The Deterministic and Speculative Component of the Terms of Trade of Primary Commodity: an "Eclectic" Real Option Value Approach

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Abstract

This paper analyzes the evolution of the barter terms of trade (BTT) of primary commodities using the longest time series available (1900-2007), with the objective to test the hypothesis that BTTs are affected by a secular tendency to decline. The paper reviews the literature on the subject and explores some new dimensions of the problem, such as, in particular, the influence of the size distribution of BTTs over time and the presence of a speculative component depending on the call option value of commodity stocks. The results appear to confirm the absence of any significant tendency for a secular decline.

Keywords: barter terms of trade, trend, speculative component, volatility, option

Introduction

This paper aims to study the dynamics of the long term price series of primary commodities, with a focus to agricultural ones. Based on a previous study of Scandizzo and Diakosavvas (1987, 1991), and by making use of the time series used by this study and subsequently updated by Grilli and Yang (1988) and by Pfaffenzeller et al. (2007), we will analyze the evolution of the primary and manufactured price series from 1900 to present, to pursue the following objectives:

1) to make use of the longest annual time series available to test the Prebisch –Singer hypothesis of a secular decline of the terms of trade,

2) to analyze the long term dynamics, volatility and distribution of barter terms of trade for primary commodities, the main aggregates and some key agricultural commodity.

3) to investigate the broader question of long term bias (in terms of relative price level, volatility and speculative behavior) in international markets towards primary commodities

and agriculture as compared to manufactures.

4) to shade some light on the long term bias, if any, towards agricultural international prices as compared to prices of the manufacturing sector.

Compared to the existing literature, the contribution of this paper is twofold. First, we test the existence of a secular trend in terms of trade with different specifications of the net barter terms of trade with a 100 year old time series that incorporates both the historical reconstruction in the Scandizzo-Diakossavas and Grilli and Yang series and the most recent data available. Second, we analyze the evolution of averages in the price series and their covariates, and integrate these findings in a new theoretical setting that combines both a fundamental and a speculative component of commodity prices. This original framework allows us to elaborate a model that encompasses non observable components of price formation and tests for the presence of both a trend and bubbles depending on price volatility.

The paper is structured as follows. The first section reviews the motivations of our study, and highlights the recent patterns of agricultural commodity prices. Section two describes the empirical regularities of these series and the most recent studies on the terms of trade. Section three illustrates our theoretical model of real option theory applied to agricultural commodity prices aiming to distinguish the fundamental and speculative components of agricultural commodity prices. Section four describes the estimation strategy and illustrates the main econometric results. The last section concludes by considering implications for policy and future research.

1. Background and Motivations

Since the mid-80s, the priority accorded to agriculture has been constantly declining in the international trade agenda. The reason could be imputed to the conventional wisdom of the Prebisch-Singer (PS) empirical evidence. The two economists independently published in 1950 the results of their analysis on long term series of prices of primary commodities and manufactured goods. They claimed that, on the base of the evidences, the barter terms of trade for primary commodity exporters exhibited a clear tendency to decline. The reason for this decline was identified in the lower demand elasticities and the higher supply elasticities characterizing agricultural commodities as the main exports of developing countries as compared to their main imports, i.e. industrial goods.

The "old wine" story (Singer, 1991), or the PS conventional wisdom or, which was broadly accepted by the overall international community, was partly responsible for the reduced importance that agriculture and rural development had played in the development economics, for more than two decades. This idea was reinforced by the almost constant decline of agricultural commodity prices that the world has experienced from the '70, which was only interrupted a few years ago.

By the end of the nineties, Sapford and Singer (1998) noted that both the World Bank and the International Monetary Fund (Wilson, 1994; The World Bank, 1996) were supporting this empirical evidence of a long term decline trend rather than a cyclical behavior, thereby recommending developing countries to diversify their export towards manufactured goods.

From a broader point of view, barter terms of trade (BTT) for agricultural commodities prices have not been always declining, but they have experienced, since the beginning of the 20^{th} century, different period of dramatic changes. In addition to the events of the two World Wars, with agricultural BTTs increasing throughout the first part of 1900, maize price showed a spectacular surge, reaching a peak in 1917, and then collapsing in 1921. Price spikes for agricultural goods were also generated in the mid'30s, originating from weather problems and supply controls. After World War II, however, two decades of price decline followed. Figures 1 summarizes the evolution of BTTs from 1900 to 2007, with a focus on maize prices.

[Figure 1 around here]

Fast forwarding to the second half of the twentieth century, the two most important periods of agricultural BTT prices increases have been the 1973 oil price shock, and the mid nineties. During the early seventies, after decades of downward trends, the prices of the three principal agricultural commodities (wheat, maize and soybean) rose without interruption for two consecutive years, till 1974. The boom of the mid nineties was less spectacular than the former escalation, but agricultural BTTs began to increase from 1994, reaching the highest peak in 1995 and 1996 for corn and wheat, and soybeans, respectively. Each period of price boom was followed by a decline, as the conditions that induced the rapid increase were reversed. The spike of the nineties, although less spectacular, could be imputed to the collapse of the Soviet Union.

Since the beginning of the last decade, and in particular for the past two years, international prices of several commodities have been fluctuating wildly, to reach extraordinary levels during some months. This rapid surge, in a wide range of food commodities, appears similar in percentage terms to the movements induced by the 1974 oil price shock (for example, rice prices rose up to 200 percent in the 1974 and 255 percent during the peak of the recent crisis). In terms of aggregate indicators, the FAO food price index rose on average 9 percent in 2006 with respect to 2005, and 23 percent in 2007 compared to 2006. With respect to a 130 percent increase of the IMF's index of prices of internationally traded food commodities from January 2002 to June 2008, a 56 percent increase materialized in the 18 months from January 2007 to June 2008.

In 2009, most agricultural commodities prices have fallen significantly without reverting, however, to the pre-crisis levels. World grain prices reduced by over 50 percent from their record highs earlier this year. International prices for other important foodstuff, such as vegetable oils, oilseeds or dairy products have also drifted downwards, even though they remain above their longer term trend levels. Rice is still expensive but prices may follow the path for other foodstuff as the new crop comes on stream, export restrictions are relaxed and demand shifts further to cheaper alternatives (FAO Food Outlook, 2009).

2. Empirical regularities on agricultural commodities prices

Since the PS empirical evidence was introduced, the literature has produced a plethora of works aiming at testing their initial predictions. We may classify this huge literature into two main categories: the first set of studies aiming to test the long run validity of the PS hypothesis, and to investigate the relationship between primary goods, and manufacture on long term price series. A second set of studies concentrates instead on the analysis of the short term variation of agriculture price series.

While the results of the former may be more important for us, given the aim of our analysis, we believe that short term variation is also of interest, since, seen in a long term prospect, it refers to the problem of persistence of long term variance.

This approach allows us to investigate whether price shocks dissipate rapidly or tend to persist for longer period of times, thereby adding a transitory, but continual term component to the secular trend.

Table 1 reviews the results of a selected number of papers under these two lines of research, summarizing the type of econometric estimation, the main findings, and the period to which the estimations refer.

[Table 1 around here]

The results differ according to the time period considered, the commodities to include in the BTT index and the econometric techniques used, and they are largely controversial (Zanias, 2005). According to a survey of the most recent contributions (Colman, 2009), among the papers who analyzed the terms of trade controversy between 1950 and 1985, only a small number was found to corroborate the PS hypothesis, while a remaining large number were inconclusive on the sign of the relation. In their original analysis based on the long World Bank series, Diakosavvas and Scandizzo (1987, 1991) were not able to reject the null hypothesis of secular declining of the terms of trade for the major commodities, and they highlighted the methodological limitations surrounding the question and its statistical interpretation. This work launched two decades of extensive analysis on the modification of the original data, and refinements of the econometric implementation of the statistical tests. Most of the studies produced used the commodity price index (GY COMTT) by Grilli and Yang (1988), and later updated by the IMF to 1998, and by Cashin and McDermott (2002), León and Soto (1997), and more recently extended to 2007 by Pfaffenzeller et al. (2007) and Balagtas and Holt (2009).[i]

All the studies implemented in the past two decades have focused on a restricted number of specific issues. The common denominator has been the possibility of proving the existence of a trend in the data, the nature of the trend, the effect of the cycles and the problematic issue of the introduction of exogeneous or endogeneous structural breaks , or unexpected shift in the series. In other words, the literature has tried to analyze whether the non stationarity of the long term time series takes the form of a deterministic trend, a stochastic trend, or whether there are one or more structural breaks in the series without any trend (Cashin McDermott, 2001; Cuddington and Urzua, 1989). In other words, while the downward movement in the commodity terms of trade could be found using a regular "eyeball test" , the question remains whether this effect is due to (*i*) a deterministic trend and/or (*ii*) a stochastic trend and/or (*iii*) structural breaks in the level or trend

Powell (1991), Cuddington and Urzua (1989), Ardeni and Wright (1992) showed, by using different econometric techniques, and for different periods of time, that three different unexpected shifts in BTTs emerged, namely in 1920, 1938, and 1975. When structural breaks are introduced, it is difficult to embrace the PS hypothesis. Some studies found supporting evidence only for specific commodities[ii].

Although it is widely accepted that volatility of agriculture prices is extremely important, there are few studies that attempt to bring together the issues of secular trends, long term cycles and variance over time. Concern in this regard was raised for example by Sapford and Singer (1998) who claimed the importance of examining the determinants of commodity prices and the relative importance of cyclical factors in explaining their behavior, because different policies must be adopted with regard to the relative importance of the price components. Cashin et. al. (1999) found out that shocks to primary commodity prices are long lasting with wide variability in persistence levels. Other studies, such as Sarris (1998), observed that the underlying trends in cereal prices were deterministic with some tendency of increased volatility during the 1995/96 period. Other studies used the competitive storage model to identify restrictions to the analysis of price dynamics (Deaton and Laroque, 1992, 1995, 1996; Gustafson, 1958; Williams and Wright, 1991; Cafiero 2002; Cafiero, Bobenrieth E., Bobenrieth J. and Wright, 2009).

3. The theoretical Model

Taking the lead from the studies concerning trends, shock persistence and volatility, we assume that the terms of trade index P, expressed as a ratio between export and import prices, is governed by a stochastic process of the geometric Brownian motion variety:

$$dP = \nu P dt + \sigma P d\zeta \tag{1}$$

where ν and σ are the drift and volatility parameters, and $d\zeta$ is a random variable with mean zero and variance equal to *dt*. The main reason why the terms of trade may behave stochastically is that as a form of exchange rate they are the relative price of a commodity or a group of commodities, which is traded in the international markets and, as such, is subject to external shocks affecting its trade [Dixit, 1993, p. 29]. Note, however, that the drift of the process may correspond to a fundamental component, in that it may reflect both a trend in demand and supply as a consequence of shifting market equilibrium.

Consider a representative, risk neutral firm producing a single exportable commodity. The firm operative net revenue from production, at international prices (in US dollars) is $PQ(k)$, with $Q^{'}(.) > 0 \;\; e \;\; Q^{''}(.) < 0$. K denotes domestic capital stock; no depreciation is assumed and units of measure are chosen such as the domestic price of capital is one.

Indicate with ρ the risk-free rate of interest and with $Idt = dK$ the irreversible investment, assumed to be constituted of imported goods (machinery and other industrial goods) and whose price is taken as the numeraire.

The optimal value of the firm will be obtained by maximizing the net present expected value of its cash flow:

$$V(K,P) = \max_{dK} E_t \left\{ \int_t^{\infty} \exp\left(-\int_t^{s} \rho(u) du \right) \left[PQ(K) - I \right] d\tau \right\} \tag{2}$$

where E_t indicates the expectation conditioned upon the set of information available at time t.

The Bellman optimality condition for the firm can be stated as follows:

$$\rho V dt = \max\{[PQ(K) - I]dt + E[dV(K,P)]dt\}$$

(3)

Applying Ito's lemma, we obtain:

$$E_t\, dV(K,P) = (V_k I + V_P \alpha P + \frac{1}{2} V_{PP} \sigma^2 P^2)dt$$

(4)

Where small subscripts indicate partial derivatives.

Substituting into (3) and dividing by dt:

$$\rho V = \max_{dK} \{[P\pi(K) - I]\} + [V_k I + V_P \alpha P + V_{PP} \sigma^2 P^2]$$

(5)

The solution of the maximization of the RHS of (5) with respect to I yields the optimal condition for capital investment: $V_k dI = dI$, which implies $V_k = 1$ namely, at the optimum, the marginal value of investment must be equal to unity. This condition, once applied to (5) implies the following differential equation:

$$\rho V = PQ + V_P \alpha P + \frac{1}{2} V_{PP} \sigma^2 P^2$$

(6)

In order to solve this equation we first solve the homogeneous part, hypothesizing that the resolving function has the form:

$$V = AP^{\beta}$$

(7)

where *A is* a constant to be determined.

By substituting into the homogenous part of equation (6) the value of the function in (7) and its derivatives, we obtain a characteristic equation whose two roots are given by the expression:

$$\beta = \left[\frac{(1/2\sigma^2 - \alpha) \pm \sqrt{(1/2\sigma^2 - \alpha)^2 + 2\rho\sigma^2}}{\sigma^2} \right]$$

(8)

In order to derive a general solution of equation (6), we must add to the solution of the homogeneous part a particular solution. A meaningful particular solution can be specified by noting that the fundamental value of the firm equals to the present value of its cash flow : $P\frac{Q}{\delta}$, where $\delta = \rho - \alpha$. By adding this value to the contingent part in (7), we obtain:

$$V = P\frac{Q}{\delta} + AP^{\beta} \tag{9}$$

Equation (9) implies that, by following the optimum investment rule, the value of the firm equals the expected present value of optimum profit plus a contingent value. This contingent value reflects the speculative opportunities as $P \rightarrow \propto$ (Dixit and Pindyck ,1994, p.181-182) i.e. the speculative bubbles that may be associated with an expected depreciation of the currency, and may lead operators to value the exporting firm above its fundamentals . An alternative way to interpret the contingent value, however, is to assume that it reflects a call option value (Calcagnini and Saltari, 2000), since it is associated to the opportunity for the firm to grow through an increase in investment if terms of trade improve.

Dividing both sides of (8) by the production level Q, we obtain:

$$V / Q = P_s = \frac{P}{\delta} + \frac{A}{Q}P^{\beta} \tag{9}$$

Equation (9) implies that the observed level of the terms of trade (i.e. the unit value of production) can be decomposed into two parts: (i) a fundamental price component , representing the present value of future revenues and , (ii) an option value depending on both the level and the volatility of such a component. Assuming that the demand function is also a function of the fundamental component with a constant elasticity :

$$Q = BP^{-\eta} \tag{10}$$

under market equilibrium, equation (9) can be re-written as:

$$V / Q = P_s = \frac{P}{\delta} + \frac{A}{B}P^{\beta-\eta} \tag{11}$$

Consider the fundamental component. From equation (1), we know that it is affected by a trend (positive or negative) in the form:

$$P_t = F(t, X_t)P_{ft} \qquad (12)$$

where $F(t)$ denotes its value as a function of time t and other explanatory variables X_t and P_{ft} the fundamental value net of the time component.

Equation (11) can then be expressed in an estimable form, by further decomposing the fundamental component:

$$p_t = f(t, X_t) + p_{ft} + u_t \qquad (13)$$

where small cases denote logarithms and u_t a well behaved disturbance.

Equations (11) and (13) summarize the structure of the model as a combination of a trend (eq.13), a fundamental, and a speculative component. This decomposition suggests that the debate of the BTT decline may have missed the complexity of establishing unequal partnership about primary commodity trading. Even though the BTT trend may have a definite sign (negative or positive), in fact, the combination of the other two components could either reinforce or overturn it, both in some specific periods of time and over the long run.

4. The estimation strategy and the empirical results

4.1 Some methodological considerations

The hypothesis of declining terms of trade is not easy to test for a series of reasons. First, prices may go up and down with exogenous circumstances and whether there is a systematic tendency to do so may be mostly a matter of interpretation. Second, some prices may exhibit a tendency to go up and other down during the same period of time, so that the aggregate effect may be the consequence of the weights used to construct a general or a partial index. Third, any time trend may also be changing over time. Fourth, a central tendency to change in one direction may coexist with different trends in other directions, if the distribution of changes, and not only the average values are considered. Fifth, the volatility of the change and its tendency over time cannot be neglected as a component of the evolution of commodity prices.

In order to deal with these problems, our estimation strategy is based on a gradualist approach. Thus, we first deal with the tests for the existence of a long term trend, of changing circumstances and different prices using traditional GLS regressions for aggregate BTT indexes and for individual commodities. In this context, we also test for structural breaks due to major changes in regimes of international trade. Once we have established a first foothold as a set of basic conclusions in this direction, we deal with the distribution question, by testing the existence of trends and structural breaks through quantile regressions both on aggregate indices and on the full panel of BTTs of all primary commodities. Finally, we tackle the issue of the volatility by applying the decomposition model exposed in section 3. Finally, we tackle the issue of the volatility by applying the decomposition model exposed in section 3. Since this model is based on an unobserved "price fundamental" variable, as shown in section 4.2 below, we develop a stage-wise approach, based on the combination of a first stage ARCH estimation and a second stage based on the use of the residual of the first stage.

4.2 Deconstructing prices

Consider equations (11) (where the added subscript t stands for time) and (13) in the following form:

$$P_{st} = \frac{P_t}{\delta} + \frac{A}{B} P_t^{\beta-\eta} \tag{15}$$

$$P_t = F(t, X_t) P_{ft} \tag{16}$$

Substituting (16) into (15), and adding a well behaved error term ε_t, we obtain:

$$P_{st} = \frac{F(t, X_t) P_{ft}}{\delta} + \frac{A}{B} (F(t, X_t) P_{ft})^{\beta-\eta} + \varepsilon_t \tag{17}$$

We estimate the trend component and $(\beta - \eta)$ in (17) through an ARCH regression between P_{st} and (t, X_t), piecewise linearize (17) and then estimate the models:

$$\hat{U}_t = a_o + a(\beta_t - \eta) + G(t) \tag{18}$$

Where $\hat{U}_t$ is the residual of the first stage regression and $G(t)$ is a function of the time trend.

4.3 The tests on the evolution of terms of trade

Tables 2 and 3a present a first set of results for the analysis of the BTT trends. GLS estimates have been obtained of the model:

$$p_t = \log P_t = a + bt + cD_{73}t + \gamma D_{21} + \lambda d_{73} + u_t \tag{14}$$

In (14) P_t is an index of net barter terms of trade for all primary commodities and for selected ones, D_{21} and D_{73} are dummy variables for the structural breaks 1921 and 1973, and d_{73} is a slope dummy for all years after 1973. These dummies have been selected after testing for structural breaks in the constant and slopes over a series of alternative intervals. In general, all the regressions show significantly negative trends, although the absolute magnitudes of the yearly decline are generally small and below 1%. The decline becomes stronger after 1973, even though it remains absolutely small. The degree of fit of the equation is poor, but still impressive, considering that only one explanatory variable is used.

[Tables 2 and 3a and 3b around here]

Table 3b presents a different test, based on a panel treatment of the data set. This equation tests the hypothesis that all primary commodities are affected by a common trend component, while fixed effects can explain the differences among commodities as shifts in the constant. As the regression estimates show, it is not possible to reject the hypothesis that no common trend has affected the commodities considered.

The results of the first two tests can be summarized under the following points:

1) BTTs of primary commodities do appear to exhibit a small negative trend, of about -1% per year;

2) This trend remains constant (except for the aggregate food index, which shows a significant quadratic component) and roughly of the same size until 1973, and worsens after this year;

3) Both the years before 1921 and after 1973 exhibit different levels and trend coefficients.

4) No common trend to all commodities appear to exist in the period considered.

These results confirm the consensus of the recent literature and, to some extent, are similar to the ones obtained by Diakossavas and Scandizzo. They do not allow drawing firm conclusions both because of the small nature of the effects detected and because, in spite of the GLS method used, the residuals of all regressions exhibit heteroskedasticity.

Tables 4-10 present further results obtained by applying quantile regression (QR) over the commodity panel, through estimates performed for the 20%, the 50% (the median) and the 70% quantile. As explained in the vast literature on this technique (for a recent review see Koenker, 2005)[iii], QR allows to obtain parameter estimates of the quantile values of the dependent variable, conditional to the values of the explanatory variables. In our case, the QR trend and structural break coefficients can be interpreted as testing the hypothesis of BTT trends, at the values of the 20, 50 and 70% quantile statistics of BTTs, conditional to the values of the other covariates. These values may be expected to be different from the conditional expectations of ordinary regression analysis for various reasons. First, a long term trend in BTTs may be present for one part of the distribution and not for other parts. Second, the BTT conditional distribution may be asymmetric (so that expectations are different from median values). Third, the conditional distribution may exhibit a “fat tail”, i.e. the conditional probability of one of the tails may be very large as compared to the other.

As Table 4 shows, the first significant difference between the QR and the ordinary regressions is that the linear component of the trend is positive, while the quadratic component turns out to be significant, but very small. The coefficients of the quadratic component do not appear to change significantly across the quantiles, while the linear ones show a decline in the equations with the structural breaks (SB) and become non significant for the median and the 70% quintile. The 1921 SB appears to be significant for the level and only for the 20% quintile, while all other SBs both on constant and trends are significant and of the same order of magnitude.

The results for metals BTTs (Table 5) show a different behavior, with large declining rates, which increase in absolute value from the smallest quantile to the median. The quadratic component is positive and does not show significant distributional differences, while the other effects appear to be significant only for the 70% quintile.

The non food index (Table 6) shows, as the general index, an increasing trend, with significant distributional differences: declining linear growth across quintiles, corresponding declines of the absolute values of the quadratic coefficients and higher values of the SB coefficients concentrated on the first quantile considered.

The food index (Table 7) suggests that the aggregate tendency for food prices to decline as compared to industrial prices may be established only for the first quantile over the whole period considered, while, since 1973, it appears robust and of the same order of magnitudes for all the points of the distribution considered.

The panel regressions (Tables 7 and 8) provide more evidence to the conclusion that if we take into account the distribution of price changes, we cannot reject the hypothesis that the BTTs have followed a stationary pattern, while we can reject the same hypothesis for the period after 1973. For this period, we may conclude on the existence of a tendency for BTTs to decline for all commodities, with the largest effects concentrated on the 20% quantile.

In sum, the QR results appear to differ significantly from the ordinary regressions results and suggest that once distributional effects are taken into account, there is no secular tendency of BTTs to decline. Long term linear negative trends, tempered by quadratic terms and concentrated in the lower quintiles appear to be present from 1973.

Finally, Tables 10 to 12 show the main results of the analysis taking into account the price volatility. The option component and the trends appear to be both highly significant and, once the speculative component is introduced, a positive, though still absolutely small emerges for all major commodity groups.

[Tables 10 to 12 around here]

For each index (TOT, the Metal, Food and Non Food indexes), the trend coefficient is significant and negative, pointing towards the existence of the declining trend over the long term period. However, the level of the coefficient is very low, almost equal to zero, especially in the case of TOT and Metal. The coefficient of the slope after 1973 is strongly significant and negative pointing towards a real declining trend after this date. The positive and significant level of the structural breaks 1921, show that before that date, the level of the series was significantly larger.

To understand how the speculative component computed from (9), affects the level of the series, we use a Prais- Winsten generalized least square regression on the residuals of the ARCH estimate. The underlying hypothesis is that, once the long term pattern is analyzed through yhe first step ARCH estimate, the residual will be explained by short term variations, namely by the speculative component. In all the cases, TOT, Metal, Food and Non Food Indexes, the coefficient is positive and strongly significant, thereby corroborating the effect of speculation on agriculture price series. The Durbin Watson statistics are higher, very close to 2, indicating an absence of serial correlation in the residuals.

Conclusions

In this paper we have taken a fresh look at the question of the evolution of the terms of trade for primary commodities. The existence of a "secular decline" hypothesized by Prebisch and Singer as the possible basis for unequal partnership, although still an icon of economic radicalism, seems to have lost much of its drama. In part, this is the consequence of industrial development of developing countries and the establishment of a new pattern of international division of labour. In this pattern, cheap industrial exports seem to have substituted, to an extent, primary commodities as the emblem of unequal and possibly "immiserizing" trade.

These considerations notwithstanding, the question of declining terms of trade (TT) for primary commodities and, in particular, for agricultural goods, still appears interesting for a number of reasons. Many developing countries, in fact, depend on these commodities for most of their export earnings and some of them, for their import expenditure. In recent years, furthermore, increasing TT volatility and temporary surges have characterized periods of high instability and intense speculation in international markets. For agriculture, the increasing possibility to utilize several crops as biomass inputs to obtain energy rather than food or fibre, has also caused changes that may become even more important in the future. Finally, while TTs may not be so critical as in the past to determine the gain from trade and the growth prospects of developing countries, their evolution may be a threat or an opportunity for the future.

While our study has the primary objective to further look at an old question, without any pretence to definitely settle it, nevertheless we believe that we have found a number of new important results. First, we have shown that the question of the decline of terms of trade is moot if it disregards the distribution of the possible declines. If such a distribution is considered, the bulk of the evidence appears to be against the existence of a secular trend, even though the lower values (the 20% quintile) of the indices do seem more sensitive to the passing of time. Second, the data show evidence of a discontinuous relation between BTTs and time, with two significant structural breaks before 1921 and after 1973. These dates, validated by the tests applied, correspond to two important historical events: the end of the First World War and the combination of the aftermath of the first oil crisis with the end of the dollar parity regime. Third, we have found some validation of the hypothesis that BTTs can be decomposed into a fundamental and an option-like speculative component, whose size depends and presumably feeds back into historical volatility. More research is needed, however, to establish whether such a finding is robust and can be interpreted with confidence as something that can be useful not only for better understanding price dynamics, but also for policy purposes.

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Figure 1: Evolution Barter Total Terms of Trade 1900-2007

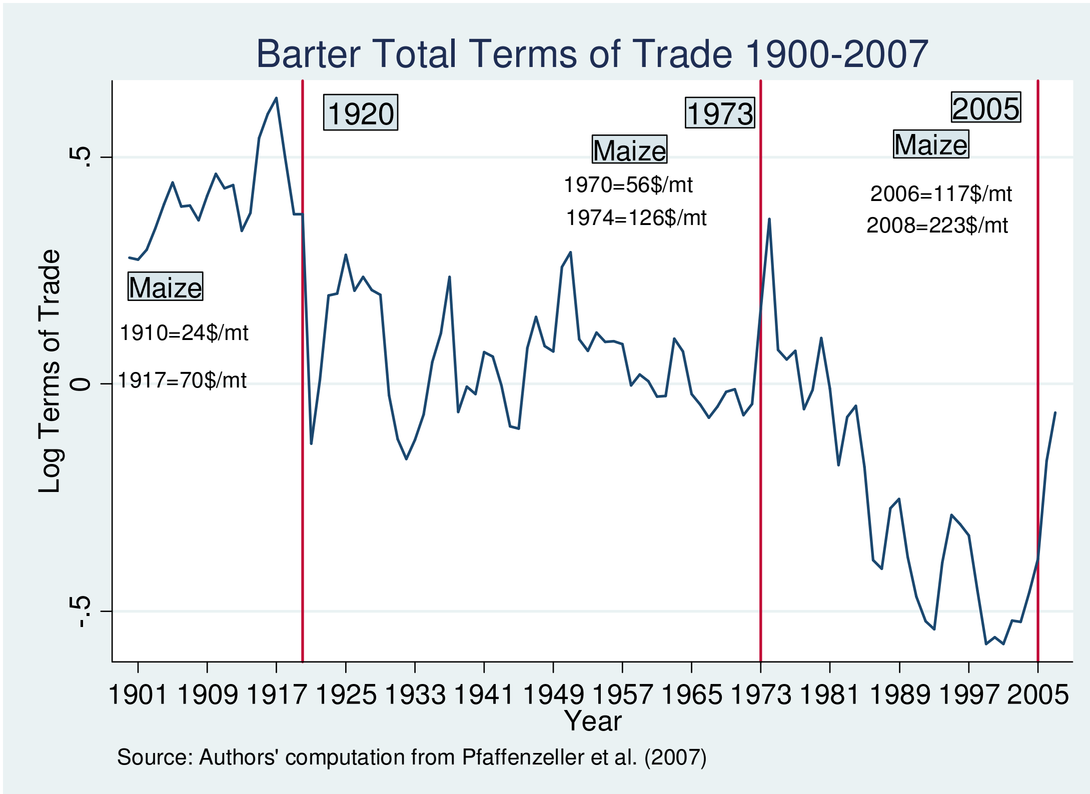

Table 1: Summary on the literature and findings on Terms of Trade

Authors	Type of Model	Main findings	Time span
Grilli-Yang (1988)	Trend Sationary model	Negative trend	(1900-1986)
Diakosavvas and Scandizzo (1987, 1991)	Trend stationary model	Negative trend (and not asymmetric response to shocks as supposed by PB)	
Cuddington- Urzúa (1989)	Trend Stationary model with superimposed break	Trend not statistically significant, when account for a break in 1921	GY index (1900-1986)
Powell (1991)	Trend Stationary model with superimposed breaks	Trend not statistically significant when account for three downward jumps (1921,1938 and 1975)	GY index (1900-1986)
Ardeni and Wright (1992)	Structural model (trend and cycle decomposition)	Negative trend, scarce effects of braks introduced by Powell	GY index (1900-1988)
Cuddington (1992)	Unit Root Test with superimposed structural breaks	12 over 24 commodity prices are non-stationary (Some commodities had negative price trends, while others had positive trends)	Each of the 24 component commodities in the GY index (1900-1986).
Reinhat and Wickham (1994)	ADF test + Structural model (trend and cycle decomposition)	Metal stationary with break, Food non stationary, all commodities index ambiguous. Increasing volatility	1957:1-1993:2 (quarterly data)
Leon and Soto (1997),	ZAP-Perron test (search for structural break at unknown date)	Negative trend for GY index, but not for all the commodities	Extended GY series (1900-1992)
Cuddington (2002)	ZAP-ADF test (search for structural break at unknown date)	Trend not statistically significant, when account for a break in 1921 and a spike in 1974	CY Index (all primary commodities) (1900-1998)
Zanias (2005)	ZAP-ADF test (search for structural break at unknown date)	Trend not statistically significant, when account for breaks in 1921 and 1974	CY Index (1900-1998)
Baltagas and Holt (2009)	Time-varying autoregression model (to account non linearity)	They reject linearity for 19 over 24 commodities.	Each of the 24 component commodities in the GY index (1900-2003)

Source: Authors' Review

Table 2 GLS regressions -- iterated estimates on Terms of Trade

	Total TOT			Metals			Non Food			Food		
	Base	**With SB**	**With Structural Break in constant (SB) and slope**	**Base**	**With SB**	**With SB and Slope**	**Base**	**With SB**	**With SB and Slope**	**Base**	**With SB**	**With SB and Slope**
Time Trend	-0.007***	-0.004	-0.002*	-0.006*	-0.005*	-0.002	-0.007***	-0.004***	-0.004***	-0.007***	0.024***	0.023***
	[5.05]	[1.48]	[1.73]	[1.91]	[1.74]	[0.76]	[6.00]	[3.50]	[2.82]	[3.73]	[3.87]	[4.13]
Square Trend											-0.0002***	0.0002***
											[4.69]	[-4.82]
Structural Break 1921		0.446***	0.373***		0.262*	0.334***		0.332***	0.341***		0.578***	0.571***
		[4.71]	[4.50]		[1.98]	[2.75]		[3.80]	[3.99]		[5.09]	[5.23]
Structural Break 1973		0.137			0.162							
		[1.43]			[1.21]							
Slope from 1973			-0.007**			-0.012***			-0.004			-0.006**
			[2.42]			[2.73]			[1.13]			[-1.8]
Constant	0.396***	0.085	0.113	0.422**	0.29	0.16	0.493***	0.270***	0.250***	0.312***	-0.518***	-0.509***
	[4.65]	[0.56]	[1.23]	[2.24]	[1.57]	[1.11]	[6.36]	[3.05]	[2.88]	[2.75]	[3.04]	[-3.25]
Observations	108	108	108	108	108	108	108	108	108	108	108	108
R-squared	0.2	0.25	0.38	0.04	0.11	0.21	0.26	0.39	0.43	0.11	0.37	0.43

Absolute value of t statistics in brackets
** significant at 10%; ** significant at 5%; *** significant at 1%*
Durbin Watson statistics vary between 0.45 to 0.75

Table 3a: GLS regressions -- iterated estimates on Terms of Trade for single commodities
Dependent Variable Log BTTs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Maize	**Maize with SF**	**Wheat**	**Wheat with SF**	**Rice**	**Rice with SF**	**Palm Oil**	**Palm Oil with SF**	**Cotton**	**Cotton with SF**
Time Trend	-0.010***	-0.007***	-0.008***	-0.006***	-0.012***	-0.013***	-0.010***	-0.007**	-0.011***	-0.010***
	[5.60]	[3.13]	[5.07]	[2.93]	[4.81]	[5.28]	[4.34]	[2.60]	[3.93]	[2.86]
Structural Break 1921		0.114		0.142		-0.305**		0.169		0.121
		[0.78]		[1.13]		[2.12]		[0.97]		[0.79]
Slope after 1973		-0.013**		-0.007		-0.009*		-0.010		0.000
		[2.24]		[1.47]		[1.70]		[1.58]		[0.02]
Constant	0.794***	0.668***	0.709***	0.588***	0.713***	0.897***	0.511***	0.360*	0.698***	0.599**
	[6.86]	[4.57]	[6.87]	[4.48]	[4.63]	[5.59]	[3.36]	[1.95]	[3.72]	[2.52]
Observations	108	108	108	108	108	108	108	108	108	108
R-squared	0.23	0.32	0.20	0.26	0.18	0.31	0.15	0.21	0.13	0.11

Absolute value of t statistics in brackets
** significant at 10%; ** significant at 5%; *** significant at 1%*
Durbin Watson statistics vary between 0.20 to 0.70

Table 3b: GLS regressions – iterated estimates on Terms of Trade for Panel of 24 Commodities

	Log Terms of Trade	**with SB and Slope and Commodity Dummies**
Time Trend	-0.003**	0.001
	[2.62]	[0.48]
Structural Break 1921		0.301**
		[7.34]
Slope after 1973		-0.005**
		[3.38]
Dummy Banana	-0.278	-0.28
	[1.08]	[1.07]
Dummy Beef	-1.291**	-1.292**
	[5.00]	[4.95]
Dummy Cocoa	-1.485**	-1.486**
	[5.75]	[5.69]
Dummy Coffee	-1.343**	-1.346**
	[5.20]	[5.15]
Dummy Copper	-0.36	-0.359
	[1.39]	[1.38]
Dummy Cotton	-0.409	-0.412
	[1.58]	[1.58]
Dummy Hides	-0.421	-0.423
	[1.63]	[1.62]
Dummy Jute	-0.412	-0.415
	[1.60]	[1.59]
Dummy Lamb	-1.304**	-1.305**
	[5.05]	[5.00]
Dummy Lead	-0.721**	-0.721**
	[2.79]	[2.76]
Dummy Maize	-0.257	-0.259
	[1.00]	[0.99]
Dummy Palm oil	-0.526*	-0.527*
	[2.04]	[2.02]
Dummy Rice	-0.394	-0.396
	[1.53]	[1.52]
Dummy Rubber	0.122	0.123
	[0.47]	[0.47]
Dummy Silver	-1.123**	-1.123**
	[4.35]	[4.30]
Dummy Sugar	-0.288	-0.289
	[1.11]	[1.11]
Dummy Tea	-0.486	-0.488
	[1.88]	[1.87]
Dummy Timber	-0.904**	-0.906**
	[3.50]	[3.47]
Dummy Tin	-1.303**	-1.304**
	[5.04]	[4.99]
Dummy Tobacco	-0.760**	-0.763**

	[2.94]	[2.92]
Dummy Wheat	-0.209	-0.21
	[0.81]	[0.81]
Dummy Wool	-0.064	-0.066
	[0.25]	[0.25]
Dummy Zinc	-0.399	-0.399
	[1.54]	[1.53]
Constant	0.612**	0.383
	[3.21]	[1.96]
Observations	2592	2592
R-squared	0.06	0.08
Durbin Watson	0.19	0.21

Absolute value of t statistics in brackets
** significant at 10%; ** significant at 5%; *** significant at 1%*

Table 4: Quantile Regressions: Total BTTs

TOTAL TOT	Quant. 2	Quant. 5	Quant. 7	Quant. 2	Quant. 5	Quant. 7
Trend	0.0131**	0.0047	0.0023	0.0144**	0.0164**	0.0097**
	[0.0035]	[0.0086]	[0.0059]	[0.0026]	[0.0034]	[0.0028]
Trend Sq.	-0.0001**	-0.0001	-0.0001	-0.0001**	-0.0002**	-0.0002**
	[0.0000]	[0.0001]	[0.0001]	[0.0000]	[0.0000]	[0.0000]
Structural Break 1921	0.6076**	0.248	0.0611	0.6220**	0.5303**	0.3065**
	[0.0905]	[0.2181]	[0.1418]	[0.0738]	[0.0792]	[0.0653]
Structural Break 1973	12.6608**	11.4429**	13.5818**	-0.1975**	0.115	0.1763**
	[1.0695]	[2.2408]	[1.3662]	[0.0389]	[0.0723]	[0.0610]
Trend until 1921	0.0044	0.0227	0.0213*			
	[0.0112]	[0.0216]	[0.0103]			
Trend since 1973	-0.2740**	-0.2455**	-0.2948**			
	[0.0234]	[0.0501]	[0.0310]			
Trend Sq. * Struc. Break 1921	-0.0004	-0.0009	-0.0003			
	[0.0004]	[0.0008]	[0.0004]			
Trend Sq. * Struc. Break 1973	0.0014**	0.0013**	0.0016**			
	[0.0001]	[0.0003]	[0.0002]			
Constant	-0.3580**	0.0024	0.1948	-0.3789**	-0.2674**	0.0446
	[0.0712]	[0.1961]	[0.1356]	[0.0837]	[0.1004]	[0.0824]
Observations	108	108	108	108	108	108

Standard errors in bracket
** significant at 10%; ** significant at 5%; *** significant at 1%*

Table 5: Quantile Regressions Metals BTTs

METAL TOT	Quant. 2	Quant. 5	Quant. 7	Quant. 2	Quant. 5	Quant. 7
Trend	-0.03452	-0.04396**	-0.04124**	-0.00459	-0.00394	0.00005
	[0.01856]	[0.01181]	[0.01221]	[0.00977]	[0.00586]	[0.00414]
Trend Sq.	0.00040*	0.00042**	0.00039**	-0.00006	-0.00003	-0.00003
	[0.00020]	[0.00012]	[0.00013]	[0.00008]	[0.00005]	[0.00004]
Structural Break 1921	0.16644	-0.43746	-0.45223	0.16174	0.35159*	0.48672**
	[0.40537]	[0.29477]	[0.30296]	[0.25997]	[0.13568]	[0.09437]
Structural Break 1973	6.98788	5.16023	11.62138**	0.31844*	0.13276	0.06737
	[3.56183]	[2.85543]	[3.77204]	[0.12295]	[0.12177]	[0.09528]
Trend until 1921	0.0158	0.0577	0.06883*			
	[0.03233]	[0.02958]	[0.03197]			
Trend since 1973	-0.11831	-0.08501	-0.22903**			
	[0.07797]	[0.06411]	[0.08559]			
Trend Sq. * Struc. Break 1921	-0.00094	-0.00241*	-0.00145			
	[0.00121]	[0.00119]	[0.00127]			
Trend Sq. * Struc. Break 1973	0.00033	0.00021	0.00103*			
	[0.00045]	[0.00037]	[0.00049]			
Constant	0.49556	1.09650**	1.06844**	0.26842	0.29513	0.20017
	[0.39598]	[0.26476]	[0.26497]	[0.30034]	[0.17317]	[0.12066]
Observations	108	108	108	108	108	108

Standard errors in bracket
** significant at 10%; ** significant at 5%; *** significant at 1%*

Table 6: Quantile Regressions: Non Food Index BTTs

NON FOOD	Quant. 2	Quant. 5	Quant. 7	Quant. 2	Quant. 5	Quant. 7
Trend	0.04928**	0.01973**	0.01131*	0.01197*	0.00418	0.00138
	[0.00604]	[0.00559]	[0.00525]	[0.00471]	[0.00407]	[0.00309]
Trend Sq.	-0.00050**	-0.00025**	-0.00019**	-0.00013**	-0.00008*	-0.00007*
	[0.00007]	[0.00006]	[0.00005]	[0.00004]	[0.00003]	[0.00003]
Structural Break 1921	1.33915**	0.53041**	0.21254	0.61771**	0.39799**	0.35310**
	[0.13304]	[0.13464]	[0.12451]	[0.11757]	[0.09301]	[0.07044]
Structural Break 1973	7.90203**	4.36129**	4.82432**	0.02341	0.01291	0.05492
	[1.72834]	[1.39471]	[1.14248]	[0.09961]	[0.08528]	[0.06324]
Trend until 1921	0.01469	0.04519**	0.05471**			
	[0.01343]	[0.01277]	[0.01012]			
Trend since 1973	-0.19350**	-0.10522**	-0.11258**			
	[0.03791]	[0.03114]	[0.02577]			
Trend Sq. * Struc. Break 1921	-0.00226**	-0.00272**	-0.00272**			
	[0.00053]	[0.00054]	[0.00040]			
Trend Sq. * Struc. Break 1973	0.00123**	0.00066**	0.00069**			
	[0.00021]	[0.00018]	[0.00015]			
Constant	-1.14925**	-0.21469	0.10202	-0.29546	0.11459	0.27496**
	[0.12524]	[0.12557]	[0.11978]	[0.14992]	[0.12075]	[0.08996]
Observations	108	108	108	108	108	108

Standard errors in bracket
** significant at 10%; ** significant at 5%; *** significant at 1%*

Table 7: Quantile Regressions: Food Index BTTs

FOOD	Quant. 2	Quant. 5	Quant. 7	Quant. 2	Quant. 5	Quant. 7
	Spec1 q.2					
Trend	0.00973*	-0.00378	0.00845	0.02458**	0.02533**	0.02148**
	[0.00397]	[0.01079]	[0.01002]	[0.00183]	[0.00330]	[0.00414]
Trend Sq.	-0.00007	-0.00001	-0.00013	-0.00022**	-0.00028**	-0.00026**
	[0.00004]	[0.00011]	[0.00010]	[0.00001]	[0.00003]	[0.00004]
Structural Break 1921	0.46657**	-0.19807	0.01412	0.73049**	0.49987**	0.32354**
	[0.08842]	[0.26037]	[0.23901]	[0.04736]	[0.07681]	[0.09821]
Structural Break 1973	15.82362**	16.12876**	15.20587**	-0.25534**	0.19874**	0.23469**
	[1.21610]	[2.78473]	[2.83176]	[0.04042]	[0.07093]	[0.08664]
Trend until 1921	-0.01832*	0.02208	0.00735			
	[0.00874]	[0.02340]	[0.01902]			
Trend since 1974	-0.33535**	-0.34058**	-0.32420**			
	[0.02686]	[0.06207]	[0.06272]			
Trend Sq. * Struc. Break 1921	0.00130**	0.00014	0.00062			
	[0.00035]	[0.00091]	[0.00072]			
Trend Sq. * Struc. Break 1973	0.00171**	0.00175**	0.00171**			
	[0.00015]	[0.00035]	[0.00035]			
Constant	-0.39428**	0.24458	0.05459	-0.74341**	-0.45998**	-0.24310*
	[0.08328]	[0.24071]	[0.22451]	[0.05916]	[0.09750]	[0.12093]
Observations	108	108	108	108	108	108

Standard errors in bracket
** significant at 10%; ** significant at 5%; *** significant at 1%*

Table 8: Quantile Regressions on Panel of 24 Commodities. Dependent Variable. Log_BTTs TOT

	Quant. 2	Quant. 5	Quant. 7	Quant. 2	Quant. 5	Quant. 7
Trend	-0.0007	0.0181**	0.0104	0.0216**	0.0166**	0.0082**
	[0.0059]	[0.0056]	[0.0078]	[0.0020]	[0.0024]	[0.0027]
Trend Square.	0.0001	-0.0002**	-0.0002	-0.0002**	-0.0002**	-0.0001**
	[0.0001]	[0.0001]	[0.0001]	[0.0000]	[0.0000]	[0.0000]
Structural Break 1921	-0.075	0.3053*	0.0648	0.2457**	0.3888**	0.4281**
	[0.1473]	[0.1404]	[0.1964]	[0.0500]	[0.0543]	[0.0605]
Structural Break 1973	6.2521**	7.3061**	5.7136**	0.1202**	-0.0653	-0.1138*
	[1.6684]	[1.4552]	[2.0623]	[0.0391]	[0.0498]	[0.0543]
Slope until 1921	0.0081	0.0476**	0.0397*			
	[0.0149]	[0.0143]	[0.0197]			
Slope since 1973	-0.1190**	-0.1624**	-0.1333**			
	[0.0369]	[0.0324]	[0.0461]			
Trend Sq. * Struc. Break 1921	0.0001	-0.0029**	-0.0003			
	[0.0006]	[0.0006]	[0.0008]			
Trend Sq. * Struc. Break 1973	0.0005*	0.0009**	0.0008**			
	[0.0002]	[0.0002]	[0.0003]			
Constant	0.3949**	0.5836**	1.2035**	-0.0372	0.6425**	1.1874**
	[0.1324]	[0.1256]	[0.1758]	[0.0617]	[0.0706]	[0.0774]
Observations	2592	2592	2592	2592	2592	2592

Standard errors in bracket
** significant at 10%; ** significant at 5%; *** significant at 1%*

Table 9: Quantile Regressions on Panel of 24 Commodities. Dependent Variable. Log BTTs TOT with Commodity Dummies

	Quant. 2	Quant. 5	Quant. 7	Quant. 2	Quant. 5	Quant. 7
Trend	0.0007	0.0101*	0.0011	0.0136**	0.0139**	0.0139**
	[0.0033]	[0.0044]	[0.0066]	[0.0014]	[0.0018]	[0.0023]
Trend Sq.	0.0001	-0.0001*	0	-0.0001**	-0.0001**	-0.0001**
	[0.0000]	[0.0000]	[0.0001]	[0.0000]	[0.0000]	[0.0000]
Structural Break 1921	-0.0488	0.2545*	-0.0237	0.1602**	0.3472**	0.3937**
	[0.0799]	[0.1101]	[0.1676]	[0.0341]	[0.0399]	[0.0522]
Structural Break 1973	8.3294**	6.1628**	7.2400**	-0.1391**	-0.0568	0.1038*
	[0.8399]	[1.1461]	[1.7292]	[0.0262]	[0.0367]	[0.0472]
Slope until 1921	0.0159*	0.018	0.0263			
	[0.0081]	[0.0113]	[0.0171]			
Slope since 1974	-0.1744**	-0.1346**	-0.1510**			
	[0.0187]	[0.0255]	[0.0386]			
Trend Sq. * Struc. Break 1921	-0.0005	-0.0012**	0.0001			
	[0.0003]	[0.0005]	[0.0007]			
Trend Sq. * Struc. Break 1973	0.0008**	0.0007**	0.0008**			
	[0.0001]	[0.0001]	[0.0002]			
Dummy banana	0.0524	0.0463	-0.7125**	0.0588	0.0643	-0.7266**
	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy beef	-0.8391**	-0.8435**	-1.2477**	-0.8742**	-0.8354**	-1.3194**
	[0.0333]	[0.0458]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy cocoa	-0.8248**	-0.7790**	-1.6182**	-0.8674**	-0.8075**	-1.6995**
	[0.0333]	[0.0458]	[0.0692]	[0.0447]	[0.0534]	[0.0666]
Dummy coffee	-0.7312**	-0.7338**	-1.5542**	-0.7702**	-0.7221**	-1.5865**
	[0.0330]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy copper	-0.2082**	-0.1987**	-0.9857**	-0.2540**	-0.1770**	-1.0518**
	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy cotton	-0.0996**	0.0476	-0.6520**	-0.1792**	0.0532	-0.7302**
	[0.0330]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy hides	-0.2471**	-0.0878	-0.8912**	-0.2345**	-0.083	-0.9848**
	[0.0333]	[0.0458]	[0.0691]	[0.0447]	[0.0532]	[0.0666]
Dummy jute	-0.0863**	-0.0997*	-0.7277**	-0.1247**	-0.0762	-0.7856**
	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy lamb	-0.8368**	-0.7453**	-1.3089**	-0.8709**	-0.7268**	-1.3921**
	[0.0333]	[0.0459]	[0.0696]	[0.0446]	[0.0534]	[0.0670]
Dummy lead	-0.3695**	-0.4998**	-1.2951**	-0.4000**	-0.4846**	-1.3370**
	[0.0333]	[0.0457]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy maize	-0.0167	0.0883	-0.5424**	-0.022	0.1069*	-0.5805**
	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy palm oil	-0.1972**	-0.1908**	-0.9878**	-0.2365**	-0.1618**	-1.0649**
	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0532]	[0.0670]
Dummy rice	-0.1125**	-0.0641	-0.7050**	-0.1664**	-0.0501	-0.8101**

	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy rubber	-0.1245**	0.1862**	0.0138	-0.1462**	0.1998**	-0.0689
	[0.0333]	[0.0459]	[0.0692]	[0.0447]	[0.0534]	[0.0670]
Dummy silver	-0.7452**	-0.7730**	-1.5105**	-0.7934**	-0.7571**	-1.5969**
	[0.0333]	[0.0457]	[0.0696]	[0.0446]	[0.0534]	[0.0670]
Dummy sugar	-0.1304**	-0.0894	-0.5865**	-0.1690**	-0.0598	-0.6213**
	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy tea	-0.1377**	-0.2240**	-0.8953**	-0.1785**	-0.1931**	-0.9508**
	[0.0333]	[0.0459]	[0.0696]	[0.0442]	[0.0534]	[0.0670]
Dummy timber	-0.5950**	-0.5540**	-1.2980**	-0.6350**	-0.5441**	-1.3703**
	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy tin	-0.6952**	-0.7769**	-1.6068**	-0.7322**	-0.7643**	-1.6860**
	[0.0330]	[0.0459]	[0.0692]	[0.0447]	[0.0534]	[0.0670]
Dummy tobacco	-0.3770**	-0.2748**	-1.0739**	-0.4491**	-0.2617**	-1.1404**
	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0532]	[0.0669]
Dummy wheat	0.0593	0.0475	-0.5452**	0.0147	0.0484	-0.6065**
	[0.0333]	[0.0459]	[0.0696]	[0.0447]	[0.0534]	[0.0670]
Dummy wool	-0.0188	0.5967**	0.0892	-0.0022	0.6187**	0.0565
	[0.0333]	[0.0458]	[0.0696]	[0.0446]	[0.0534]	[0.0670]
Dummy zinc	-0.1994**	-0.2158**	-1.0522**	-0.2437**	-0.2065**	-1.1150**
	[0.0333]	[0.0459]	[0.0692]	[0.0447]	[0.0532]	[0.0669]
Constant	1.0084**	0.9953**	2.1232**	0.8043**	0.9105**	1.8876**
	[0.0740]	[0.1034]	[0.1584]	[0.0505]	[0.0637]	[0.0848]
Observations	2592	2592	2592	2592	2592	2592

Standard errors in bracket
** significant at 10%; ** significant at 5%; *** significant at 1%*

Table 10: Two stage estimate of the model: BTTs TOT Indexes

	Total TOT	Metal	Food	Non Food
Trend	-0.002**	-0.001**	-0.005**	-0.004**
	[0.001]	[0.000]	[0.001]	[0.001]
Structural Break 1921	0.263**	0.472**	0.229**	0.022
	[0.043]	[0.051]	[0.039]	[0.058]
Slope 1973	-0.018**	-0.017**	-0.006**	-0.022**
	[0.002]	[0.001]	[0.002]	[0.003]
Constant	0.170**	0.167**	0.395**	0.248**
	[0.039]	[0.042]	[0.036]	[0.056]
ARCH				
L1	0.578*	0.940**	0.534*	0.882**
	[0.246]	[0.356]	[0.218]	[0.309]
Constant	0.008**	0.008**	0.010**	0.009**
	[0.002]	[0.003]	[0.002]	[0.003]
Observations	108	108	108	108
Chi2	785	484.4	405.2	788

Standard errors in bracket
** significant at 10%; ** significant at 5%; *** significant at 1%*

Table11: Option Value or Speculative Component through GLS Estimation

	Total TOT	Metal	Food	Non Food
Speculative Component	1.145**	0.458**	0.870**	0.966**
	[0.088]	[0.058]	[0.040]	[0.071]
Trend	0.005**	0.003**	0.007**	0.005**
	[0.001]	[0.001]	[0.001]	[0.001]
Constant	-1.471**	-0.732**	-1.379**	-1.241**
	[0.118]	[0.096]	[0.069]	[0.098]
Observations	108	108	108	108
R-squared	0.62	0.38	0.82	0.64
DW stat.	2.04	2.07	1.89	2.09

Standard errors in bracket
** significant at 10%; ** significant at 5%; *** significant at 1%*

Table 12: Two stage estimate of the model: Panel of 24 Commodities BTTs

	Arch Total TOT	Arch Total TOT with Commodities Dummies
Main Equation		
Trend	-0.003***	-0.002***
	[0.000]	[0.000]
Structural Break 1921	0.013	0.066***
	[0.022]	[0.018]
Slope 1974	-0.012***	-0.013***
	[0.001]	[0.001]
Dummy Banana		0.112***
		[0.038]
Dummy Beef		-1.139***
		[0.038]
Dummy Cocoa		-1.129***
		[0.037]
Dummy Coffee		-0.806***
		[0.035]
Dummy Copper		-0.117***
		[0.038]
Dummy Cotton		0.036
		[0.040]
Dummy Hides		-0.111***
		[0.034]
Dummy Jute		-0.116***
		[0.037]
Dummy Lamb		-0.789***
		[0.044]
Dummy Lead		-0.527***
		[0.036]
Dummy Maize		0.085**
		[0.037]
Dummy Palm oil		-0.136***
		[0.035]
Dummy Rice		-0.015
		[0.039]
Dummy Rubber		0.180***
		[0.036]
Dummy Silver		-0.999***
		[0.043]
Dummy Sugar		0.104***
		[0.032]
Dummy Tea		-0.195***
		[0.037]
Dummy Timber		-0.532***
		[0.043]
Dummy Tin		-1.076***
		[0.042]
Dummy Tobacco		-0.169***
		[0.041]
Dummy Wheat		0.036
		[0.037]

Dummy Wool		0.443***
		[0.040]
Dummy Zinc		-0.179***
		[0.032]
Constant	0.279***	0.347***
	[0.019]	[0.034]
ARCH		
L.arch	0.922***	0.945***
	[0.060]	[0.055]
Constant	0.031***	0.025***
	[0.001]	[0.001]
Observations	2592	2592
Chi2	899.1	9670

Standard errors in bracket
** significant at 10%; ** significant at 5%; *** significant at 1%*

[i] This is the mostly wide used price index in all the empirical analysis implemented in the last two decades. The GY series of the commodities terms of trade (COMTT) combine in a single ratio an index of non-fuel commodity prices (COM) and a price index of manufactures (MUV), based on the United Nations Manufacturing Unit Values (MUV) index as the deflator. Besides giving information on 24 non-fuel commodities, the index summarizes aggregate information for food, metals, and agricultural non-food series.

[ii] Cuddington and Urzua studied the period 1900-1983 and found that the terms of trade of 16 of them were trendless, 5 were negative and 5 were positive. Leon and Soto (1997) extended the period to 1993, and found out that 17 commodities had negative trends, 3 were trendless and four 4 positive (Colman, 2009).

[iii] "The remaining conditional quantile functions are estimated by minimizing an asymmetrically weighted sum of absolute errors. Taken together the ensemble of estimated conditional quantile functions offers a much more complete view of the effect of covariates on the location, scale and shape of the distribution of the response variable" (Koenker, 2005)