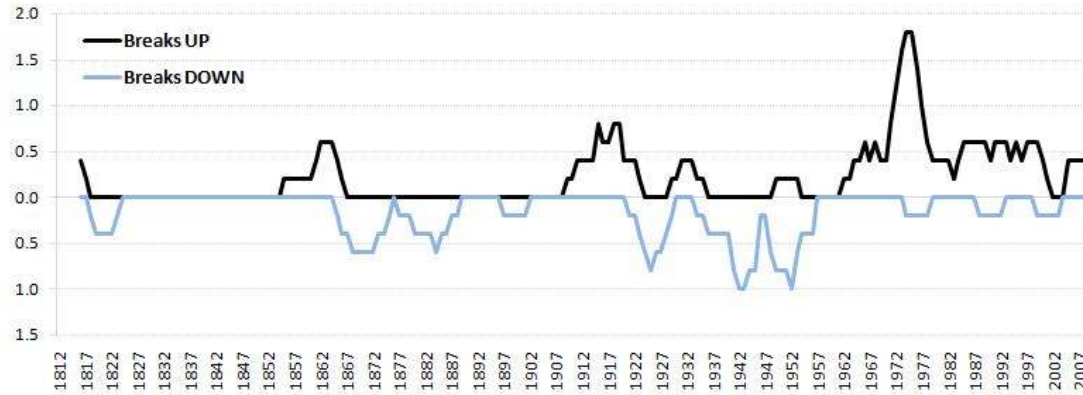
Source: Authors' calculations

6. Conclusions

Our paper is motivated by three main questions. First, is there a pattern of volatility across commodities over time? Second, is there a long-run trend in commodity price volatility? Third, are there identifiable breaks in commodity price volatility? For example, do we see changes in volatility when the world went from relatively open (1820 – 1913) to closed (1914 – 1949) and then to open (1950-2009)?

Drawing on a large unbalanced panel of monthly prices of 45 individual commodities and 5 commodity price indices we address these issues by implementing two tests for detecting structural change. Both tests have the advantage of not imposing a priori the dates of potential structural breaks. While both tests are based on CUSUM-type test statistics, they differ in how they establish the threshold above which a change in volatility is considered a structural break. The Kokoszka-Leipus test uses an estimate of the long-run variance of the entire time series to determine such a threshold level. As a result, it is a more stringent test resulting in fewer breaks and by and large only three periods in history are associated with breaks in volatility in most (but not all) commodities: the two world wars and the collapse of the Bretton-Woods system. The Inclan-Tiao (IT) test, in contrast, considers only the properties of the time series since the last identified break in volatility. As a result, threshold volatilities are re-defined every time a break is found. This results in less stringent thresholds and therefore more breaks in volatility – both upwards and downwards. Therefore, even though break-points may overlap, the IT test, constructed to be more sensitive, picks up more frequent shifts. However, the historical breaks coincide under both methodologies.

The main conclusions are as follows. First, the timing and number of breaks in volatility vary considerably across individual commodities. This result cautions against broad generalizations and the use of commodity price indices to analyze changes in volatility. Second, the three most significant breaks common to most (but not all) commodities, are the two world wars and the collapse of the Bretton-Woods system. In recent years, however, there has been an uptick in price volatility in a number of commodities. During the last food crisis though, it is clear that volatility spiked, starting to rise before the actual increase in price levels especially for the most tradable commodities. However, the

evidence suggests that structural breaks marking increased price volatility are subsequently followed by downward breaks in volatility so that there is no upward or downward trend in volatility over time.

Annex – selected individual commodity price series

Cocoa

Monthly Price
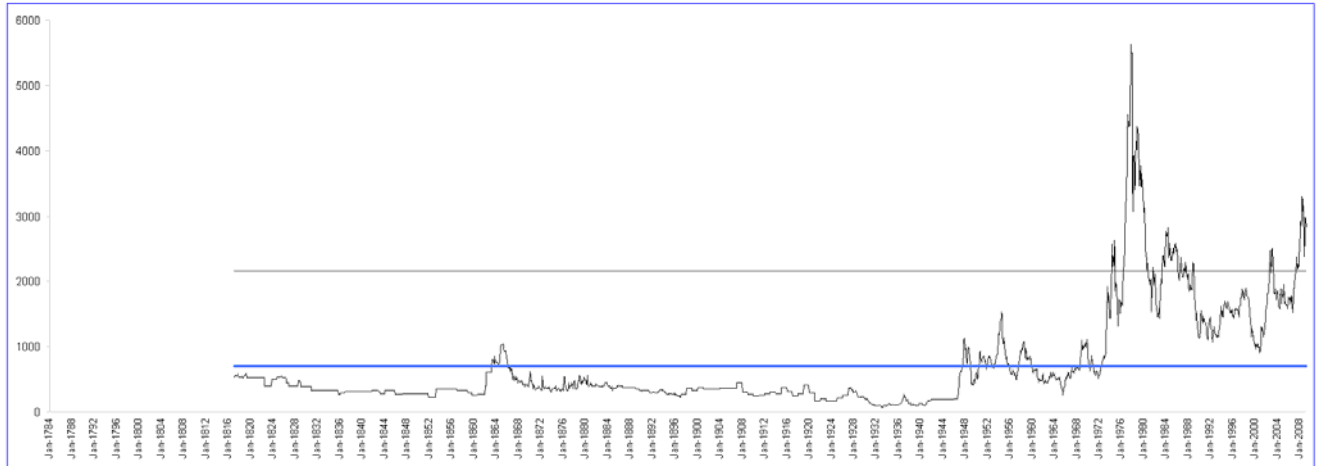
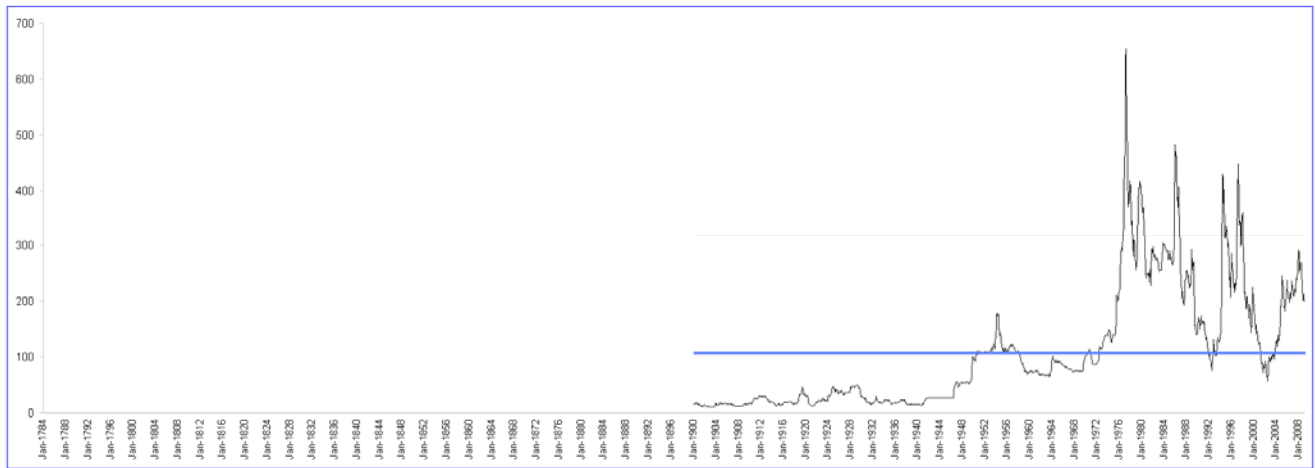**Monthly Returns (% change) and KL (2000) test detected breaks**
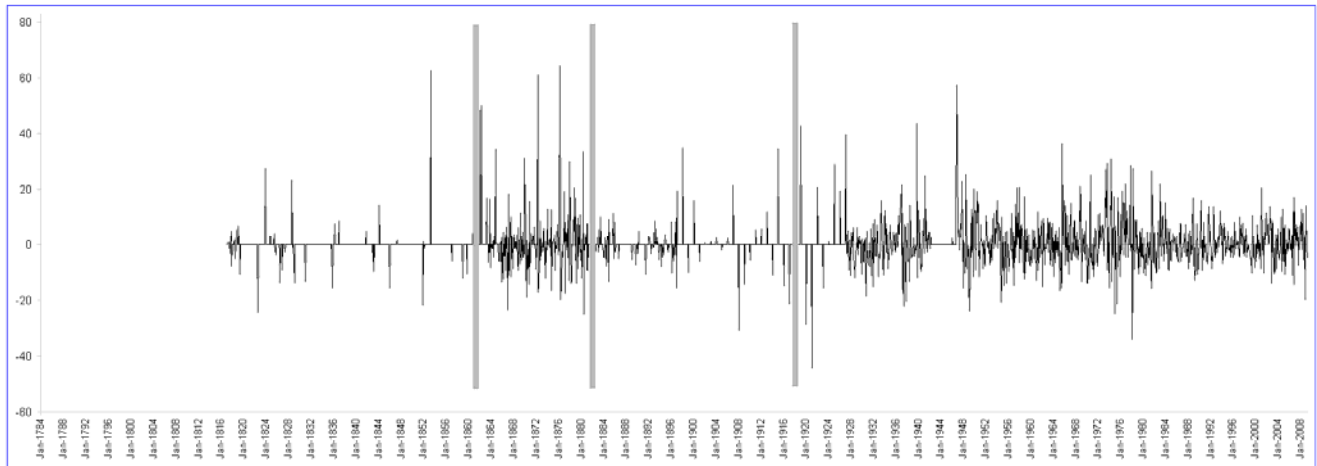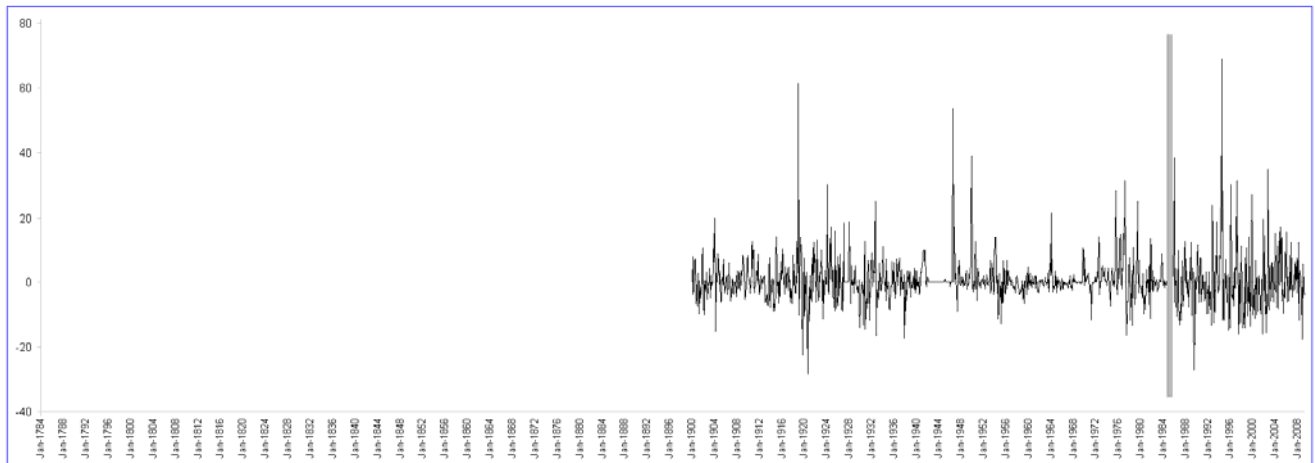

Detected Breaks by KL (2000) test:

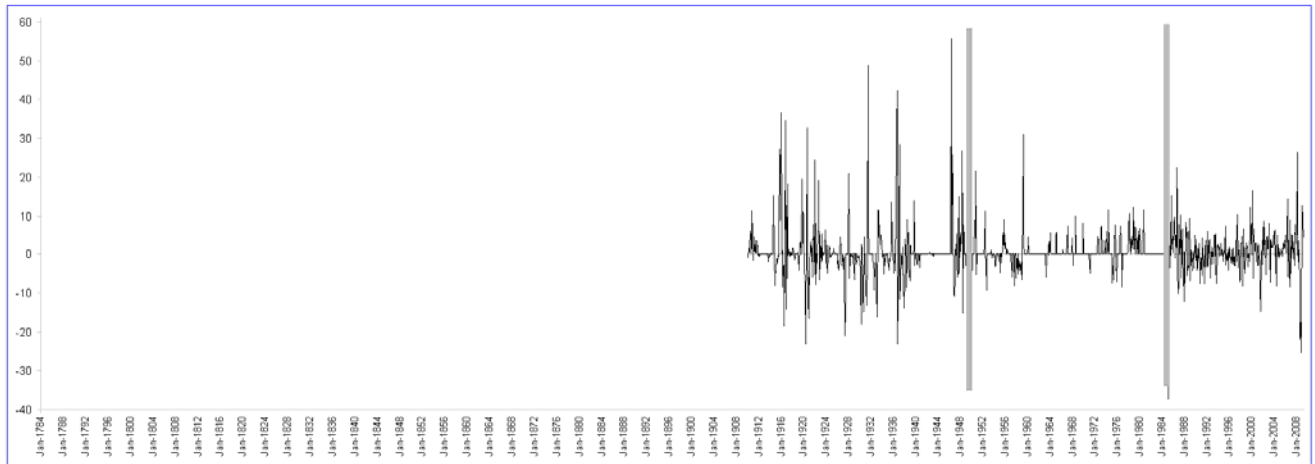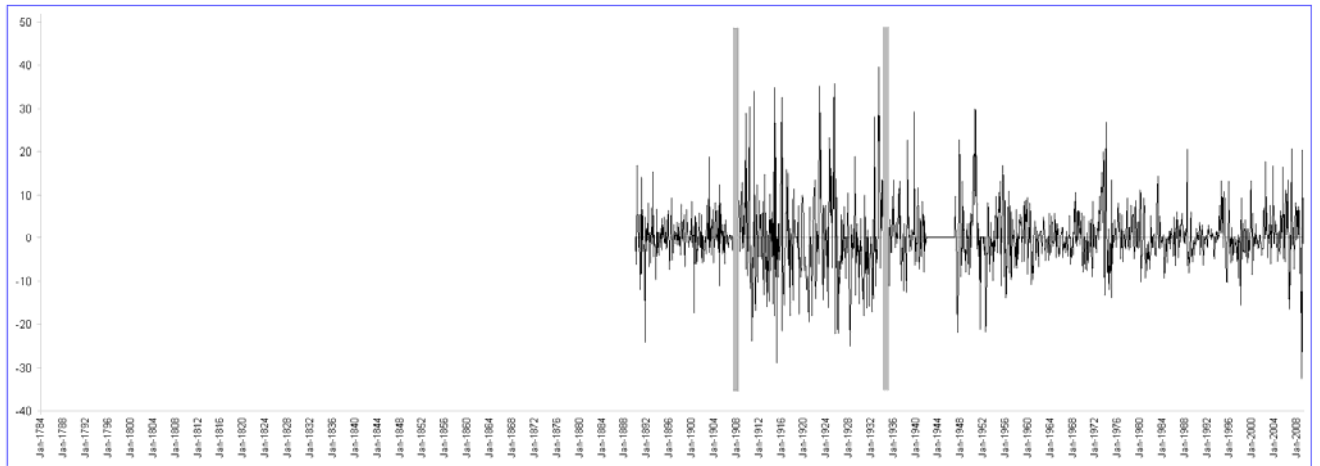December 1861 (Increase in volatility), June 1880 (Decrease in volatility), December 1918 (Increase in volatility).

Coffee

Monthly Price

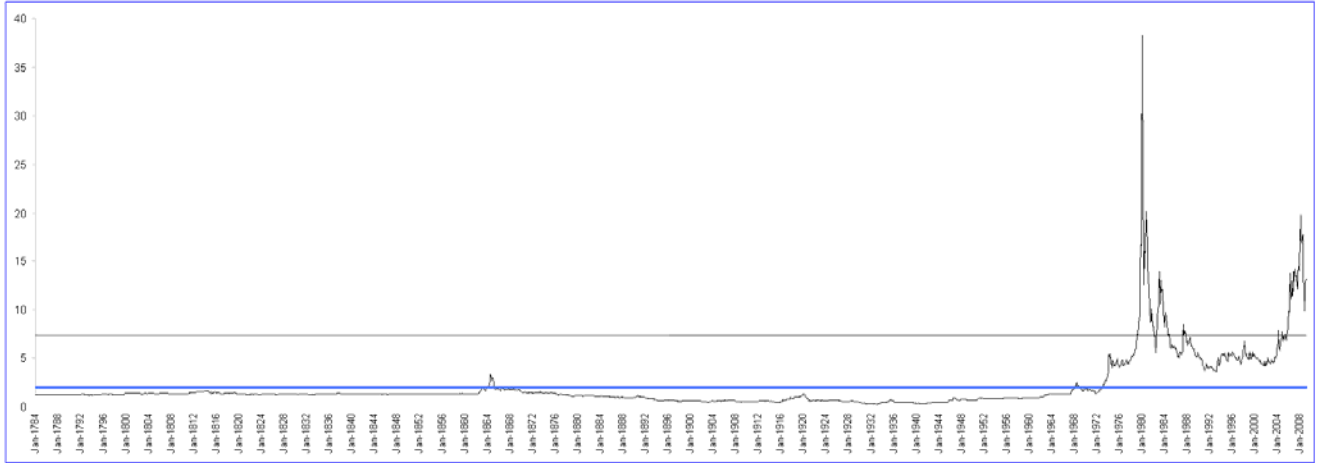**Monthly Returns (% change) and KL (2000) test detected breaks**

Detected Breaks by KL (2000) test:

September 1985 (Increase in volatility).

Copper

Monthly Price
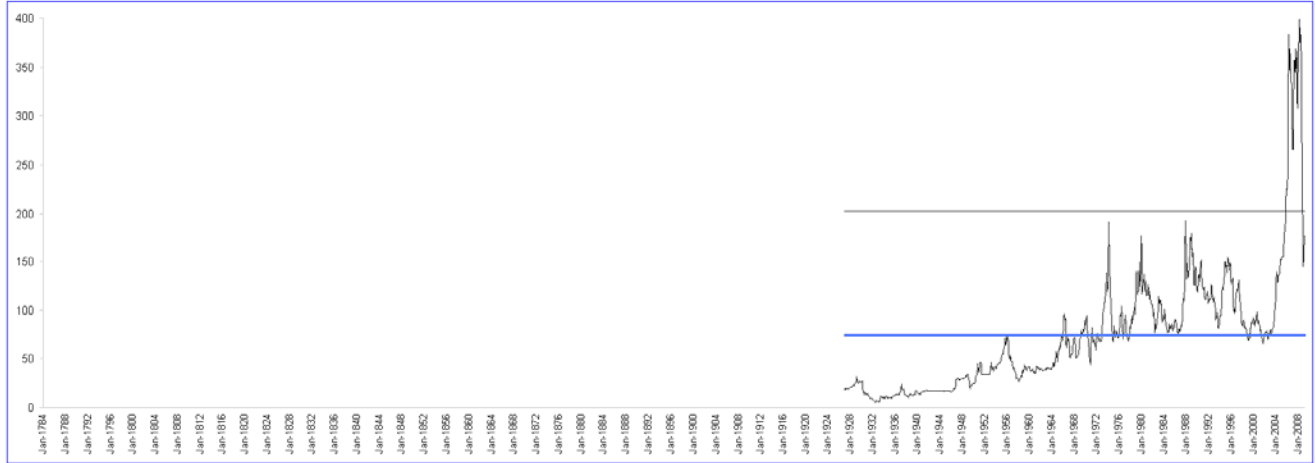
Monthly Returns (% change) and KL (2000) test detected breaks
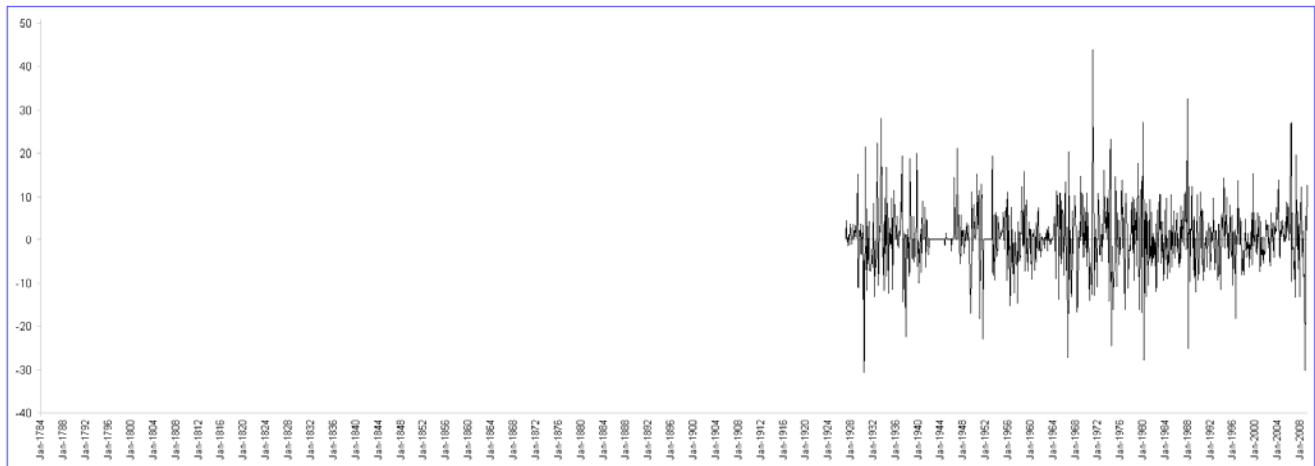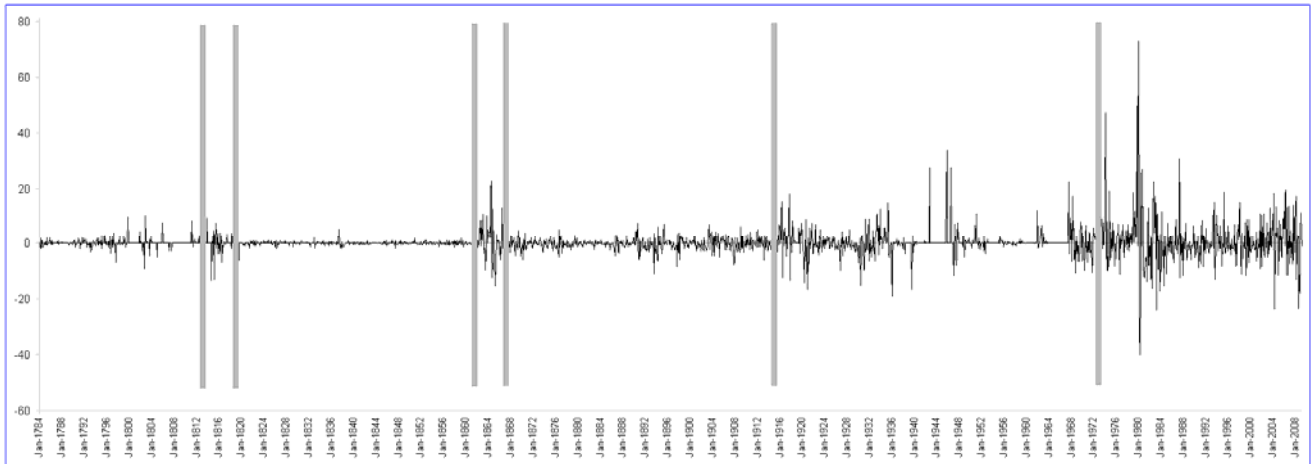

Detected Breaks by KL (2000) test:

No breaks detected.

Crude Petroleum

Monthly Price
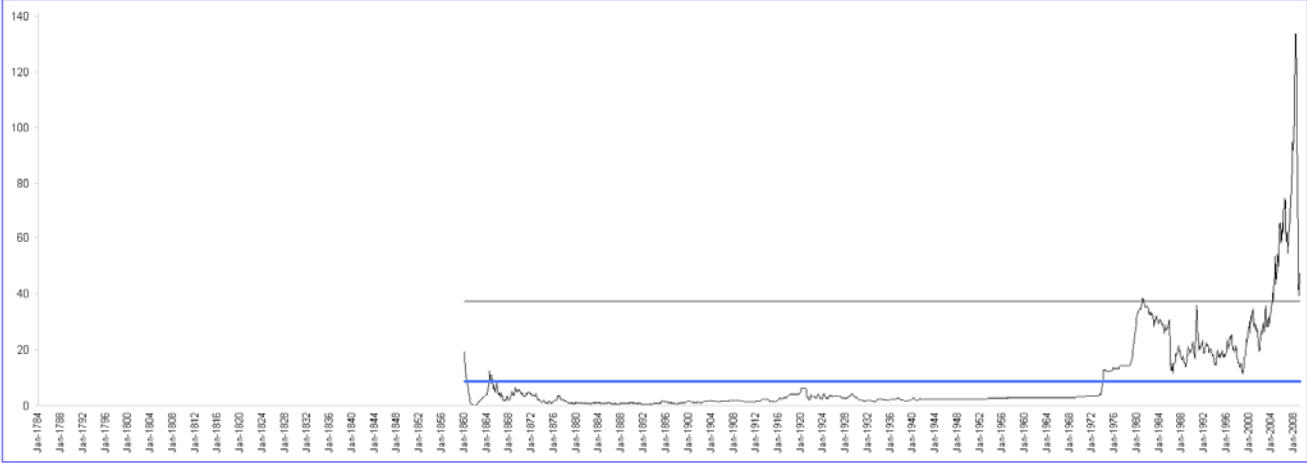
Monthly Returns (% change) and KL (2000) test detected breaks
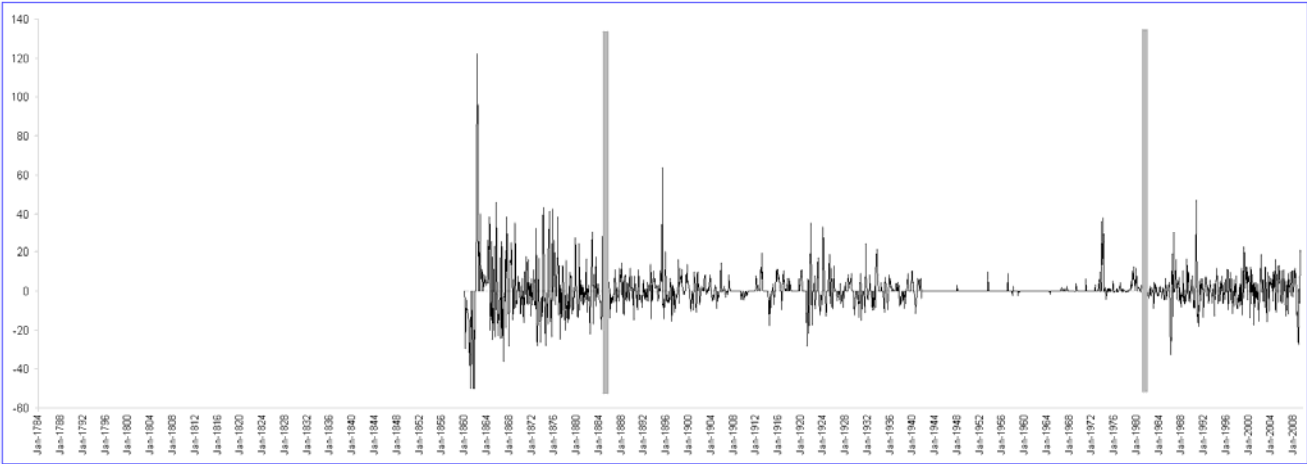
Detected Breaks by KL (2000) test:

July 1884 (Decrease in volatility), May 1981 (Increase in volatility).

Platinum

Monthly Price
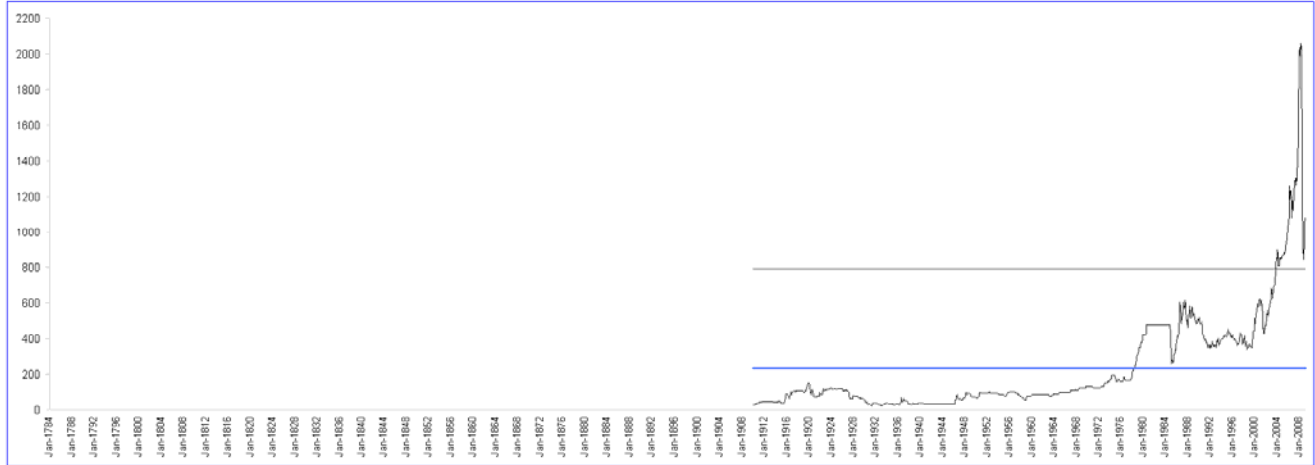
Monthly Returns (% change) and KL (2000) test detected breaks

Detected Breaks by KL (2000) test:

July 1948 (Decrease in volatility), December 1984 (Increase in volatility).

Rubber

Monthly Price

Monthly Returns (% change) and KL (2000) test detected breaks

Detected Breaks by KL (2000) test:

July 1909 (Increase in volatility), May 1934 (Decrease in volatility).

Silver

Monthly Price

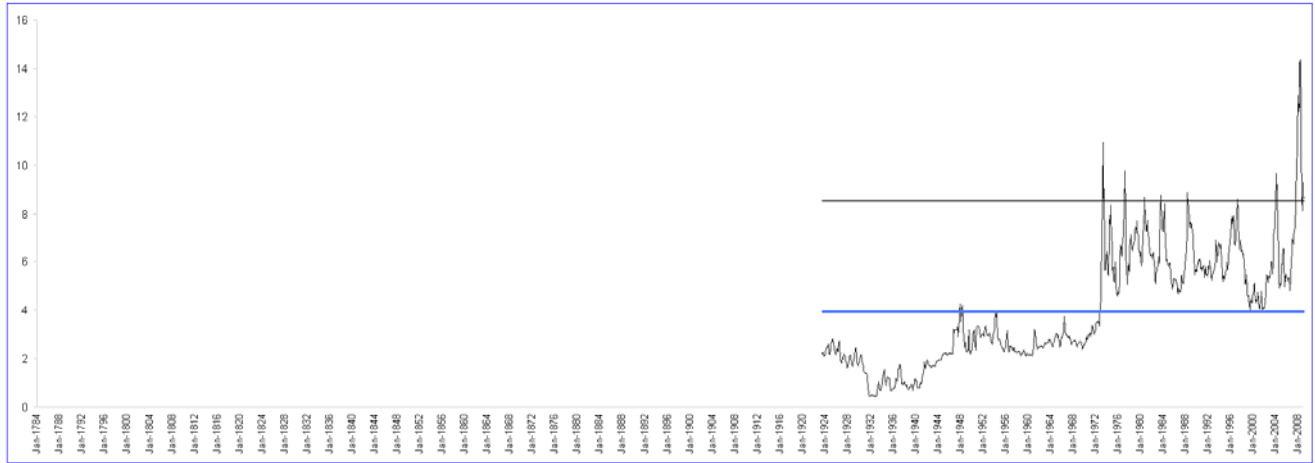**Monthly Returns (% change) and KL (2000) test detected breaks**
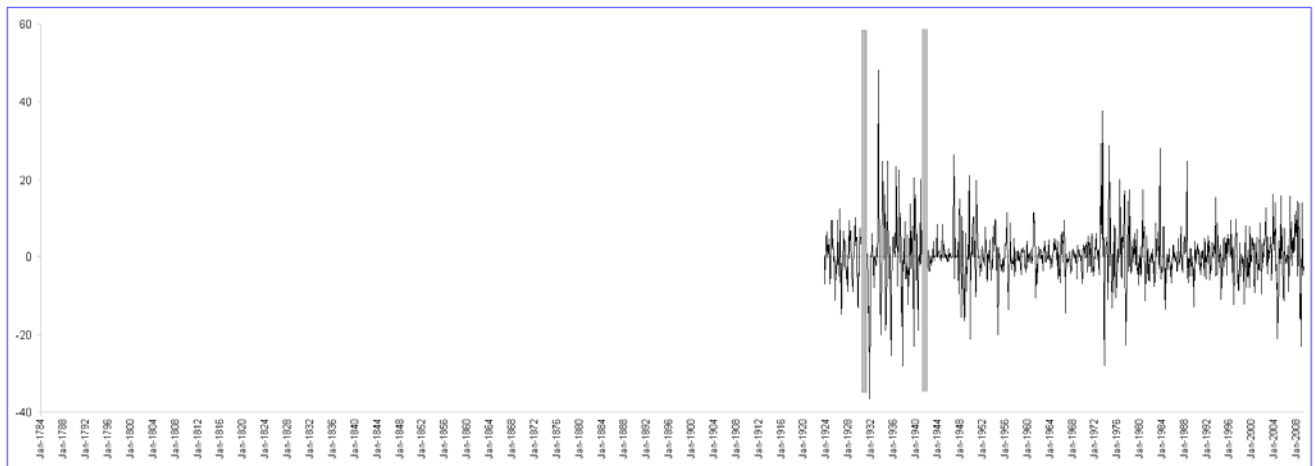

Detected Breaks by KL (2000) test:

October 1813 (Increase in volatility), July 1819 (Decrease in volatility), May 1862 (Increase in volatility), June 1866 (Decrease in volatility), October 1915 (Increase in volatility), November 1973 (Increase in volatility).

Soybeans

Monthly Price

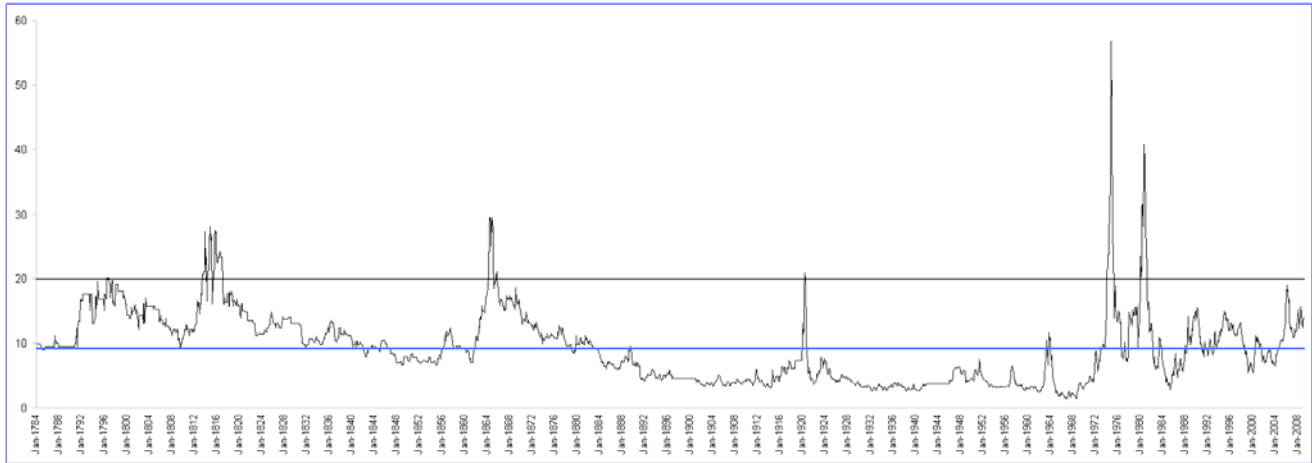**Monthly Returns (% change) and KL (2000) test detected breaks**

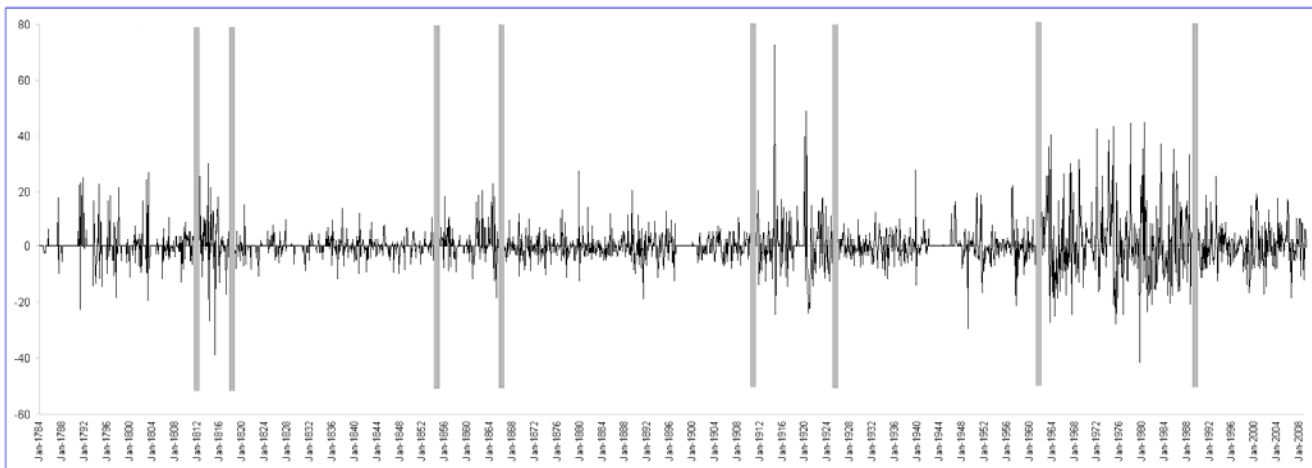**Detected Breaks by KL (2000) test:**

May 1931 (Increase in volatility), September 1941 (Decrease in volatility).

Sugar

Monthly Price

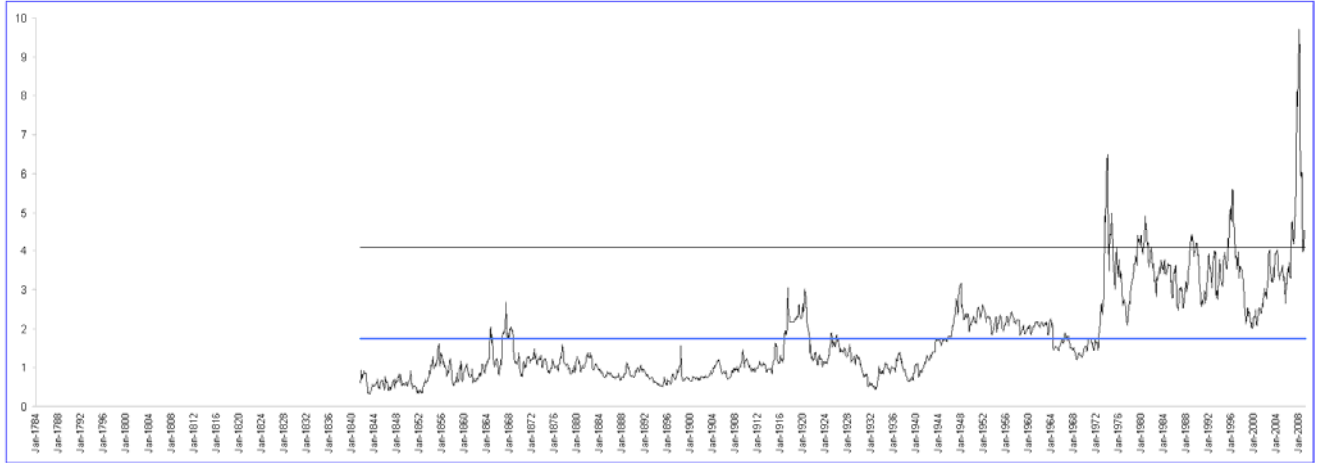**Monthly Returns (% change) and KL (2000) test detected breaks**
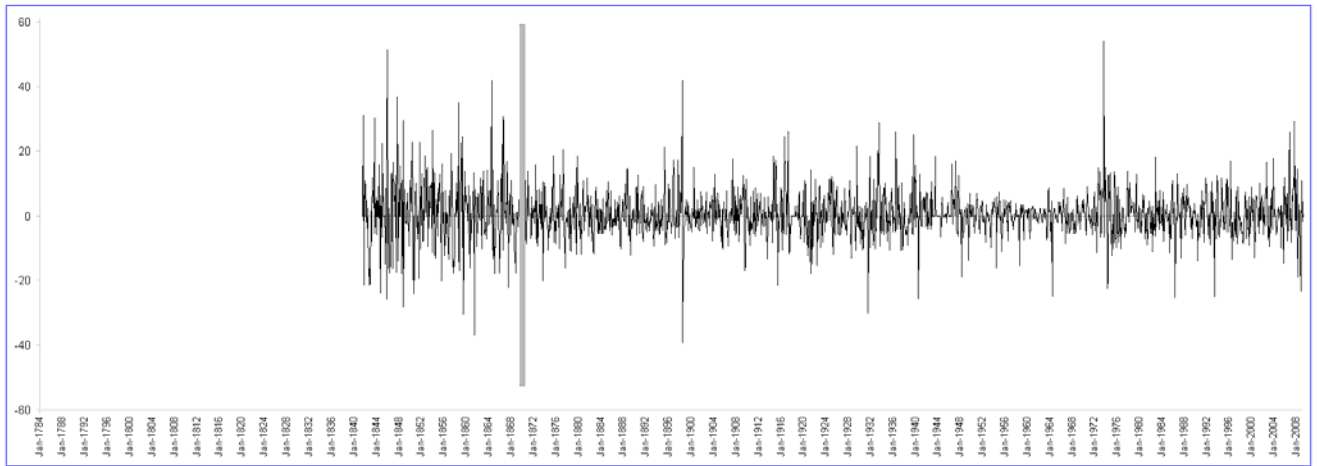

Detected Breaks by KL (2000) test:

June 1812 (Increase in volatility), May 1818 (Decrease in volatility), October 1855 (Increase in volatility), May 1865 (Decrease in volatility), June 1911 (Increase in volatility), January 1925 (Decrease in volatility), October 1962 (Increase in volatility), August 1988 (Decrease in volatility).

Wheat

Monthly Price

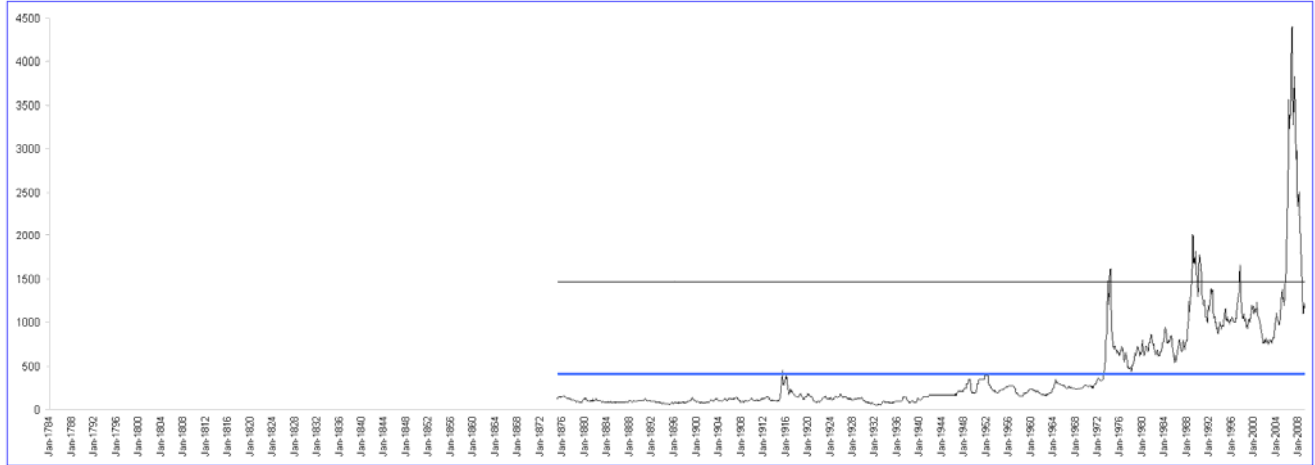**Monthly Returns (% change) and KL (2000) test detected breaks**

Detected Breaks by KL (2000) test:

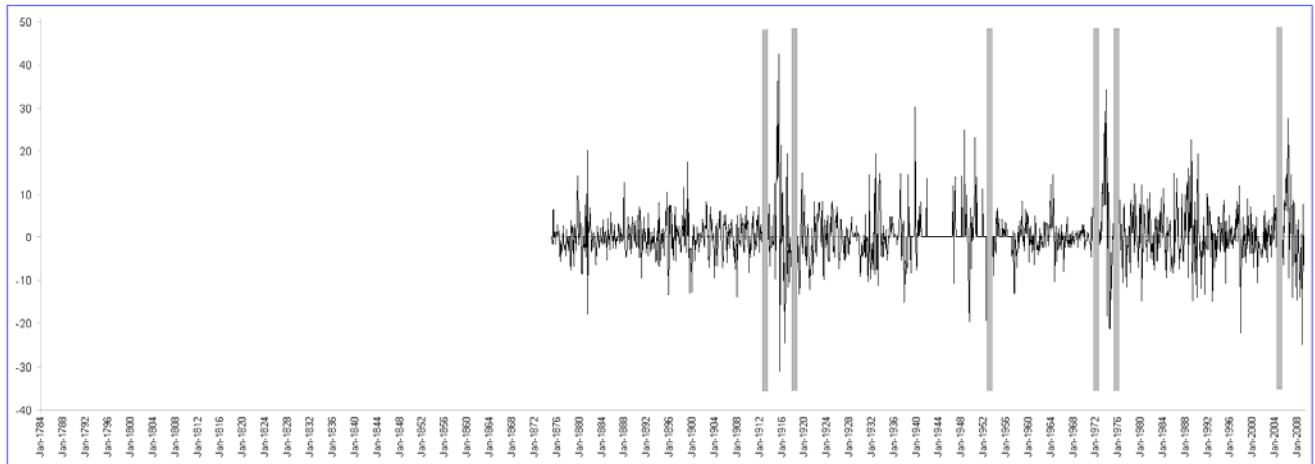May 1870 (Decrease in volatility).

Zinc

Monthly Price

Monthly Returns (% change) and KL (2000) test detected breaks

Detected Breaks by KL (2000) test:

July 1914 (Increase in volatility), January 1917 (Decrease in volatility), August 1952 (Decrease in volatility), January 1973 (Increase in volatility), October 1974 (Decrease in volatility), January 2005 (Increase in volatility).

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